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APPENDIX ‘B’

Geotechnical Report

City of Winnipeg North Transit Garage

Geotechnical Report

City of Winnipeg

Project number: 60721079

February 4, 2025

Delivering a better world

Statement of Qualifications and Limitations

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AECOM: 2015-04-13

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1. Introduction

AECOM Canada Ltd. was retained to undertake a geotechnical investigation to evaluate the existing soil conditions and provide foundation recommendations for the proposed new transit garage and accompanying infrastructure such as sidewalks or pavement recommendations. The project site is in Winnipeg, MB on:

- Lots 49 – 58 of Plan 24342;
- Block 3 of Plan 17744;
- Selkirk Avenue, City owned, right of way west of Oak Point Highway; and
- Hyde Avenue, City owned, right of way west of Oak Point Highway.

It is AECOM's understanding that a new transit garage will be constructed on the project site. In 2023, TREK Geotechnical drilled 9 testholes to obtain a preliminary understanding of the soil stratigraphy at the project site. TREK's Geotechnical Factual Report can be found in **Appendix F**. AECOM's project team determined a more thorough understanding of the soil stratigraphy was required at the project site to support the design, so an additional 22 testholes were drilled from January 29 to February 9, 2024. The scope of work for this project was outlined in our proposal dated January 5, 2024. Authorization to proceed with the geotechnical investigation was provided on January 24, 2024.

The work that was performed as part of this geotechnical study included:

- A geotechnical drilling and soil sampling program at the proposed site to identify the existing soil and groundwater conditions. Rock coring was performed in five testholes;
- A laboratory testing program to determine the engineering properties relevant to the foundation design. The testing program included moisture contents on all collected grab samples, pocket torvane testing on grab samples, Atterberg limits, particle size analysis, unconfined compressive strength test on soil and bedrock, one-dimensional consolidation, one-dimensional swell (Method C), standard proctors, and California Bearing Ratio tests on selected soil samples;
- Evaluate the geotechnical capacity of cast-in-place friction piles, precast driven concrete piles and driven steel H-piles for the proposed new garage;
- Slab recommendations for potential heave of soil supported slabs.
- Three pavement design options that include light-duty and heavy-duty flexible pavements, and a rigid pavement design.
- Preparation of this geotechnical report outlining the existing site conditions, frost implications, and foundation recommendations.

Use of this report is subject to the Statement of Qualifications and Limitations provided at the beginning of this report.

2. Project Site and Proposed Construction

The project site is located on Lots 49 – 58 of Plan 24342, Block 3 of Plan 17744, Selkirk Avenue, City owned, right of way west of Oak Point Highway; and Hyde Avenue, City owned, right of way west of Oak Point Highway. The proposed area of the project site is approximately 28 acres.

In the past, the project site was operated as a City of Winnipeg landfill known as the Brooklands Landfill. The landfill is located on the western portion of the project site and is currently still buried. The materials that entered the landfill included items such as household supplies, construction waste, etc. The eastern portion of the project site was previous owned and operated by Imperial Oil. Therefore, there is a high probability of the presence of hydrocarbons within the project site.

The project site terrain is comprised of long grass and weeds, with sparsely forested areas. As you travel from the southeast to the northwest direction of the project site, there is a significant grade change. With a change in elevation from 234.20 metres above sea level (m ASL) to 238.45 m ASL, there is a rough elevation change of 4.25 m. At this time, the finish floor elevation (FFE) for the Bus Storage Garage, Bus Maintenance Garage, and Administrative Building will be 235.3 m ASL. It is understood that all constructed areas will result in a cut of the existing material.

The transit garage will be comprised of several structures and will include the necessary associated infrastructure. The main building includes a bus storage area, maintenance/bus repair area, and office space. The bus storage area is the largest section of the building at approximately 20,629.0 m^2 for the ground floor and 451.5 m^2 for the second floor. The bus storage area is above ground and can house roughly 114 – 40 ft buses and 56 – 60 ft buses. The next largest section of the main building is the maintenance facility, which will be approximately 3,741.0 m^2 for the ground floor, and approximately 205.2 m^2 for the second floor. The office space, located on the west side of the building is one floor with an area of 1,275.1 m^2. It is understood the proposed finished floor elevation will be 235.3 m ASL for all structures. The floor slab tolerance is required to be in the range of 1/500, and a maximum settlement of 25 mm. All areas of the main building are to be heated.

For infrastructure, an external parking area will be provided for the employees. The parking areas are expected to be roughly 6,802.0 m^2 and will be located outside. An electrical substation will be required to provide power to the facility which is located near the parking area and is roughly 468.0 m^2. To access the parking and building, paved driveways will be provided around the building. Water and sewer main lines will be required for the facility, with the required depth below the frost line..

Photographs of the project site taken at the time of the field drilling program are provide in **Appendix A**.

3. Investigation Program

3.1 Past Drilling and Soil Sampling

In October 2023, TREK Geotechnical conducted a field investigation at the proposed project site to determine soil stratigraphy and groundwater conditions at the site. In total, TREK drilled 9 testholes; 3 shallow testholes along Oak Point Highway, and 6 deep testholes within the project site. TREK cored to bedrock in one testhole TH23-09. TREK installed 5 standpipe piezometers in TH23-05 (SP23-05), TH23-06 (SP23-06), TH23-07 (SP23-07A and SP23-07B), and TH23-08 (SP23-08).

TREK visually classified the soils based on the Unified Soil Classification System (USCS) and collected disturbed and relatively undisturbed samples at selected depths. The samples collected by TREK were transported back to their lab in Winnipeg, MB. Testing conducted on the samples collected included moisture contents on all disturbed samples, bulk unit weight and unconfined compression tests on Shelby tube and core samples, and Atterberg limits and grain size analysis (hydrometer method) tests on select samples.

Testhole logs created by TREK included information regarding groundwater and sloughing conditions, and a summary of the laboratory test results.

3.2 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted between January 29 and February 9, 2024. Drilling services were provided by Paddock Drilling under the supervision of AECOM geotechnical field personnel. The testhole location plan is provided in **Appendix B**. 22 testholes were drilled on the project sites using a track-mounted drill rig Mobile B48 which was equipped with 125 mm solid stem augers. Testholes TH24-02, TH24-04 to TH24-08, TH24-10, TH24-11, TH24-13, TH24-14, TH24-16, and TH24-17 were drilled to auger refusal within the proposed bus garage footprint. Auger refusal was encountered in the testholes at depths ranging from 9.60 m to 13.80 m. Due to sloughing conditions, hollow stem augers were required in testholes TH24-06 to TH24-08, to allow for proper Shelby Tube sampling and Standard Penetration Tests (SPTs). Rock coring was performed in testholes TH24-01, TH24-03, TH24-09, TH24-12, and TH24-15 to a final depth ranging from 19.80 m to 25.90 m. TH24-18 and TH24-19 were drilled to 4.5 m, and TH24-20 to TH24-22 were drilled to a depth of 3.1 m within the proposed pavement areas.

Soil samples were obtained directly from the auger flights at depth intervals ranging from 0.3 to 1.5 m. Undisturbed soil samples were also obtained with 75 mm diameter Shelby tubes. SPTs were conducted to assess the relative density of cohesionless soils. The soil samples were visually classified in the field and returned to our soil laboratory for additional examination and testing. Cohesive soil samples were tested using a mini torvane and pocket penetrometer to estimate the undrained shear strength and the compressive soil strength.

Upon completion of drilling, the testholes were examined for evidence of sloughing and groundwater seepage, sealed with bentonite at the bottom and backfilled with auger cuttings. Excess auger cuttings were left at the testhole location on the project site. The detailed testhole records are provided in **Appendix C**, which include a summary sheet outlining the symbols and terms of the testhole record.

3.3 Laboratory Testing

A laboratory testing program was performed on soil samples obtained during the drilling program to determine the relevant engineering properties of the subsurface materials. Diagnostic testing included moisture contents (ASTM D2216), on all collected soil samples, as well as particle size analysis (ASTM D422), Atterberg limits tests (ASTM D4318), one-dimensional consolidation (ASTM D2435), one-dimensional swell (ASTM 4546), unconfined compressive strength for soil (ASTM D2166) and unconfined compressive strength of intact rock core specimen (ASTM D2938), standard proctor (ASTM D698) and California Bearing Ratio (ASTM D1883) on select soil samples. In addition, mini torvane and pocket penetrometer readings were taken on auger grab samples. The results of the laboratory testing are shown on the testhole records in **Appendix C** and on the laboratory test reports in **Appendix D**.

4. Investigation Results

Subsurface conditions observed during testhole drilling and sampling were visually documented by AECOM geotechnical personnel in accordance with the Unified Soil Classification System (USCS).

The conditions of the site have been based on the investigation results obtained during the field and laboratory investigation programs. The pertinent results from these investigations are outlined below.

4.1 Stratigraphy

The soil stratigraphy on the project site generally consists of topsoil or asphalt, sand or clay fill overlying a clay deposit, which is underlain by a sand till and bedrock. A silt layer was observed between the fill and clay deposit in several testholes. A description of the soil stratigraphy is provided below. The detailed testhole records are provided in **Appendix C**, which include a summary sheet outlining the symbols and terms of the testhole record.

4.1.1 Asphalt

Asphalt was encountered at the ground surface in testholes TH24-01, TH24-04, TH24-05, and TH24-22. The thickness of the asphalt was approximately 0.10 m.

4.1.2 Topsoil

Topsoil was encountered at the ground surface in testholes TH24-02, TH24-03, TH24-06 to TH24-21. The thickness of the topsoil was approximately 0.10 m.

4.1.3 Fill – Silty Sand (SM)

Silty SAND (SM) fill material was encountered below the asphalt/topsoil in TH24-01, TH24-04, TH24-05, TH24-06, TH24-11, TH24-16, TH24-18, and TH24-22 ranging from a thickness of 0.36 m to 2.03 m. The silty SAND (SM) fill layer was generally observed to be loose to compact.

4.1.4 Fill – Sandy Fat CLAY (CH)

Sandy fat CLAY (CH) fill material was encountered below the asphalt/topsoil in TH24-02, TH24-03, TH24-07 to TH24-10, TH24-12 to TH24-15, TH24-17, and TH24-19 to TH24-21. The sandy fat CLAY (CH) was encountered below the silty SAND (SM) fill in TH24-01, TH24-04, TH24-05, TH24-06, TH24-11, TH24-16, TH24-18, and TH24-22. The thickness of the sandy fat CLAY (CH) ranged from a thickness of 0.67 m to 11.67 m. The clay fill layer was generally observed to be firm to stiff.

4.1.5 SILT (ML)

Silt (ML) was encountered below the fill material in TH24-03, TH24-04, TH24-06 to TH24-12, TH24-15 to TH24-17. The silt (ML) ranged in thickness from 0.30 m to 2.50 m. It was encountered at depths ranging from 0.30 m to 3.80 m and extended to depths ranging from 0.75 m to 4.60 m. The silt was classified as brown, and very loose to compact. The moisture content of the silt ranged from 10.9% to 23.5% with an average of 18.6%.

4.1.6 Fat CLAY (CH)

Fat CLAY (CH) was encountered directly below the clay fill in TH24-01, TH24-02, TH24-05, TH24-13 to TH24-16, TH24-18, TH24-19, TH24-20, and TH24-22. In TH24-03, TH24-04, TH24-06 to TH24-12, and TH24-17 the fat CLAY (CH) was encountered directly below the silt (ML) layer. The fat CLAY (CH) ranged in thickness from approximately 4.25 m (TH24-06) to 9.50 m (TH24-09). It was encountered at depths ranging from 0.75 m to 4.60 m and extended to depths ranging from 7.60 m to 12.20 m. The fat clay was high in plasticity and began as brown firm to stiff clay and transitioned to grey and very soft to soft with depth. The moisture content of the fat clay ranged from 18.1% to 65.3% with an average of 39.2%.

4.1.7 Poorly Graded SAND (SP) TILL

Poorly graded SAND (SP) till was encountered below the fat CLAY (CH) in TH24-01 to TH24-17. The poorly graded SAND (SP) till was encountered at depths ranging from 7.60 m to 12.20 m and extended to depths up to 20.15 m. Auger refusal was met in the poorly graded SAND (SP) till early in this range, and required coring methods to reach the 20.15 m. The poorly graded SAND (SP) till was grey to tan in colour. Standard Penetration Tests (SPTs) completed within the poorly graded SAND (SP) till show uncorrected “N” values ranging from 9 to >50 per 300 mm of penetration, classifying the materials as loose to very dense in relative density. The moisture content ranged from 6.8% to 19.7% with an average of 12.3%. In the poorly graded SAND (SP) till layer, it was common to find cobbles and boulders.

4.1.8 Bedrock

Bedrock (BR) was encountered below the poorly graded SAND (SP) till in cored testholes; TH24-01, TH24-03, TH24-09, TH24-12, and TH24-15. Two different types of rock were observed in the coring, the first being mudstone; a Gunn Member of the Stony Mountain Formation, and Dolomite; a Gunton Member of the Stoney Mountain Formation. The mudstone was observed at elevations ranging from 223.19 m ASL to beyond 216.79 m ASL. The mudstone was dark greyish red to purplish grey, with calcareous shale to argillaceous dolomite, and was interbedded with relatively clean limestone. The dolomite was observed at elevations ranging from 218.09 m ASL and extended to elevations beyond 212.30 m ASL. The dolomite was buff in colour, finely crystalline, sparsely fossiliferous, and nodular bedded. The quality and strength of the bedrock varied significantly which will be discussed further in **Section 4.3**. **Section 4.3.1** describes the total core recovery (TCR), **Section 4.3.2** describes the solid core recovery (SCR), **Section 4.3.3** describes the rock quality designation (RQD), and **Section 4.3.4** describes the bedrock classification results.

4.1.9 Groundwater and Sloughing Conditions

Groundwater seepage or soil sloughing conditions were observed in most testholes upon completion of drilling. Details of the location and nature of the sloughing, seepage, and groundwater encountered are provided on the testhole logs in **Appendix C** and presented in **Table 1**.

Table 1 - Observed Groundwater Seepage and Sloughing Conditions

Testhole No.	Groundwater Seepage	Depth of Groundwater Seepage (m)	Groundwater Depth Upon Completion of Drilling (m)	Depth of Soil Sloughing
TH24-01	Heavy	8.53	Unavailable[1]	10.36
TH24-02	Heavy	8.53	7.47	None
TH24-03	Heavy	9.14	Unavailable[1]	10.97
TH24-04	Heavy	10.06	9.14	9.14
TH24-05	Heavy	9.14	None	9.14
TH24-06	Heavy	8.84	None	2.13
TH24-07	Heavy	9.14	4.11	2.44 and 10.67
TH24-08	Heavy	9.75	7.77	3.05 and 10.67
TH24-09	Heavy	9.14	Unavailable[1]	3.35
TH24-10	Heavy	9.14	3.69	3.05 and 10.67
TH24-11	Heavy	6.10	4.42	None
TH24-12	Heavy	9.14	Unavailable[1]	10.36
TH24-13	Heavy	12.19	4.79	12.19
TH24-14	None	None	5.33	None
TH24-15	Heavy	12.19	Unavailable[1]	None
TH24-16	Heavy	10.67	6.10	2.13
TH24-17	None	None	None	1.83
TH24-18	None	None	None	None

TH24-19	None	None	None	None
TH24-20	None	None	None	None
TH24-21	None	None	None	None
TH24-22	None	None	None	None

(1) Unavailable due to coring method

Groundwater readings were taken upon completion of the testhole drilling utilizing the standpipes installed by TREK Geotechnical at the project site in 2023. Additional groundwater readings were recorded in the summer of 2024. The readings recorded are summarized in **Table 2**.

Table 2 - Groundwater Readings

Standpipe		Groundwater Elevation (m ASL)							
	Stratum/Tip El.	Oct. 12, 2023	Oct. 13, 2023	Oct. 18, 2023	Nov. 6, 2023	Nov. 9, 2023	Feb. 12, 2024	Jul. 15, 2024	Jan. 10, 2025
SP23-05	poorly graded sand till/224.84	225.93	225.99	226.29	227.30	227.43	dry	231.42	230.62
SP23-06	poorly graded sand till/225.33	226.99	227.42	228.66	230.02	230.26	230.44	233.01	230.94
SP23-07A	poorly graded sand till/223.80	223.04	223.28	224.23	227.12	227.48	230.08	230.67	230.68
SP23-07B	Silt / 233.81	dry	dry	234.00	234.08	dry	dry	235.08	234.02
SP23-08	Silt / 232.82	dry	233.64	233.77	233.72	233.68	233.47	235.28	233.69

A graphical summary of these results are provided in **Figure 1**.

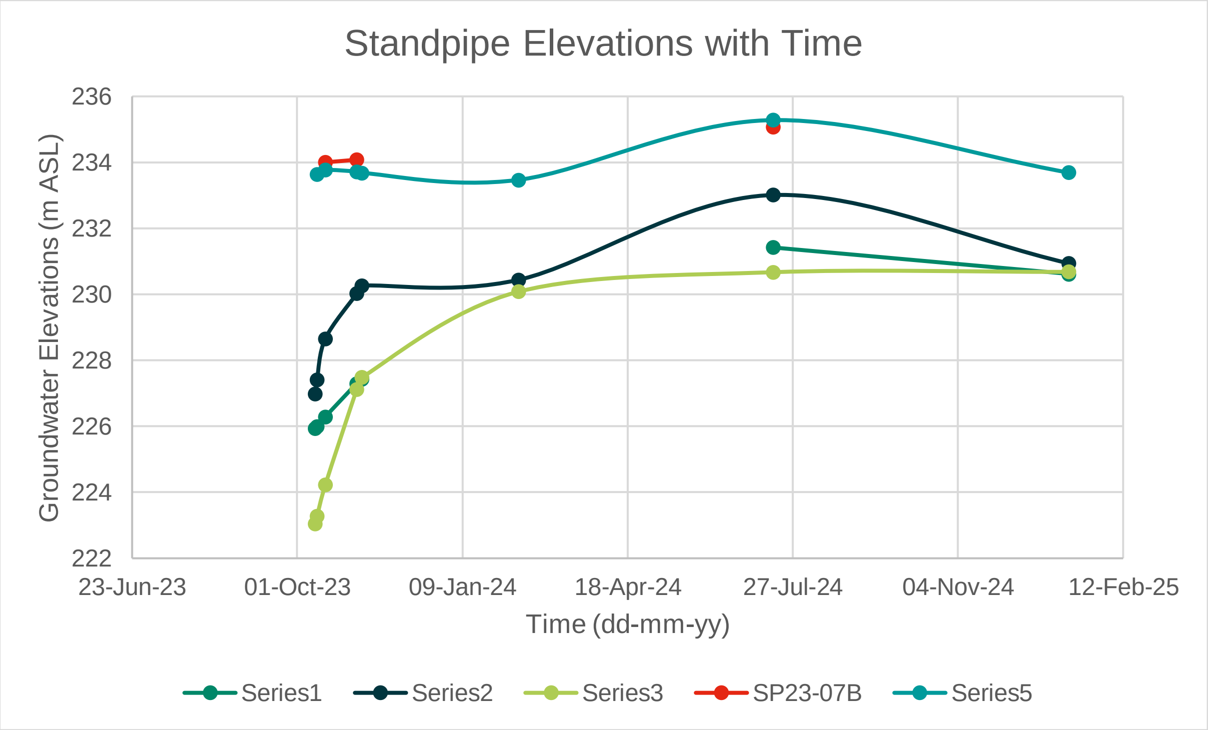


Figure 1 - Graph of Groundwater Elevations Versus Time

Only short-term seepage and sloughing conditions were observed in the testholes. Groundwater levels will normally fluctuate during the year and will be dependent on precipitation, surface drainage, and regional groundwater regimes. Groundwater seepage and soil sloughing should be expected from the SILT (ML) layer and the poorly graded SAND (SP) till layer.

4.2 Laboratory Test Results

A variety of laboratory testing was performed on select samples collected from the field drilling program. Moisture content tests were conducted on soil samples recovered from the testholes with the moisture content (ASTM D2216) test results shown on the testhole records provided in **Appendix C**. Select representative soil samples were also tested for particle size analysis (ASTM D422), Atterberg limits (ASTM D4318), one-dimensional consolidation (ASTM D2435), one-dimensional swell (ASTM 4546), unconfined compressive strength soil (ASTM D2166) and unconfined compressive strength of intact rock core specimen (ASTM D2938), standard proctor (ASTM D698), and CBR (ASTM D1883).

Table 3 - Particle Size Analysis

Testhole No.	Sample Depth	Soil Type	Particle Size			
			Gravel 75 to 4.75 mm	Sand <4.75 to 0.075 mm	Silt <0.075 to 0.002 mm	Clay <0.002 mm
TH24-02	8.99 – 9.14 m	CL	0.8%	8.0%	69.4%	21.8%
TH24-03	4.42 – 4.57 m	CH	0.0%	1.1%	25.9%	73.0%
TH24-04[1]	3.05 – 3.66 m	CH	0.0%	0.7%	18.3%	81.0%
TH24-05[1]	1.52 – 2.13	CH	0.0%	1.6%	19.5%	78.9%
TH24-05[1]	2.29 – 2.90	CH	0.0%	0.6%	25.9%	73.5%
TH24-07	2.90 – 3.05 m	ML	0.0%	11.0%	81.1%	7.9%
TH24-08[1]	9.14 – 9.75 m	CH	0.0%	6.7%	29.8%	63.5%
TH24-11[1]	6.10 – 6.71 m	CH	0.0%	0.7%	26.6%	72.7%
TH24-12	1.37 – 1.52 m	CH	5.9%	27.7%	33.9%	32.5%
TH24-13	10.52 m – 10.67 m	CH	1.6%	11.3%	43.7%	43.3%
TH24-14[1]	1.52 – 2.13 m	CL	8.7%	29.7%	31.1%	30.5%
TH24-16	0.61 – 0.76 m	ML	0.3%	11.6%	75.5%	12.5%
TH24-18	0.61 – 0.76 m	CL	10.3%	45.9%	28.3%	15.5%

Note: Testing conducting by Solum Consultants Ltd

Table 4 - Atterberg Limits Test Data

Testhole No.	Sample Depth	Soil Type	Liquid Limit	Plastic Limit	Plasticity Index	Activity
TH24-02	8.99 – 9.14 m	CL	24	14	10	0.46
TH24-03	4.42 – 4.57 m	CH	79	21	57	0.78
TH24-04[1]	3.05 – 3.66 m	CH	92	34	58	0.72
TH24-05[1]	1.52 – 2.13	CH	73	30	43	0.54
TH24-05[1]	2.29 – 2.90	CH	81	32	49	0.67
TH24-07	2.90 – 3.05 m	ML	16	14	2	0.25
TH24-08[1]	9.14 – 9.75 m	CH	65	24	41	0.65
TH24-11[1]	6.10 – 6.71 m	CH	81	31	50	0.69
TH24-12	1.37 – 1.52 m	CH	50	15	36	1.11
TH24-13	10.52 – 10.67 m	CH	56	14	42	0.97
TH24-14[1]	1.52 – 2.13 m	CL	41	21	20	0.66
TH24-16	0.61 – 0.76 m	ML	17	14	3	0.24
TH24-18	0.61 – 0.76 m	CL	32	15	18	1.16

Note: Testing conducting by Solum Consultants Ltd

Table 5 - One-Dimensional Consolidation Test Data

Testhole No.	Sample Depth	Saturation (%)	Moisture Content (%)	Initial Void Ratio	Compression Index (kPa)	Preconsolidation Pressure (kPa)
TH24-04	3.05 – 3.66 m	97.3	48.3	1.341	0.56	177
TH24-05	1.52 – 2.13 m	97.4	42.9	1.190	0.28	153
TH24-05	2.29 – 2.90 m	97.3	48.7	1.350	0.36	154
TH24-08	9.14 – 9.75 m	98.2	43.2	1.188	0.49	117
TH24-11	6.10 – 6.71 m	97.4	50.4	1.395	0.63	217
TH24-14	1.52 – 2.13 m	96.1	19.7	0.554	0.08	109

Table 6 - One-Dimensional Swell (Method C)

Testhole No.	Sample Depth	Swelling Pressure (kPa)	Unit Weight of Soil (kN/m^3)	Initial Void Ratio	Swelling Index
TH24-05	1.52 – 2.13 m	100	17.27	1.193	0.028
TH24-05	2.29 – 2.90 m	50	16.74	1.378	0.066
TH24-14	1.52 – 2.13 m	40	20.39	0.544	0.045

Table 7 - Unconfined Compressive Strength Test (Soil)

Testhole No.	Sample Depth	Soil Type	Moisture Content (%)	Undrained Shear Strength (kPa)	Unconfined Compressive Strength (kPa)
TH24-06	4.57 – 5.18 m	CH	57.8	36.46	72.92
TH24-06	6.10 – 6.71 m	CH	46.6	41.58	83.17
TH24-06	7.62 – 8.23 m	CH	39.8	25.76	51.53
TH24-07	4.57 – 5.18 m	CH	44.0	35.20	70.39
TH24-07	6.10 – 6.71 m	CH	60.5	35.06	70.12
TH24-07	7.62 – 8.23 m	CH	37.9	26.97	53.95
TH24-08	9.14 – 9.75 m	CH	43.6	21.04	42.09

Table 8 - Unconfined Compressive Strength of Intact Rock Core Specimens Results

Testhole No.	Sample Depth	Maximum Load (kN)	Compressive Strength (MPa)
TH24-03	10.21 – 10.82 m	293.4	94
TH24-01	18.29 – 18.59 m	106.6	34

Table 9 – Standard Proctor Results

Testhole No.	Sample Depth	Soil Type	Maximum Dry Density (kg/m^3)	Optimum Moisture Content (%)
TH24-18.21.22 (B1)	0.3 – 1.5 m	Clay Fill	1707	19.1
TH24-19.20 (B2)	0.3 – 1.5 m	Clay Fill	1759	15.9

Table 10 – California Bearing Ration Results (1)

Testhole No.	Sample Depth	Soil Type	Dry Density (kg/m^3)	CBR at 2.54 mm	CBR at 5.08 mm
TH24-18.21.22 (B1)	0.3 – 1.5 m	Clay Fill	1622	3.3	2.5
TH24-19.20 (B2)	0.3 – 1.5 m	Clay Fill	1671	2.6	2.4

Note: CBRs tested at 95% of maximum dry density

Table 11 – Electrochemical Testing

Testhole ID	Sample ID	Sample Depth (m)	Soil Type	Water Soluble Sulphate (%)	pH (pH Units)	Conductivity (mS/cm)	Resistivity (ohm · cm)

TH24-08	G3	1.37 – 1.52 m	Clay Fill	0.118	7.97	1.08	920
TH24-10	G8	4.42 – 4.57 m	CH	3.16	8.10	8.57	120
TH24-11	G11	7.47 – 7.62 m	CH	0.119	8.25	1.24	810

4.3 Bedrock Classification

The rock strength can be categorized with the unconfined compressive strength of the rock based on International Society of Rock Mechanics (ISRM) Standard (1979) as shown in **Table 12**. AECOM attempted to prepare six (6) rock specimens for the unconfined compressive strength of intact rock tests, however, the first three (3) samples (TH24-01 C16, TH24-03 C17 and TH24-15 C19) sent to the lab were unable to be processed due to the presences of horizontal and vertical microfractures. AECOM attempted to provide a second set of three (3) samples (TH24-03 C11, TH24-03 C16 and TH24-01 C18), TH24-03 C16 was unable to be processed due to microfractures, but TH24-01 C18 and TH24-03 C11 were processed for testing.

Table 12 – Rock Strength Categorization

Grade	Term	Unconfined Compressive Strength (MPa)
R6	Extremely Strong	>250
R5	Very Strong	100 – 250
R4	Strong	50 – 100
R3	Medium Strong	25 – 50
R2	Weak	5 – 25
R1	Very Weak	1 – 5
R0	Extremely Weak	0.25 – 1

The results of the testing of TH24-01 C18 sample was an unconfined compressive strength of 34 MPa, and the result for TH24-03 C11 was an unconfined compressive strength of 94 MPa. Due to the inability to process four (4) samples, and the results of the two (2) samples that were tested, AECOM can conclude the rock strength categorization was from extremely weak (R0) to strong (R4).

4.3.1 Total Core Recover (TCR)

Total core recovery (TCR) is the testhole core recovery percentage. TCR is expressed as follows:

$$TCR\ (\%) = \frac{sum\ of\ recovered\ core\ length}{total\ core\ length}\ x\ 100$$

The TCR was calculated for each bedrock core run advanced within the testholes. A summary of the TCR values is provided in **Table 14**. The TCR ranged from 0% to 100%.

4.3.2 Solid Core Recover (SCR)

Solid core recovery (SCR) is the testhole core recovery percentage of solid cylindrical rock. SCR is expressed as follows:

$$SCR\ (\%) = \frac{sum\ of\ recovered\ solid\ cylindrical\ core\ lengths}{total\ core\ length}\ x\ 100$$

The SCR was calculated for each bedrock core run advanced within the testhole. A summary of the SCR values is provided in **Table 14**. The SCR ranged from 0% to 98%.

4.3.3 Rock Quality Designation (RQD)

RQD is based on the ISRM classification System. The RQD is an indirect measure of the number of fractures and the amount of jointing in the rock mass. The RQD is expressed as a percentage of the ratio of summed core lengths (greater than 10 cm) to the total length cored. The RQD index is used to provide a classification of the rock quality shown in **Table 13**.

Table 13 – Rock Classification Ranges

RQD (%)	Rock Quality Designation
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

Rock quality designation (RQD) is expressed as follows:

$$RQD\ (\%) = \frac{sum\ of\ recovered\ core\ lengths\ greather\ than\ 10\ cm}{total\ core\ length}\ x\ 100$$

The RQD was calculated for each core run advanced within TH24-01, TH24-03, TH24-09, TH24-12, and TH24-15. A summary of the RQD values is provided below in **Table 14**. The RQD ranged from 0% to 94%.

4.3.4 Bedrock Classification Results

Based on the rock classification and laboratory test results, the encountered bedrock classification ranges from very poor to excellent quality, with a range of rock strength from extremely weak (R0) to strong (R4).

Table 14 – TCR, SCR, and RQD Results

Testhole ID	Sample Number	Core Run No.	Core Run Depth (m bgs)	Elevation (m asl)	TCR (%)	SCR (%)	RQD (%)
TH24-01	C16	4	15.24 – 16.76	219.60 – 218.08	98	93	51
	C17	5	16.76 – 18.29	218.08 – 216.55	93	83	50
	C18	6	18.29 – 19.81	216.55 – 215.03	100	96	94
TH24-03	C11	1	10.21 – 10.82	225.32 – 224.71	71	67	38
	C12	2	10.82 – 12.34	224.71 – 223.19	20	0	0
	C13	3	12.34 – 13.87	223.19 – 221.66	37	18	11
	C14	4	13.87 – 15.39	221.66 – 220.14	57	37	23
	C15	5	15.39 – 16.92	220.14 – 218.61	98	95	72
	C16	6	16.92 – 18.44	218.61 – 217.09	93	82	52
	C17	7	18.44 – 19.96	217.09 – 215.57	100	98	93
TH23-09	C11	1	10.97 – 12.50	225.94 – 224.41	21	21	21
	C15	5	17.07 – 18.59	219.84 – 218.32	50	50	31
	C16	6	18.59 – 20.12	218.32 – 216.79	25	21	21
TH24-12	C16	3	15.54 – 17.07	222.39 – 220.86	65	56	15
	C17	4	17.07 – 18.59	220.86 – 219.34	40	32	25
	C18	5	18.59 – 20.12	219.34 – 217.81	28	8	8
	C19	6	20.12 – 21.64	217.81 – 216.29	71	46	23
	C20	7	21.64 – 23.16	216.29 – 214.77	92	43	31
	C21	8	23.16 – 24.69	214.77 – 213.24	66	37	13
	C22	9	24.69 – 25.76	213.24 – 212.17	88	30	30
TH24-15	C13	2	14.02 – 15.54	224.19 – 222.67	62	22	12
	C14	3	15.54 – 17.07	222.67 – 221.14	27	7	7
	C15	4	17.07 – 18.59	221.14 – 219.62	4	0	0
	C16	5	18.59 – 20.12	219.62 – 218.09	36	3	0
	C17	6	20.12 – 21.64	218.09 – 216.57	70	23	0
	C18	7	21.64 – 23.16	216.57 – 215.05	95	63	45
	C19	8	23.16 – 24.69	215.05 – 213.52	92	52	33

C20	9	24.69 – 26.21	213.52 – 212.00	88	26	13

<u>TH24-01:</u> required coring to advance through three (3) core runs of till, where it eventually reached the mudstone layer. The mudstone layer was classified as poor to fair quality. After one and half (1.5) core runs the dolomite was met, and a classification of excellent rock was deemed after passing through the first half (0.5) core run. During coring water was observed to be returning.

<u>TH24-03:</u> immediately began with fractured dolomite rock for the first three (3) core runs. The recovery was weak, and the rock classification was very poor to poor. The next two and half (2.5) core runs were through the mudstone and had an improved recovery. The mudstone classification ranged from very poor to fair quality. The last one and a half (1.5) core runs were through the dolomite layer. There was excellent recovery of this material and the rock quality ranged from fair to excellent. During coring water was observed to be returning.

<u>TH24-09:</u> the first core run was likely through a boulder, as the following three (3) core runs resulted in zero recovery. The zero recovery was likely due to a sand seam layer. The sand seam was approximately 4.57 m thick, at an approximate depth of 225.5 m ASL to 220.2 m ASL. The final two (2) core runs resulted in mudstone intermixed with sand. The recovery of the material was poor, and the rock classification resulted in very poor to poor quality. The coring was stopped at a depth of 217.2 m ASL due to multiple jams in the sand and mudstone layers and the risk of losing the coring equipment within this layer. During coring water was observed to be returning, although at lower volumes than other testholes.

<u>TH24-12:</u> the first two (2) core runs were required to pass the very dense till. Following the till four (4) core runs were required to pass through the mudstone layer. The mudstone layer had very poor to fair recovery resulting in a rock classification of very poor to poor. The final three (3) core runs were in very poor to poor dolomite, with the final core meeting another sand seam layer of a thickness of approximately 1.75 m. The testhole was stopped due to the inability to reach good to excellent bedrock quality at an approximate elevation of 212.2 m ASL (approximate depth of 25.75 m BGS). During coring water was observed to be returning, although at lower volumes than other testholes.

<u>TH24-15:</u> had just over one (1) core run of till before immediately meeting fractured bedrock. There was four (4) runs of this fractured bedrock material that resulted in very poor rock quality. At the sixth (6) core run dolomite was met, a total of five (5) cores were run in the dolomite with a rock quality of very poor to poor. During coring water was observed to be returning.

5. Geotechnical Concerns

Based on our current understanding of the proposed development and the results of our geotechnical investigation, the primary geotechnical concerns at the project site are:

- Potential soil sloughing and groundwater seepage from the SILT (ML) layer during installation of cast-in-place friction piles. The distance between the till and the bottom of the cast-in-place friction pile is highly variable. A pile inspector will be required onsite, and a means to control any developing groundwater, is needed;
- Based on the water levels collected, the water table was observed as high as 235.28 m ASL. This is a perched water table (water trapped within the silt layer) and will affect the design and construction methods. The FFE of 235.3 m ASL approaches the perched water table expected in the silt layer observed during the geotechnical investigation.
- Variable depths to refusal for driven precast concrete piles and driven steel H-piles due to the presence of cobbles and boulders within the poorly graded SAND (SP) till and variations in bedrock depth;
- Floor slab movement related to volume change of the high plasticity clay fill and clay.
- The proposed above ground employee parking lot location has changed since the proposed drilling plan was submitted and the field investigation took place. This new location is directly above the existing landfill. Limited geotechnical testhole data was documented in this location.

These issues will be discussed in the following sections.

6. Recommendations

6.1 Perimeter Clay Cutoff Wall

A perimeter clay cutoff wall shall be excavated around the perimeter of the building to a depth below the bottom of the silt layer. Silt was observed in testholes during the geotechnical investigation as low as 231.07 m ASL. The trench should be excavated 0.30 m below the silt layer. This would bring the bottom elevation of the trench to approximately 230.77 m ASL. This elevation was based off the lowest silt elevation observed in the testhole data, this bottom elevation will change based on field conditions observed during construction. The perimeter clay cutoff wall should have a 1 m width.

The cutoff wall should be backfilled with a low permeability clay fill, to prevent the water from the perched water table within the silt layer from migrating to beneath the structure. The clay fill shall be placed in lifts no greater than 150 mm and compacted to 98% SPMDD. 1.0 m from the surface, the excavation shall be tapered at a 1H:1V slope, to reduce the impact of the excavation on the above asphalt/concrete roadways.

6.2 Weeping Tile

Due to the groundwater elevation, weeping tile is required. The main concern is the groundwater table was recorded as high as 235.28 m ASL. This is right at the FFE of 235.3 m ASL. As such, the geotechnical group recommends weeping tile within the entire building footprint. The weeping tile shall drain in the direction from southwest to northeast towards Oak Point Highway where it should meet a sump. The recommended weeping tile spacing is at 15.00 m, however, the spacing of the weeping tile may be increased depending on observations during construction. The weeping tile is recommended to be placed at an elevation of 233.2 m ASL (2.10 m below FFE). The weeping tile will need to discharge into a sump and the water needs to be pumped away.

The City of Winnipeg has standard construction specifications (CW3120) for installation of subdrains. The drainage pipe states a diameter of 150 mm gasketed bell and spigot HDPE Type SP pipe with class 2 perforations in accordance with AASHTO M252-07. All perforations shall be slotted with a minimum water inlet area of 30 square centimeters per meter of pipe. The drainage pipe shall have a minimum stiffness of 320 kPa at 5% deflection. The weeping tile shall include a filter sock to prevent fine materials from entering the pipe. A City of Winnipeg subdrain installation detail is available per SD-245.

The weeping tile shall be surrounded by a free-draining gravel material that meets the gradation in **Table 15**.

Table 15 – Drainage Material Grading Requirements

Canadian Metric Sieve Size (um)	Percent of Total Dry Weight Passing Each Sieve
40,000	100%
25,000	50-80%
20,000	5-20%
12,500	0-5%
80	0-3%

The free draining gravel placed around the weeping tile should be wrapped in a geotextile that meets or exceed the requirements of separation geotextile fabric in CW3130.

Once the weeping tile is installed there must be a means to temporarily remove the water. It is recommended that the weeping tile beneath the office and service area be connected to either a sump or to the floor drain system.

6.3 Foundation Design

Based on the soil and groundwater conditions encountered at the testhole locations, several foundation options were evaluated. Design parameters for cast-in-place concrete friction piles, driven precast concrete piles, and driven steel H-piles are provided in the following sections. It is generally recommended that different foundation systems not be used to support the same structure unless they are used to support independent structural elements of the structure.

6.3.1 Limit States Design

The use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations according to the 2020 National Building Code of Canada (NBCC). The limit states are classified into two groups: the Ultimate Limit State (ULS) and the Serviceability Limit State (SLS).

The Ultimate Limit State case is primarily concerned with structural collapse and hence, safety. For foundation design, ultimate limit state consists of:

- Exceeding the load-carrying capacity of the foundation;
- Sliding;
- Uplift;
- Large deformation of foundation, leading to an ultimate limit state being induced in the superstructure or building;
- Overturning; and,
- Loss of overall stability.

The factored resistance at the ULS is the ultimate geotechnical resistance multiplied by the appropriate resistance factor.

The Serviceability Limit State (SLS) case considers mechanisms that restrict or constrain the intended use or occupancy of the structure. They are typically associated with movements that interrupt or hinder the purpose of the structure. For foundation design, serviceability limit state consists of:

- Excessive movements; and,
- Unacceptable vibrations.

The SLS case is addressed by determining the maximum available resistance to keep the foundation under service loads within tolerable limits as provided by the structural engineer. Unfactored permanent and transitory loads are used for calculating total deformation in non-cohesive soils. Unfactored permanent loads and appropriate portions of transitory loads are used for the initial and time-dependent final deformations of cohesive soils. Therefore, the foundation loads and serviceability tolerances must be known to properly determine the SLS resistance values. In cases where tolerable movements are not provided by the structural engineer, the tolerable limit of the total settlement for foundations subject to compression is typically assumed to be 25 mm.

6.3.2 Frost

6.3.2.1 Frost Penetration

The depths of frost penetration have been estimated for a range of annual air freezing identified in **Table 16**. The annual average freezing index was inferred from Figure K-4 of the National Building Code of Canada (2020) Commentary document. The ten-year return annual freezing index was calculated using the mean annual freezing index value and recommendations outlined in the Canadian Foundation Engineering Manual (CFEM 4e). The fifty-year return annual freezing index was taken from Figure K-5 of the National Building Code of Canada (2020) Commentary document.

Factors such as snow cover, vegetation at surface, soil type and groundwater conditions can all significantly impact the depth of frost penetration. The predominant soil type on the project site is fat clay.

Table 16 – Frost Penetration Depth

Parameter	Period		
	Mean	10-Year Return	50-Year Return
Annual Air Freezing Index (°C-days)	1825	1875	2375
Estimated Frost Penetration (Fat Clay Subgrade) – gravel surface, no snow cover (m)	1.9	2.0	2.5
Estimated Frost Penetration (Fat Clay Subgrade) – grass with snow cover (m)	1.7	1.9	2.2

For foundation design considerations, the CFEM recommends using the ten-year return annual freezing index to predict frost penetration. It is the responsibility of the design team to select an adequate frost penetration depth to be incorporated into the design.

6.3.2.2 Frost Susceptibility

The qualitative frost susceptibility of a soil is typically assessed using guidelines developed by Casagrande (1932) based on the percentage by weight of the soil finer than 0.02 mm, and the Plasticity Index. The classification system has been adapted by the U.S. Army Corps of Engineers and the Canadian Foundation Engineering Manual (2006). Soils are classed as F1 through F4 in order of increasing frost susceptibility.

The soils (fat clay and silt) encountered during the geotechnical investigation fall mostly within the frost groups F3 and F4. The F3 group has high to very high susceptibility to frost and F4 has very high susceptibility. Frost susceptibility has been assigned to the encountered soil type and is summarized in **Table 17**.

Table 17 – Frost Susceptibility

Soil Unit	USCS Soil Type	Frost Group	Frost Susceptibility
Sand fill	SM	F2	Medium to high susceptibility
Fat clay/Fat clay fill	CH	F3	High to very high susceptibility
Silt	ML	F4	Very high susceptibility

(1) Source: Canadian Foundation Engineering Manual (CFEM, 4e), Chapter 13 Frost Action

6.3.3 Adfreezing

Frozen soil in contact with foundation elements can develop an adfreeze bond which can result in uplift forces on the foundations. The CFEM (Canadian Foundation Engineering Manual, 4e) lists adfreeze bond stresses of 100 kPa for fine grained soils to steel and 65 kPa for fine grained soils to concrete.

This adfreeze stress should be applied to the perimeter of the piles for unheated structures to a depth of 2.0 m measured from final grade. The uplift forces from adfreeze stresses are resisted by the permanent dead load of the structure plus the uplift resistance of the foundation element. More details are provided in **Sections 6.3.4**, **6.3.5** and **6.3.6**.

6.3.4 Cast-in-Place Friction Piles

Cast-in-place concrete friction piles may be a suitable foundation option to support buildings at the project site. Cast-in-place concrete friction piles can support light loads and may be designed based on the shaft resistance shown in **Table 18**.

Table 18 – Geotechnical Shaft Resistance for Cast-in-Place Concrete Friction Piles

Elevation FFE = 235.3 (m ASL)	Depth Interval Below Existing Grade (m)	Factored Geotechnical Shaft Resistance in Axial Compression at ULS (1)	Factored Geotechnical Shaft Resistance in Axial Tension at ULS (2)
		RF = 0.4	RF = 0.3
235.3 to 233.3	0 to 2.0 (3)	0 kPa	0 kPa
233.3 to 229.3	2.0 to 6.0 (4)	16 kPa	12 kPa

Notes:

(1) *As per 2020 NBCC, a resistance factor of 0.4 is used for calculating the factored geotechnical shaft resistance in compression at ULS.*

(2) *As per 2020 NBCC, a resistance factor of 0.3 is used for calculating the factored geotechnical shaft resistance in Axial Tension at ULS.*

(3) *The skin friction in the upper 2.0 m should be ignored.*

(4) *The fat CLAY (CH) layer extended to an elevation range of approximately 228.30 m ASL to 224.93 m ASL based on testholes TH24-01 to TH24-15.*

For friction piles, less than 15 mm of settlement is required to mobilize shaft resistance, and therefore, the SLS case does not govern the pile design.

The shaft resistance value applied to the pile circumference within the clay stratum over the depth intervals indicated in **Table 18**. Due to presence of fill (clay fill) at a shallow depth, the potential for soil drying and shrinkage near the ground surface may occur. The frictional support in the upper 2.0 m should be excluded in the calculation of the pile capacity. The contribution from end bearing should be ignored in pile capacity calculations.

The minimum pile spacing should be three pile diameters measured centre to centre to avoid pile group effects. If cast-in-place floating piles will be considered, a detailed settlement analysis for a pile group based on foundation load will be required. If pile spacing is less than three pile diameters, additional analyses will be required to evaluate the settlement and capacity of the pile group. Settlement calculations for a pile group is based on the foundation load and the consolidation properties of the soil below the base of the piles. The capacity of a pile group is reduced as the pile spacing is decreased.

Sloughing was observed in the silt (ML) layer in TH24-07 to TH24-10, TH24-16, and TH24-17, at depths ranging from 233.467 m ASL to 233.863 m ASL. Groundwater was observed in poorly graded SAND (SP) till in TH24-02, TH24-04, TH24-05, TH24-07, TH24-08, TH24-10, TH24-11, TH24-13, TH24-16, ranging from depths from 224.933 m ASL to 227.082 m ASL. Temporary sleeves should be available during pile installation to control soil sloughing and groundwater seepage. It should be noted based on water level readings in SP23-07B and SP23-8, a perched groundwater table was observed in the silt (ML) layer. If groundwater is encountered in the piles, it should be removed prior to concrete placement with the use of a pumping system. If the removal of groundwater is not possible by a pumping system, the contractor may need to remove the water by way of a tremie method. The pile holes should be inspected during installation and the concrete for the piles should be poured immediately after drilling to minimize potential problems related to soil sloughing and water seepage. Pile reinforcement, diameter and length should be confirmed by an inspector. It is recommended that pile lengths do not exceed 6.0 m below the FFE to reduce the risk of encountering poorly graded SAND (SP) till during pile installation.

A minimum void space of 150 mm should be provided beneath all pile caps and grade beams to accommodate potential heave of the high plasticity clay and clay fill. Inspection by qualified geotechnical personnel should be approved during foundation construction to confirm that the cast-in-place concrete friction piles are constructed in accordance with the project specifications.

Boring for the construction of cast-in-place concrete friction piles will produce auger cuttings that will need to be disposed of. Piles for the new structures should be spaced a minimum of three pile diameters from the foundations of the existing structures. It is generally recommended that different foundation systems not be used to support the same structure unless they are used to support independent structural elements of the structure.

6.3.5 Driven Precast Concrete

A foundation system suitable for moderate to heavy foundation loads is a system of driven, pre-stressed, precast concrete piles. These piles, when driven to practical refusal with a hammer capable of delivering a minimum rated energy of 40 kJ per blow, may be designed based on the factored geotechnical axial compression resistances and axial tension resistances shown in **Table 19**.

Table 19 – Geotechnical Axial Resistance for Precast Concrete Piles

Nominal Pile Size	Factored Geotechnical Resistance in Axial Compression at ULS (1) Φ = 0.4	Factored Geotechnical Resistance in Axial Tension at ULS (2)(3) Φ = 0.3	Refusal Criteria
305 mm	550 kN	46 kN	5 blow/25 mm
356 mm	750 kN	54 kN	8 blow/25 mm
406 mm	1000 kN	61 kN	12 blow/25 mm

Notes:

(1) As per 2020 NBCC, a resistance factor of 0.4 is used for calculating the factored geotechnical shaft resistance in compression at ULS.

(2) As per 2020 NBCC, a resistance factor of 0.3 is used for calculating the factored geotechnical shaft resistance in Axial Tension at ULS.

(3) Due to variability in the thickness of clay, an assumption was made for the worst case scenario (TH24-06) of 4 m of clay.

For piles end-bearing on dense till or bedrock, SLS conditions generally do not govern the design since the loads required to induce 25 mm of movement (i.e., the typical SLS criteria) exceed those at ULS.

Assuming a unit adfreeze bond of 65 kPa in the upper 2.0 m of precast concrete piles in unheated areas, uplift forces from frost adfreeze of 125 kN, 146 kN, and 166 kN are possible for pile sizes of 305 mm, 356 mm, and 406 mm, respectively. It should be noted by the structural engineer that these provided uplift forces have not been factored, and the structural engineer must apply the proper load factors. If piles are left for a period of time during winter conditions, risk of the piles heaving due to frost heave is possible. It is the responsibility of the structural engineer to consider this heave potential and design for it.

The refusal criteria indicated in **Table 19** should be achieved at least three times for the final resistance. Pre-boring to a depth of approximately 2.0 m should be considered for all driven piles to enhance pile alignment, and limit vibrations. The pre-bored hole diameter should be slightly larger than the nominal pile diameter. Pre-boring the pile locations will reduce the lateral support along the pre-bored depth of the pile. To maintain lateral support along the pile, the annulus (i.e., space between the pile and the pre-bored soil) should be filled with grout.

All piles should be driven continuously to their required depth once driving is initiated. Pile heave for piles within five pile diameters of each other should be monitored and re-driving should be done where pile heave occurs. Pile spacing should not be less than 2.5 pile diameters, measured center to center. In the Winnipeg area, precast concrete piles driven to practical refusal will develop most of their capacity from toe resistance, and therefore, a reduction in pile capacity is generally not required for group action. Settlement beyond the elastic compression of the pile is expected to be less than 10 mm with an end-bearing pile system for the anticipated geotechnical axial resistance.

Auger refusal was encountered at depths ranging from 223 m ASL to 226 m ASL. From observations made during drilling, auger refusal was encountered in dense till with cobbles and boulders in all testholes. In our experience in the Winnipeg area, driven precast concrete piles will typically reach the required refusal criteria at the depth of auger refusal on suspected dense till with cobbles and boulders (i.e., depths of 223 m ASL to 226 m ASL).

The depth of pile penetration at the project site will depend on localized till and bedrock conditions. Sand seams were noted within the bedrock layer in several testholes. Pile tip elevations may vary considerably throughout the project site. The poorly graded SAND (SP) till was encountered at depths ranging from 224.93 m ASL to 228.30 m ASL and extended to elevations ranging from 218.09 m ASL to 223.19 m ASL. Cobbles and boulders were both encountered during the site investigation; thus, cobbles and boulders may be encountered within the poorly graded SAND (SP) till layer during pile installation. There is therefore potential for piles to refuse in poorly graded SAND (SP) till due to presence of boulders and develop insufficient lateral capacity. The foundation contractor and structural engineer should be prepared to adapt the pile layout should piles refuse at a shallower depth than required by the structural engineering design.

A minimum void space of 150 mm should be provided beneath all pile caps and grade beams to accommodate potential heave of the high plasticity clay. To ensure that the piles achieve their design capacities, full time inspection by AECOM geotechnical personnel is recommended during pile installation. It is generally recommended that different foundation systems not be used to support the same structure unless they are used to support independent structural elements of the structure.

6.3.6 Driven Steel H-Piles

6.3.6.1 Pile Capacity

The capacity of steel H-piles driven to practical refusal on the underlying bedrock could potentially approach the structural capacity of the steel member. Based on the field drilling program, the poorly graded SAND (SP) till thickness and depth to bedrock were highly variable, and sand seams were noted within the bedrock layer in several testholes, therefore the piling contractor should perform test piles to gain a thorough understanding of the pile refusal criteria. Based on AECOM's experience, it has been observed that the capacities of steel H-piles driven to practical refusal on dense till or fractured bedrock materials are generally within the range of 40% to 60% of the structural capacity of the steel member. It is assumed that the ultimate axial capacity is assumed to be 50% of the structural capacity of the steel, therefore:

$$Q_u = 0.5A_tF_y'$$

Where:

A_t = 0.0141 m^2 for HP310x110 and 0.0222 m^2 for HP360x174 (cross sectional area of the pile tip).
F_y' = 350 Mpa (yield stress of the pile).

For driven HP 310x110 piles and HP 360x174 piles, potential axial compression capacities at ULS based on 50% of the structural capacity of the steel are given in **Table 20**.

Table 20 – Driven Steel H-Pile Capacity Based on Structural Strength

Pile Size	Pile Embedment Length Range Below Existing Grade (1)	Axial Compression at ULS		Axial Tension at ULS
		RF = 0.4 (2)	RF = 0.5 (3)(5)	RF = 0.3 (4) (6)
HP310 x 110	Highly Variable	987 kN	1234 kN	59
HP360 x 174	Highly Variable	1554 kN	1943 kN	71

(1) High variability was the result of inconsistent poorly graded SAND (SP) till thicknesses, soft mudstone layers, poor core recovery, and poor rock quality (RQD) obtained.
(2) As per 2020 NBCC, when semi-empirical analysis using laboratory and in situ test data is available, a resistance factor of 0.4 is used for calculating the geotechnical shaft resistance in compression at ULS.
(3) As per 2020 NBCC, when analysis using dynamic monitoring results is available, a resistance factor of 0.5 is used for calculating the factored geotechnical shaft resistance in compression at ULS.
(4) As per 2020 NBCC, when uplift resistance by semi-empirical analysis is available, a resistance factor of 0.3 is used for calculating the factored geotechnical shaft resistance in tension at ULS.
(5) To use axial compression at ULS value using an RF of 0.5, PDA must be completed on at least 5% of the production piles.
(6) Due to variability in the thickness of clay, an assumption was made for the worst case scenario (TH24-06) of 4 m of clay.

As stated above, SLS conditions generally do not govern the design since the loads required to induce 25 mm of movement exceed those at ULS. Vertical settlements of steel H-piles driven to refusal are expected to be negligible.

Assuming a unit adfreeze bond of 100 kPa in the upper 2.0 m of steel HP310x110 and HP360x174 piles in unheated areas, uplift forces from frost adhesion of 365 kN and 439 kN, respectively are possible. It should be noted by the structural engineer that these provided uplift forces have not been factored, and the structural engineer must apply the proper load factors. This capacity does not include the buoyant weight of the pile or potential permanent loading.

The estimated axial pile capacities for the driven steel HP310x110 and HP360x174 piles given in **Table 20** have been based on the following assumptions:

1. For the calculations of resistance in axial tension at ULS (excluding adfreeze) and frost adhesion uplift resistance, the frictional capacity in the upper 2.0 m of the pile has been ignored to account for potential soil drying and shrinking near the ground surface.
2. Geotechnical resistance factors (RF) of 0.4 and 0.5 for axial compression and 0.3 for axial tension have been used as per the NBCC (2020).
3. To use the axial compression at ULS value using an RF of 0.5, Pile Driving Analyzer (PDA) testing must be completed on at least 5% of the production piles. Refer to **Section 6.3.6.4** for complete details.
4. A minimum of void space of 150 mm should be provided beneath all structural elements to accommodate potential heave of the high plasticity clay fill and clay.

The piles should be driven with a minimum pile spacing of 2.5 pile diameters measured center to center within pile groups. Pile heave should be monitored, and piles should be re-driven when pile heave is observed. Pile heave more than 10 mm require redriving of the piles. A surveyor should record the pile elevations upon completion of pile driving, to correct the pile heave, if needed.

To help minimize the damage to the end of the pile during the driving process, a driving shoe should be installed at the end of each pile. The driving shoe should not extend beyond the pile perimeter tip area of the steel H-pile to prevent disturbance of the soils during installation of the pile.

6.3.6.2 Pile Type

Prior to the pile installation, the piles should be inspected to confirm that the material specifications are satisfied. As a minimum, steel piles should meet the requirements of CAN/CSA-G40.20/G40.21, Grade 350W. The piles should be free from protrusions, which could create voids in the soil around the pile during driving.

6.3.6.3 Pile Driving Criteria

During the installation of the driven steel piles, the maximum compression and tension stresses developed within any pile (commonly referred to as the driving stresses) should be limited to $0.9F'_y$.

The hammer energy delivered to the pile head for driving the steel piles should be a minimum of 60 kJ for piles based on structural strength. This hammer energy is for a hydraulic hammer. For other hammer types, the required energy may vary depending on the energy transfer ratio.

On a preliminary basis, the definition of practical refusal may be taken as 15 blows per each 25 mm interval for three consecutive sets. The driving criteria can be developed using a wave equation analysis program (GRLWEAP) once the hammer type, hammer energy and pile type are confirmed, and the pile loads have been proven by PDA tests.

6.3.6.4 Pile Driving Analyzer Tests

To use a geotechnical resistance factor of 0.5 for axial compression, Pile Driving Analyzer (PDA) tests must be conducted on approximately 5% of the piles during installation. These tests should be performed both at the end of initial drive (EOID) of the pile and at the beginning of restrike (BOR) of the pile to ensure that the piles reach and maintain the specified capacity. At EOID, the piles should be driven to the design depth. If piles do not reach their expected capacity at EOID, the piles will be tested at BOR after a period of 24 to 72 hours. The energy for BOR pile tests shall be determined prior to BOR pile testing.

The designer should get Case Pile Wave Analysis Program (CAPWAP) analyses performed in conjunction with PDA tests during pile installation monitoring to confirm expected axial pile capacities.

6.3.6.5 Pile Installation Monitoring

The designer should consider monitoring of the pile installation by an AECOM geotechnical inspector to verify that the piles are installed in accordance with design assumptions and the driving criteria are satisfied. For each pile, a complete driving record in terms of the number of blows per 300 mm of penetration should be recorded by the inspector and reviewed during pile installation by the designer.

6.3.7 Drag Load

Consolidation settlement of the native clay layer caused by fill material may potentially induce drag load (i.e., negative skin friction) on deep foundation elements. Fill materials are not expected due to finish floor elevations of 234.5 m ASL and 236.0 m ASL. These finish floor elevations result in the need for cutting of material, therefore there is no drag load.

6.4 Seismic Considerations

As per Table 6.1A of the CFEM, the site classification for seismic site response is dependent on the average properties in the top 30 m of the soil profile. Based on a soil profile having more than 3 m of high plasticity clay, a Seismic Site Class E can be assigned to the site.

The 2020 National Building Code of Canada (NBCC) Seismic Hazard Calculation for the site is provided in **Appendix E**. It includes values of spectral acceleration (for time periods of 0.2, 0.5, 1.0, 2.0, 5.0 and 10.0 seconds), peak ground acceleration, and peak ground velocity for 2%, 5%, and 10% probability of exceedance in 50 years.

6.5 Soil-Supported Floor Slab

At the time of this report, the AECOM geotechnical team understands that there will be one finish floor elevation (FFE) of 235.3 m ASL for the entire building at the Winnipeg North Transit Garage. This includes the bus storage area, the bus maintenance area, and the office space. The floor slab tolerance is required to be in the range of 1/500, and a maximum settlement of 25 mm.

It is understood that the transit garage will be constructed using a soil supported floor slab. Based on the subsurface conditions identified at the site, slab-on-grade structures will bear directly on either clay fill, sand fill or fat clay, depending on location within the site. A summary of the suspected bearing material is provided in **Table 21.**

Table 21 – Bearing Material

Finish Floor Elevation of 235.3 m ASL

Testhole ID	Soil Type
TH24-01	Sand Fill
TH24-02	Clay Fill
TH24-03	Clay Fill
TH24-05	Sand Fill
TH24-06	Clay Fill
TH24-07	Clay Fill
TH24-08	Clay Fill
TH24-09	Fat Clay
TH24-10	Clay Fill
TH24-11	Clay Fill

Due to the presence of high plasticity clay fills and fat clays at the site, the potential exists for heave of soil-supported floor slabs. Soil moisture contents will typically increase after construction which causes swelling of clay soils. It is important to note that this estimated range of swell relates to soil moisture content changes. Due to the project site requiring significant cuts (0.54 m to 3.13 m) to reach the finish floor elevations of 235.3 m ASL; it was determined that slab heave would be the primary concern. The clay heave properties determined through laboratory testing are provided in **Table 22**.

Table 22 – Material Swell Properties

Material	Swelling Pressure (kPa)	Unit Weight of Soil (kN/m^3)	Initial Void Ratio	Swelling Index
Clay Fill	40	20.39	0.544	0.045
Brown Clay	100	17.27	1.193	0.028
Grey Clay	50	16.74	1.378	0.066

Using the swell properties provided in **Table 22** and information on the soil stratigraphy collected during the field investigation, calculations were conducted at the testhole locations within the building footprint to determine the worst heave conditions expected in the subgrade material. Based on the soil conditions encountered on the project site and the swell calculations conducted, the maximum heave of a soil-supported floor slab is estimated in the range of 15 mm to 25 mm. The structural engineer should consider this range of movement in design as it will affect the serviceability of the soil-supported floor slab. Heave is generally higher on sites where trees are removed prior to construction or in areas where leaking water supply/sewer lines or poor drainage lead to increased moisture contents in the clay soil after construction. To minimize potential heave of a soil-supported floor slab, measures must be taken to prevent drying of the subgrade soils during construction. Based on the FFE and the recommended soil-supported floor slab thickness, it is likely the perched water table in the silt (ML) layer will be encountered.

For the FFE of 235.3 m ASL, the bearing material was not observed to be the silt layer based on the testholes drilled. Therefore, the recommended soil-supported slab design was based on the calculated heave range and is provided in **Table 23**.

Table 23 - Soil-Supported Floor Slab Recommendation for FFE of 235.3 m ASL

Design Recommendation	Heave Range
200 mm – concrete slab[1] 100 mm – granular A base course 200 mm – 50 mm granular A 500 mm – 100 mm granular A **Total Subcut = 1000 mm**	10 mm – 20 mm

Note: the concrete slab thickness is an assumed thickness and should be determined by the structural engineer. Any decrease in slab thickness, must be offset by an increase in granular material to obtain the necessary total subcut.

For the FFE of 235.3 m ASL construction of the recommended soil-supported slab should be as follows:

- Remove topsoil within the building footprint;
- Excavate to the design subgrade elevation; Place a nonwoven geotextile (Titan TE-8 or an approved equivalent) above the subgrade (in accordance with City of Winnipeg CW3130);
- Place biaxial geogrid (Titan Earth Grid^{TM} or an approved equivalent) above the nonwoven geotextile (in accordance with CW3135);
- Place the 100 mm Granular A material in one 500 mm lift. The 100 mm Granular A material shall be compacted by a nonvibratory roller packer. Due to the size of the aggregate, the degree of compaction shall be tested by proof rolling the material and approved by a qualified geotechnical representative. The proof rolling equipment shall be a tandem-axle end dump truck fully loaded with either gravel or clay. Tire pressure shall be no less than 90 percent the manufacturer’s recommended maximum inflation. The truck shall make passes at speeds between 4.0 and 8.0 km/hr. Proof rolling must be carried out the same calendar day that compaction is completed. Rutting more than 15 mm shall not be accepted and the granular subbase shall be recompacted.
- Upon acceptance of the 100 mm granular A layer, place the 50 mm granular A in maximum 200 mm lift and compact to 100% SPMDD.
- The granular A base course shall be placed above the 50 mm granular A in maximum 100 mm lift and compacted to 100% of the SPMDD.

The 50 mm down subbase and base course materials should be compacted to at least 100% of Standard Proctor Maximum Dry Density (SPMDD). The grading limits for the subbase and base course materials for a soil-supported slab are shown in **Table 24**.

Table 24 - Fill Material Grading Limits for Floor Slabs

Canadian Metric Sieve Size (µm)	100 mm Down Subbase	50 mm Down Subbase	Base Course
125,000	100%		
100,000	85%-100%		
75,000	70%-92%	100%	
50,000	50%-78%	97%-100%	
37,500	--	75%-95%	
28,000			100%
25,000	25%-58%	55%-87%	97%-100%
20,000	--	--	85%-95%
10,000	15%-40%	25%-60%	47%-70%
5,000	--	16%-48%	32%-55%
2,500	--	--	18%-45%
1,250	5%-20%	8%-30%	11%-35%
630	--	--	8%-26%
315	3%-14%	4%-18%	5%-18%
80	2%-8%	2%-8%	2%-8%

To prevent frost-related movements in the floor slab, the subgrade must not be allowed to freeze during construction and there should be no frost present in the subgrade soils prior to concrete placement for the floors slab. Sieve analysis and compaction testing of the crushed limestone base course materials should be conducted during construction to ensure that the materials and the compaction comply with the specification requirements. The base course and subbase materials should comply with the current City of Winnipeg Design and Construction Specifications CW3110.

6.6 Structural Floor Slab

If the potential movements of a soil-supported floor slab are unacceptable, slab movement may be eliminated by providing a structural floor system. A structural floor should be provided with a minimum 150 mm void space between the soil and the underside of the slab to accommodate potential heave of the underlying clay. Structural floor slabs are traditionally supported by deep foundation systems.

6.7 Concrete Sidewalks

It is understood at the time of writing this report that the Winnipeg North Transit Garage will require pedestrian pathways for access to certain locations of the new facility. AECOM’s geotechnical team has provided minimum recommendations for the construction of concrete sidewalk in **Table 25**.

Table 25 - Concrete Sidewalk Recommendations

Sidewalk Component	Design Recommendation
Concrete Sidewalk Thickness	100 mm
Concrete Sidewalk Width	1500 mm
Base Course Thickness	300 mm
Cross Slope Minimum	2%
Cross Slope Maximum	4%

Preparation of the subgrade and construction of the concrete sidewalks should comply with the City of Winnipeg SD-228A. This shop drawing references the City of Winnipeg Standard Construction Specification CW3235, CW3310, and CW3325. It is important to adhere to these construction specifications.

6.8 Entrance Slabs

Frost heave of exterior concrete slabs in front of building entrances is a common problem in Winnipeg. It is recommended that a void space is incorporated into the design of entrance slabs dowelled into the grade beam. This will mitigate effects of the entrance slab tipping up due to rotation around the doweled connection, which could lead to cracking of the entrance slab and blocking of entrance doors. Void space should also be incorporated into the design of entrance slabs that are not dowelled into the grade beam to prevent heaving adjacent to the exterior wall that could lead to blocking of entrance doors and crushing of exterior wall facings with insufficient clearance above the exterior slab.

The magnitude of heave is dependent upon several factors including the soil type, soil moisture content, climatic conditions, and heat loss from the structure. Due to the many factors that play a role in frost heave, the magnitude of heave is very difficult to predict. Maximum heave in the range of 60 to 120 mm has been observed for exterior concrete slabs at building entrances with similar soil conditions.

If the potential movements of a soil-supported floor slab are unacceptable, slab movement may be eliminated by providing a structural floor system. A structural floor should be provided with a minimum 150 mm void space between the soil and the underside of the slab to accommodate potential heave of the underlying clay. Structural floor slabs are traditionally supported by deep foundation systems.

6.9 Soil Chemistry

The electrochemical tests conducted (water soluble sulphate, pH, conductivity, and resistivity) were completed on three (3) samples. A summary of the results are provided in **Table 26**.

Table 26 - Summar of Electrochemical Testing

Testhole ID	Sample ID	Sample Depth (m)	Soil Type	Water Soluble Sulphate (%)	Potential for Sulphate Attack	Resistivity (ohm · cm)	Corrosivity Rating
TH24-08	G3	1.37 – 1.52 m	Clay Fill	0.118	Moderate	920	Extremely Corrosive
TH24-10	G8	4.42 – 4.57 m	CH	3.16	Very Severe	120	Extremely Corrosive
TH24-11	G11	7.47 – 7.62 m	CH	0.119	Moderate	810	Extremely Corrosive

Based on the electrochemical laboratory test results, the corrosivity potential for steel elements buried in the clay fill or fat clay is extremely corrosive; The selection and design should consider the possibility of corrosion in steel piles, and other metal structures.

The potential of sulphate attack on concrete is discussed in **Section 6.10**.

6.10 Foundation Concrete

Clay soils in the Winnipeg area contain sulphates that will cause deterioration of concrete. The class of exposure for concrete in contact with clay soil in Winnipeg is severe (S-2 in CSA A23.1-09 Table 3). The requirements for concrete exposed to severe sulphate attack are provided in **Table 27**.

Table 27 - Foundation Concrete Requirements

Parameter	Design Requirement
Class Exposure	S-2
Compressive Strength	32 MPa at 56 days
Air Content	4 to 7%
Water-to-Cement Materials Ratio	0.45 max.
Cement	Type HS or HSb

6.11 Pavement

Multiple pavement sections will be constructed throughout the Winnipeg North Transit Garage project site. The current site has elevations from 234.84 m ASL to 238.45 m ASL, the finish floor elevations are 235.3 m ASL, it is understood that all constructed areas will result in a cut of the existing material.. Two different flexible pavement designs will be incorporated; a heavy-duty flexible pavement (staff parking lot entrance and exit routes from Oak Point Highway) and a light duty flexible pavement (staff parking stalls). Additionally, it is understood that a rigid pavement design will be utilized near the exterior of the building structure and includes the bus access point at Oak Point Highway and Selkirk Avenue.

TH24-18 to TH24-22 were used to determine the design parameters required for developing the flexible and rigid pavement designs for the surrounding area of the building TH24-18 and TH24-19 were terminated at a depth of 4.57 meters below grounds surface (m BGS), while TH24-20, TH24-21, and TH24-22 were terminated at a depth of 3.05 m BGS. The surface material was topsoil in all testholes except TH24-22 that had an existing asphalt surface. In all testholes the surface material was followed by fill, and beneath the fill, fat clay. TH24-18 and TH24-19 had a layer of sand fill before transitioning to a fat clay fill, while the other testholes consisted solely of fat clay fill.

Bulk samples were collected from TH24-18 to TH24-22 from a depth ranging from 0.3 m BGS to 1.50 m BGS. Standard proctor and California Bearing Ratio tests were performed on the bulk samples. The CBRs were soaked at 95% maximum dry density. TH24-18, TH24-21, and TH24-22 were included in bulk sample 1, the standard proctor resulted in a maximum dry density of 1707 kg/m^3 and optimum moisture content (OMC) of 19.1%, and a CBR value was calculated at 3.6. TH24-19 and TH24-20 were included in bulk sample 2, the standard proctor resulted in a maximum dry density of 1759 kg/m^3 and OMC of 15.9%, and the CBR value was calculated at 3.0.

TH24-18 and TH24-19 were drilled in the vicinity of the existing landfill. Various waste was observed in these testholes. In TH24-18 metal remains were observed at an approximate depth of 0.75 m BGS to approximately 4.0 m BGS in the fat clay fill. AECOM's environmental team conducted an extensive field investigation in the landfill vicinity that included testpits, boreholes, and monitoring wells. TP24-03 to TP24-12 focused exclusively on the existing landfill and the waste material observed within it. Metal, wood, glass bottles and other glass, ceramics, concrete, plastic, bricks, car tires and other car parts, rebar, and the presence of hydrocarbons were all observed within these test pits. A map of the environmental investigation and the respective logs can be found in **Appendix G**.

6.11.1 Traffic

The pavement designs were completed following the AASHTO 1993 *Guide for the Design of Pavement Structure,* Part II of the design guide provides details on pavement design procedures for new construction or reconstruction.

The design of a pavement structure is highly dependent upon the number and type of vehicles that will be driving on the roadways. Traffic loadings from different types of vehicles are then equated to the number of Equivalent Single Axle Loads (ESALs), which is defined by the summation of equivalent 18,000-pound single axle loads used to combine mixed traffic to design traffic for the design period. The estimated traffic distribution for light duty flexible pavement design is provided in **Table 28**.

Table 28 - Traffic Data - Light Duty – Flexible Pavement

Design Parameters	Value
Truck Percentage (%)	10%
Distribution (%):	
2 & 3 axle	5%
5 axles	5%
Bus	90%

The light duty pavement areas are designed for the facility employees and will primarily be used in areas such as the employee parking lots. Therefore, it is not expected to have large vehicles such as semis or buses. AECOM has estimated a truck percentage of 10%, as there is still potential for these types of vehicles to enter the light duty pavement areas. Of this 10%, AECOM has estimated 5% are 2 & 3 axle trucks, 5% are 5 axle trucks, and 90% are buses.

The estimated traffic distribution for heavy duty flexible pavement design are provided in **Table 29**.

Table 29 - Traffic Data - Heavy Duty - Flexible Pavement

Design Parameters	Value
Truck Percentage (%)	25%
Distribution (%):	
2 & 3 axle	25%
5 axles	25%
Bus	50%

The heavy-duty flexible pavement design accounts for a larger increase in truck percentage (25%), this pavement design will allow for the potential use for deliveries, or towing requirements. Of the 25% truck percentage, AECOM has estimated 25% are 2 & 3 axle trucks, 25% are 5 axle trucks, and 50% are buses.

The estimated traffic distribution for heavy-duty rigid pavement design are provided in **Table 30**.

Table 30 - Traffic Data - Heavy Duty - Rigid Pavement

Design Parameters	Value
Truck Percentage (%)	75%
Distribution (%):	
Bus	100%

The heavy-duty rigid pavement areas are the suitable bus routes and are designed to support larger frequencies of heavier traffic. AECOM has estimated a truck percentage of 75% for these pavement types, 100% of which are estimated to be buses.

6.11.2 Pavement Design

Traffic loads were converted to an Equivalent Single Axle Load (ESAL) used in the AASHTO pavement design procedure. The design ESALs were based on the percentage of trucks in the total cumulative traffic loads over the length of the design life. The pavement design parameters are presented in **Table 31**, **Table 32**, and

Table 33.

Table 31 - Pavement Design Parameters – Flexible Pavement – Light Duty

Traffic	**AADT: 1000** **Commercial Vehicles: 10%** **Number of Lanes: 2** **Annual Growth Rate: 1%** **500,000 Design ESALS for 20-year design life**	
Design Life	20 years (Flexible)	
Reliability	90%	
Standard Deviation	0.44	
Serviceability	Flexible – Initial: 4.4 Terminal: 2.2	
Asphalt Pavement Material Structural Layer Coefficients	**New Structures**	**SLC**
	Hot Mix Asphalt, 150 – 200 (A) Grade	0.42
	28 mm granular A base	0.14
	100 mm granular A subbase	0.14

Table 32 – Pavement Design Parameters – Flexible Pavement – Heavy Duty

Traffic	**AADT: 1000** **Commercial Vehicles: 25%** **Number of Lanes: 2** **Annual Growth Rate: 1%** **1,630,000 Design ESALS for 20-year design life**	
Design Life	20 years (Flexible)	
Reliability	90%	
Standard Deviation	0.44	
Serviceability	Flexible – Initial: 4.4 Terminal: 2.2	
Asphalt Pavement Material Structural Layer Coefficients	**New Structures**	**SLC**
	Hot Mix Asphalt, 150 – 200 (A) Grade	0.42
	28 mm granular A base	0.14
	100 mm granular A subbase	0.14

Table 33 - Pavement Design Parameters – Rigid Pavement

Traffic	**AADT: 1200** **Commercial Vehicles: 75%** **Number of Lanes: 2** **Annual Growth Rate: 1%** **4,050,616 Design ESALS for 20-year design life**
Design Life	20 years (Rigid)
Reliability	90%
Standard Deviation	0.44
Serviceability	Rigid – Initial: 4.4 Terminal: 2.2
Concrete Pavement Material Properties and Design Features	Flexural Strength: 4.48 MPa Elastic Modulus: 25.7 GPa

The design parameters noted above were used in the pavement design analysis. Pavement design options developed are presented below in **Table 34**.

Table 34 - Pavement Design Options - Winnipeg North Transit Garage

Pavement Design Option	Pavement Structure Details	Service Life (yrs.)
Flexible Pavement – Light Duty	• 75 mm – hot mix asphalt • 100 mm – 28 mm granular A base • 375 mm – 100 mm granular A subbase • Geotextile separation thickness • Geogrid Class A **550 mm total thickness**	20
Flexible Pavement – Heavy Duty	• 100 mm – hot mix asphalt • 75 mm – 28 mm granular A base • 375 mm – 100 mm granular A subbase • Geogrid Class A • Geotextile separation fabric **575 mm total thickness**	20
Rigid Pavement	• 230 mm plain doweled concrete • 75 mm – 28 mm granular A base • 375 mm – 100 mm granular A subbase • Geogrid Class A • Geotextile separation fabric **705 mm total thickness***	20

Based on these pavement design thicknesses, it is very likely that the perched water table in the silt (ML) layer will be breached.

Preparation of the subgrade and construction of the subbase and base course for the pavement areas should comply with the City of Winnipeg Standard Construction Specification CW 3110. Supply and installation of geogrid and geotextile should be comply with the City of Winnipeg Standard Construction Specifications CW3135 and CW3130, respectively. Additional materials, if required to increase the final grade for the pavements, should consist of crushed sub-base material.

The light duty pavement section should be used where traffic loading will consist of passenger vehicles and light duty trucks. The heavy-duty pavement sections should be used for pavements subjected to traffic loading greater than passenger vehicles and light duty trucks, but do not exceed the normal maximum allowable axle loads permissible by City of Winnipeg traffic bylaws. Sieve analysis and compaction testing of the granular fill materials are recommended to ensure the materials and compaction comply with the specifications.

The pavement design should consider a drainage system within the granular layer to prevent water accumulation with the granular material between the asphalt and the clay layers. Water trapped within the granular layers will freeze in the winter months and expand, possibly causing damages in the pavement structure.

6.11.3 Construction of Pavement on Various Subgrades

6.11.3.1 Constructing on Clay and Clay Fills Subgrades

If clay or clay fill is encountered at the subgrade level (i.e., the bottom of the subbase layer) proceed as follows:

- Topsoil and organic material must be removed prior to pavement construction.
- Preparation of the subgrade and construction of the subbase and base course for the pavement areas should comply with City of Winnipeg Standard Construction Specification CW 3110.
- Excavate to the required subgrade elevation.
- Proof roll the subgrade to identify soft or unsuitable materials at the subgrade level. Although silt was not observed in the testholes conducted for the pavement areas, field conditions may differ from what was observed during the geotechnical investigation.
- Method for soft or unsuitable subgrade materials:
    - Unsuitable materials identified during proof rolling must be excavated approximately 0.5 m below the design subgrade elevation. If the unsuitable soil continues deeper than the excavated 0.5 m, placement of a nonwoven geotextile and geogrid class A is required.
    - Place a non-woven geotextile over the excavated subgrade.
    - Replace the excavated unsuitable material with 100 mm granular A subbase in a single 500 mm lift.
    - Compact the 100 mm granular A subbase using a vibratory roller compactor.
- Place a geotextile separator layer on top of the subgrade prior to placement of the 100 mm granular A subbase and 28 mm granular A base course.
- Compact the 100 mm granular A subbase and 28 mm granular A base using a vibratory roller compactor.
- Compaction of the subbase and base course should be to at least 100% of Standard Proctor Maximum Dry Density (SPMDD).

6.11.3.2 Constructing on Clay Fills in Waste Disposal Area

TH24-18 and TH24-19 were drilled near the existing waste disposal area. For pavements constructed in the existing waste disposal area, proceed as follows:

- Topsoil and organic material must be removed prior to pavement construction.
- Preparation of the subgrade and construction of the subbase and base course for the gravel surfaced parking areas should comply with City of Winnipeg Standard Construction Specification CW 3110.
- Excavate to the required subgrade elevation.
- If any waste material (metal, wood, ceramic, etc.) is observed at the subgrade level. Excavate and remove the waste material and dispose of the material properly at a City of Winnipeg Landfill.
- Method for infilling depressions resulting from removal of any waste material:
    - Place a non-woven geotextile over the excavated subgrade.
    - Replace the excavated unsuitable material with 100 mm granular A subbase in a single 500 mm lift or or clay fill compacted to 98% Standard Proctor Maximum Dry Density (SPMDD) in 300 mm lifts.
    - Compact the 100 mm granular A subbase using a vibratory roller compactor.

- Proof roll the subgrade to identify soft or unsuitable materials at the subgrade level.
- Method for soft or unsuitable subgrade materials:
    - Unsuitable materials identified during proof rolling must be excavated approximately 0.5 m below the design subgrade elevation.
    - Place a non-woven geotextile over the excavated subgrade.
    - Replace the excavated unsuitable material with 100 mm granular A subbase in a single 500 mm lift.
    - Compact the 100 mm granular A subbase using a vibratory roller compactor.
- Place a geotextile separator layer on top of the subgrade prior to placement of the 100 mm granular A subbase and 28 mm granular A base course.
- Compact the 100 mm granular A subbase and 28 mm granular A base using a vibratory roller compactor.
- Compaction of the subbase and base course should be to at least 100% of Standard Proctor Maximum Dry Density (SPMDD).

6.11.3.3 Constructing on Silt Subgrades

Although silt was not observed in testholes drilled within pavement areas, a silt layer was observed in TH24-03. TH24-04, TH24-06 to TH24-12, and TH24-15 to TH24-17. If silt is encountered at the subgrade level (i.e., the bottom of the subbase layer), bridging should proceed as follows:

- Topsoil and organic material must be removed prior to pavement construction.
- Preparation of the subgrade and construction of the subbase and base course for the gravel surfaced parking areas should comply with City of Winnipeg Standard Construction Specification CW3110.
- Excavate to a depth of 1.0 m below the top of pavement elevation.
- If excavation below the top of the pavement design elevation reaches the silt (ML) layer, there is increased likelihood of encountering a perched water table.
- Place a non-woven geotextile over the silt.
- Place 100 mm Granular A material in a single 500 mm lifts and compact with a non-vibratory roller compactor.
- Compaction of the subbase and base course should be to at least 100% of Standard Proctor Maximum Dry Density (SPMDD).

6.11.3.4 Constructing on Granular Subgrades

If granular material is encountered at the subgrade level (i.e., the bottom of the subbase layer) proceed as follows:

- Topsoil and organic material must be removed prior to pavement construction.
- Preparation of the subgrade and construction of the subbase and base course for the gravel surfaced parking areas should comply with City of Winnipeg Standard Construction Specification CW3110.
- Inspect the material to determine if it is suitable for construction. If the granular material is too intermixed with silts and clays, excavate to a depth of 1.0 m below the top of pavement elevation.
- If it is determined that the material is suitable for construction, proof roll the material to identify loose material. If loose material is observed, compact the granular subgrade using a vibratory roller compactor.
- Place a geotextile separator layer on top of the subgrade prior to placement of the 100 mm granular A subbase and 2 mm granular A base course.
- Compact the 100 mm granular A subbase and 28 mm granular A base using a vibratory roller compactor.
- Compaction of the subbase and base course should be to at least 100% of Standard Proctor Maximum Dry Density (SPMDD).

6.12 Drainage

All roof downspouts should be directed away from structures and the ground surface around the structures should be graded to promote drainage away from the foundation, therefore minimizing the risk of water accumulation and potential soil swelling. Final site grading should ensure that all surface runoff is directed away from structures using a minimum gradient of 2%. To compensate for potential settlement of backfill materials adjacent to structures, the grade should be increased to 10% for the first 2 m from the structures.

The pavement design should consider a drainage system within the granular layer to prevent water accumulation with the granular material between the asphalt and the clay layers. Water trapped within the granular layers will freeze in the winter months and expand, possibly causing damages in the pavement structure.

6.13 Quality Assurance and Quality Control

During construction, it is recommended that the contractor provides an approved quality assurance and quality control program (QA/QC). This program should include but is not limited to periodic testing of granular gradation, L.A. abrasion loss, material proctors, and field density tests.

6.14 Design Review, Construction Monitoring and Testing

AECOM should be retained to review the foundation plans and specifications for conformance with the intent of this report. During construction, it is recommended that an AECOM representative be involved with the following tasks:

- Inspection of foundation installation;
- Inspection of subgrade conditions for soil-supported floor slabs;
- Testing of concrete and bituminous paving mix;
- Field density tests during placement and compaction of granular fill materials; and,
- Inspection during proof rolling of subgrade and sub-base materials.

The purpose of the foundation and subgrade inspection services would be to provide AECOM the opportunity to observe the soil conditions encountered during construction, evaluate the applicability of the information presented in this report to the soil conditions encountered, and provide appropriate changes in design or construction procedures if conditions differ from those described herein. The purpose of the concrete and bituminous mix testing is to ensure these materials comply with the specification requirements. The purpose of the field density tests is to confirm the fill materials have been compacted to the specified density.

7. References

Bezys, R. K., Bamburak, J. D., & Conley, G. G. (2002). *Bedrock Mineral Resources of Manitoba's Capital Region.* Winnipeg: Manitoba Geological Survey.

Canadian Commission on Building and Fire Codes National Research Council of Canada. (2020). *National Building Code of Canada (NBCC) 2020.* Ottawa: National Research Council of Canada 2020.

Canadian Geological Society. (2006). *Canadian Foundation Engineering Manual 4th Edition.*

Trek Geotechnical . (2023). *City of Winnipeg North Transit Garage Geotechnical Factual Report.* Winnipeg: Trek Geotechnical.

Appendix A

Site Photos

Figure 2 - Snow Clearing Conducted on Project Site

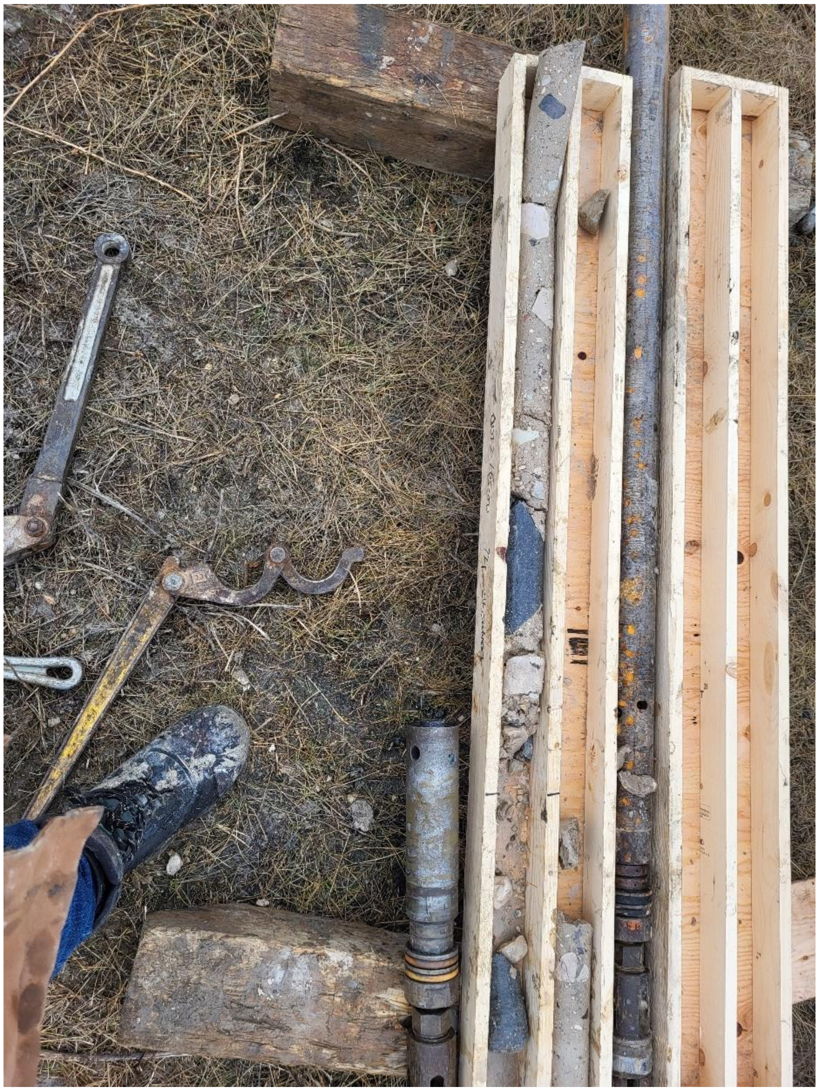


Figure 3 - Dense Till with Cobbles and Boulders Observed On Site

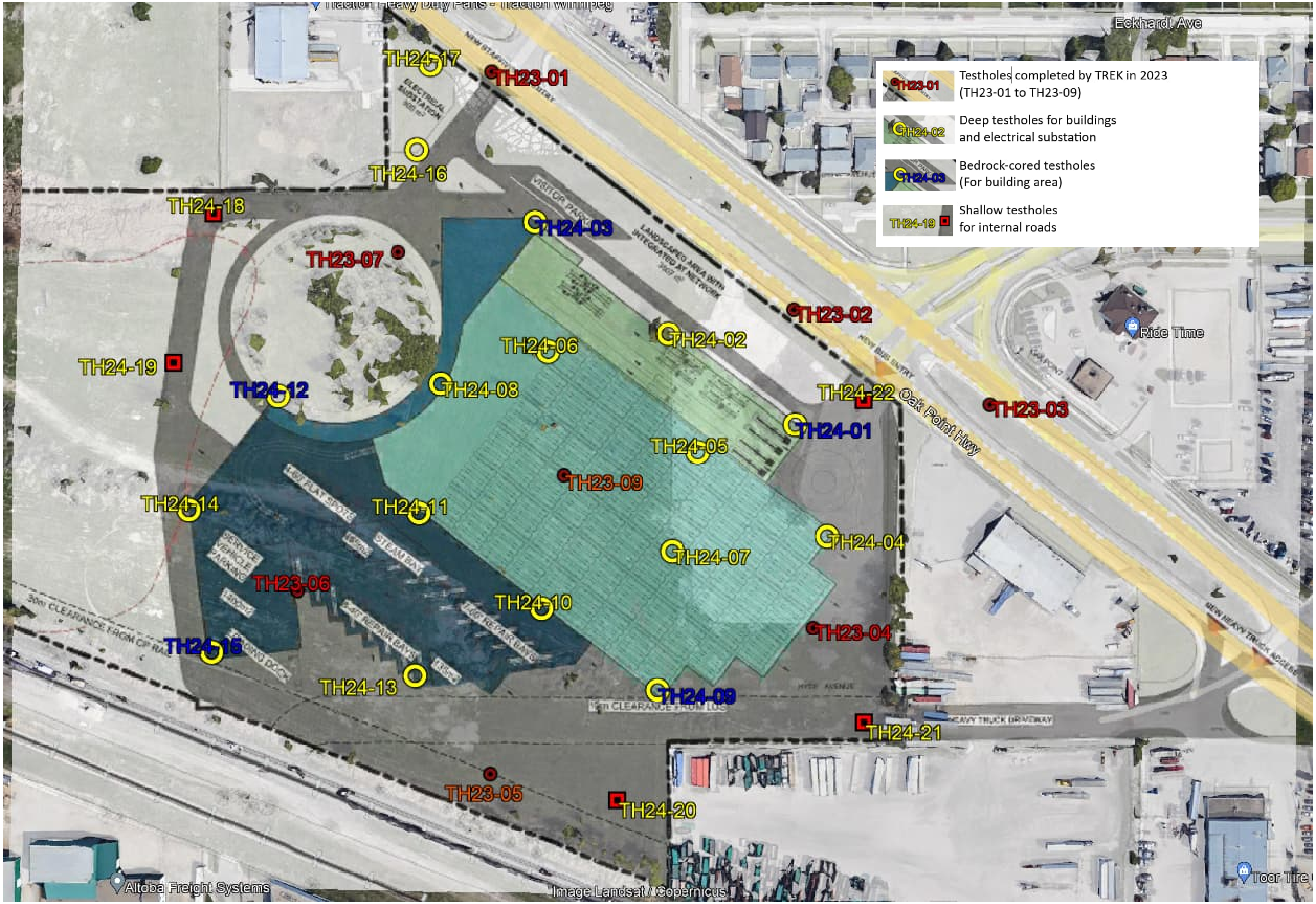
Figure 4 - Coring Conducted Onsite and Mobile B48 Drill Rig (TH24-09)

Figure 5 - Solid Stem Auger for TH24-12

Figure 6 - Coring Method for TH24-15

Appendix B

Testhole Location Plan



City of Winnipeg
December 2023

WINNIPEG TRANSIT GARAGE
TESTHOLE LOCATIONS PLAN FOR PHASE 1 – OPTION 1

AECOM

Appendix C

Testhole Logs

EXPLANATION OF FIELD & LABORATORY TEST DATA

The field and laboratory test results, as shown for each hole, are described below.

1. EXPLANATION OF SOIL

Each soil stratum is classified and described noting any special conditions. The Modified Unified Classification System (MUCS) is used. The soil profile refers to the existing ground level at the time the hole was done. Where available, the ground elevation is shown. The soil symbols used are shown in detail on the soil classification chart.

1.1 Tests on Soil Samples

Laboratory and field tests are identified by the following and are on the logs:

γ_D - Dry Unit Weight. Usually expressed in kN/m^3.

γ_T - Total (moist, wet, or bulk) Unit Weight. Usually expressed in kN/m^3.

C_U - Undrained Shear Strength. Usually expressed in kPa. This value can be determined by a field vane shear test and may also be used in determining the allowable bearing capacity of the soil.

C_{PEN} - Pocket Penetrometer Reading. Usually expressed in kPa. Estimate of the undrained shear strength as determined by a pocket penetrometer.

N - Standard Penetration Test (SPT) Blow Count. The SPT is conducted in the field to assess the in-situ consistency of cohesive soils and the relative density of non-cohesive soils. The N value recorded is the number of blows from a 63.5 kg hammer free falling of 760 mm (30 in.) which is required to drive a 50 mm (2 in.) split spoon sampler 300 mm (12 in.) into the soil.

Q_U - Unconfined Compressive Strength. Usually expressed in kPa and may be used in determining allowable bearing capacity of the soil.

The following tests may also be performed on selected soil samples and the results are given on separate sheets enclosed with the logs:

- Grain Size Analysis
- Standard or Modified Proctor Compaction Test
- California Bearing Ratio Test
- Direct Shear Test
- Permeability Test
- Consolidation Test
- Triaxial Test

1.2 Natural Moisture Content

The relationship between the natural moisture content and depth is significant in determining the subsurface moisture conditions. The Atterberg Limits for a sample should be compared to its natural moisture content and plotted on the Plasticity Chart to determine the soil classification.

Descriptive Term	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

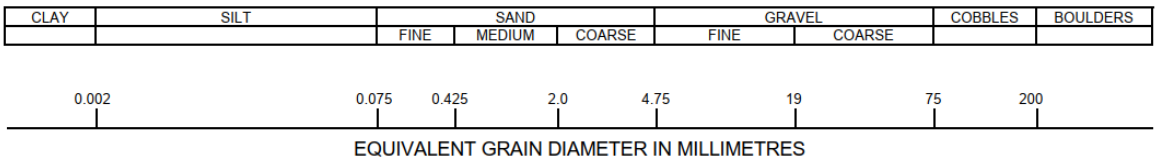
1.3 Grian Size Distrubtion

Laboratory grain size analyses provided by AECOM follow the following system. Note that, with the 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.

SOIL COMPONENTS

FRACTION		SIEVE SIZE (mm)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	IDENTIFIER
GRAVEL	COARSE	75	19	50 – 35	AND
	FINE	19	4.75		
SAND	COARSE	4.75	2.00	35 – 20	ADJECTIVE
	MEDIUM	2.00	0.425		
	FINE	0.425	0.075	20 – 10	SOME
SILT (non-plastic) or CLAY (plastic)		0.075		10 – 1	TRACE
OVERSIZE MATERIALS					
ROUNDED OR SUB-ROUNDED COBBLES 75 mm TO 200 mm BOULDERS >200 mm			ANGULAR ROCK FRAGMENTS ROCKS > 0.75 m3 IN VOLUME		

ISSMFE / USCS SOIL CLASSIFICATION



1.4 Soil Compactness and Consistency

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. These approximate relationships are summarized in the following tables:

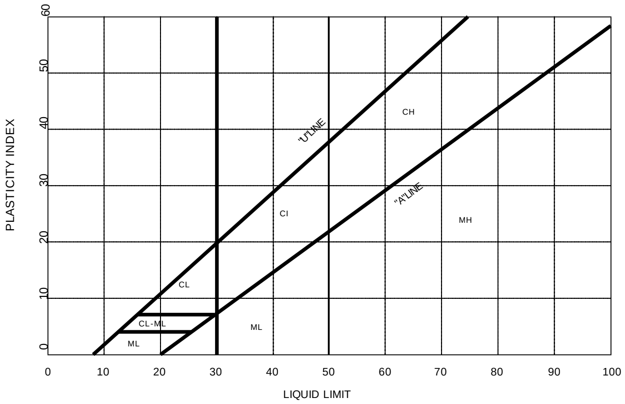
Table 1 Cohesive Soils

Consistency	SPT N (blows/0.3m)	C_u (kPa) approx.
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

Table 2 Cohesionless Soils

Compactness Condition	SPT N (blows/0.3m)
Very Loose	0 – 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

MAJOR DIVISION			UCS	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS	GRAVELS (MORE THAN HALF COARSE GRAINS LARGER THAN 4.75 mm)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{to} 3$	
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW ‘A’ LINE W_p LESS THAN 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE ‘A’ LINE W_p MORE THAN 7
	SANDS (MORE THAN HALF COARSE GRAINS SMALLER THAN 4.75 mm)	CLEAN SANDS (LITTLE R NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{to} 3$	
			SP	POORLY GRADED SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW ‘A’ LINE W_p LESS THAN 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE ‘A’ LINE W_p MORE THAN 7
FINE GRAINED SOILS	SILTS (BELOW ‘A’ LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 50$	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW) WHENEVER THE NATURE OF THE FINE CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER ‘F’. E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY	
		$W_L > 50$	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS		
	CLAYS (ABOVE ‘A’ LINE NEGLIGIBLE ORGANIC CONTENT)	$W_L < 30$	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS		
		$30 < W_L < 50$	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS		
		$W_L > 50$	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS (BELOW ‘A’ LINE)	$W_L < 50$	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
		$W_L > 50$	OH	ORGANIC CLAYS OF HIGH PLASTICITY		
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE	
BEDROCK			BR	SEE REPORT DESCRIPTION		
FILL			FILL	SEE REPORT DESCRIPTION		



SOIL COMPONENTS

FRACTION		SIEVE SIZE (mm)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
		PASSING	RETAINED	PERCENT	IDENTIFIER
GRAVEL	COARSE	75	19	50 – 35	AND
	FINE	19	4.75		
SAND	COARSE	4.75	2.00	35 – 20	_____Y
	MEDIUM	2.00	0.425		
	FINE	0.425	0.075	20 – 10	SOME
SILT (non-plastic) or CLAY (plastic)		0.075		10 – 1	TRACE
OVERSIZE MATERIALS					
ROUNDED OR SUB-ROUNDED COBBLES 75 mm TO 200 mm BOULDERS >200 mm			ANGULAR ROCK FRAGMENTS ROCKS > 0.75 m3 IN VOLUME		

NOTE:

1. BOUNDARY CLASSIFICATION POSSESSING CHARACTERISTICS OF TWO GROUPS ARE GIVEN GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL MIXTURE WITH CLAY BINDER BETWEEN 5% AND 12%

MODIFIED UNIFIED SOIL
CLASSIFICATION SYSTEM

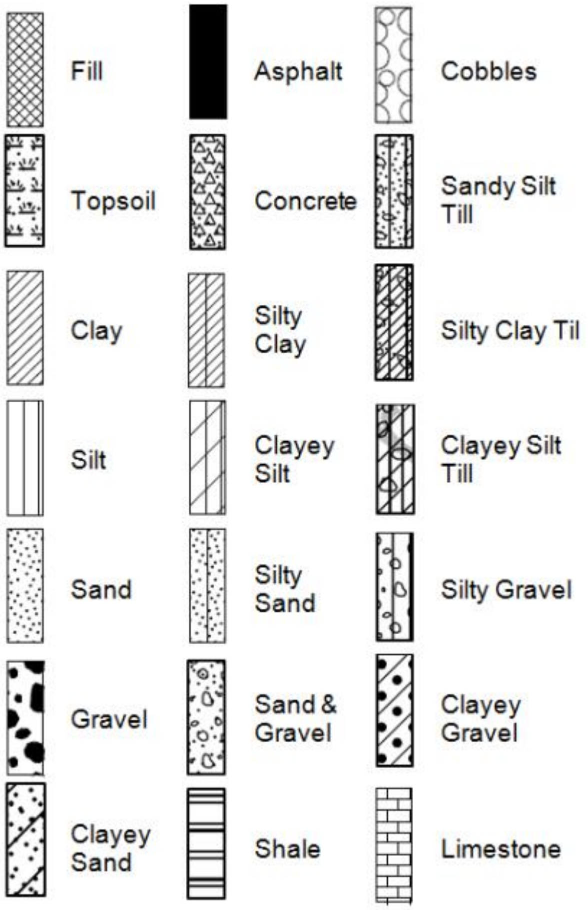
February 2022

1.5 Sample Type, Symbols and Abbreviations

The depth, type, and condition of samples are indicated on the logs by the following symbols or abbreviations:

Sample abbreviations:	Symbols:
GS: Grab Sample	■ Grab ▤ Bulk ◩ No Recovery ▥ Shelby Tube ☒ Split Spoon ◨ Core Sample
BK: Bulk Sample	
NR: No Recovery	
ST: Shelby Tube	
SS: Split Spoon	
Core: Core Samples	
FV: Field Vane	
PP: Pocket Penetrometer	
DCPT: Dynamic cone penetration test	

1.6 STRATA/Graphic Plot (Shall be Changed For Different Guidelines)



2. EXPLANATION OF ENVIROMENTAL SAMPLE

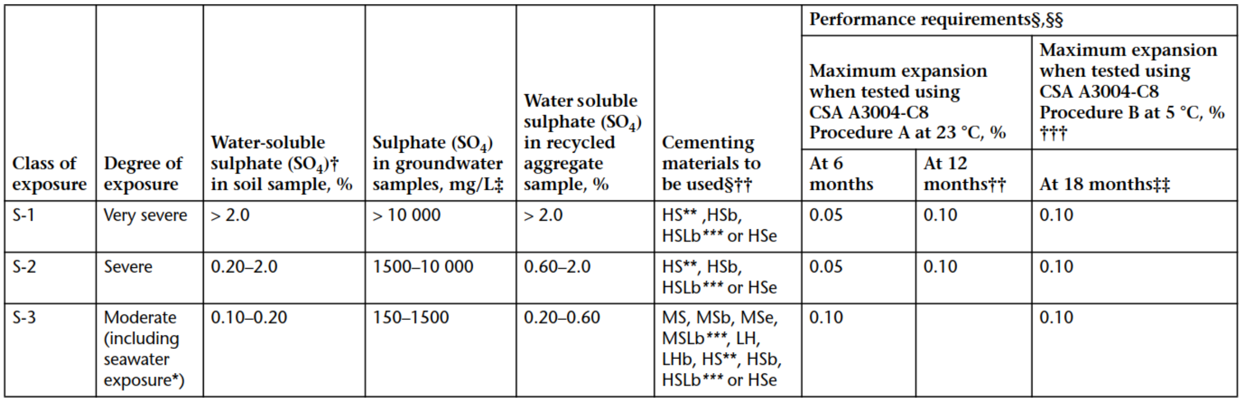
2.1 Contaminant Abbreviations

Contaminant Abbreviations	
BNAE	Base/neutral/acid extractables
BTEX	Benzene, toluene, ethylbenzene, xylenes
OCP	Organochlorine pesticides
MI	Metals and inorganics
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PHC	CCME petroleum hydrocarbons (fractions 1-4)
VOC	Volatile organic compounds (includes BTEX)
SO_4	Water Soluble Sulphate Content

2.2 Water Soluble Sulphate Concentration

The following table, from CSA Standard A23.1-14, indicates the requirements for concrete subjected to sulphate attack based upon the percentage of water-soluble sulphate as presented on the logs. CSA Standard A23.1-14 should be read in conjunction with the table.

Table 3 Requirements for Concrete Subjected to Sulphate Attack*



Class of exposure	Degree of exposure	Water-soluble sulphate (SO_4)† in soil sample, %	Sulphate (SO_4) in groundwater samples, mg/L‡	Water soluble sulphate (SO_4) in recycled aggregate sample, %	Cementing materials to be used§††	Performance requirements§,§§		
						Maximum expansion when tested using CSA A3004-C8 Procedure A at 23 °C, %		Maximum expansion when tested using CSA A3004-C8 Procedure B at 5 °C, % †††
						At 6 months	At 12 months††	At 18 months‡‡
S-1	Very severe	> 2.0	> 10 000	> 2.0	HS** ,HSb, HSLb*** or HSe	0.05	0.10	0.10
S-2	Severe	0.20–2.0	1500–10 000	0.60–2.0	HS**, HSb, HSLb*** or HSe	0.05	0.10	0.10
S-3	Moderate (including seawater exposure*)	0.10–0.20	150–1500	0.20–0.60	MS, MSb, MSe, MSLb***, LH, LHb, HS**, HSb, HSLb*** or HSe	0.10		0.10

*For sea water exposure, also see Clause 4.1.1.5.

†In accordance with CSA A23.2-3B.

‡In accordance with CSA A23.2-2B.

§Where combinations of supplementary cementing materials and portland or blended hydraulic cements are to be used in the concrete mix design instead of the cementing materials listed, and provided they meet the performance requirements demonstrating equivalent performance against sulphate exposure, they shall be designated as MS equivalent (MSe) or HS equivalent (HSe) in the relevant sulphate exposures (see Clauses 4.1.1.6.2, 4.2.1.1, and 4.2.1.3, and 4.2.1.4).

**Type HS cement shall not be used in reinforced concrete exposed to both chlorides and sulphates, including seawater. See Clause 4.1.1.6.3.

††The requirement for testing at 5 °C does not apply to MS, HS, MSb, HSb, and MSe and HSe combinations made without portland limestone cement.

‡‡ If the increase in expansion between 12 and 18 months exceeds 0.03%, the sulphate expansion at 24 months shall not exceed 0.10% in order for the cement to be deemed to have passed the sulphate resistance requirement.

§§For demonstrating equivalent performance, use the testing frequency in Table 1 of CSA A3004-A1 and see the applicable notes to Table A3 in A3001 with regard to re-establishing compliance if the composition of the cementing materials used to establish compliance changes.

***Where MSLb or HSLb cements are proposed for use, or where MSe or HSe combinations include Portland-limestone cement, they must also contain a minimum of 25% Type F fly ash or 40% slag or 15% metakaolin (meeting Type N pozzolan requirements) or a combination of 5% Type SF silica fume with 25% slag or a combination of 5% Type SF silica fume with 20% Type F fly ash. For some proposed MSLb, HSLb, and MSe or HSe combinations that include Portland-limestone cement, higher SCM replacement levels may be required to meet the A3004-C8 Procedure B expansion limits. Due to the 18-month test period, SCM replacements higher than the identified minimum levels should also be tested. In addition, sulphate resistance testing shall be run on MSLb and HSLb cement and MSe or HSe combinations that include Portland-limestone cement at both 23 °C and 5 °C as specified in the table.

†††If the expansion is greater than 0.05% at 6 months but less than 0.10% at 1 year, the cementing materials combination under test shall be considered to have passed.

2.3 Soil Corrosivity

The following table, from the Handbook of Corrosion Engineering (Roberge, 1999) indicates the corrosivity rating can be obtained from the soil resistivity, presented on the logs.

Table 4 Corrosivity Ratings Based on Soil Resistivity

Soil Resistivity (ohm-cm)	Corrosivity Rating
>20,000	Essentially non-corrosive
10,000 – 20,000	Mildly corrosive
5,000 – 10,000	Moderately corrosive
3,000 – 5,000	Corrosive
1,000 – 3,000	Highly corrosive
<1,000	Extremely corrosive

3. HYDROGEOLOGICAL

The groundwater table is indicated by the equilibrium level of water in a standpipe installed in a test hole or test pit. This level is generally taken at least 24 hours after installation of the standpipe. The groundwater level is subject to seasonal variations and is usually highest in the spring. The symbol on the logs indicating the groundwater level is an inverted solid triangle (▼).

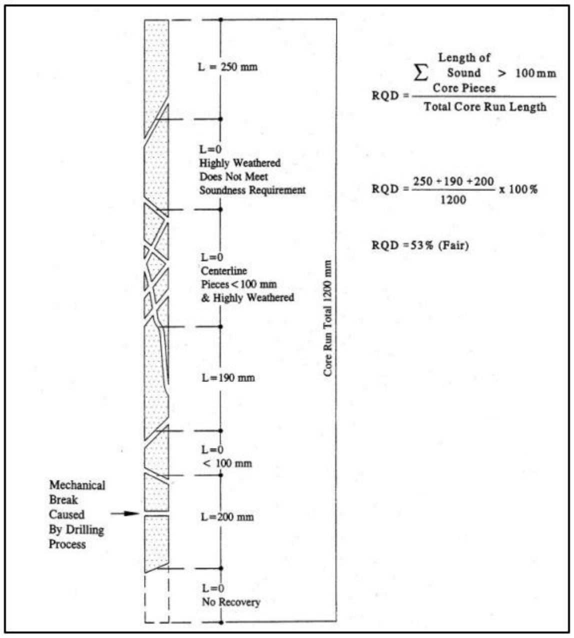
4. EXPLANATION OF ROCK

4.1 General Description and Terms

General Description of Geotechnical Unit including: Quantitative description including rock type (s), percentage of rock types, frequency and sizes of interbeds, colour, texture, weathering, strength and general joint spacing

Total Core Recovery (TCR): Total length of core recovered expressed as percentage of core run length.
Solid Core Recovery (SCR): Total length of solid full diameter core expressed as percentage of core run length.
Rock Quality Designation (RQD): Sum of lengths of solid core pieces longer than 100 mm expressed as percentage of core run length.
Fracture Index (FI): Number of fractures per meter of core.

4.2 Rock Quality Designation (RQD)

RQD(%)	RQD Classification	
0 – 25	Very Poor Quality	
25 – 50	Poor Quality	
50 – 75	Fair Quality	
75 – 90	Good Quality	
90 – 100	Excellent Quality	

4.3 Classification of Strength

Grade	Description	Field identification	Approximate range of Uniaxial compression strength (MPa)
R0	Extremely weak rock	Indented by thumbnail	0.25-1.0
R1	Very weak rock	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0-5.0

R2	Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0-25
R3	Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25-50
R4	Strong rock	Specimen requires more than one blow of geological hammer to fracture it	50-100
R5	Very strong rock	Specimen requires many blows of geological hammer to fracture it	100-250
R6	Extremely strong rock	Specimen can only be chipped with geological hammer	>250

4.4 Classification of Weathering

Grade	Description	Field identification
W1	Fresh	No visible sign of rock material weathering; perhaps slight discolouration on major discontinuity surface
W2	Slightly Weathered	Discolouration indicates weathering of rock material and discontinuity surface. All the rock material may be discoloured by weathering and may be somewhat weaker externally than in its fresh condition
W3	Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones.
W4	Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones.
W5	Completely Weathered	All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact. All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but soil has not been significantly transported.
W6	Residual Soil	Residual Soil

4.5 Type of discontinuity

Symbol	Description
F	Fault
J	Joint
Sh	Shear
Fo	Foliation
V	Vein
B	Bedding

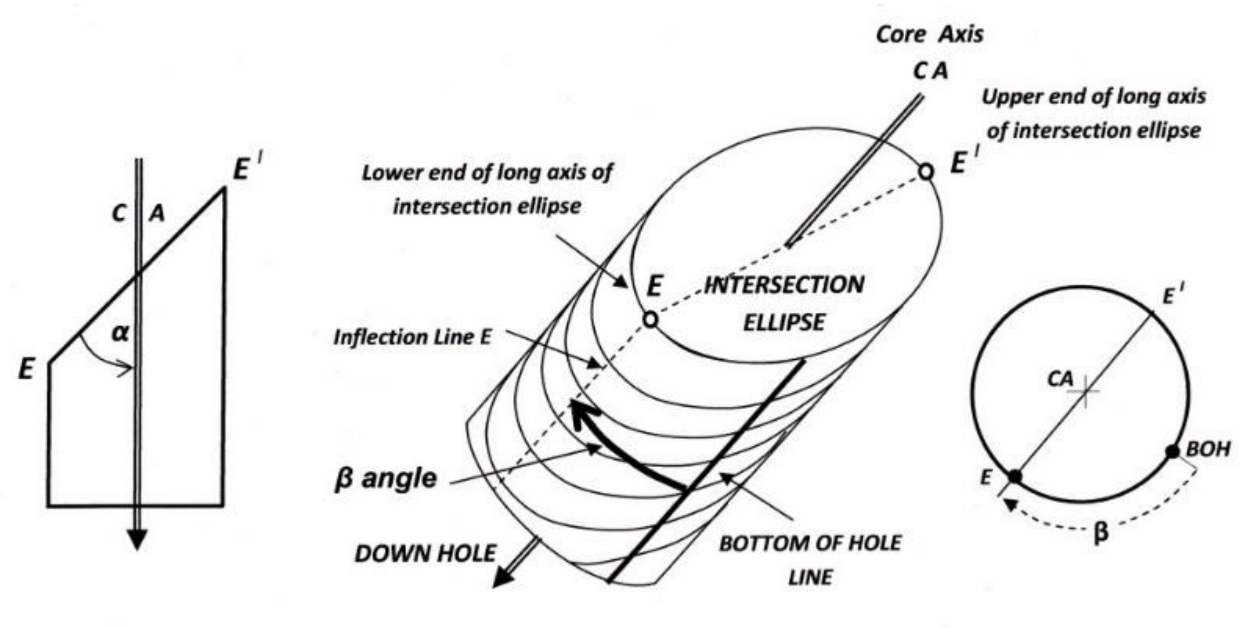
4.6 Spacing of discontinuity

Spacing Classification	Spacing width
Extremely close	<0.02m

Very close	0.02-0.06m
Close	0.06-0.2m
Moderately Close	0.2-0.6m
Wide	0.6-2.0m
Very Wide	2.0-6.0m
Extremely Wide	>6.0m

4.7 Joint Orientation

The orientation of a planar surface intersected by drill core can be defined by two angles called alpha (α) and beta (β). The definition of these angles is shown in the diagram below:



4.8 Inclination

Term	Inclination (degrees from the horizontal)
Sub-horizontal	0-5
Gently Inclined	6-15
Moderately Inclined	16-30
Steeply Inclined	31-60
Very Steeply Inclined	61-80
Sub-vertical	81-90

4.9 Stratification/foliation

Term	Spacing
Very Thickly Bedded	>2m
Thickly Bedded	600mm-2m
Medium Bedded	200mm-600mm
Thinly Bedded	60mm-200mm

Term	Spacing
Very Thinly Bedded	20mm-60mm
Laminated	6mm-20mm
Thinly Laminated	2mm-6mm
Fissile	<2mm

4.10 Grain Size

Term	Size
Very Coarse Grained	>60 mm
Coarse Grained	2mm-60mm
Medium Grained	60 microns – 2mm
Fine Grained	2 microns – 60 microns
Very Fine Grained	<2 microns

4.11 Aperture of open discontinuity

Symbol	Aperture Opening	Description	
VT	<0.1 mm	Very tight	Closed Features
T	0.1-0.25mm	Tight	
PO	0.25-0.5mm	Partly open	
O	0.5-2.5mm	Open	Gapped Features
MW	2.5-10mm	Moderately open	
W	>10mm	Wide	
VW	1-10cm	Very wide	Open Features
EW	10-100cm	Extremely wide	
C	>1m	Cavernous	

4.12 Width of filled discontinuity

Symbol	Width	Description
W	12.5-50mm	Wide
MW	2.5-12.5mm	Moderately Wide
N	1.25-2.5mm	Narrow
VN	<1.25mm	Very Narrow
T	0mm	Tight

4.13 Roughness of discontinuity

Symbol	Description
Slk	Slickenside (surface has smooth, glassy finish with visual evidence of striations)
S	Smooth (surface appears smooth and feels so to the touch)
SR	Slightly rough (asperities on the discontinuity surfaces are distinguishable and can be felt)
R	Rough (some ridges and side-angle steps are evident; asperities are clearly visible, and discontinuity surface feels very abrasive)

Symbol	Description
VR	Very rough (near-vertical steps and ridges occur on the discontinuity surface)

4.14 Shape of discontinuity

Symbol	Description
Pl	Planar
St	Stepped
Un	Undulating
Ir	Irregular

4.15 Filling amount

Symbol	Description
Su	Surface Stain
Sp	Spotty
Pa	Partially Filled
Fi	Filled
No	None

4.16 Filling Type

Symbol	Term	Hard/Soft
Ab	Albite	Hard
Ah	Anhydrite	Hard
Bt	Biotite	Soft
Bn	Bornite	Hard
Ca	Calcite	Hard
Cb	Carbonate	Hard
Ch	Chlorite	Soft
Cpy	Chalcopyrite	Hard
Cy	Clay	Soft
Do	Dolomite	Hard
Ep	Epidote	Hard
Fd	Feldspar	Hard
FeOx	Iron Oxide	Hard
Go	Gouge	Soft
Gr	Graphite	Soft
Gy	Gypsum	Soft
He	Hematite	Hard
Ka	Kaolinite	Soft
Kf	K-feldspar	Hard

Symbol	Term	Hard/Soft
Lm	Limonite/FeOx	Soft
Ms	Muscovite	Soft
Mt	Magnetite	Hard
Py	Pyrite	Hard
Qz	Quartz	Hard
Rb	Rubble	Hard
Sa	Sand	Hard
Se	Sericite/Illite	Soft
Si	Silt	Hard
Sm	Smectite	Soft
Su	Sulphide	Hard
Ta	Talc	Soft
UH	Unknown Hard	Hard
US	Unknown Soft	Soft
OTH - see comments		

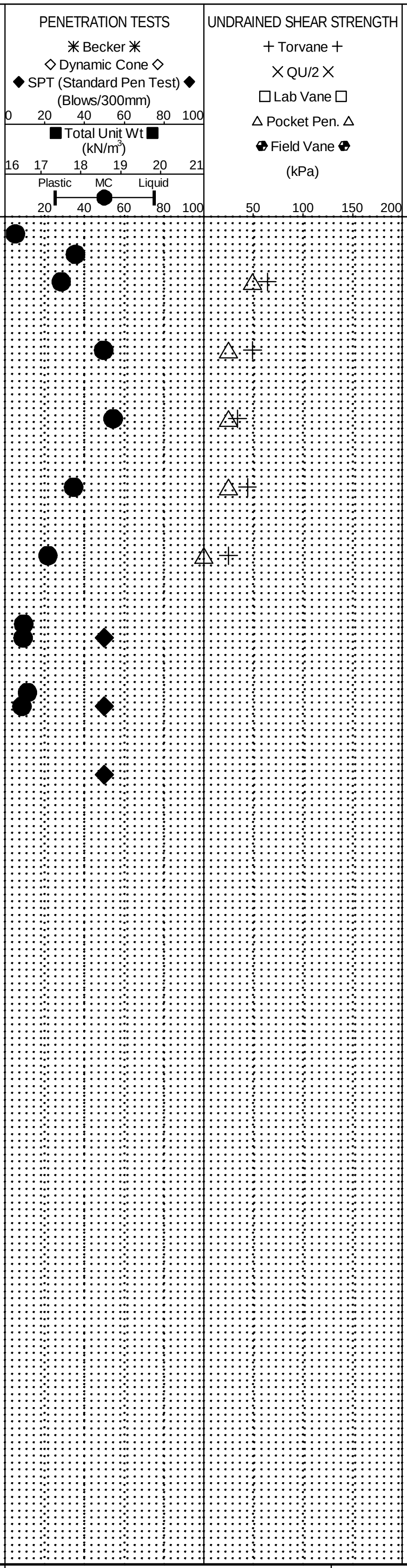
PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-01
LOCATION: UTM: 14U, 5532433.279 m N, 0628334.527 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Core	ELEVATION (m): 234.84

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE #	SPT (N)	COMMENTS
ASPH	ASPHALT - 100 mm thick	G1		
FILL	FILL: biege silty SAND (SM) - moist, loose to compact	G2		
		G3		
FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff			
CH	firm to stiff brown fat CLAY (CH) - moist - silt inclusions - grey - soft to firm	G4		
		G5		
		G6		
		G7		
SP	very loose to loose grey poorly graded SAND (SP) TILL -moist - dense to very dense - cobbles and boulders	G8		
		S9	50	
		G10		
		S11	50	
		C12		
		S13	50	
		C14		
BR	MUDSTONE (Stony Mountain Formation, Gunn Member) - dark greyish red to purplish grey - calcareous shale to argillaceous dolomite - interbeds of relatively clean limestone	C15		
		C16		TCR = 98%, SCR = 93%, RQD = 51%
BR	DOLOMITE (Stony Mountain Formation, Gunton Member) - buff - finely crystalline - sparsely fossiliferous - nodular-bedded - R3 - unconfined compressive strength of 34 MPa at 18.29 m	C17		TCR = 93%, SCR = 83%, RQD = 50%
		C18		TCR = 100%, SCR = 96%, RQD = 94%

END OF TEST HOLE
- auger refusal at a depth of 10.67 m in poorly graded SAND (SP) TILL
- sloughing observed at a depth of 10.36 m in poorly graded SAND (SP) TILL
- heavy seepage observed at a depth of 8.53 m in poorly graded SAND (SP) TILL
- water level unavailable due to use of coring method

DEPTH (m): 0 – 30; ELEVATION: 234 – 205

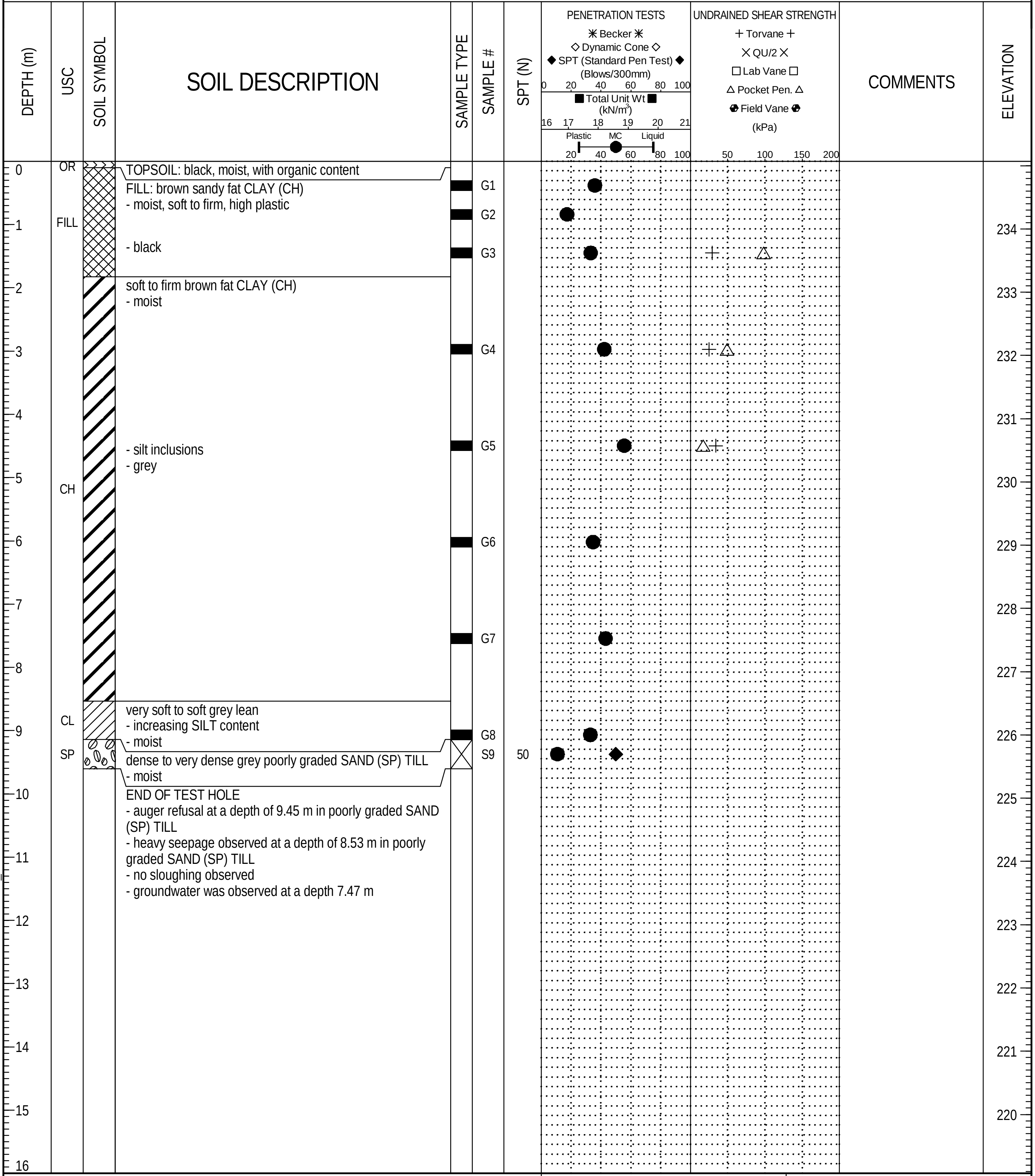


LOGGED BY: CW	COMPLETION DEPTH: 19.81 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-30
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

AECOM

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-02
LOCATION: UTM: 14U, 5532473.116 m N, 0628286.160 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 235.07

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ◨ CORE



USC	SOIL DESCRIPTION	SAMPLE #	SPT (N)
OR	TOPSOIL: black, moist, with organic content		
FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm, high plastic - black	G1 G2 G3	
CH	soft to firm brown fat CLAY (CH) - moist - silt inclusions - grey	G4 G5 G6 G7	
CL	very soft to soft grey lean - increasing SILT content - moist	G8	
SP	dense to very dense grey poorly graded SAND (SP) TILL - moist	S9	50

END OF TEST HOLE
- auger refusal at a depth of 9.45 m in poorly graded SAND (SP) TILL
- heavy seepage observed at a depth of 8.53 m in poorly graded SAND (SP) TILL
- no sloughing observed
- groundwater was observed at a depth 7.47 m

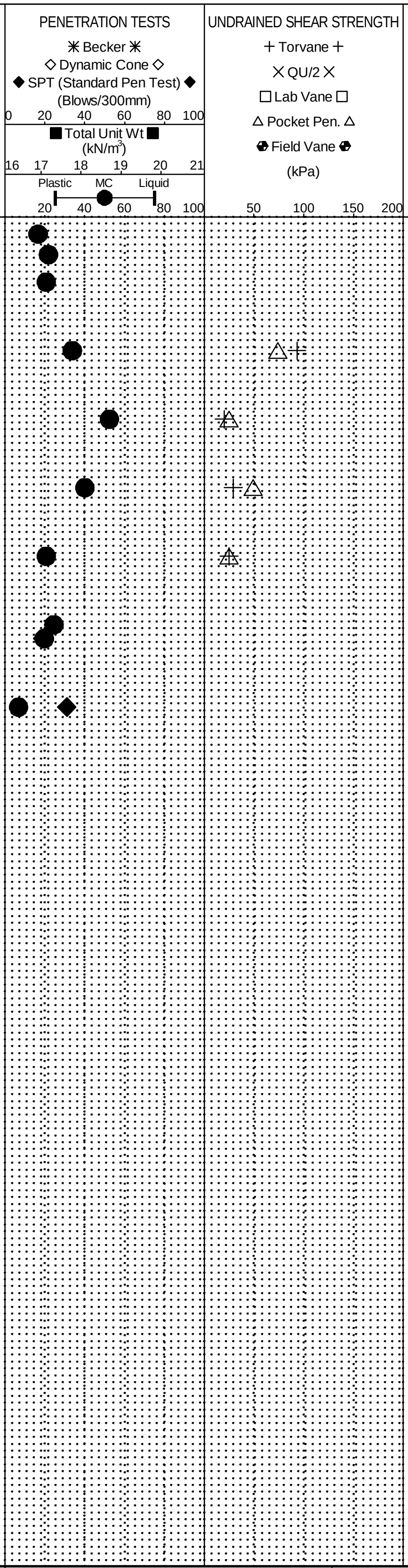
LOGGED BY: CW	COMPLETION DEPTH: 9.60 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-7
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-03
LOCATION: UTM: 14U, 5532502.090 m N, 0628225.720 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Core	ELEVATION (m): 235.53

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ▱ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE #	SPT (N)	COMMENTS
OR	TOPSOIL: black, moist, with organic content	G1		
FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm, high plastic - wood remains - black	G2 G3		
ML	loose to compact brown SILT (ML) - moist	G4		
CH	firm to stiff brown fat CLAY (CH) - moist - grey	G5 G6 G7		
SP	loose to compact grey poorly graded SAND (SP) TILL - moist - compact to dense - cobbles and boulders	G8 S9 C11 S10 C12	19 31	TCR = 71%, SCR = 67%, RQD = 38% TCR = 20%, SCR = 0%, RQD = 0%
BR	MUDSTONE (Stony Mountain Formation, Gunn Member) - dark greyish red to purplish grey - calcareous shale to argillaceous dolomite - interbeds of relatively clean limestone	C13 C14 C15		TCR = 37%, SCR = 18%, RQD = 11% TCR = 57%, SCR = 37%, RQD = 23% TCR = 98%, SCR = 95%, RQD =72%
BR	DOLOMITE (Stony Mountain Formation, Gunton Member) - buff - finely crystalline - sparsely fossiliferous - nodular-bedded	C16 C17		TCR = 93%, SCR = 82%, RQD = 52% TCR = 100%, SCR = 98%, RQD = 93%

END OF TESTHOLE
- auger refusal at a depth of 11.43 m in poorly graded SAND (SP) TILL
- heavy seepage observed at a depth of 9.14 m in poorly graded SAND (SP) TILL
- sloughing observed at a depth of 10.97 m in poorly graded SAND (SP) TILL
- water level unavailable due to use of coring method



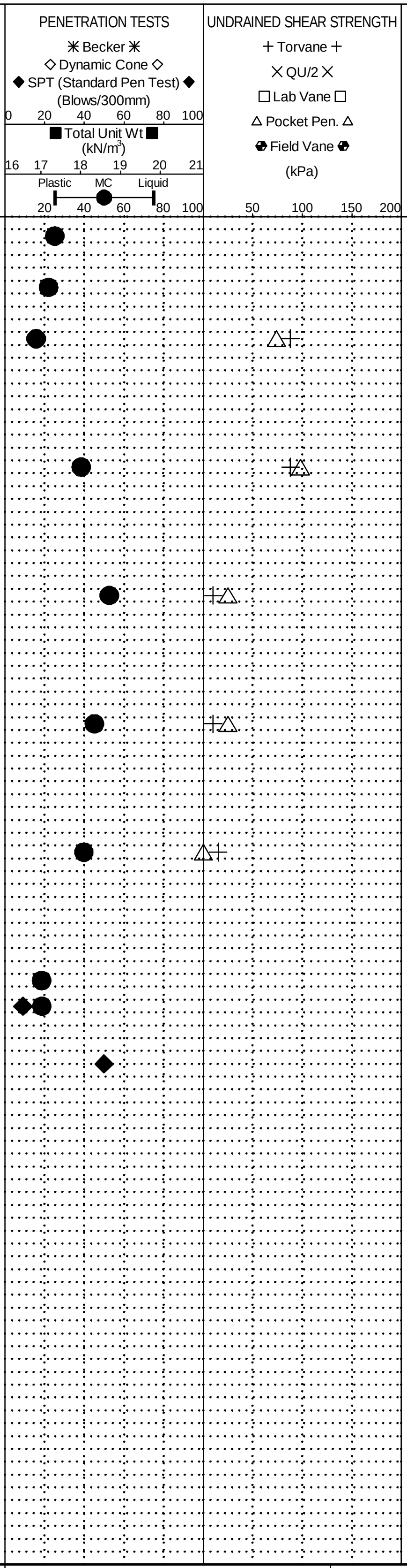
LOGGED BY: CW	COMPLETION DEPTH: 19.96 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-31
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-04
LOCATION: UTM: 14U, 5532383.943 m N, 0628344.708 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 235.39

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▐ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0	ASPH	ASPHALT - 100 mm thick					
	FILL	FILL: tan silty SAND (SM) - moist, loose to compact	■	G1			235
1	FILL	FILL: tan sandy fat CLAY (CH) - moist, loose to compact	■	G2			
			■	G3			234
	ML	loose to compact brown SILT (ML) - moist	▥	T4			
2	CH	stiff to very stiff brown fat CLAY (CH) - high plastic - moist					233
3			■	G6			232
			▥	T7			
4							231
		- grey - very soft to soft	■	G8			
5			▥	T9			230
6			■	G10			229
			▥	T11			
7							228
			■	G12			
8							227
9	SP	very loose to loose grey poorly graded SAND (SP) TILL - moist	■	G13			226
			☒	S14	9		
10				S15	50		225

END OF TESTHOLE
- testhole was terminated at a depth of 10.06 m in poorly graded SAND (SP) TILL
- heavy seepage observed at 10.06 m in poorly graded SAND (SP) TILL
- sloughing was observed at a depth of 9.14 m in poorly graded SAND (SP) TILL
- groundwater was observed at a depth of 9.14 m

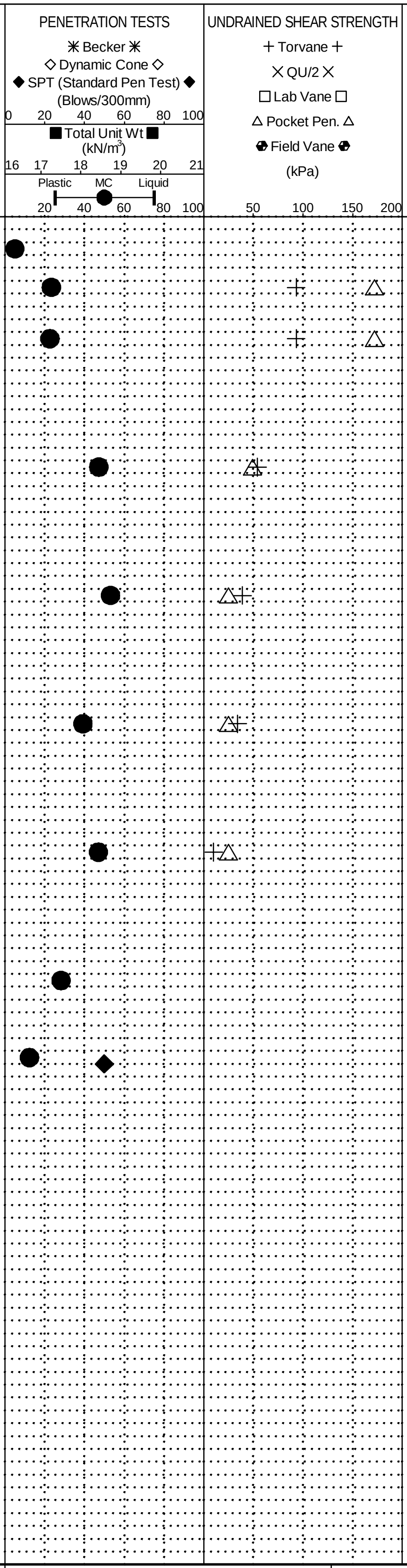


LOGGED BY: CW	COMPLETION DEPTH: 10.52 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-5
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: TH24-05
LOCATION: UTM: 14U, 5532417.307 m N, 0628302.753 m E
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling
METHOD: Solid Stem Auger
ELEVATION (m): 234.95

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	ELEVATION
0	ASPH	ASPHALT - 100 mm thick				
	FILL	FILL: tan silty SAND (CH) - moist, loose to compact	GRAB	G1		
1	FILL	FILL: tan sandy fat CLAY (CH) - moist, loose to compact	GRAB	G2		234
	CH	stiff to very stiff brown fat CLAY (CH) - high plastic - moist	GRAB	G3		
2			SHELBY TUBE	T4		233
			SHELBY TUBE	T5		
3		- grey - firm to stiff	GRAB	G6		232
			SHELBY TUBE	T7		
4						231
			GRAB	G8		
5						230
6		- very soft to soft	GRAB	G9		229
7						228
			GRAB	G10		
8						227
9			GRAB	G11		226
	SP	very loose to loose grey poorly graded SAND (SP) TILL - moist				
10			GRAB	G12		225
		END OF TESTHOLE - testhole was terminated at a depth of 10.06 m in poorly graded SAND (SP) TILL - heavy seepage observed at 9.14 m poorly graded SAND (SP) TILL - sloughing was observed at a depth of 9.14 m in poorly graded SAND (SP) TILL - no groundwater observed		S13	50	
11						224
12						223
13						222
14						221
15						220
16						



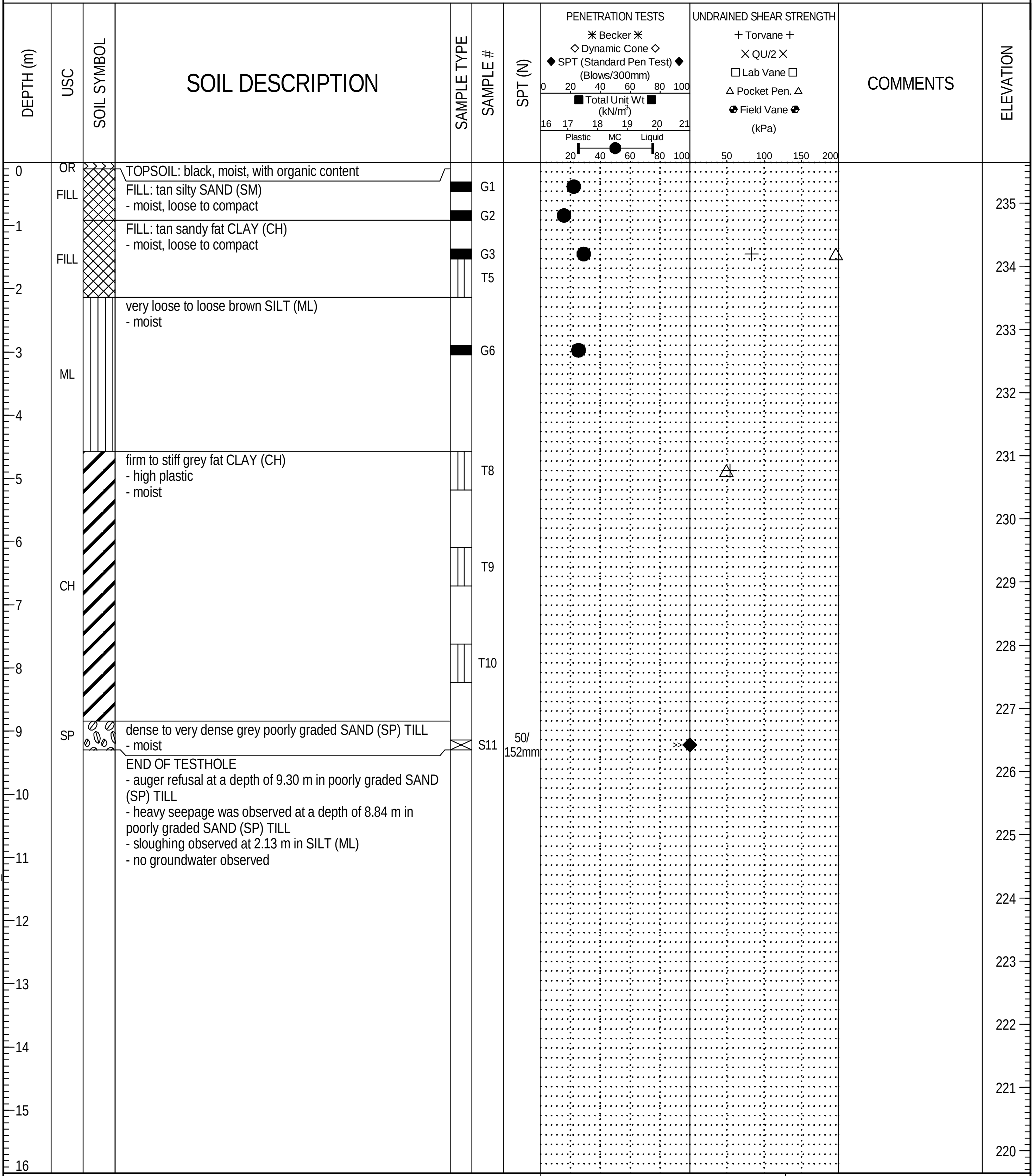
COMMENTS

LOGGED BY: CW
REVIEWED BY: GL
PROJECT ENGINEER: Russ Golightly
COMPLETION DEPTH: 10.52 m
COMPLETION DATE: 24-2-5

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-06
LOCATION: UTM: 14U, 5532462.977 m N, 0628231.994 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Hollow Stem Auger	ELEVATION (m): 235.64

SAMPLE TYPE: ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS
OR	TOPSOIL: black, moist, with organic content				
FILL	FILL: tan silty SAND (SM) - moist, loose to compact	■ ■	G1 G2		
FILL	FILL: tan sandy fat CLAY (CH) - moist, loose to compact	■ ▥	G3 T5		
ML	very loose to loose brown SILT (ML) - moist	■	G6		
CH	firm to stiff grey fat CLAY (CH) - high plastic - moist	▥ ▥ ▥	T8 T9 T10		
SP	dense to very dense grey poorly graded SAND (SP) TILL - moist	☒	S11	50/ 152mm	
	END OF TESTHOLE - auger refusal at a depth of 9.30 m in poorly graded SAND (SP) TILL - heavy seepage was observed at a depth of 8.84 m in poorly graded SAND (SP) TILL - sloughing observed at 2.13 m in SILT (ML) - no groundwater observed				



LOGGED BY: CW	COMPLETION DEPTH: 9.60 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-2
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

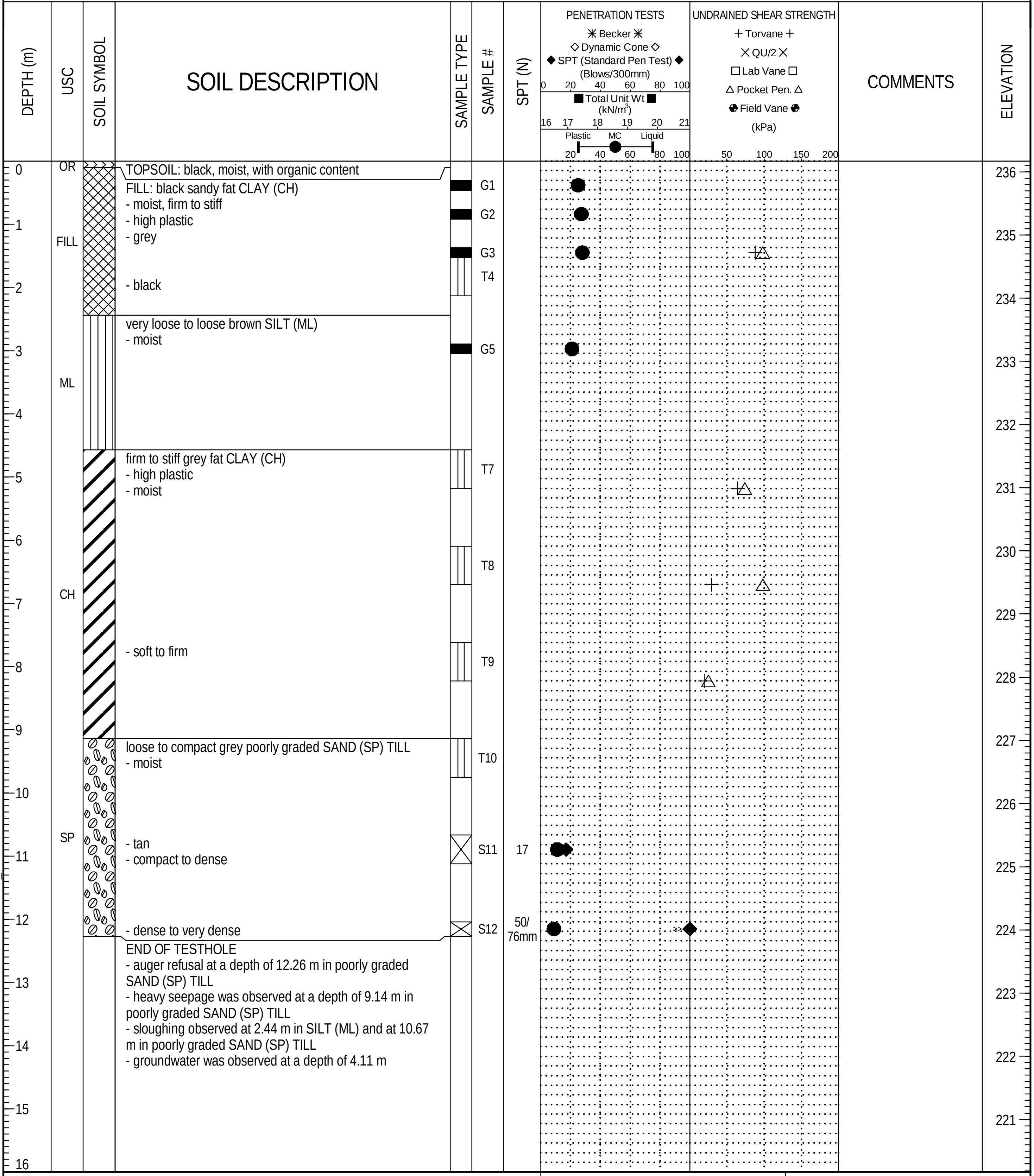
PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-07
LOCATION: UTM: 14U, 5532375.238 m N, 0628273.388 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Hollow Stem Auger	ELEVATION (m): 236.17

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE #	SPT (N)
OR	TOPSOIL: black, moist, with organic content		
FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic - grey - black	G1 G2 G3 T4	
ML	very loose to loose brown SILT (ML) - moist	G5	
CH	firm to stiff grey fat CLAY (CH) - high plastic - moist - soft to firm	T7 T8 T9	
SP	loose to compact grey poorly graded SAND (SP) TILL - moist - tan - compact to dense - dense to very dense	T10 S11 S12	 17 50/ 76mm

END OF TESTHOLE
- auger refusal at a depth of 12.26 m in poorly graded SAND (SP) TILL
- heavy seepage was observed at a depth of 9.14 m in poorly graded SAND (SP) TILL
- sloughing observed at 2.44 m in SILT (ML) and at 10.67 m in poorly graded SAND (SP) TILL
- groundwater was observed at a depth of 4.11 m

COMMENTS

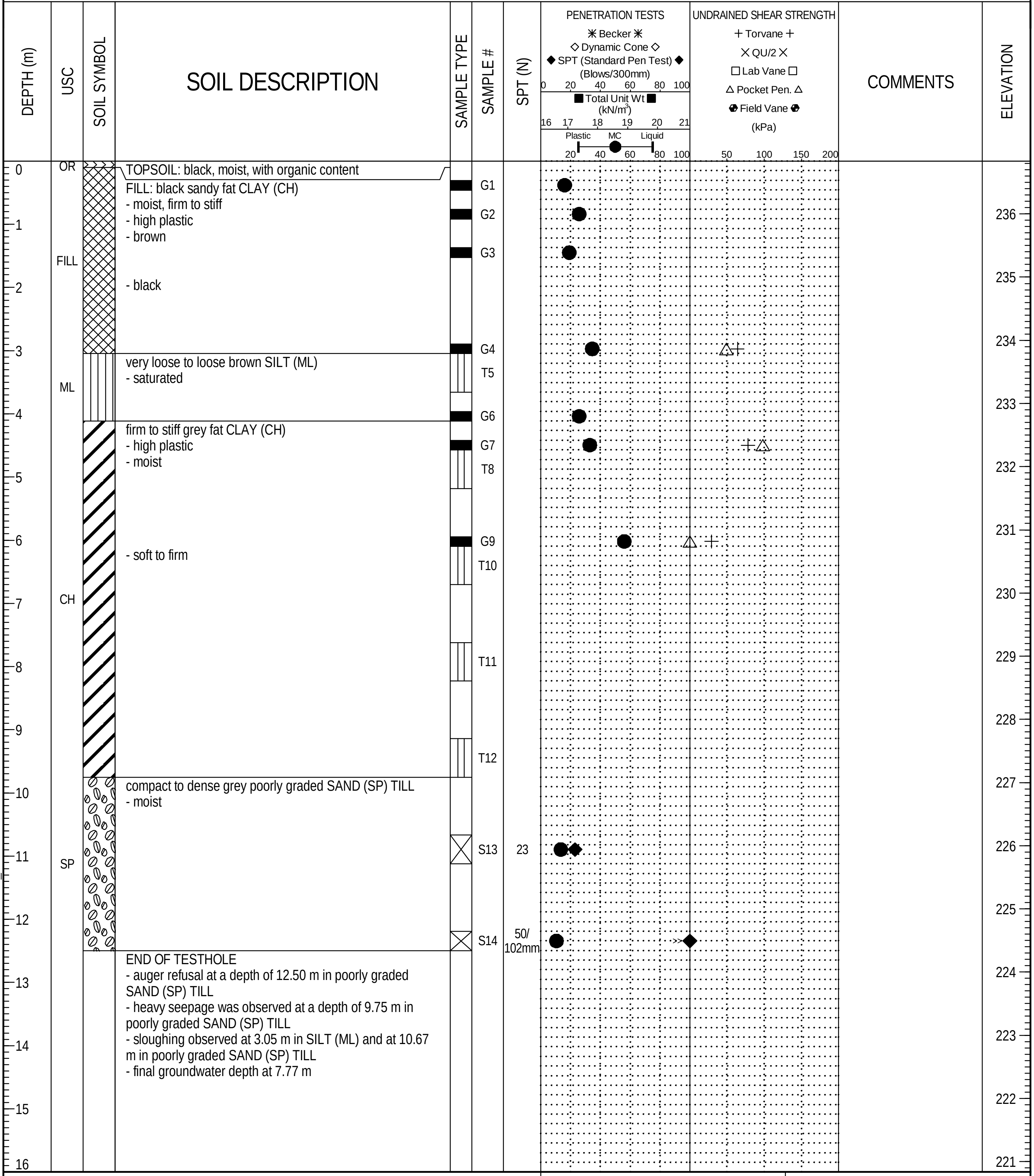


LOGGED BY: CW	COMPLETION DEPTH: 12.50 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-5
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

AECOM

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: TH24-08
LOCATION: UTM: 14U, 5532449.508 m N, 0628193.277 m E
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling
METHOD: Solid Stem Auger
ELEVATION (m): 236.84

SAMPLE TYPE: ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▌ CORE



TOPSOIL: black, moist, with organic content

FILL: black sandy fat CLAY (CH)
- moist, firm to stiff
- high plastic
- brown
- black

very loose to loose brown SILT (ML)
- saturated

firm to stiff grey fat CLAY (CH)
- high plastic
- moist
- soft to firm

compact to dense grey poorly graded SAND (SP) TILL
- moist

END OF TESTHOLE
- auger refusal at a depth of 12.50 m in poorly graded SAND (SP) TILL
- heavy seepage was observed at a depth of 9.75 m in poorly graded SAND (SP) TILL
- sloughing observed at 3.05 m in SILT (ML) and at 10.67 m in poorly graded SAND (SP) TILL
- final groundwater depth at 7.77 m

AECOM

LOGGED BY: CW
REVIEWED BY: GL
PROJECT ENGINEER: Russ Golightly
COMPLETION DEPTH: 12.65 m
COMPLETION DATE: 24-2-2

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-09
LOCATION: UTM: 14U, 5532323.360 m N, 0628267.783 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Core	ELEVATION (m): 236.91

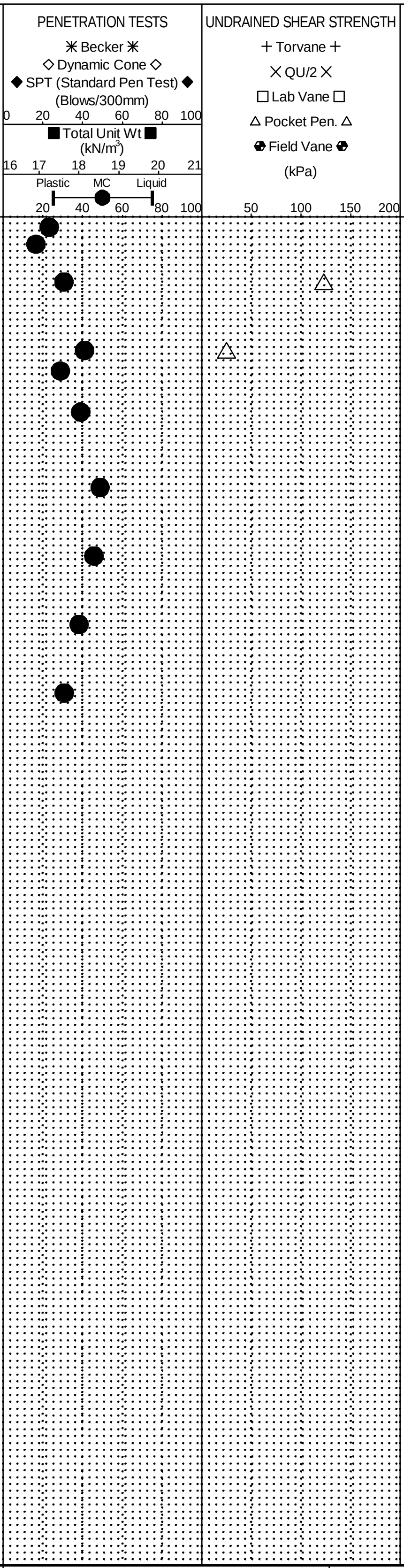
SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
OR	TOPSOIL: black, moist, with organic content	■	G1	
FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm - high plastic	■ ■	G2 G3	
ML	very loose to loose brown SILT (ML) - moist			
CH	firm to stiff black fat CLAY (CH) - moist - black oily remains	■ ■ ■	G4 G5 G6	
ML	very loose to loose brown SILT (ML) - moist			
CH	firm to stiff brown fat CLAY (CH) - moist - black oily remains - grey - very soft to soft	■ ■ ■ ■	G7 G8 G9 G10	
SP	compact to dense grey poorly graded SAND (SP) TILL - boulders - 12.5 m to 17. 1 m poorly graded SAND (SP) that could not be recovered in core runs	▮ ▮ ▮ ▮	C11 C12 C13 C14	TCR = 21%, SCR = 21%, RQD = 21%
BR	MUDSTONE (Stony Mountain Formation, Gunn Member) - dark greyish red to purplish grey - calcareous shale to argillaceous dolomite - interbeds of relatively clean limestone	▮ ▮	C15 C16	TCR = 50%, SCR = 50%, RQD = 31% TCR = 25%, SCR = 21%, RQD = 21%
	END OF TEST HOLE - auger refusal at a depth of 10.82 m in poorly graded SAND (SP) TILL - sloughing observed at a depth of 3.35 m in SILT (ML) - heavy seepage observed at a depth of 9.14 m in poorly graded SAND (SP) TILL - water level unavailable due to use of coring method			

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30

ELEVATION: 236, 235, 234, 233, 232, 231, 230, 229, 228, 227, 226, 225, 224, 223, 222, 221, 220, 219, 218, 217, 216, 215, 214, 213, 212, 211, 210, 209, 208

SPT (N)



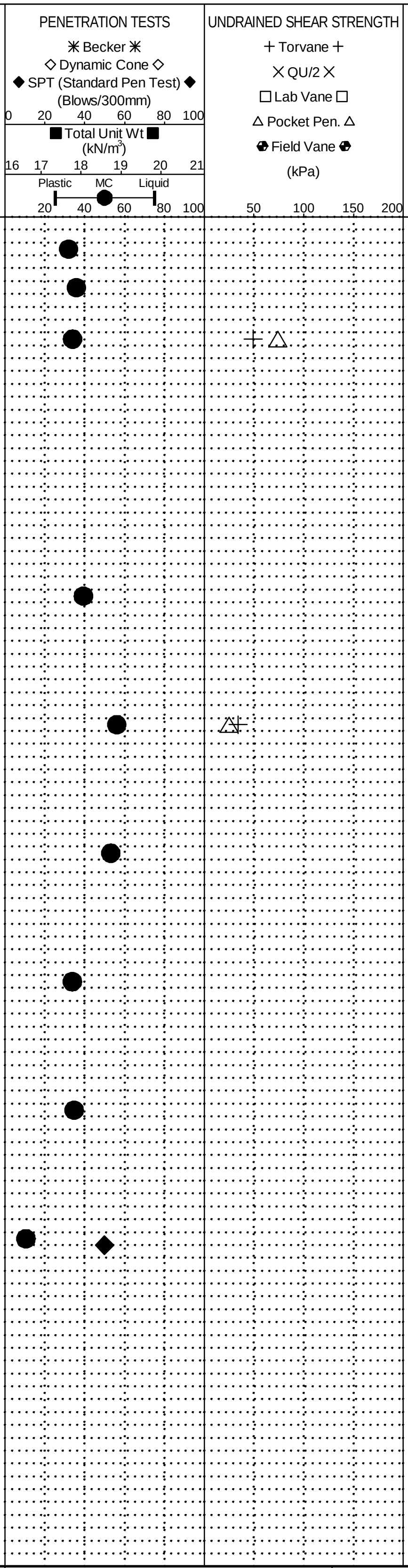
LOGGED BY: CW	COMPLETION DEPTH: 20.12 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-6
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

AECOM

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-10
LOCATION: UTM: 14U, 5532349.209 m N, 0628235.631 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 236.91

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	ELEVATION
0	OR	TOPSOIL: black, moist, with organic content				
	FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic	■ ■ ■ ▥ ▥	G1 G2 G3 T4 T5		236 235 234
3	ML	very loose to loose brown SILT (ML) - moist	▥	T6		233
4	CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - grey - soft to firm - very soft to soft	■ ■ ■ ■ ■	G8 G9 G10 G11 G12		232 231 230 229 228 227
10.5	SP	compact to dense grey poorly graded SAND (SP) TILL - moist	■	G13 S14	50	226 225
12		END OF TESTHOLE - auger refusal at a depth of 12.19 m in poorly graded SAND (SP) TILL - heavy seepage was observed at a depth of 10.67 m in poorly graded SAND (SP) TILL - sloughing observed at 3.05 m in SILT (ML) and at 10.67 m in poorly graded SAND (SP) TILL - final groundwater depth observed at 3.69 m				224 223 222 221



COMMENTS

LOGGED BY: CW	COMPLETION DEPTH: 12.65 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-7
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage

CLIENT: City of Winnipeg

TESTHOLE NO: TH24-11

LOCATION: UTM: 14U, 5532387.627 m N, 0628183.369 m E

PROJECT NO.: 60721079

CONTRACTOR: Paddock Drilling

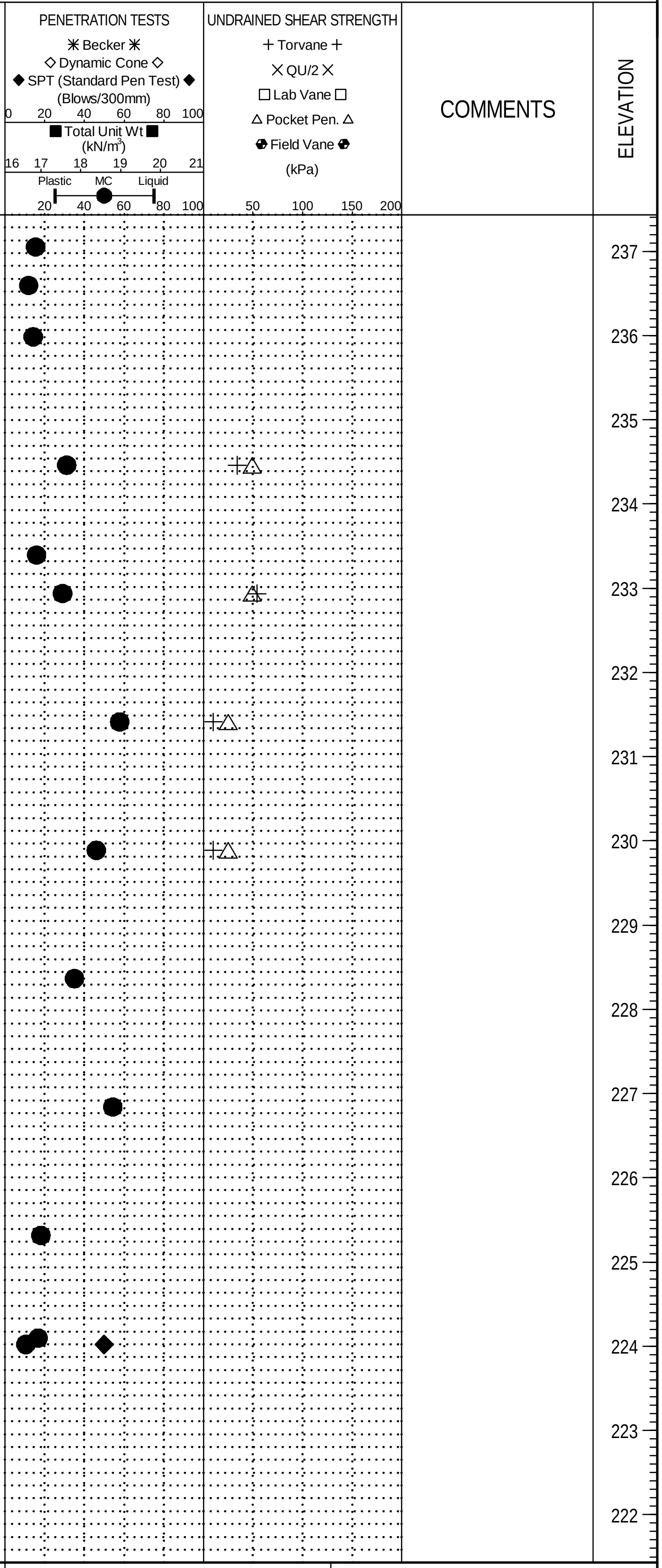
METHOD: Solid Stem Auger

ELEVATION (m): 237.43

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◩ NO RECOVERY ▮ CORE

USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)
OR	TOPSOIL: black, moist, with organic content			
FILL	FILL: brown silty SAND (SM) - moist, loose to compact	■ ■	G1 G2	
FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic	■ ▥ ■	G3 T4 G5	
ML	very loose to loose brown sandy SILT (ML) - moist	■	G6	
CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - grey - very soft to soft	■ ▥ ■ ▥ ■ ▥ ■ ■ ■	G7 T8 G9 T10 G11 T12 G13 G14 G15	
SP	compact to dense grey poorly graded SAND (SP) TILL - moist	■ ☒	G16 S17	50
	END OF TESTHOLE - auger refusal at a depth of 13.41 m in poorly graded SAND (SP) TILL - heavy seepage was observed at a depth of 12.19 m in poorly graded SAND (SP) TILL - no sloughing observed - final groundwater depth observed at 4.42 m			

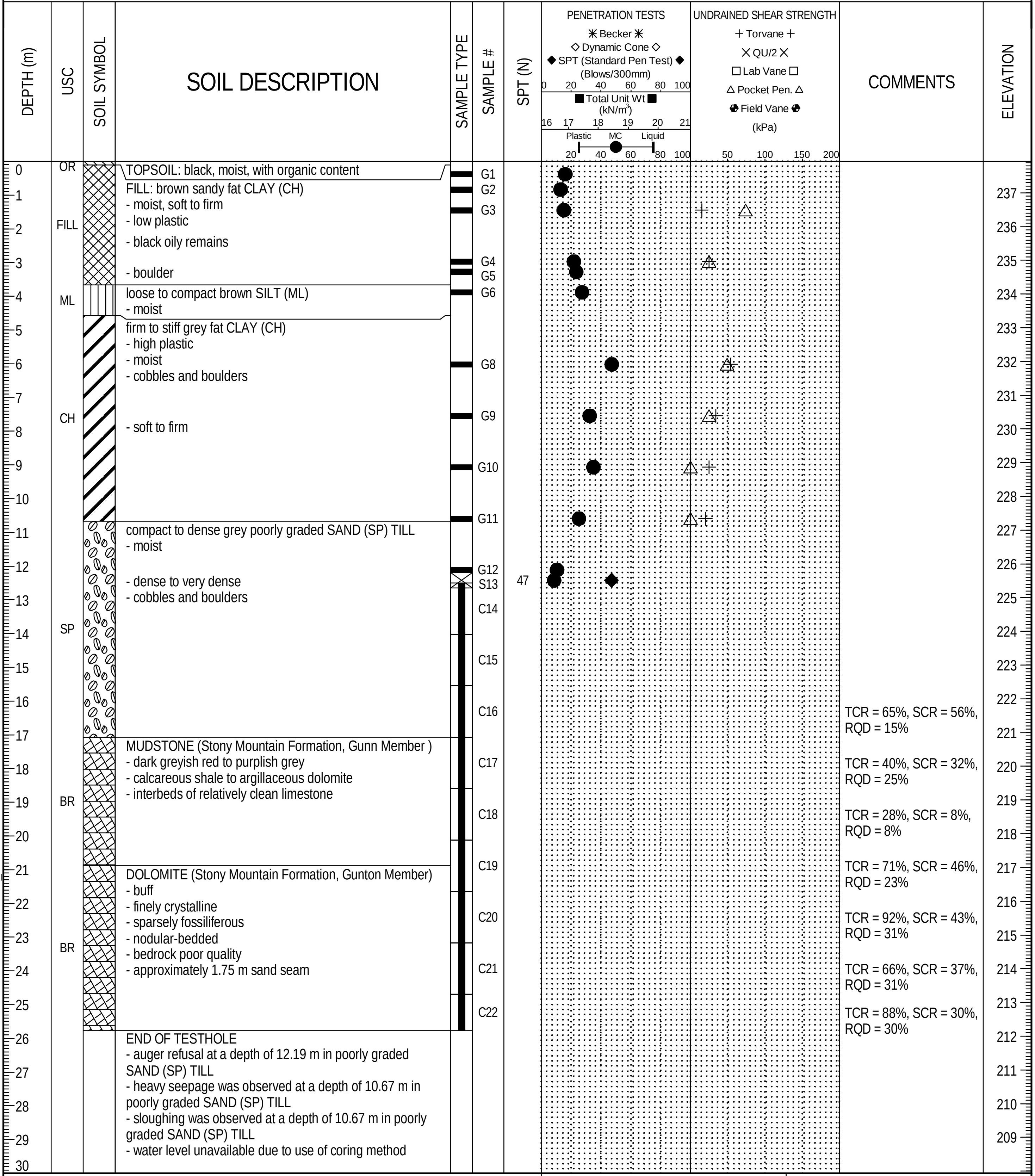
DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16



LOGGED BY: CW	COMPLETION DEPTH: 13.87 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-7
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-12
LOCATION: UTM: 14U, 5532443.423 m N, 628118.013 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Core	ELEVATION (m): 237.93

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ▮ CORE



USC	SOIL DESCRIPTION
OR	TOPSOIL: black, moist, with organic content
FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm - low plastic - black oily remains - boulder
ML	loose to compact brown SILT (ML) - moist
CH	firm to stiff grey fat CLAY (CH) - high plastic - moist - cobbles and boulders - soft to firm
SP	compact to dense grey poorly graded SAND (SP) TILL - moist - dense to very dense - cobbles and boulders
BR	MUDSTONE (Stony Mountain Formation, Gunn Member) - dark greyish red to purplish grey - calcareous shale to argillaceous dolomite - interbeds of relatively clean limestone
BR	DOLOMITE (Stony Mountain Formation, Gunton Member) - buff - finely crystalline - sparsely fossiliferous - nodular-bedded - bedrock poor quality - approximately 1.75 m sand seam

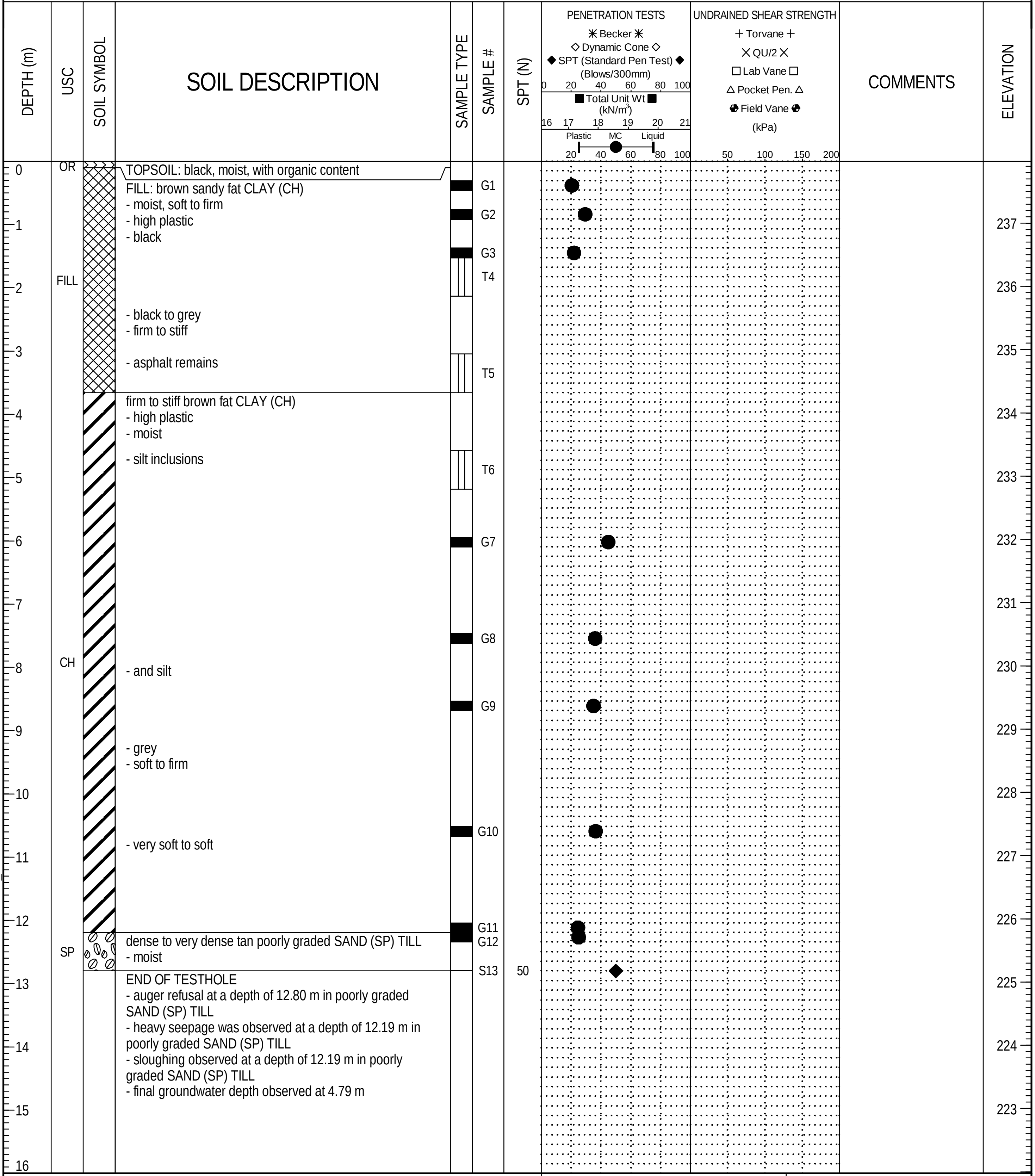
END OF TESTHOLE
- auger refusal at a depth of 12.19 m in poorly graded SAND (SP) TILL
- heavy seepage was observed at a depth of 10.67 m in poorly graded SAND (SP) TILL
- sloughing was observed at a depth of 10.67 m in poorly graded SAND (SP) TILL
- water level unavailable due to use of coring method

SAMPLE #	SPT (N)	COMMENTS
G1		
G2		
G3		
G4		
G5		
G6		
G8		
G9		
G10		
G11		
G12		
S13	47	
C14		
C15		
C16		TCR = 65%, SCR = 56%, RQD = 15%
C17		TCR = 40%, SCR = 32%, RQD = 25%
C18		TCR = 28%, SCR = 8%, RQD = 8%
C19		TCR = 71%, SCR = 46%, RQD = 23%
C20		TCR = 92%, SCR = 43%, RQD = 31%
C21		TCR = 66%, SCR = 37%, RQD = 31%
C22		TCR = 88%, SCR = 30%, RQD = 30%

LOGGED BY: CW	COMPLETION DEPTH: 25.76 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-1
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-13
LOCATION: UTM: 14U, 55323326.097 m N, 0628171.223 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 237.98

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▌CORE



TOPSOIL: black, moist, with organic content

FILL: brown sandy fat CLAY (CH)
- moist, soft to firm
- high plastic
- black
- black to grey
- firm to stiff
- asphalt remains

firm to stiff brown fat CLAY (CH)
- high plastic
- moist
- silt inclusions
- and silt
- grey
- soft to firm
- very soft to soft

dense to very dense tan poorly graded SAND (SP) TILL
- moist

END OF TESTHOLE
- auger refusal at a depth of 12.80 m in poorly graded SAND (SP) TILL
- heavy seepage was observed at a depth of 12.19 m in poorly graded SAND (SP) TILL
- sloughing observed at a depth of 12.19 m in poorly graded SAND (SP) TILL
- final groundwater depth observed at 4.79 m

AECOM

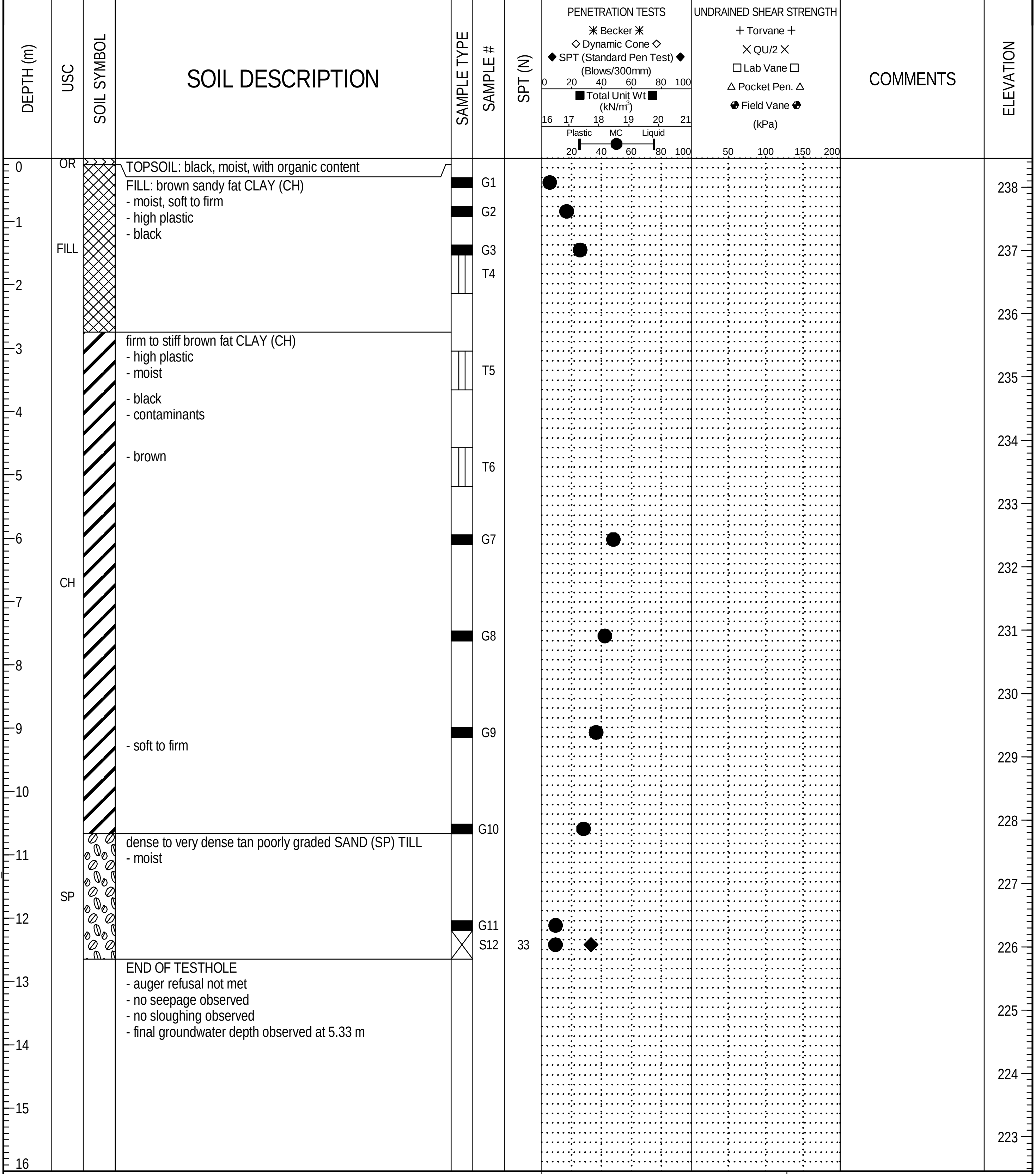
LOGGED BY: CW	COMPLETION DEPTH: 13.26 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-9
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-14
LOCATION: UTM: 14U, 5532381.560 m N, 0628082.716 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 238.45

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ◧ CORE

DEPTH (m)	USC	SOIL DESCRIPTION
0	OR	TOPSOIL: black, moist, with organic content
	FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm - high plastic - black
	CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - black - contaminants - brown - soft to firm
	SP	dense to very dense tan poorly graded SAND (SP) TILL - moist
		END OF TESTHOLE - auger refusal not met - no seepage observed - no sloughing observed - final groundwater depth observed at 5.33 m

SAMPLE TYPE	SAMPLE #	SPT (N)
■	G1	
■	G2	
■	G3	
▥	T4	
▥	T5	
▥	T6	
■	G7	
■	G8	
■	G9	
■	G10	
■	G11	
☒	S12	33



LOGGED BY: CW	COMPLETION DEPTH: 12.65 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-9
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-15
LOCATION: UTM: 14U, 5532334.920 m N, 0628084.718 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Core	ELEVATION (m): 238.21

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◩ NO RECOVERY ▮ CORE

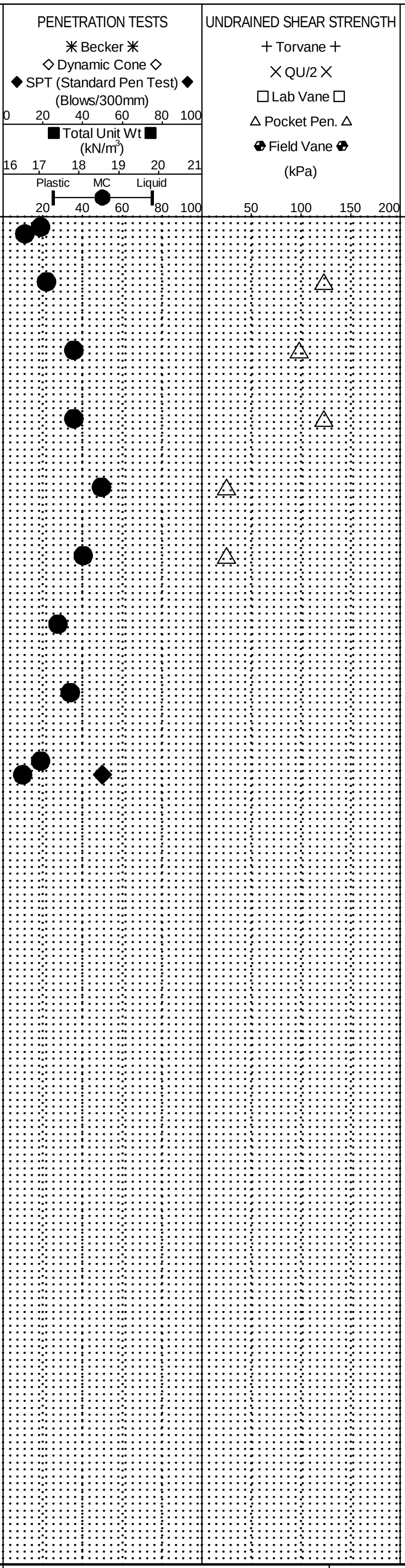
USC	SOIL DESCRIPTION
OR	TOPSOIL: black, moist, with organic content
FILL	FILL: brown sandy fat CLAY (CH) - moist, soft to firm - high plastic
ML	very loose to loose brown SILT (ML) - moist
FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic
CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - black oily remains - brown - silt inclusions - grey - some silt
SP	dense to very dense tan poorly graded SAND (SP) TILL - moist - cobbles and boulders
BR	DOLOMITE (Stony Mountain Formation, Gunton Member) - buff - finely crystalline - sparsely fossiliferous - nodular-bedded - bedrock poor quality

END OF TESTHOLE
- auger refusal at a depth of 12.19 m in poorly graded SAND (SP) TILL
- heavy seepage was observed at a depth of 1poorly graded SAND (SP) TILL
- no sloughing observed
- water level unavailable due to use of coring method

SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS
■	G1		
■	G2		
■	G3		
■	G4		
■	G5		
■	G6		
■	G7		
■	G8		
■	G9		
■	G10		
☒	S11	50	
▮	C12		
▮	C13		TCR = 62%, SCR = 22%, RQD = 12%
▮	C14		TCR = 27%, SCR = 7%, RQD = 7%
▮	C15		TCR = 4%, SCR = 0%, RQD = 0%
▮	C16		TCR = 36%, SCR = 3%, RQD = 0%
▮	C17		TCR = 70%, SCR = 23%, RQD = 0%
▮	C18		TCR = 95%, SCR = 63%, RQD = 45%
▮	C19		TCR = 92%, SCR = 52%, RQD = 33%
▮	C20		TCR = 88%, SCR = 26%, RQD = 13%

DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

ELEVATION: 238 237 236 235 234 233 232 231 230 229 228 227 226 225 224 223 222 221 220 219 218 217 216 215 214 213 212 211 210 209

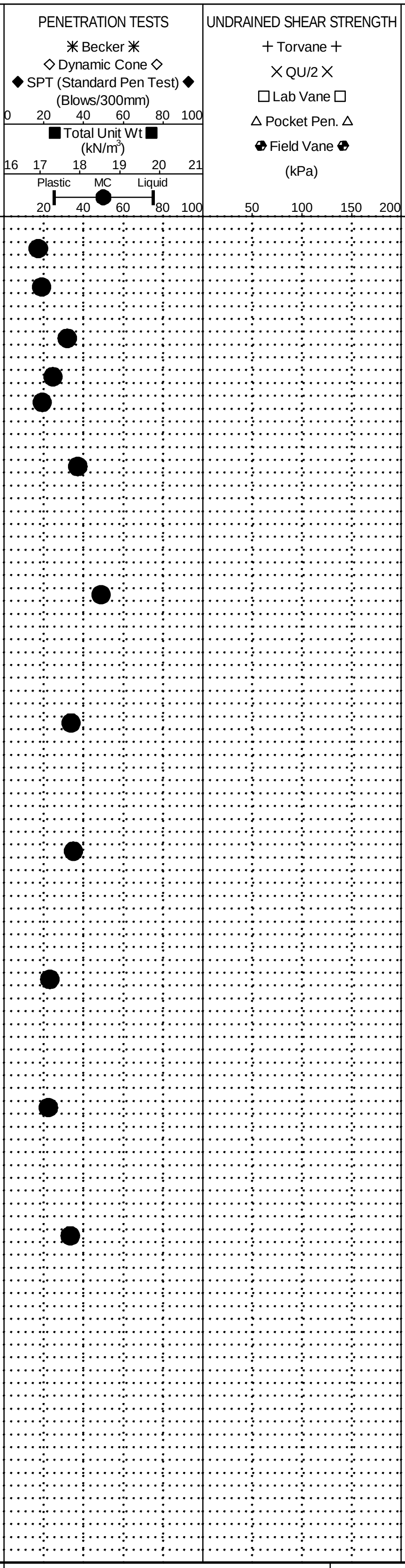


LOGGED BY: CW	COMPLETION DEPTH: 25.91 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-8
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-16
LOCATION: UTM: 14U, 5532549.964 m N, 0628161.513 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 235.60

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ◨ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS
0	OR	TOPSOIL: black, moist, with organic content				
	FILL	FILL: brown silty SAND (SM) - moist, loose to compact	■ ■ ■	G1 G2 G3		
2	FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic	■	G4		
	ML	loose to compact brown SILT (ML) - moist	■	G5		
	CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - silt inclusions - some silt - soft to firm - silt inclusions - firm to stiff - grey - soft to firm	■ ■ ■ ■ ■ ■	G6 G7 G8 G9 G10 G11		
	SP	dense to very dense tan poorly graded SAND (SP) TILL - moist	■	G12		
		END OF TESTHOLE - auger refusal at a depth of 12.19 m in poorly graded SAND (SP) TILL - heavy seepage was observed at a depth of 10.67 m in poorly graded SAND (SP) TILL - sloughing observed at a depth of 2.13 m in SILT (ML) - final groundwater depth observed at 6.10 m				



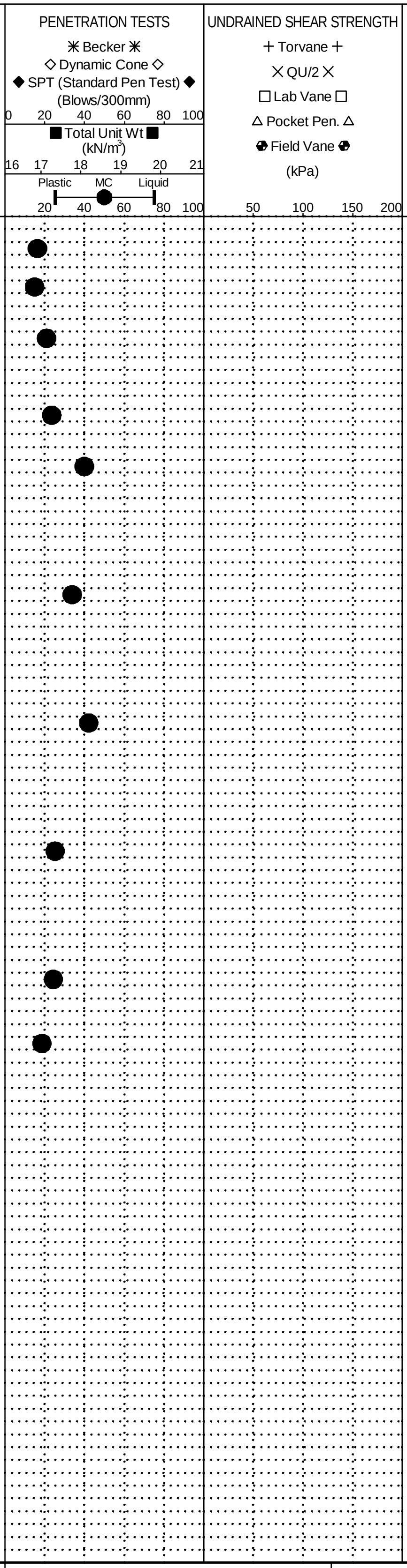
LOGGED BY: CW	COMPLETION DEPTH: 12.19 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-9
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

AECOM

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-17
LOCATION: UTM: 14U, 5532571.153 m N, 0628175.964 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 235.33

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ◧ CORE

USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #
OR	TOPSOIL: black, moist, with organic content		
FILL	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic	■ ■ ■	G1 G2 G3
ML	very loose to loose grey SILT (ML) - moist	■	G4
CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - some silt - soft to firm - very soft	■ ■ ■ ■	G5 G6 G7 G8
SP	dense to very dense tan poorly graded SAND (SP) TILL - moist	■ ■	G9 G10
	END OF TESTHOLE - auger refusal at a depth of 9.91 m in poorly graded SAND (SP) TILL - no seepage observed - sloughing observed at a depth of 1.83 m SILT (ML) - no groundwater observed		



DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

ELEVATION: 235 234 233 232 231 230 229 228 227 226 225 224 223 222 221 220

SPT (N)

COMMENTS

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 9.91 m
REVIEWED BY: GL	COMPLETION DATE: 24-2-9
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

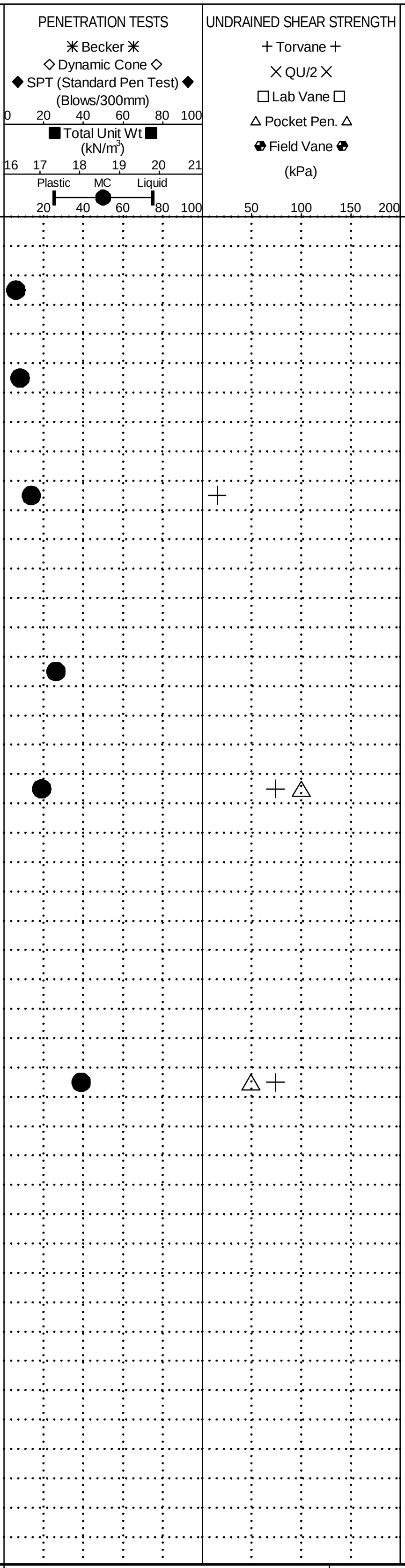
PROJECT: Winnipeg North Transit Garage | CLIENT: City of Winnipeg | TESTHOLE NO: TH24-18

LOCATION: UTM: 14U, 5532504.346 m N, 0628098.352 m E | PROJECT NO.: 60721079

CONTRACTOR: Paddock Drilling | METHOD: Solid Stem Auger | ELEVATION (m): 236.67

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◫ NO RECOVERY ▌ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0	OR	TOPSOIL: black, moist, with organic content					
	FILL	FILL: tan silty SAND (SM) - moist, loose	■	G1			
							236
1	FILL	FILL: brown sandy fat CLAY (CH) - metal remains - moist, soft to firm	■	G2			
			■	G3			
		- grey					235
2							
		- black	■	G4			
							234
3			■	G5			
		- silt Inclusions - grey - firm to stiff					
							233
		- metal remains					
4	CH	firm to stiff grey fat CLAY (CH) - moist	■	G6			
		END OF TEST HOLE - testhole terminated at a depth of 4.57 m in fat CLAY (CH). - no seepage or sloughing observed.					232
5							
							231
6							
							230
7							



LOGGED BY: CW | COMPLETION DEPTH: 4.57 m

REVIEWED BY: GL | COMPLETION DATE: 24-1-29

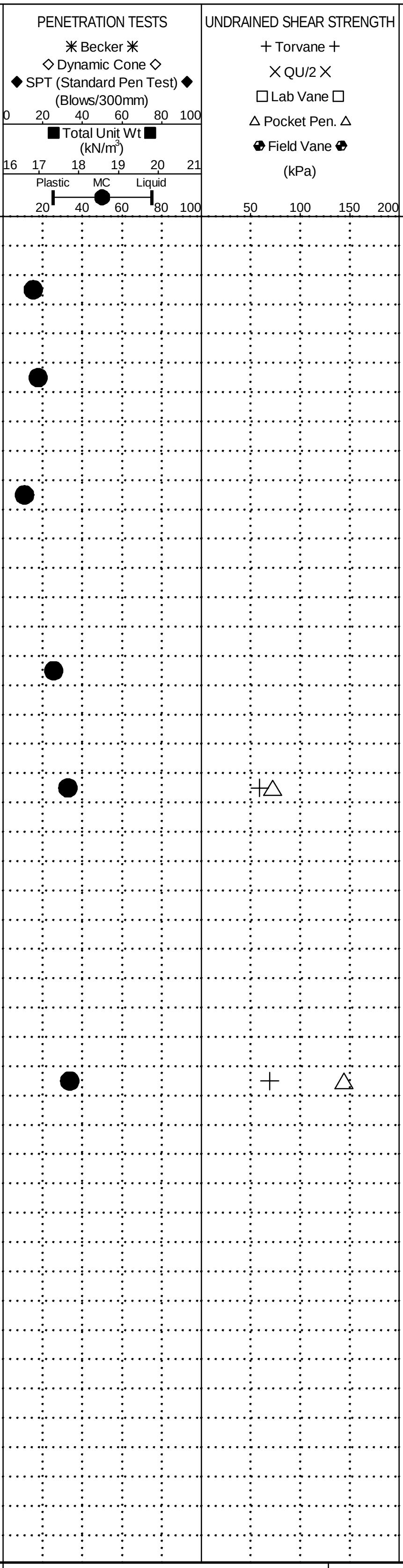
PROJECT ENGINEER: Russ Golightly

AECOM

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-19
LOCATION: UTM: 14U, 5532455.565 m N, 0628067.835 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 238.19

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION
0	OR	TOPSOIL: black, moist, with organic content				
	FILL	FILL: black sandy fat CLAY (CH) - moist, loose	■	G1		238
			■	G2		
1		- brown	■	G3		237
2			■	G4		236
3			■	G5		
	CH	brown fat CLAY (CH) - wood, glass, ceramic, and black sludge remains - moist				235
4	CH	- grey - firm to stiff - moist	■	G6		234
		END OF TEST HOLE - testhole terminated at a depth of 4.57 m in fat CLAY (CH). - no seepage or sloughing observed.				
5						233
6						232
7						



SPT (N)

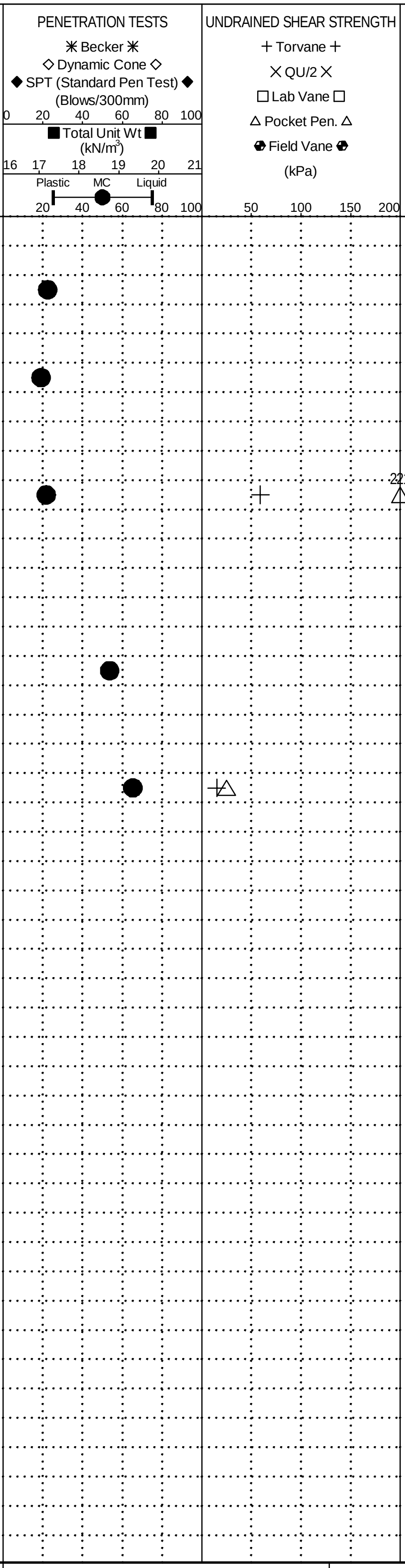
AECOM

LOGGED BY: CW	COMPLETION DEPTH: 4.57 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-29
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-20
LOCATION: UTM: 14U, 5532269.874 m N, 0628254.992 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 236.85

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ▮ CORE

DEPTH (m)	USC	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0	OR	TOPSOIL: black, moist, with organic content					
	FILL	FILL: black to brown sandy fat CLAY (CH) - moist, firm to stiff - high plastic	■	G1			
			■	G2			236
1							
	CH	firm to stiff brown fat CLAY (CH) - high plastic - moist - waste and plywood remains	■	G3			
							235
2							
		- soft to firm - black	■	G4			
			■	G5			234
3		END OF TESTHOLE - testhole terminated at a depth of 3.05 m in fat CLAY (CH). - no seepage observed - no sloughing observed - no groundwater observed					
							233
4							
							232
5							
							231
6							
							230
7							

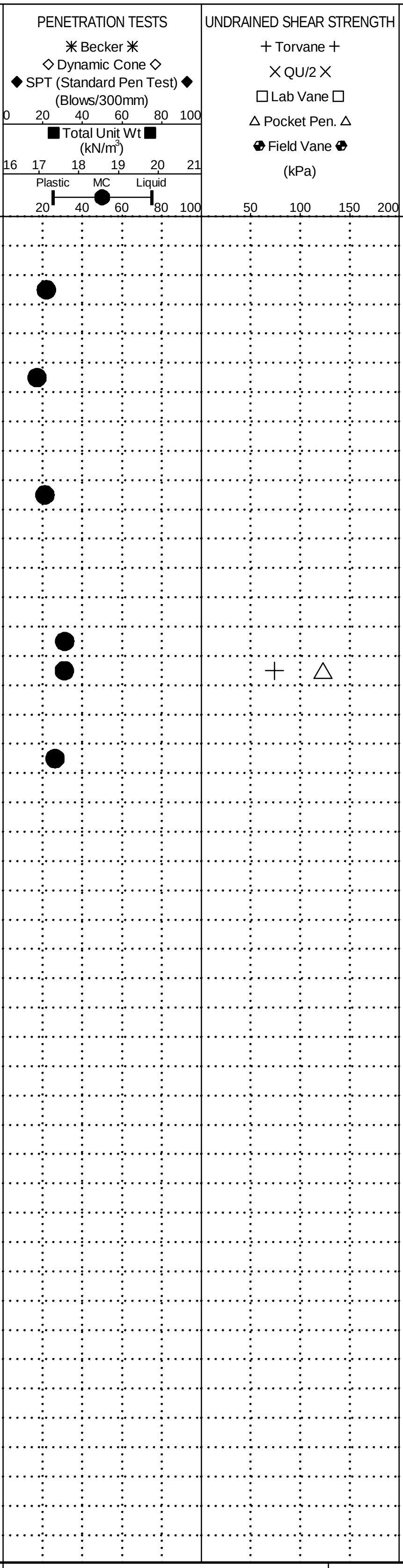


LOGGED BY: CW	COMPLETION DEPTH: 3.05 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-29
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-21
LOCATION: UTM: 14U, 5532314.445 m N, 0628358.535 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 236.47

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▌ CORE

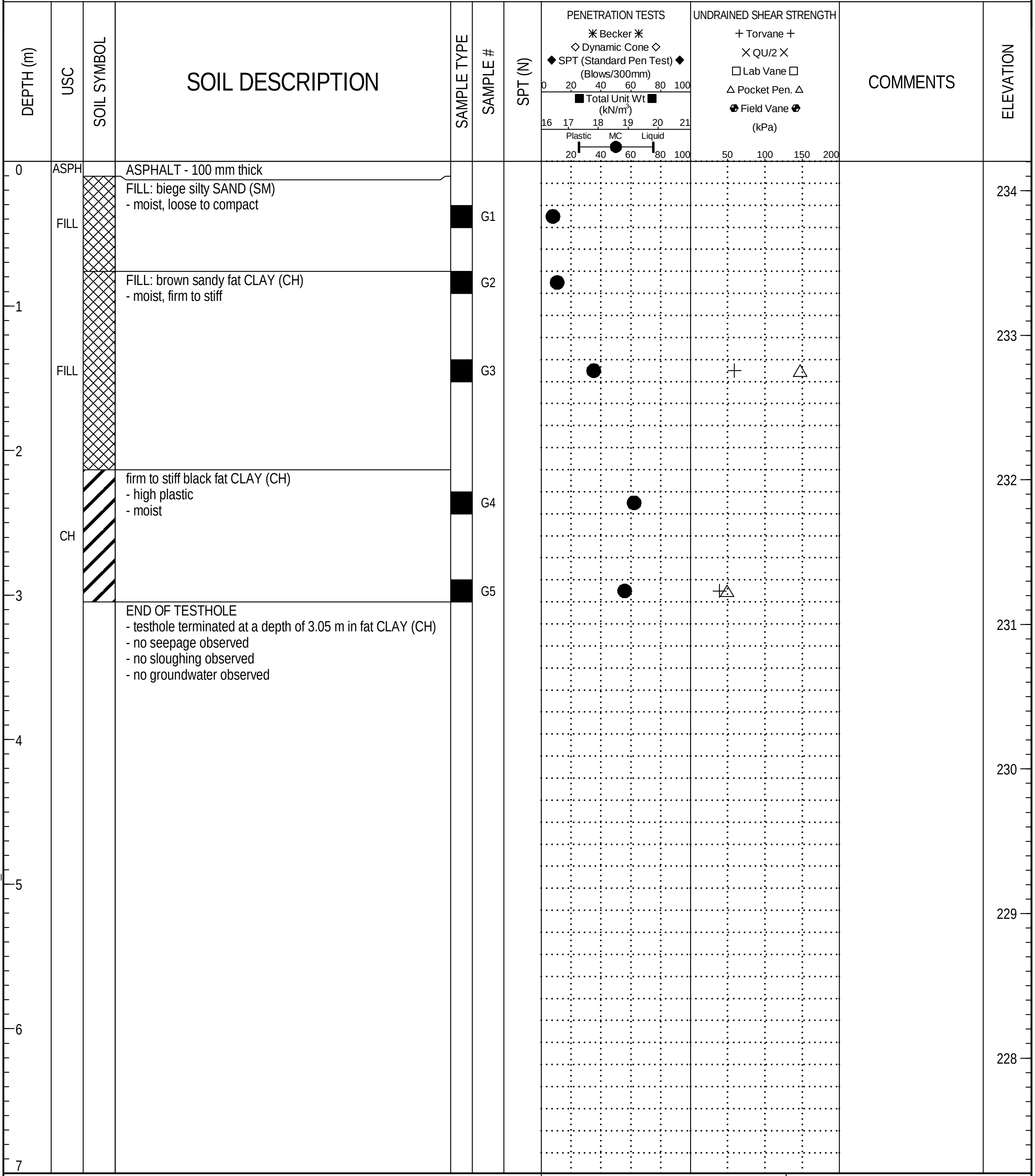
DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION
0	OR		TOPSOIL: black, moist, with organic content					
	FILL	▩	FILL: black sandy fat CLAY (CH) - moist, firm to stiff - high plastic - brown - black - firm to stiff	■ ■ ■ ■ ■	G1 G2 G3 G4 G5			
	FILL	▩	FILL: grey silty SAND (SM) - moist, loose to compact	■	G6			
			END OF TESTHOLE - testhole terminated at a depth of 3.05 m in silty SAND (SM) FILL. - no seepage observed - no sloughing observed - no groundwater observed					



LOGGED BY: CW	COMPLETION DEPTH: 3.05 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-29
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: TH24-22
LOCATION: UTM: 14U, 5532429.165 m N, 0628361.120 m E		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 234.20

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ▌ CORE



USC	SOIL DESCRIPTION	SAMPLE #
ASPH	ASPHALT - 100 mm thick	
FILL	FILL: biege silty SAND (SM) - moist, loose to compact	G1
FILL	FILL: brown sandy fat CLAY (CH) - moist, firm to stiff	G2 G3
CH	firm to stiff black fat CLAY (CH) - high plastic - moist	G4 G5

END OF TESTHOLE
- testhole terminated at a depth of 3.05 m in fat CLAY (CH)
- no seepage observed
- no sloughing observed
- no groundwater observed

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 3.05 m
REVIEWED BY: GL	COMPLETION DATE: 24-1-29
PROJECT ENGINEER: Russ Golightly	Page 1 of 1

WINNIPEG TRANSIT GARAGE

TH24-01 Core Runs

Top @ 33’6” (10.21 m)

End C11 @ 35’6” (10.82 m)

End C12 @ 40’6” (12.34 m)

End C13 @ 45’6” (13.87 m)

C11

C12

C13

C14

C15

Top @ 45’6” (13.87 m)

End C14 @ 50’6” (15.39 m)

C15 continued @ 51’6” (15.70 m)

C15 Continued @ 51’6” (15.70 m)

End C15 @ 55’6” (16.92 m)

C16 continued @ 57’6” (17.56 m)

C15

C16

C16

C16 continued @ 57’6” (17.56 m)

End C16 @ 60’0” (18.29 m)

Top @ 60’0” (18.29 m)

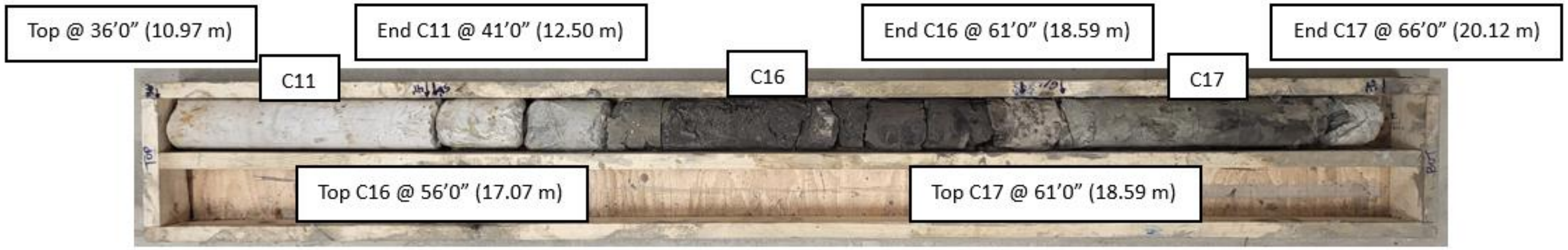
C17

C17

Bottom @ 65’0” (19.82 m)

City of Winnipeg
March 2024

WINNIPEG TRANSIT GARAGE
TH24-03 Core Runs



City of Winnipeg
March 2024

WINNIPEG TRANSIT GARAGE

TH24-09 Core Runs

Top @ 41’0” (12.50 m)

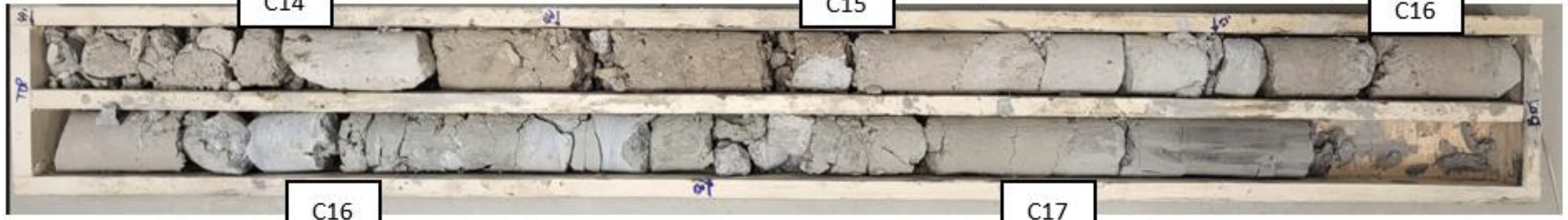
End C14 @ 46’0” (14.02 m)

End C15 @ 51’0” (14.02 m)

C14

C15

C16



C16

C17

End C16 @ 56’0” (17.07 m)

End C17 @ 61’0” (18.59 m)

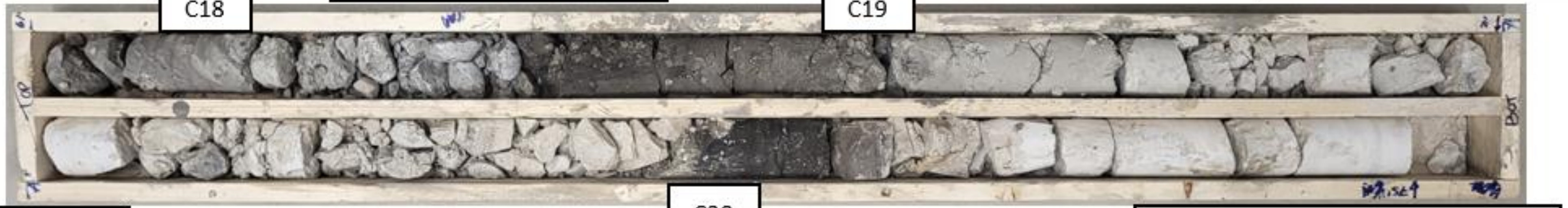
Top @ 61’0” (18.59 m)

End C18 @ 56’0” (20.12 m)

End C19 @ 71’0” (21.64 m)

C18

C19



C20

Top @ 71’0” (21.64 m)

C20 Continued @ 75’0” (22.86 m)

C20 Continued @ 75’0” (22.86 m)

End C20 @ 76’0” (23.16 m)

End C21 @ 76’0” (24.69 m)

C20

C21

C22

Top @ 81’0” (24.69 m)

Top @ 81’0” (25.76 m)

City of Winnipeg
March 2024

WINNIPEG TRANSIT GARAGE
TH24-12 Core Runs

AECOM


Top @ 41'0" (12.50 m)

C12

End C12 @ 46'0" (14.02 m)

C13

C13

End C13 @ 51'0" (15.54 m)

C14

End C14 @ 56'0" (17.07 m)

C15

C16

End C15 @ 61'0" (18.59m)

End C16 @ 66'0" (20.12 m)


End C18 @ 76'0" (23.16 m)

C18

C17

C18

Top C17 @ 66'0" (20.12 m)

End C17 @ 71'0" (21.64 m)


Top C20 @ 81'0" (24.69 m)

Bottom C20 @ 85'0" (25.91 m)

C20

C19

Top C19 @ 76'0" (23.16 m)

Bottom C19 @ 81'0" (24.69 m)

WINNIPEG TRANSIT GARAGE
TH24-15 Core Runs

Appendix D

Laboratory Results

AECOM
99 Commerce Drive
Winnipeg, MB, Canada R3P 0Y7
www.aecom.com

204 477 5381 tel
204 284 2040 fax

Memorandum

To	Colton Wooster	Page	1
CC			
Subject	WPG North Transit Garage		
From	Lee Boughton		
Date	March 7, 2024	Project Number	60721079

Please find attached the following material test result(s) on sample(s) submitted to the Winnipeg Geotechnical Laboratory:

- One Hundred Ninety-Five (195) Moisture Content Determination Test.
- Seven (7) Atterberg Limits (3 Points) Test.
- Seven (7) Grain Size Distribution (Hydrometer method) Test.
- Six (6) Unconfined Compressive Strength Test.
- Two (2) Maximum Dry Density (Standard Proctor) Test.
- Two (2) California Bearing Ratio Test.

If you have any questions, please contact the undersigned.

Prepared by:

Lee Boughton
Laboratory Manager

Reviewed by:

German Leal, M.Eng., P.Eng.
Discipline Lead, Geotechnical

Att.

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7
Phone: 204 477 5381 Fax: 204 284 2040

Project Name:	Winnipeg North Transit Garage	Supplier:	AECOM
Project Number:	60721079	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	Colton Wooster
Sample Location:	Winnipeg, MB	Sample Date:	January 29-February 9, 2024
Sample Depth:	Varies	Lab Technician:	Colton Wooster
Sample Number:	Varies	Date Tested:	February 12-14, 2024

Moisture Content (ASTM D2216-10)

Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Location	Sample	Depth (m)	**Moisture Content (%)**
TH24-01	G1	0.30 - 0.46 m	**5.2%**
TH24-01	G2	0.76 - 0.91 m	**35.4%**
TH24-01	G3	1.37 - 1.52 m	**28.3%**
TH24-01	G4	2.90 - 3.05 m	**49.6%**
TH24-01	G5	4.42 - 4.57 m	**54.4%**
TH24-01	G6	5.94 - 6.10 m	**34.5%**
TH24-01	G7	7.47 - 7.62 m	**21.6%**
TH24-01	G8	8.99 - 9.14 m	**9.4%**
TH24-01	S9	9.14 - 9.60 m	**9.1%**
TH24-01	G10	9.91 - 10.06 m	**11.3%**
TH24-01	S11	10.67 - 10.82 m	**8.5%**
TH24-02	G1	0.30 - 0.46 m	**35.9%**
TH24-02	G2	0.76 - 0.91 m	**17.2%**
TH24-02	G3	1.37 - 1.52 m	**33.1%**
TH24-02	G4	2.90 - 3.05 m	**42.2%**
TH24-02	G5	4.42 - 4.57 m	**55.6%**
TH24-02	G6	5.94 - 6.10 m	**34.7%**
TH24-02	G7	7.47 - 7.62 m	**43.1%**
TH24-02	G8	8.99 - 9.14 m	**32.9%**
TH24-02	S9	9.14 - 9.60 m	**10.8%**
TH24-03	G1	0.30 - 0.46 m	**16.6%**
TH24-03	G2	0.76 - 0.91 m	**21.8%**
TH24-03	G3	1.37 - 1.52 m	**20.7%**
TH24-03	G4	2.90 - 3.05 m	**33.8%**
TH24-03	G5	4.42 - 4.57 m	**52.4%**
TH24-03	G6	5.94 - 6.10 m	**40.1%**
TH24-03	G7	7.47 - 7.62 m	**20.7%**
TH24-03	G8	8.99 - 9.14 m	**24.5%**
TH24-03	S9	9.14 - 9.60 m	**19.7%**
TH24-03	S10	10.67 - 11.13 m	**6.8%**
TH24-04	G1	0.30 - 0.46 m	**25.1%**
TH24-04	G2	0.76 - 0.91 m	**22.0%**
TH24-04	G3	1.37 - 1.52 m	**15.7%**
TH24-04	G5	1.68 - 1.83 m	**20.3%**
TH24-04	G6	2.90 - 3.05 m	**38.4%**
TH24-04	G8	4.42 - 4.57 m	**52.6%**
TH24-04	G10	5.94 - 6.10 m	**45.1%**
TH24-04	G12	7.47 - 7.62 m	**39.8%**
TH24-04	G13	8.99 - 9.14 m	**18.5%**
TH24-04	S14	9.14 - 9.60 m	**18.6%**
TH24-05	G1	0.30 - 0.46 m	**5.0%**
TH24-05	G2	0.76 - 0.91 m	**23.3%**
TH24-05	G3	1.37 - 1.52 m	**22.6%**
TH24-05	G6	2.90 - 3.05 m	**47.2%**
TH24-05	G8	4.42 - 4.57 m	**53.1%**
TH24-05	G9	5.94 - 6.10 m	**39.2%**
TH24-05	G10	7.47 - 7.62 m	**47.0%**
TH24-05	G11	8.99 - 9.14 m	**28.2%**
TH24-05	G12	9.91 - 10.06 m	**12.3%**
TH24-06	G1	0.30 - 0.46 m	**22.1%**
TH24-06	G2	0.76 - 0.91 m	**15.6%**
TH24-06	G3	1.37 - 1.52 m	**28.8%**
TH24-06	G6	2.90 - 3.05 m	**25.3%**
TH24-06	S7	3.05 - 3.51 m	**21.3%**
TH24-07	G1	0.30 - 0.46 m	**25.0%**
TH24-07	G2	0.76 - 0.91 m	**27.2%**
TH24-07	G3	1.37 - 1.52 m	**27.9%**
TH24-07	G5	2.90 - 3.05 m	**20.9%**
TH24-07	S6	3.05 - 3.51 m	**35.7%**
TH24-07	S11	10.67 - 11.13 m	**11.0%**
TH24-07	S12	12.04 - 12.50 m	**8.8%**
TH24-08	G1	0.30 - 0.46 m	**16.0%**
TH24-08	G2	0.76 - 0.91 m	**25.7%**
TH24-08	G3	1.37 - 1.52 m	**19.1%**
TH24-08	G4	2.90 - 3.05 m	**34.5%**
TH24-08	G6	3.96 - 4.11 m	**25.7%**
TH24-08	G7	4.42 - 4.57 m	**32.9%**
TH24-08	G9	5.94 - 6.10 m	**56.0%**
TH24-08	S13	10.67 - 11.13 m	**13.4%**
TH24-08	S14	12.19 - 12.65 m	**10.5%**
TH24-09	G1	0.15 - 0.30 m	**23.2%**
TH24-09	G2	0.46 - 0.61 m	**16.5%**
TH24-09	G3	1.37 - 1.52 m	**30.6%**
TH24-09	G4	2.90 - 3.05 m	**41.0%**
TH24-09	G5	3.35 - 3.51 m	**28.8%**
TH24-09	G6	4.27 - 4.42 m	**39.0%**

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Project Name:	Winnipeg North Transit Garage	Supplier:	AECOM
Project Number:	60721079	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	Colton Wooster
Sample Location:	Winnipeg, MB	Sample Date:	January 29-February 9, 2024
Sample Depth:	Varies	Lab Technician:	Colton Wooster
Sample Number:	Varies	Date Tested:	February 12-14, 2024

Moisture Content (ASTM D2216-10)

Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Location	Sample	Depth (m)	**Moisture Content (%)**
TH24-09	G7	5.94 - 6.10 m	**48.8%**
TH24-09	G8	7.47 - 7.62 m	**45.7%**
TH24-09	G9	8.99 - 9.14 m	**38.2%**
TH24-09	G10	10.52 - 10.67 m	**30.8%**
TH24-10	G1	0.30 - 0.46 m	**31.9%**
TH24-10	G2	0.76 - 0.91 m	**35.8%**
TH24-10	G3	1.37 - 1.52 m	**33.9%**
TH24-10	S7	3.66 - 4.11 m	**34.0%**
TH24-10	G8	4.42 - 4.57 m	**39.3%**
TH24-10	G9	5.94 - 6.10 m	**56.1%**
TH24-10	G10	7.47 - 7.62 m	**53.1%**
TH24-10	G11	8.99 - 9.14 m	**33.8%**
TH24-10	G12	10.52 - 10.67 m	**34.7%**
TH24-10	G13	12.04 - 12.19 m	**10.5%**
TH24-11	G1	0.30 - 0.46 m	**15.4%**
TH24-11	G2	0.76 - 0.91 m	**11.9%**
TH24-11	G3	1.37 - 1.52 m	**14.2%**
TH24-11	G5	2.90 - 3.05 m	**31.1%**
TH24-11	G6	3.96 - 4.11 m	**15.9%**
TH24-11	G7	4.42 - 4.57 m	**29.0%**
TH24-11	G9	5.94 - 6.10 m	**57.8%**
TH24-11	G11	7.47 - 7.62 m	**46.0%**
TH24-11	G13	8.99 - 9.14 m	**35.0%**
TH24-11	G14	10.52 - 10.67 m	**54.3%**
TH24-11	G15	12.04 - 12.19 m	**18.1%**
TH24-11	G16	13.26 - 13.41 m	**16.7%**
TH24-11	S17	13.41 - 13.87 m	**10.5%**
TH24-12	G1	0.30 - 0.46 m	**16.0%**
TH24-12	G2	0.76 - 0.91 m	**12.9%**
TH24-12	G3	1.37 - 1.52 m	**15.1%**
TH24-12	G4	2.90 - 3.05 m	**21.8%**
TH24-12	G5	3.20 - 3.35 m	**23.4%**
TH24-12	G6	3.81 - 3.96 m	**27.3%**
TH24-12	S7	4.57 - 5.03 m	**28.4%**
TH24-12	G8	5.94 - 6.10 m	**47.2%**
TH24-12	G9	7.47 - 7.62 m	**32.4%**
TH24-12	G10	8.99 - 9.14 m	**34.9%**
TH24-12	G11	10.52 - 10.67 m	**25.2%**

Location	Sample	Depth (m)	**Moisture Content (%)**
TH24-12	G12	12.04 - 12.19 m	**10.5%**
TH24-12	S13	12.19 - 12.65 m	**8.6%**
TH24-13	G1	0.30 - 0.46 m	**20.5%**
TH24-13	G2	0.76 - 0.91 m	**29.4%**
TH24-13	G3	1.37 - 1.52 m	**21.9%**
TH24-13	G7	5.94 - 6.10 m	**44.9%**
TH24-13	G8	7.47 - 7.62 m	**36.1%**
TH24-13	G9	8.53 - 8.69 m	**35.0%**
TH24-13	G10	10.52 - 10.67 m	**36.4%**
TH24-13	G11	12.04 - 12.19 m	**24.5%**
TH24-13	G12	12.19 - 12.34 m	**25.0%**
TH24-14	G1	0.30 - 0.46 m	**5.3%**
TH24-14	G2	0.76 - 0.91 m	**16.6%**
TH24-14	G3	1.37 - 1.52 m	**25.6%**
TH24-14	G7	5.94 - 6.10 m	**47.9%**
TH24-14	G8	7.47 - 7.62 m	**42.2%**
TH24-14	G9	8.99 - 9.14 m	**36.3%**
TH24-14	G10	10.52 - 10.67 m	**27.9%**
TH24-14	G11	12.04 - 12.19 m	**9.2%**
TH24-14	S12	12.19 - 12.65 m	**9.1%**
TH24-15	G1	0.30 - 0.46 m	**18.8%**
TH24-15	G2	0.76 - 0.91 m	**10.9%**
TH24-15	G3	1.37 - 1.52 m	**21.8%**
TH24-15	G4	2.90 - 3.05 m	**35.6%**
TH24-15	G5	4.42 - 4.57 m	**35.6%**
TH24-15	G6	5.94 - 6.10 m	**49.5%**
TH24-15	G7	7.47 - 7.62 m	**40.3%**
TH24-15	G8	8.99 - 9.14 m	**27.6%**
TH24-15	G9	10.52 - 10.67 m	**33.8%**
TH24-15	G10	12.04 - 12.19 m	**18.9%**
TH24-15	S11	12.19 - 12.65 m	**9.8%**
TH24-16	G1	0.30 - 0.46 m	**17.2%**
TH24-16	G2	0.76 - 0.91 m	**18.9%**
TH24-16	G3	1.37 - 1.52 m	**31.8%**
TH24-16	G4	1.83 - 1.98 m	**24.6%**
TH24-16	G5	2.13 - 2.29 m	**19.2%**
TH24-16	G6	2.90 - 3.05 m	**37.1%**
TH24-16	G7	4.42 - 4.57 m	**48.8%**

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Project Name:	Winnipeg North Transit Garage	Supplier:	AECOM
Project Number:	60721079	Specification:	N/A
Client:	City of Winnipeg	Field Technician:	Colton Wooster
Sample Location:	Winnipeg, MB	Sample Date:	January 29-February 9, 2024
Sample Depth:	Varies	Lab Technician:	Colton Wooster
Sample Number:	Varies	Date Tested:	February 12-14, 2024

Moisture Content (ASTM D2216-10)

Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Location	Sample	Depth (m)	**Moisture Content (%)**
TH24-16	G8	5.94 - 6.10 m	**33.7%**
TH24-16	G9	7.47 - 7.62 m	**34.9%**
TH24-16	G10	8.99 - 9.14 m	**23.0%**
TH24-16	G11	10.52 - 10.67 m	**22.3%**
TH24-17	G1	0.30 - 0.46 m	**16.3%**
TH24-17	G2	0.76 - 0.91 m	**14.9%**
TH24-17	G3	1.37 - 1.52 m	**20.9%**
TH24-17	G4	2.29 - 2.44 m	**23.5%**
TH24-17	G5	2.90 - 3.05 m	**39.9%**
TH24-17	G6	4.42 - 4.57 m	**33.8%**
TH24-17	G7	5.94 - 6.10 m	**42.1%**
TH24-17	G8	7.47 - 7.62 m	**25.2%**
TH24-17	G9	8.99 - 9.14 m	**24.3%**
TH24-17	G10	9.75 - 9.91 m	**18.6%**
TH24-18	G1	0.30 - 0.46 m	**6.0%**
TH24-18	G2	0.76 - 0.91 m	**8.1%**
TH24-18	G3	1.37 - 1.52 m	**13.7%**
TH24-18	G4	2.29 - 2.44 m	**26.2%**
TH24-18	G5	2.90 - 3.05 m	**19.0%**
TH24-18	G6	4.42 - 4.57 m	**38.9%**
TH24-19	G1	0.30 - 0.46 m	**15.2%**
TH24-19	G2	0.76 - 0.91 m	**17.7%**
TH24-19	G3	1.37 - 1.52 m	**10.8%**
TH24-19	G4	2.29 - 2.44 m	**25.5%**
TH24-19	G5	2.90 - 3.05 m	**32.7%**
TH24-19	G6	4.42 - 4.57 m	**33.6%**
TH24-20	G1	0.30 - 0.46 m	**22.4%**
TH24-20	G2	0.76 - 0.91 m	**19.1%**
TH24-20	G3	1.37 - 1.52 m	**21.7%**
TH24-20	G4	2.29 - 2.44 m	**53.6%**
TH24-20	G5	2.90 - 3.05 m	**65.3%**
TH24-21	G1	0.30 - 0.46 m	**21.8%**
TH24-21	G2	0.76 - 0.91 m	**17.1%**
TH24-21	G3	1.52 - 1.68 m	**21.1%**
TH24-21	G4	2.13 - 2.29 m	**31.1%**
TH24-21	G5	2.29 - 2.44 m	**30.9%**
TH24-21	G6	2.74 - 2.90 m	**26.2%**
TH24-22	G1	0.30 - 0.46 m	**7.8%**

Location	Sample	Depth (m)	**Moisture Content (%)**
TH24-22	G2	0.76 - 0.91 m	**10.6%**
TH24-22	G3	1.37 - 1.52 m	**35.1%**
TH24-22	G4	2.29 - 2.44 m	**62.2%**
TH24-22	G5	2.90 - 3.05 m	**55.9%**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
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		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**
		0.00 - 0.00 m	**-**

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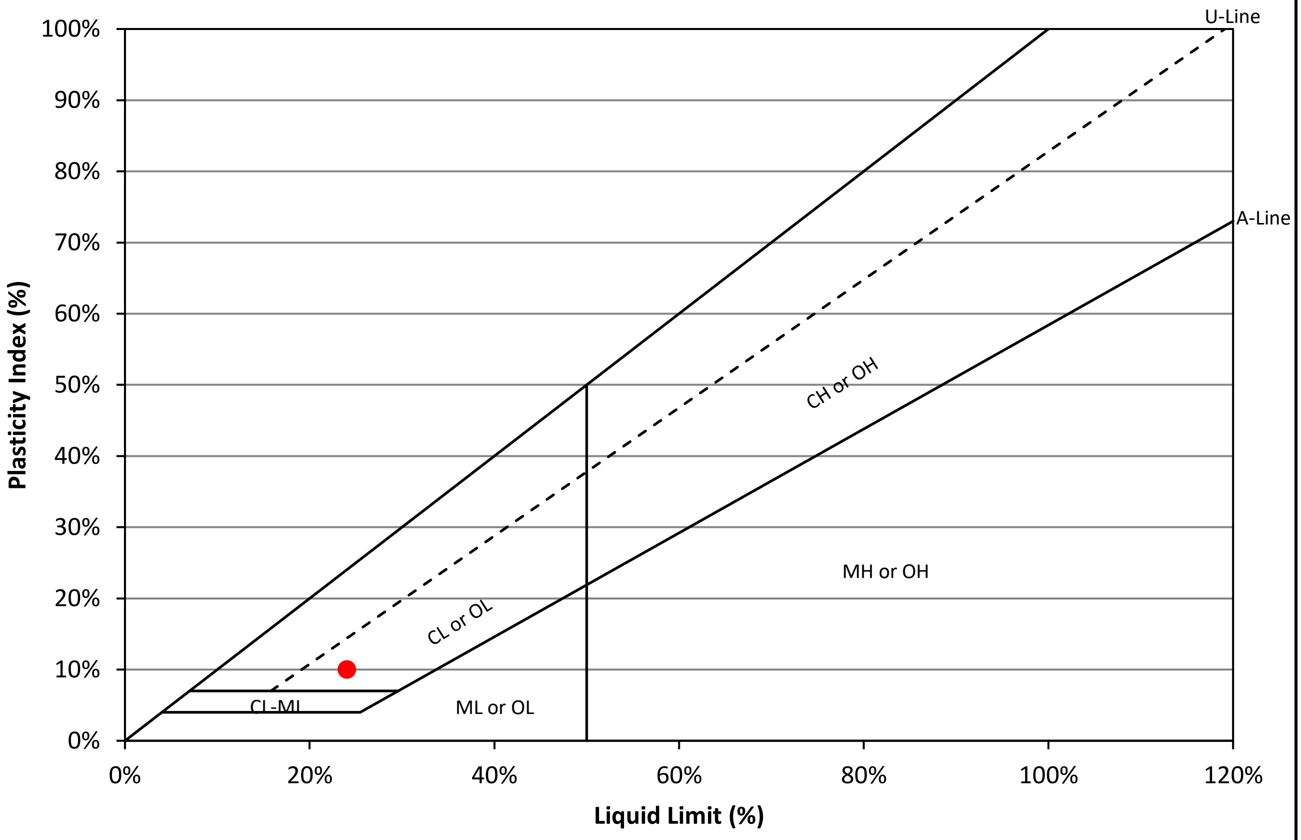
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-02	Sample Date:	February 9, 2024
Sample Depth:	8.99 - 9.14 m	Lab Technician:	LBoughton
Sample Number:	G8	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	35	25	18
Wet Sample (g)	7.9	7.9	12.4
Dry Sample (g)	6.4	6.4	9.9
Water Content (%)	23.1%	23.9%	25.1%

Plastic Limit		
Trial	1	2
Wet Sample (g)	5.5	5.6
Dry Sample (g)	4.8	4.9
Water Content (%)	14.3%	13.8%



Liquid Limit:	**24**	**Plastic Limit:**	**14**	**Plasticity Index:**	**10**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
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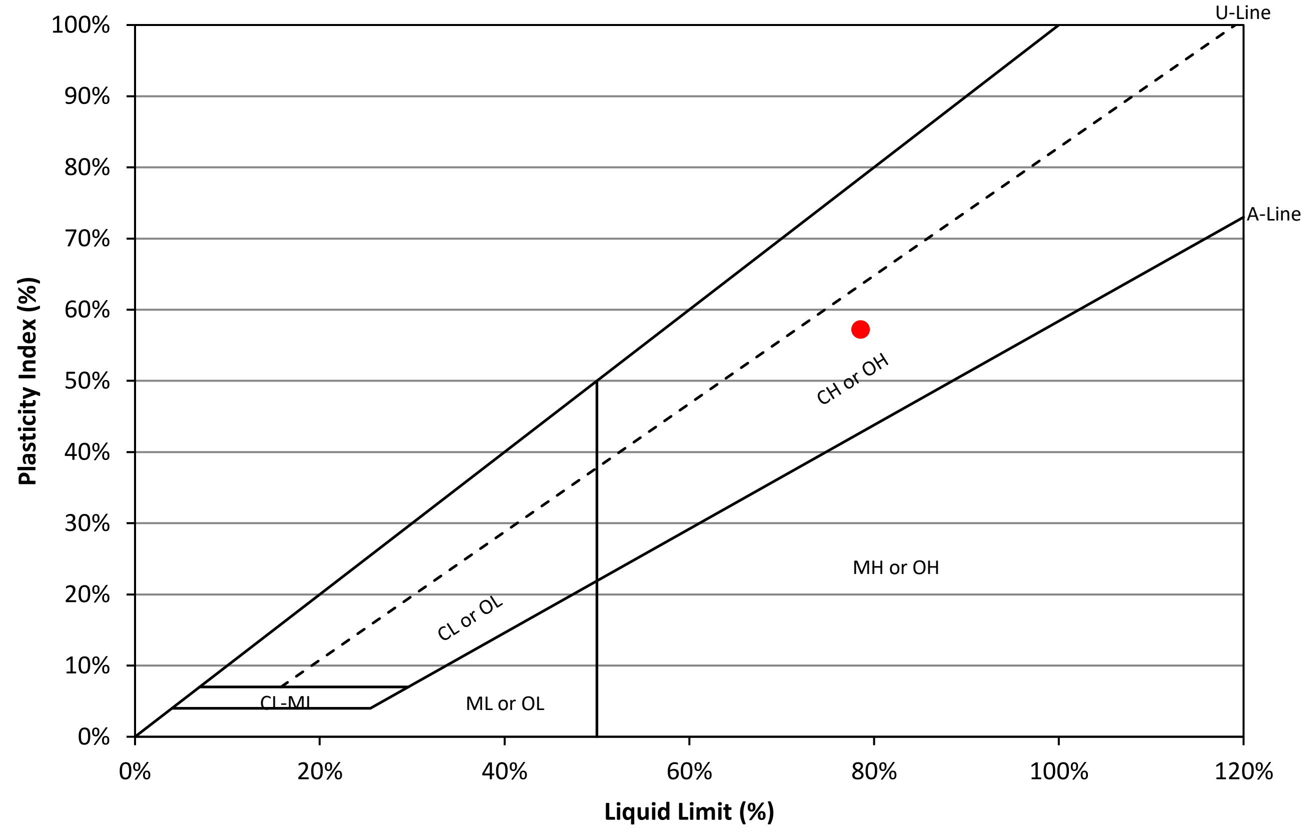
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-03	Sample Date:	February 9, 2024
Sample Depth:	4.42 - 4.57 m	Lab Technician:	LBoughton
Sample Number:	G5	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	27	20	17
Wet Sample (g)	8.9	9.2	8.9
Dry Sample (g)	5.0	5.1	4.9
Water Content (%)	77.8%	80.8%	82.6%

Plastic Limit		
Trial	1	2
Wet Sample (g)	4.8	5.1
Dry Sample (g)	4.0	4.2
Water Content (%)	21.4%	21.3%



Liquid Limit:	**79**	**Plastic Limit:**	**21**	**Plasticity Index:**	**57**

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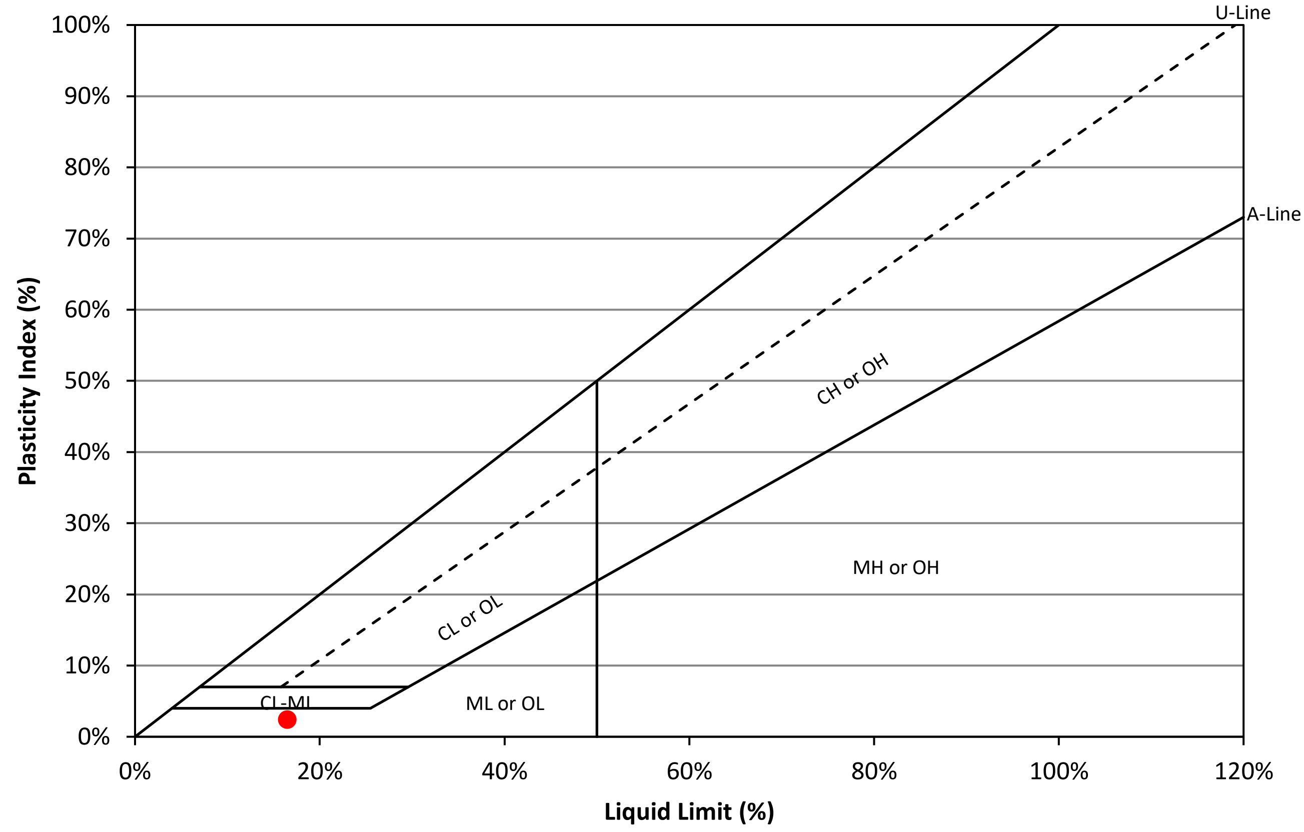
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-07	Sample Date:	February 9, 2024
Sample Depth:	2.90 - 3.05 m	Lab Technician:	LBoughton
Sample Number:	G5	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	20	25	30
Wet Sample (g)	9.5	9.5	9.5
Dry Sample (g)	8.0	8.1	8.2
Water Content (%)	18.0%	16.6%	15.2%

Plastic Limit		
Trial	1	2
Wet Sample (g)	5.9	5.6
Dry Sample (g)	5.2	4.9
Water Content (%)	13.8%	14.4%



Liquid Limit:	**16**	**Plastic Limit:**	**14**	**Plasticity Index:**	**2**

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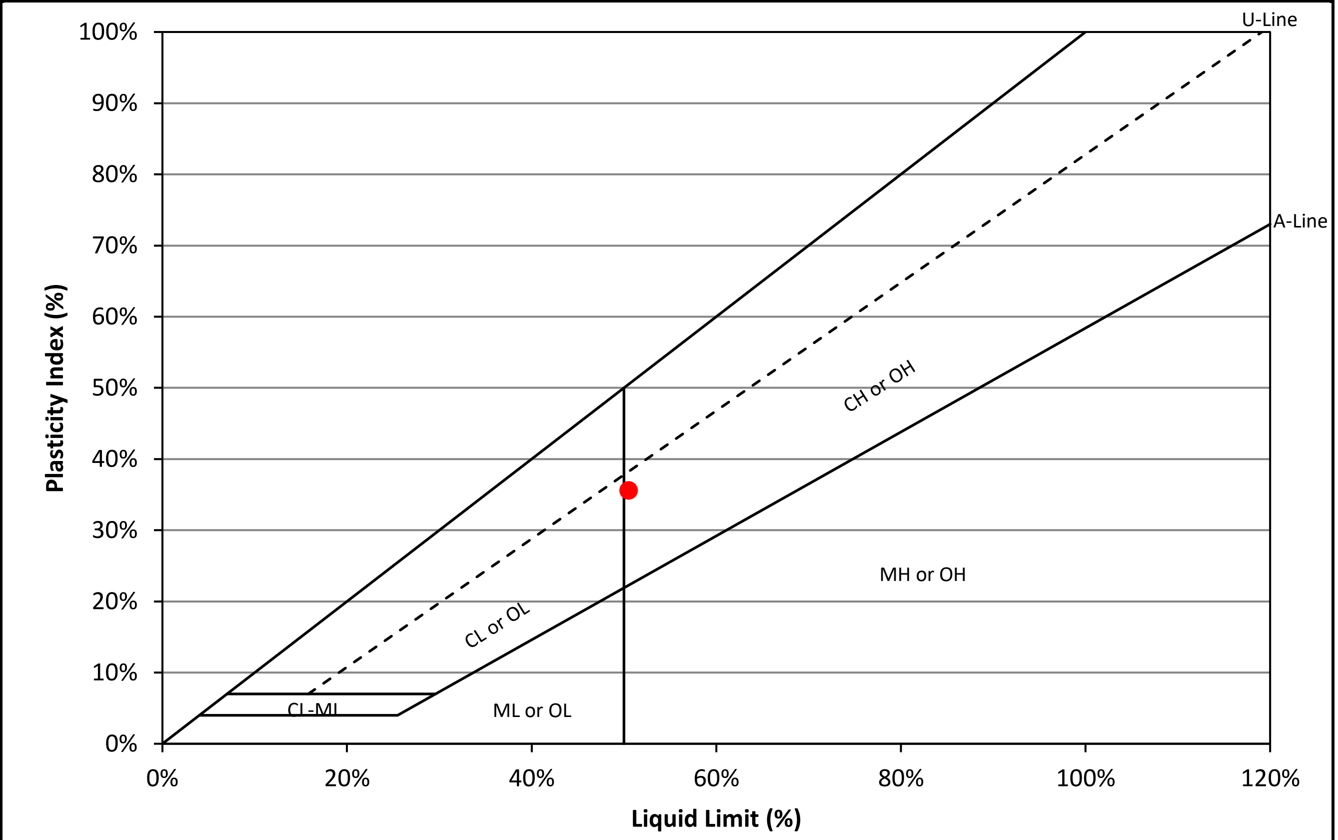
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-12	Sample Date:	February 9, 2024
Sample Depth:	1.37 - 1.52 m	Lab Technician:	LBoughton
Sample Number:	G3	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	28	20	17
Wet Sample (g)	7.7	11.7	9.4
Dry Sample (g)	5.1	7.7	6.1
Water Content (%)	49.8%	51.9%	52.7%

Plastic Limit		
Trial	1	2
Wet Sample (g)	4.6	4.9
Dry Sample (g)	4.0	4.2
Water Content (%)	15.1%	14.7%



Liquid Limit:	**50**	**Plastic Limit:**	**15**	**Plasticity Index:**	**36**

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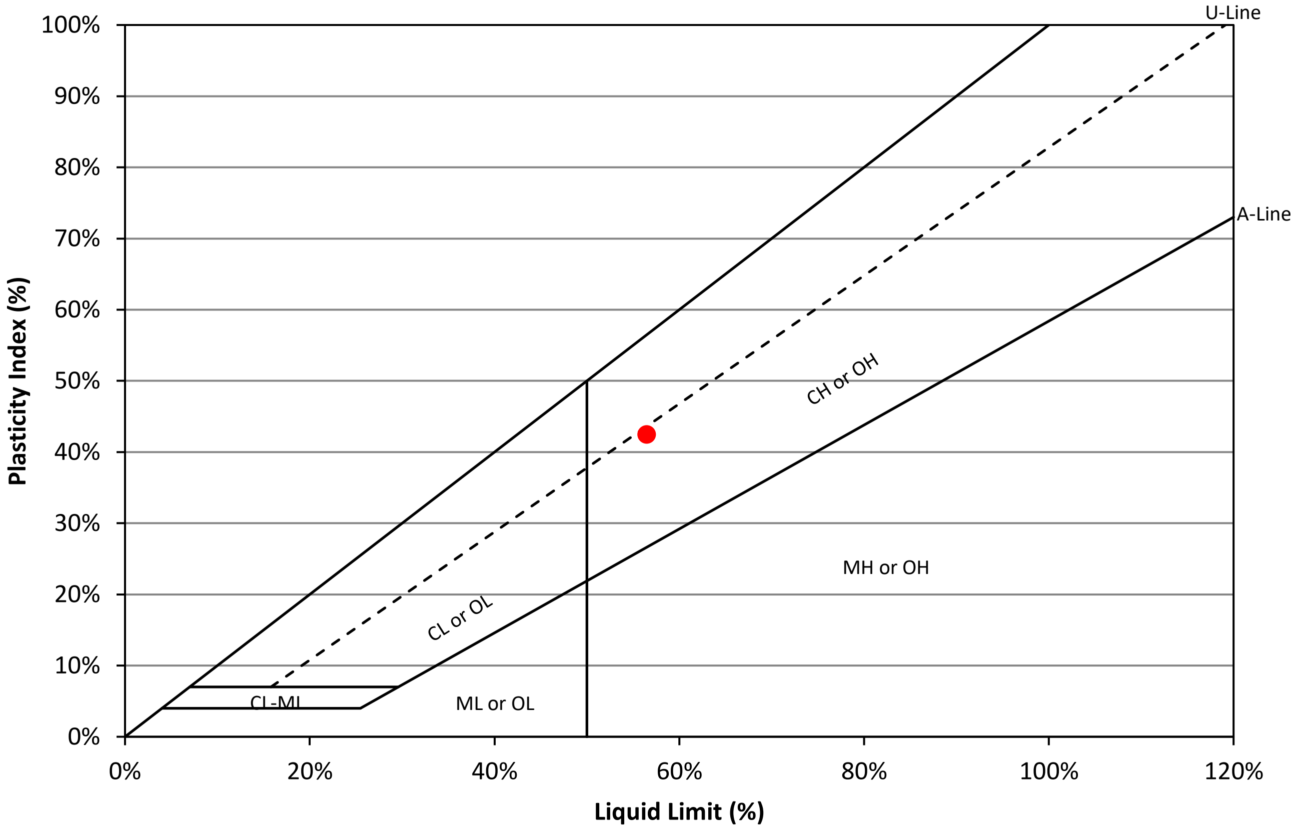
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-13	Sample Date:	February 9, 2024
Sample Depth:	10.52 - 10.67 m	Lab Technician:	LBoughton
Sample Number:	G10	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	31	25	17
Wet Sample (g)	9.0	9.9	9.7
Dry Sample (g)	5.8	6.3	6.1
Water Content (%)	54.7%	55.7%	60.8%

Plastic Limit		
Trial	1	2
Wet Sample (g)	4.7	4.2
Dry Sample (g)	4.1	3.7
Water Content (%)	14.2%	13.8%



Liquid Limit:	**56**	**Plastic Limit:**	**14**	**Plasticity Index:**	**42**

Reviewed by: Lee Boughton
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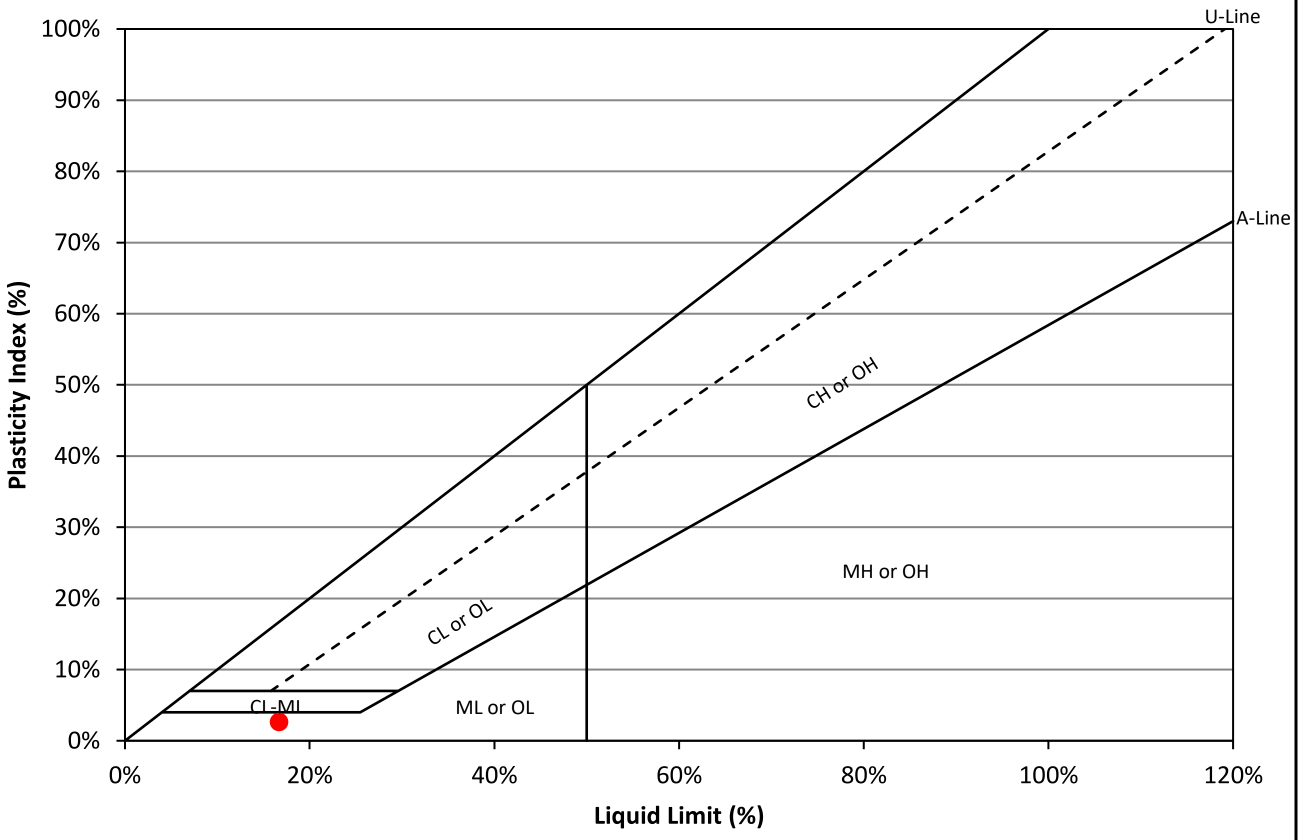
Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-16	Sample Date:	February 9, 2024
Sample Depth:	0.61 - 0.76 m	Lab Technician:	LBoughton
Sample Number:	G2	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	20	25	30
Wet Sample (g)	9.5	9.5	9.5
Dry Sample (g)	8.0	8.1	8.2
Water Content (%)	18.3%	16.9%	15.2%

Plastic Limit		
Trial	1	2
Wet Sample (g)	6.3	6.4
Dry Sample (g)	5.5	5.6
Water Content (%)	14.0%	14.2%



Liquid Limit:	**17**	**Plastic Limit:**	**14**	**Plasticity Index:**	**3**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

AECOM Canada Ltd.
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Phone: 204 477 5381

Project Name: Winnipeg North Transit Garage

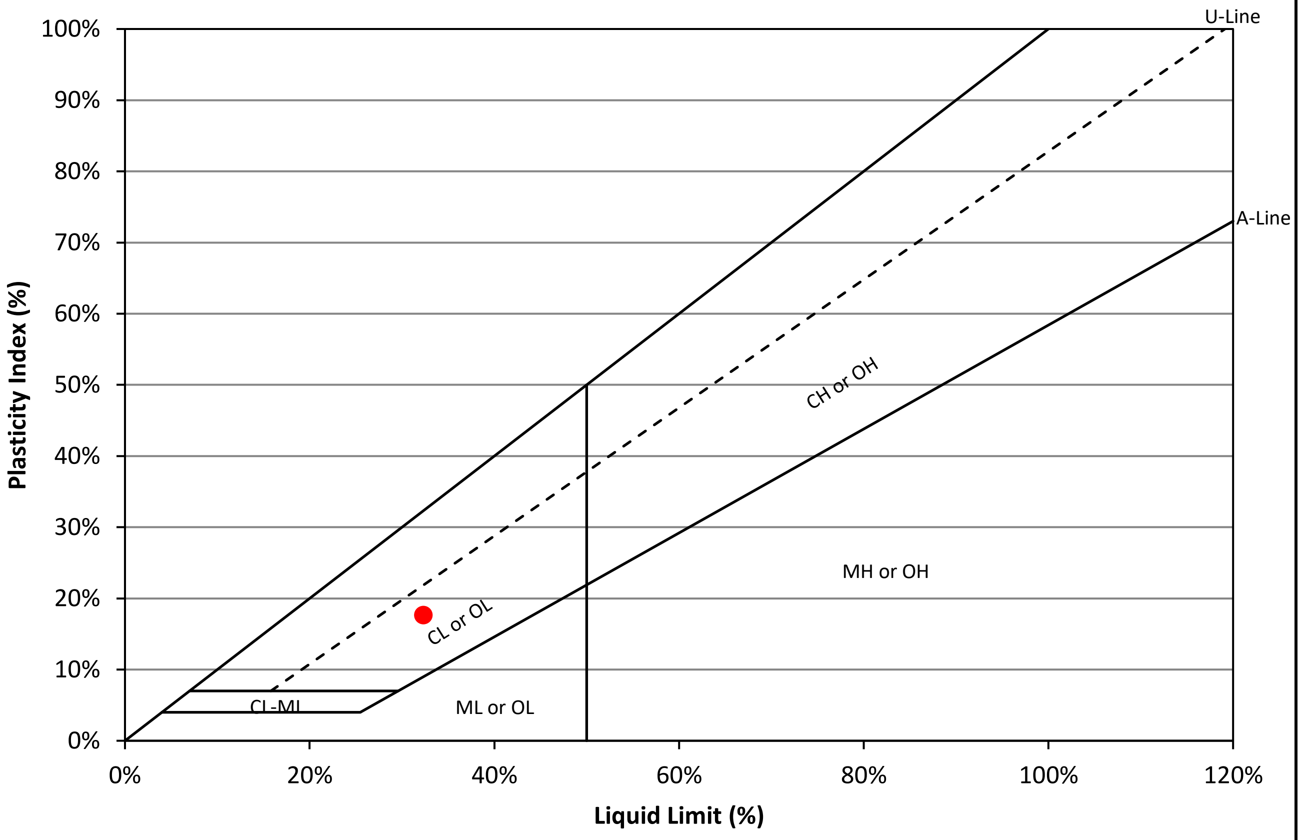
Project Number:	60721079	Supplier/Location:	Winnipeg, MB
Client:	City of Winnipeg	Field Technician:	CWooster
Sample Location:	TH24-18	Sample Date:	February 9, 2024
Sample Depth:	0.61 - 0.76 m	Lab Technician:	LBoughton
Sample Number:	G2	Date Tested:	March 6, 2024

Atterberg Limits (ASTM D4318)

Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

Liquid Limit			
Blows	25	21	18
Wet Sample (g)	12.2	10.2	11.8
Dry Sample (g)	9.2	7.7	8.7
Water Content (%)	32.5%	33.1%	34.6%

Plastic Limit		
Trial	1	2
Wet Sample (g)	5.0	4.8
Dry Sample (g)	4.3	4.2
Water Content (%)	15.0%	14.4%



Liquid Limit:	**32**	**Plastic Limit:**	**15**	**Plasticity Index:**	**18**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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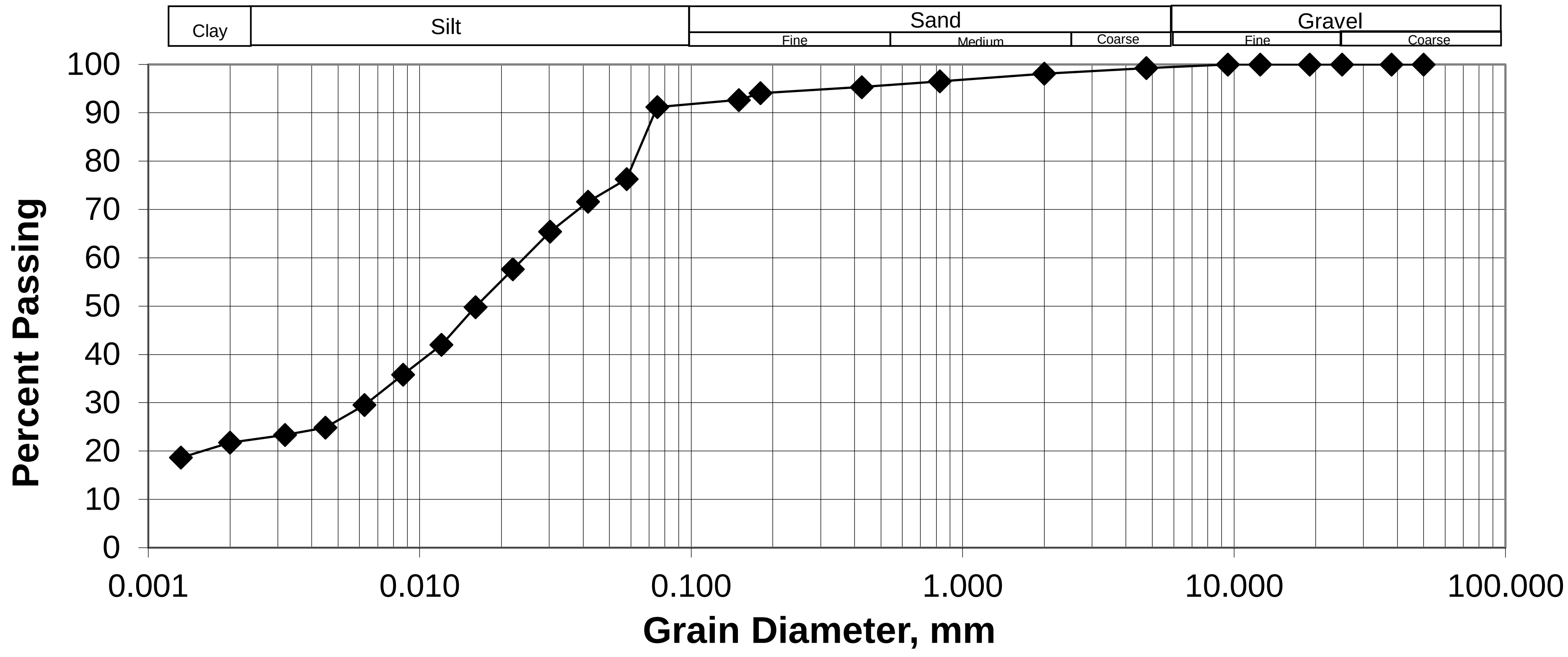
Job No.:	60721079	Hole No.:	TH24-02
Client:	City of Winnipeg	Sample No.:	G8
Project :	Winnipeg North Transit Garage	Depth:	8.99 - 9.14 m
Date Tested:	27-Feb-24	Date Sampled:	9-Feb-24
Tested By:	LBoughton	Sampled By:	CWooster

GRAVEL SIZES		**SAND SIZES**		**FINES**	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	99.2	0.0750	91.2
38.0	100.0	2.00	98.1	0.0578	76.3
25.0	100.0	0.825	96.5	0.0417	71.6
19.0	100.0	0.425	95.3	0.0303	65.4
12.5	100.0	0.18	94.1	0.0220	57.6
9.5	100.0	0.15	92.6	0.0160	49.8
4.75	99.2	0.075	91.2	0.0120	42.0
				0.0087	35.8
				0.0063	29.5
				0.0045	24.9
				0.0032	23.3
				0.0020	21.8
				0.0013	18.6

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.8%**	**Silt**	**69.4%**
Sand	**8.0%**	**Clay**	**21.8%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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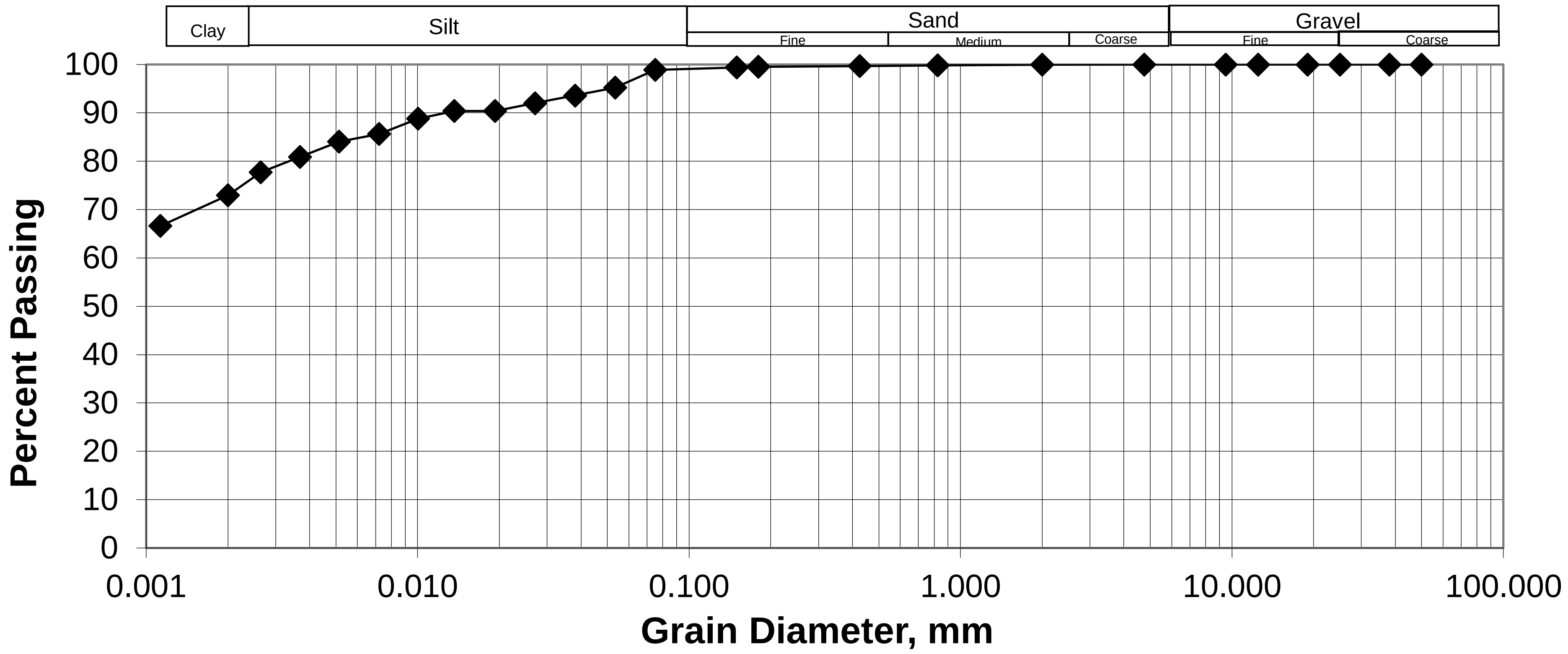
Job No.:	60721079	Hole No.:	TH24-03
Client:	City of Winnipeg	Sample No.:	G5
Project :	Winnipeg North Transit Garage	Depth:	4.42 - 4.57 m
Date Tested:	27-Feb-24	Date Sampled:	9-Feb-24
Tested By:	LBoughton	Sampled By:	CWooster

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	100.0	0.0750	98.9
38.0	100.0	2.00	99.9	0.0534	95.2
25.0	100.0	0.825	99.8	0.0380	93.6
19.0	100.0	0.425	99.7	0.0271	92.0
12.5	100.0	0.18	99.5	0.0193	90.4
9.5	100.0	0.15	99.4	0.0137	90.4
4.75	100.0	0.075	98.9	0.0100	88.8
				0.0072	85.7
				0.0051	84.1
				0.0037	80.9
				0.0026	77.7
				0.0020	73.0
				0.0011	66.6

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**25.9%**
Sand	**1.1%**	**Clay**	**73.0%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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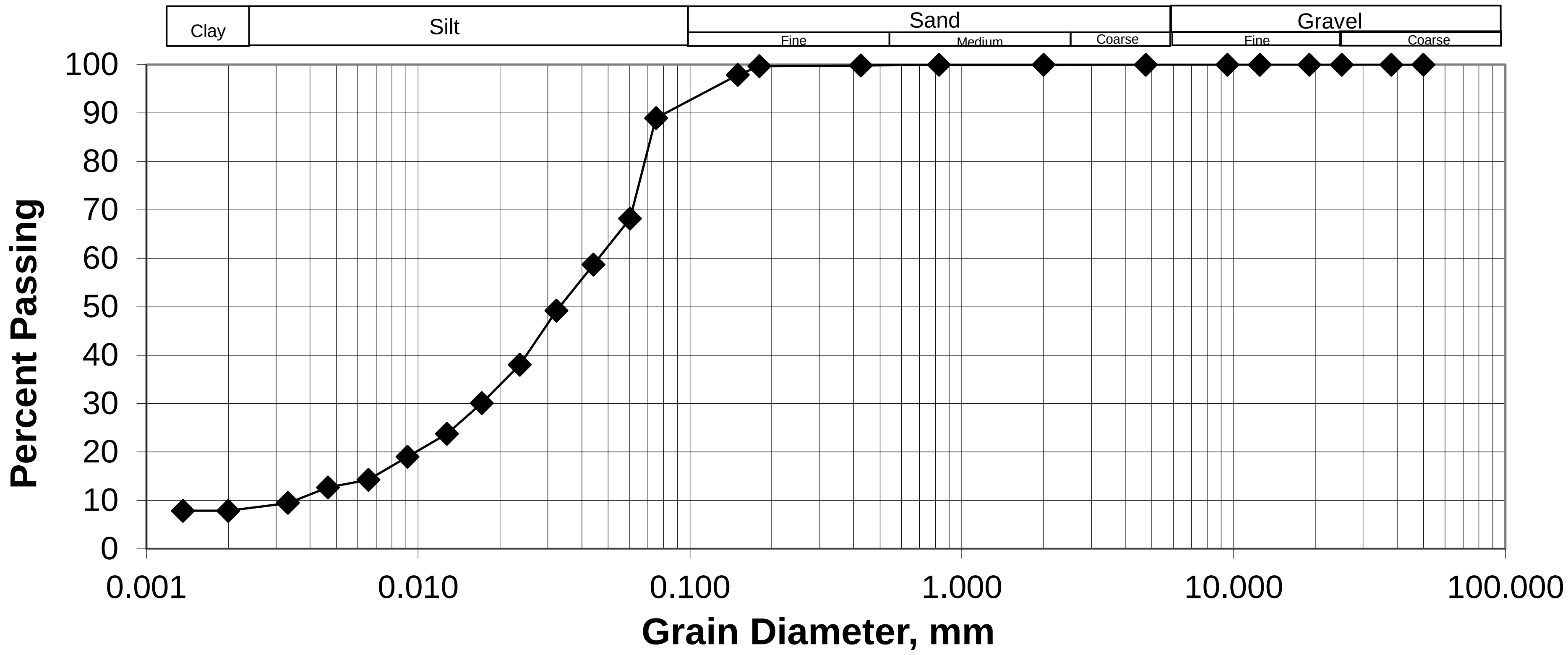
Job No.:	60721079	Hole No.:	TH24-07
Client:	City of Winnipeg	Sample No.:	G5
Project :	Winnipeg North Transit Garage	Depth:	2.90 - 3.05 m
Date Tested:	27-Feb-24	Date Sampled:	9-Feb-24
Tested By:	LBoughton	Sampled By:	CWooster

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	100.0	0.0750	89.0
38.0	100.0	2.00	100.0	0.0601	68.2
25.0	100.0	0.825	99.9	0.0441	58.7
19.0	100.0	0.425	99.8	0.0322	49.2
12.5	100.0	0.18	99.7	0.0237	38.1
9.5	100.0	0.15	97.9	0.0171	30.1
4.75	100.0	0.075	89.0	0.0128	23.8
				0.0091	19.0
				0.0066	14.2
				0.0047	12.6
				0.0033	9.5
				0.0020	7.9
				0.0014	7.9

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.0%**	**Silt**	**81.1%**
Sand	**11.0%**	**Clay**	**7.9%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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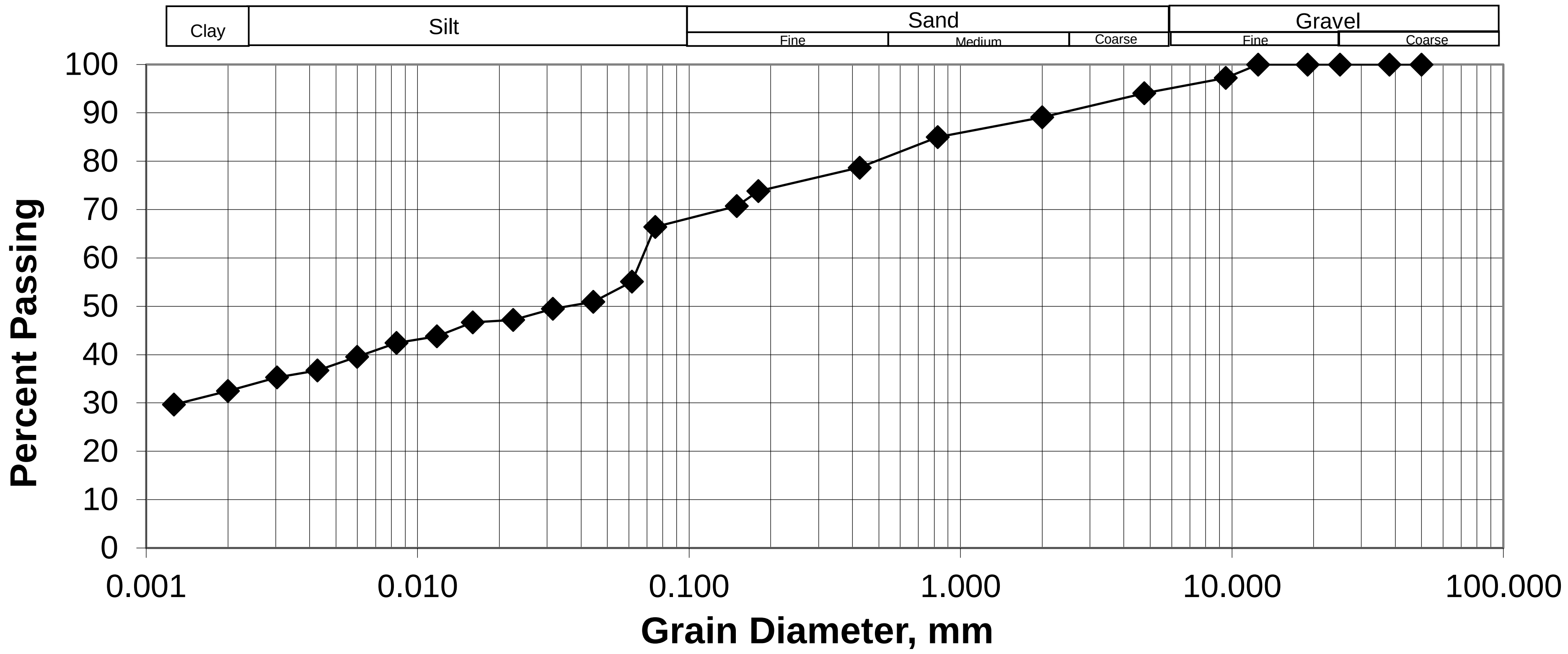
Job No.: 60721079
Client: City of Winnipeg
Project : Winnipeg North Transit Garage
Date Tested: 27-Feb-24
Tested By: LBoughton

Hole No.: TH24-12
Sample No.: G3
Depth: 1.37 - 1.52 m
Date Sampled: 9-Feb-24
Sampled By: CWooster

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	94.1	0.0750	66.4
38.0	100.0	2.00	89.1	0.0616	55.1
25.0	100.0	0.825	85.0	0.0443	50.9
19.0	100.0	0.425	78.7	0.0315	49.5
12.5	100.0	0.18	73.8	0.0225	47.2
9.5	97.2	0.15	70.7	0.0159	46.6
4.75	94.1	0.075	66.4	0.0118	43.8
				0.0084	42.4
				0.0060	39.6
				0.0043	36.7
				0.0030	35.3
				0.0020	32.5
				0.0013	29.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**5.9%**	**Silt**	**33.9%**
Sand	**27.7%**	**Clay**	**32.5%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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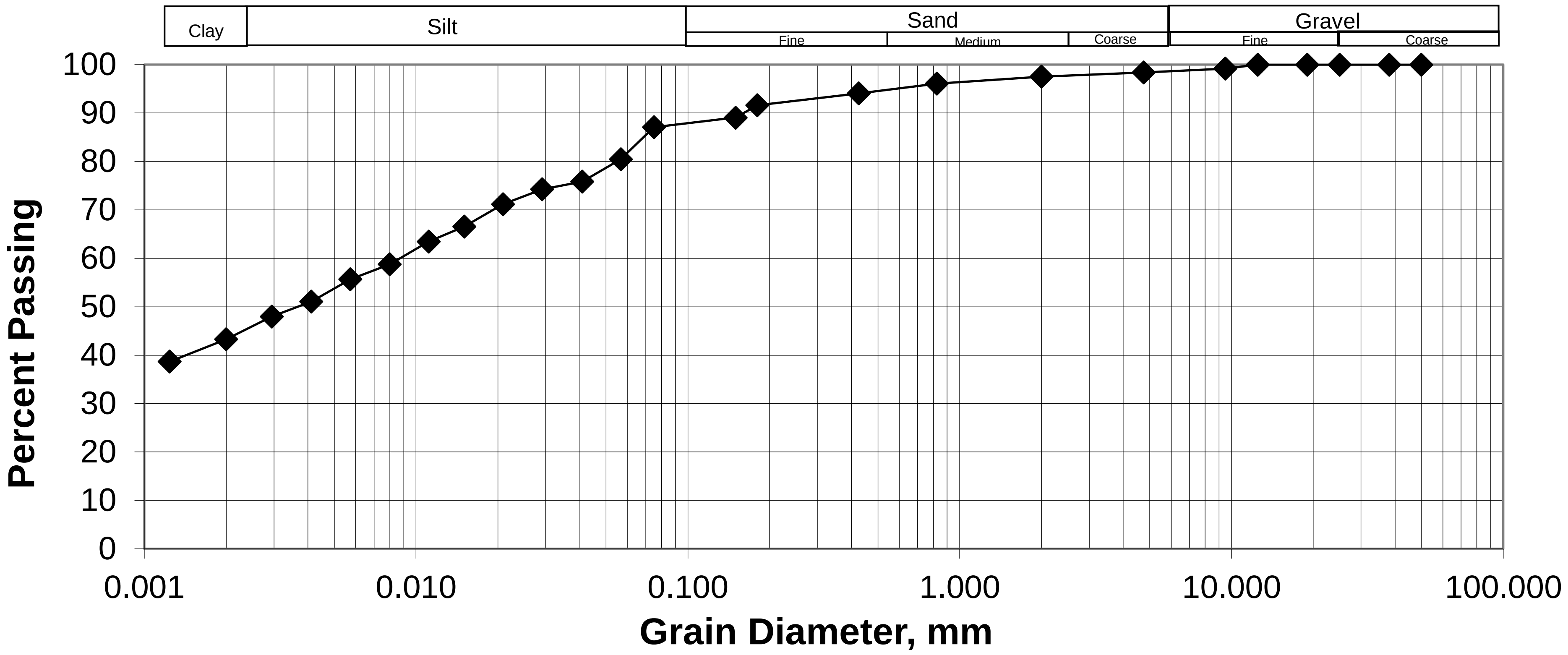
Job No.: 60721079
Client: City of Winnipeg
Project : Winnipeg North Transit Garage
Date Tested: 27-Feb-24
Tested By: LBoughton

Hole No.: TH24-13
Sample No.: G10
Depth: 10.52 - 10.67 m
Date Sampled: 9-Feb-24
Sampled By: CWooster

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	98.4	0.0750	87.0
38.0	100.0	2.00	97.5	0.0567	80.5
25.0	100.0	0.825	96.0	0.0409	75.8
19.0	100.0	0.425	94.0	0.0291	74.3
12.5	100.0	0.18	91.6	0.0209	71.2
9.5	99.2	0.15	89.1	0.0150	66.5
4.75	98.4	0.075	87.0	0.0111	63.4
				0.0080	58.8
				0.0057	55.7
				0.0041	51.0
				0.0029	47.9
				0.0020	43.3
				0.0012	38.7

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**1.6%**	**Silt**	**43.7%**
Sand	**11.3%**	**Clay**	**43.3%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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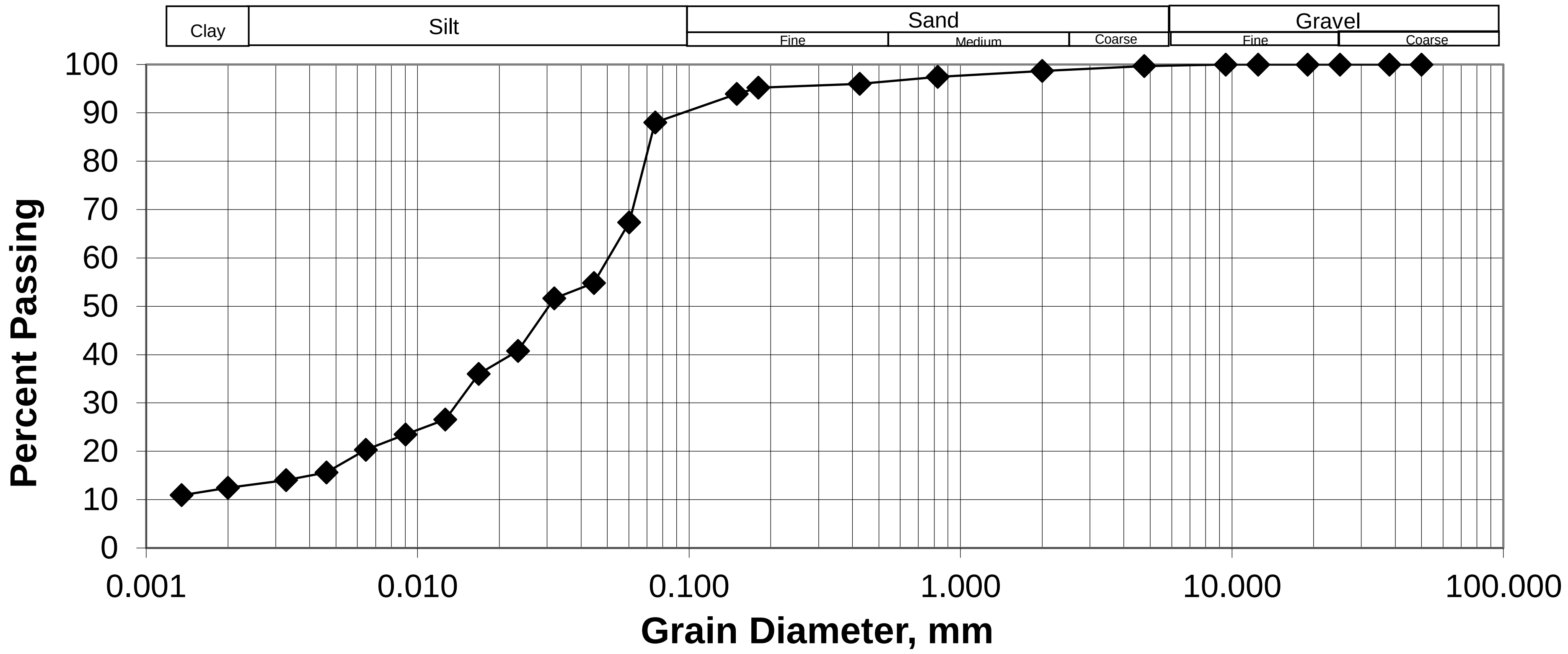
Job No.:	60721079	Hole No.:	TH24-16
Client:	City of Winnipeg	Sample No.:	G2
Project :	Winnipeg North Transit Garage	Depth:	0.61 - 0.76 m
Date Tested:	27-Feb-24	Date Sampled:	9-Feb-24
Tested By:	LBoughton	Sampled By:	CWooster

GRAVEL SIZES		**SAND SIZES**		**FINES**	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	99.7	0.0750	88.0
38.0	100.0	2.00	98.7	0.0601	67.3
25.0	100.0	0.825	97.5	0.0446	54.8
19.0	100.0	0.425	96.0	0.0319	51.6
12.5	100.0	0.18	95.2	0.0234	40.7
9.5	100.0	0.15	93.9	0.0168	36.0
4.75	99.7	0.075	88.0	0.0126	26.6
				0.0090	23.4
				0.0064	20.3
				0.0046	15.6
				0.0033	14.0
				0.0020	12.5
				0.0013	10.9

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**0.3%**	**Silt**	**75.5%**
Sand	**11.6%**	**Clay**	**12.5%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

GRAIN SIZE DISTRIBUTION
(AASHTO T88)

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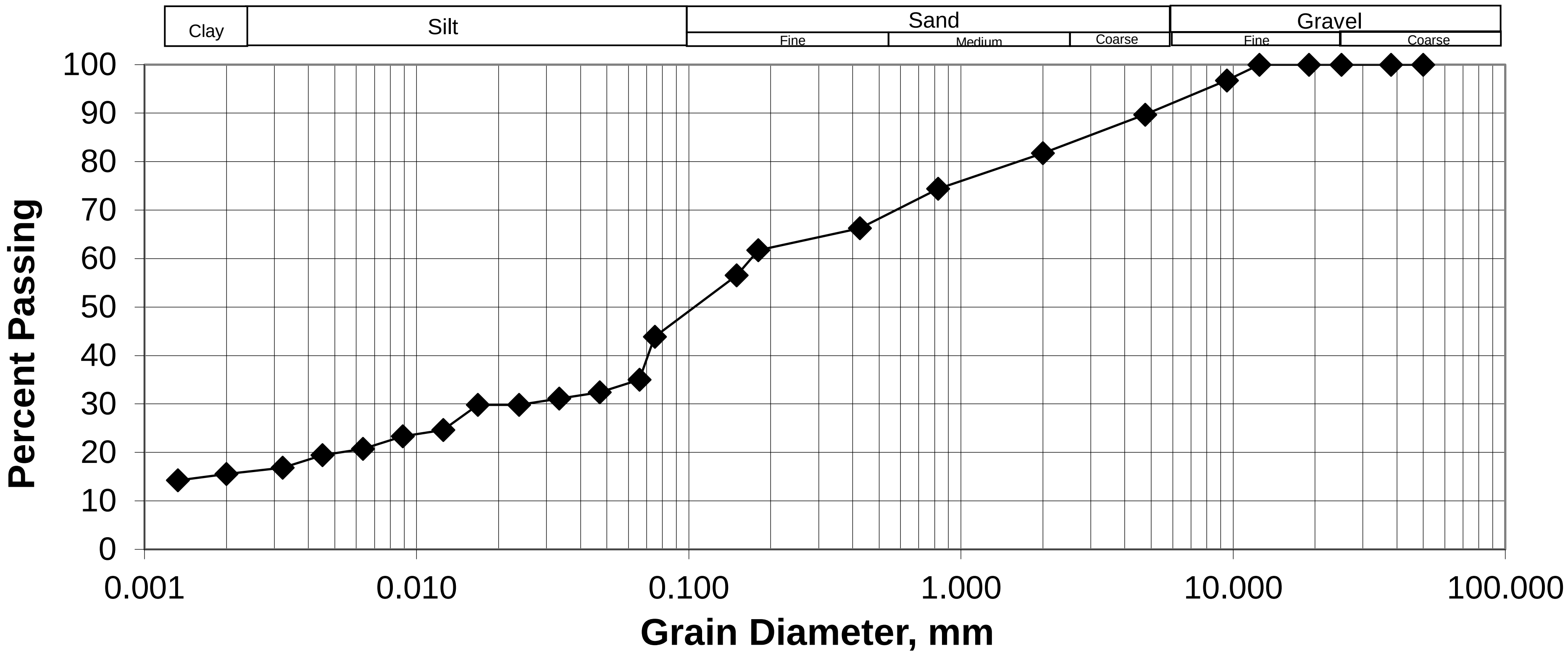
Job No.: 60721079
Client: City of Winnipeg
Project : Winnipeg North Transit Garage
Date Tested: 27-Feb-24
Tested By: LBoughton

Hole No.: TH24-18
Sample No.: G2
Depth: 0.61 - 0.76 m
Date Sampled: 9-Feb-24
Sampled By: CWooster

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	4.75	89.7	0.0750	43.8
38.0	100.0	2.00	81.7	0.0659	35.0
25.0	100.0	0.825	74.4	0.0471	32.4
19.0	100.0	0.425	66.2	0.0335	31.1
12.5	100.0	0.18	61.7	0.0238	29.8
9.5	96.8	0.15	56.5	0.0168	29.8
4.75	89.7	0.075	43.8	0.0125	24.6
				0.0089	23.3
				0.0063	20.7
				0.0045	19.4
				0.0032	16.8
				0.0020	15.5
				0.0013	14.2

GRAIN SIZE DISTRIBUTION CURVE



Gravel	**10.3%**	**Silt**	**28.3%**
Sand	**45.9%**	**Clay**	**15.5%**

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

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Winnipeg Geotechnical Laboratory
99 Commerce Drive, Winnipeg, MB R3P 0Y7
Phone: 204 477 5381

Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	4.57 - 5.18 m	Submitted By:	CWooster
Sample Location:	TH24-06	Date Tested:	February 28, 2024
Sample Number:	T8	Tested By:	LCampodonico

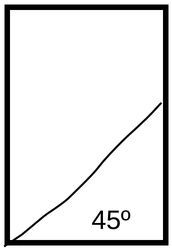
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace sand, high plasticity, homogeneous

Average Diameter (cm):	7.24
Average Length (cm):	15.01
Length/Diameter Ratio:	2.07
Moisture content (%):	57.8
Bulk Density (g/cm³):	1.673
Bulk Unit Weight (kN/m³):	16.4
Bulk Unit Weight (pcf):	104.4
Dry Unit Weight (kN/m³):	10.40

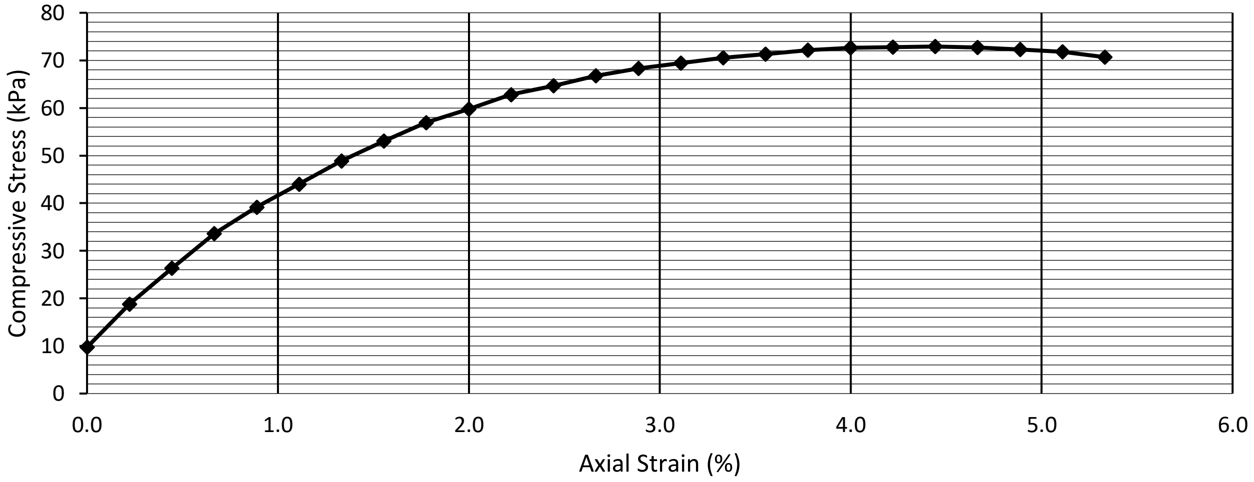
FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	41.2
Pocket Pen.	Undrained Shear Strength (kPa)	35.9

UCS	Unconfined compressive strength (kPa)	72.92	Undrained Shear Strength (kPa)	36.46
	Unconfined compressive strength (ksf)	1.523	Undrained Shear Strength (ksf)	0.761
	Avg. Rate of Strain to Failure (%/min):	1.33	Strain at Failure (%):	4.44

Unconfined Compressive Strength



Comments:

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

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Winnipeg Geotechnical Laboratory
99 Commerce Drive, Winnipeg, MB R3P 0Y7
Phone: 204 477 5381

Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	6.10 - 6.71 m	Submitted By:	CWooster
Sample Location:	TH24-06	Date Tested:	February 28, 2024
Sample Number:	T9	Tested By:	LCampodonico

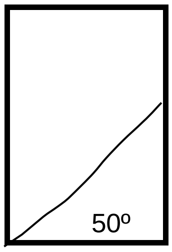
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace sand, high plasticity, homogeneous

Average Diameter (cm):	7.21
Average Length (cm):	14.88
Length/Diameter Ratio:	2.06
Moisture content (%):	46.6
Bulk Density (g/cm³):	1.841
Bulk Unit Weight (kN/m³):	18.1
Bulk Unit Weight (pcf):	115.0
Dry Unit Weight (kN/m³):	12.31

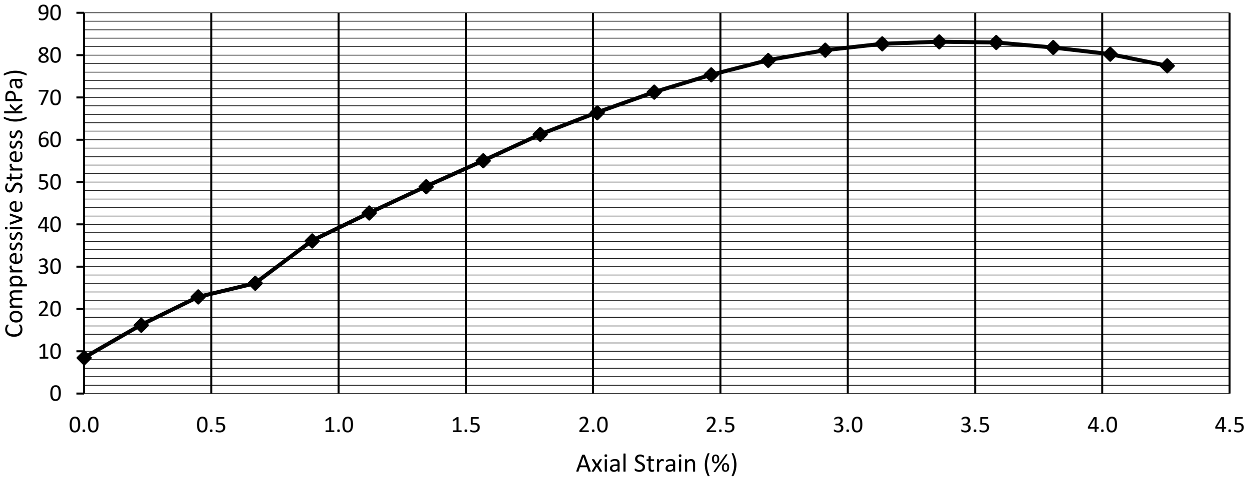
FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	37.3
Pocket Pen.	Undrained Shear Strength (kPa)	25.5

UCS	Unconfined compressive strength (kPa)	83.17	Undrained Shear Strength (kPa)	41.58
	Unconfined compressive strength (ksf)	1.737	Undrained Shear Strength (ksf)	0.868
	Avg. Rate of Strain to Failure (%/min):	1.34	Strain at Failure (%):	3.36

Unconfined Compressive Strength



Comments:

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

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Winnipeg Geotechnical Laboratory
99 Commerce Drive, Winnipeg, MB R3P 0Y7
Phone: 204 477 5381

Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	7.62 - 8.23 m	Submitted By:	CWooster
Sample Location:	TH24-06	Date Tested:	February 28, 2024
Sample Number:	T10	Tested By:	LCampodonico

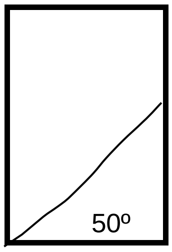
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace sand, high plasticity, homogeneous

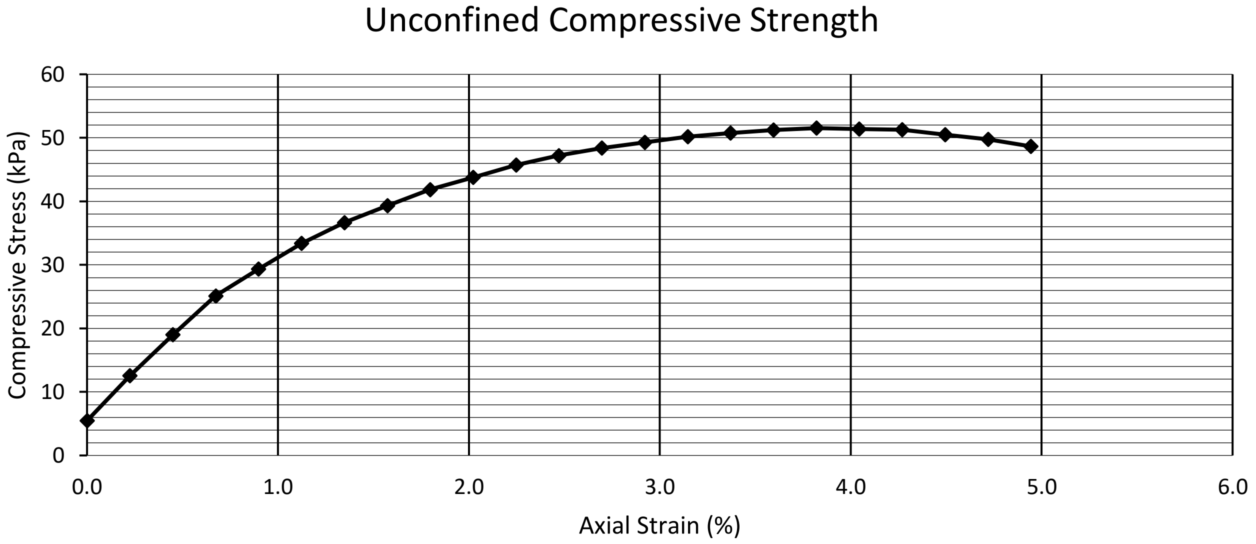
Average Diameter (cm):	7.17
Average Length (cm):	14.83
Length/Diameter Ratio:	2.07
Moisture content (%):	39.8
Bulk Density (g/cm³):	1.746
Bulk Unit Weight (kN/m³):	17.1
Bulk Unit Weight (pcf):	109.0
Dry Unit Weight (kN/m³):	12.25

FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	40.2
Pocket Pen.	Undrained Shear Strength (kPa)	22.3

UCS	Unconfined compressive strength (kPa)	51.53	Undrained Shear Strength (kPa)	25.76
	Unconfined compressive strength (ksf)	1.076	Undrained Shear Strength (ksf)	0.538
	Avg. Rate of Strain to Failure (%/min):	1.35	Strain at Failure (%):	3.82



Comments:

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

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Winnipeg Geotechnical Laboratory
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Phone: 204 477 5381

Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	4.57 - 5.18 m	Submitted By:	CWooster
Sample Location:	TH24-07	Date Tested:	February 29, 2024
Sample Number:	T7	Tested By:	LCampodonico

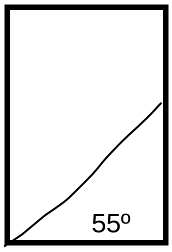
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace sand, high plasticity, blocky

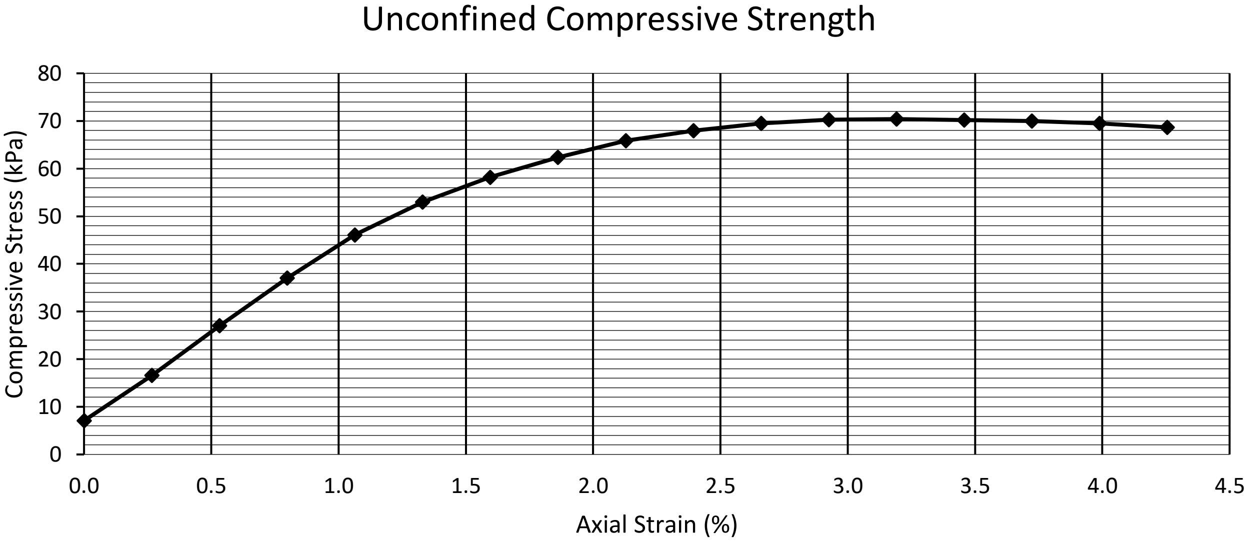
Average Diameter (cm):	7.18
Average Length (cm):	12.53
Length/Diameter Ratio:	1.74
Moisture content (%):	44.0
Bulk Density (g/cm³):	1.736
Bulk Unit Weight (kN/m³):	17.0
Bulk Unit Weight (pcf):	108.4
Dry Unit Weight (kN/m³):	11.83

FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	47.1
Pocket Pen.	Undrained Shear Strength (kPa)	61.4

UCS	Unconfined compressive strength (kPa)	70.39	Undrained Shear Strength (kPa)	35.20
	Unconfined compressive strength (ksf)	1.470	Undrained Shear Strength (ksf)	0.735
	Avg. Rate of Strain to Failure (%/min):	1.60	Strain at Failure (%):	3.19



Comments:

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive, Winnipeg, MB R3P 0Y7
Phone: 204 477 5381

Project Name:	Winnipeg North Transit Garage		
Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	6.10 - 6.71 m	Submitted By:	CWooster
Sample Location:	TH24-07	Date Tested:	February 29, 2024
Sample Number:	T8	Tested By:	LCampodonico

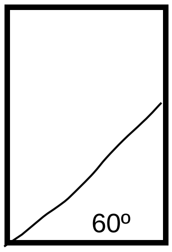
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace gravel, trace sand, high plasticity, homogeneous

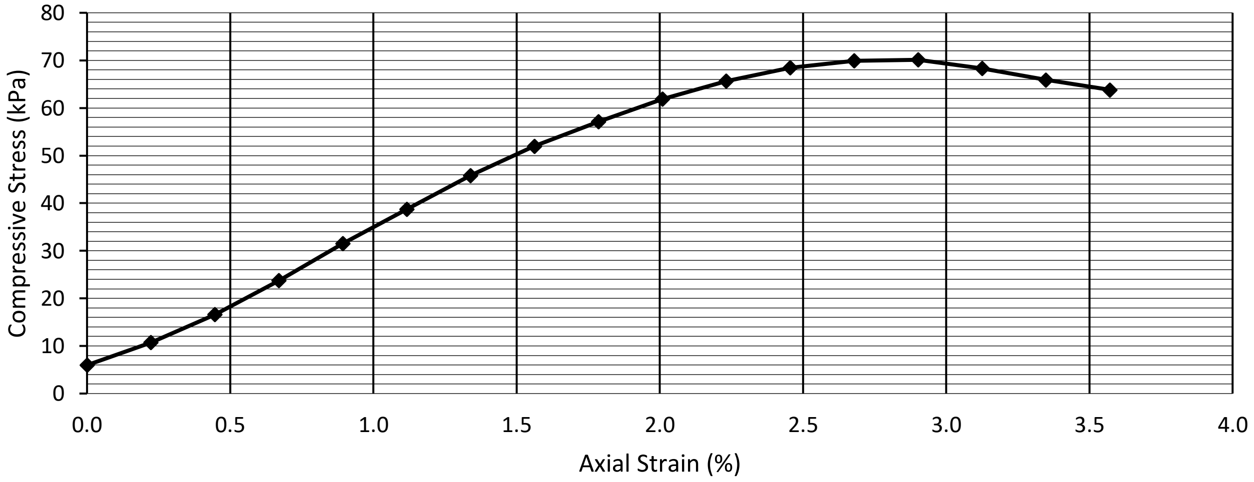
Average Diameter (cm):	7.24
Average Length (cm):	14.93
Length/Diameter Ratio:	2.06
Moisture content (%):	60.5
Bulk Density (g/cm³):	1.762
Bulk Unit Weight (kN/m³):	17.3
Bulk Unit Weight (pcf):	110.0
Dry Unit Weight (kN/m³):	10.77

FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	54.9
Pocket Pen.	Undrained Shear Strength (kPa)	35.9

UCS	Unconfined compressive strength (kPa)	70.12	Undrained Shear Strength (kPa)	35.06
	Unconfined compressive strength (ksf)	1.465	Undrained Shear Strength (ksf)	0.732
	Avg. Rate of Strain to Failure (%/min):	1.34	Strain at Failure (%):	2.90


Unconfined Compressive Strength

Comments:

Reviewed by: Lee Boughton
Laboratory Manager

Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

AECOM

AECOM Canada Ltd.
Winnipeg Geotechnical Laboratory
99 Commerce Drive, Winnipeg, MB R3P 0Y7
Phone: 204 477 5381

Project Name: Winnipeg North Transit Garage

Project Number:	60721079	Date Sampled:	February 9, 2024
Client:	City of Winnipeg	Sampled By:	CWooster
Supplier/Location:	Winnipeg, MB	Date Received:	February 9, 2024
Sample Depth (m):	7.62 - 8.23 m	Submitted By:	CWooster
Sample Location:	TH24-07	Date Tested:	February 28, 2024
Sample Number:	T9	Tested By:	LCampodonico

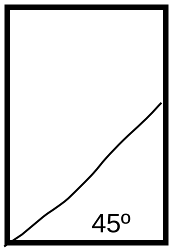
Unconfined Compressive Strength (ASTM D2166)

Standard Test Method for Unconfined Compressive Strenght of Cohesive Soil, using strain-controlled application of the axial load.

Soil Description:	CLAY - grey, firm, moist, silty, trace gravel, trace sand, high plasticity, homogeneous

Average Diameter (cm):	7.03
Average Length (cm):	15.03
Length/Diameter Ratio:	2.14
Moisture content (%):	37.9
Bulk Density (g/cm³):	1.807
Bulk Unit Weight (kN/m³):	17.7
Bulk Unit Weight (pcf):	112.8
Dry Unit Weight (kN/m³):	12.85

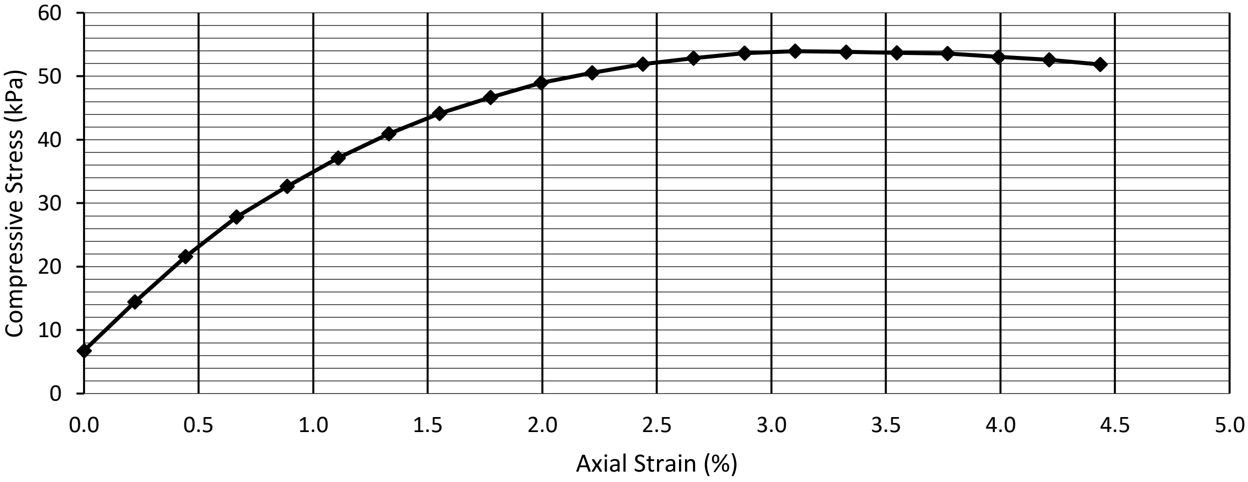
FAILURE SKETCH



Torvane	Undrained Shear Strength (kPa)	45.1
Pocket Pen.	Undrained Shear Strength (kPa)	16.0

UCS	Unconfined compressive strength (kPa)	53.95	Undrained Shear Strength (kPa)	26.97
	Unconfined compressive strength (ksf)	1.127	Undrained Shear Strength (ksf)	0.563
	Avg. Rate of Strain to Failure (%/min):	1.33	Strain at Failure (%):	3.10

Unconfined Compressive Strength



Comments:

Reviewed by: Lee Boughton
Laboratory Manager

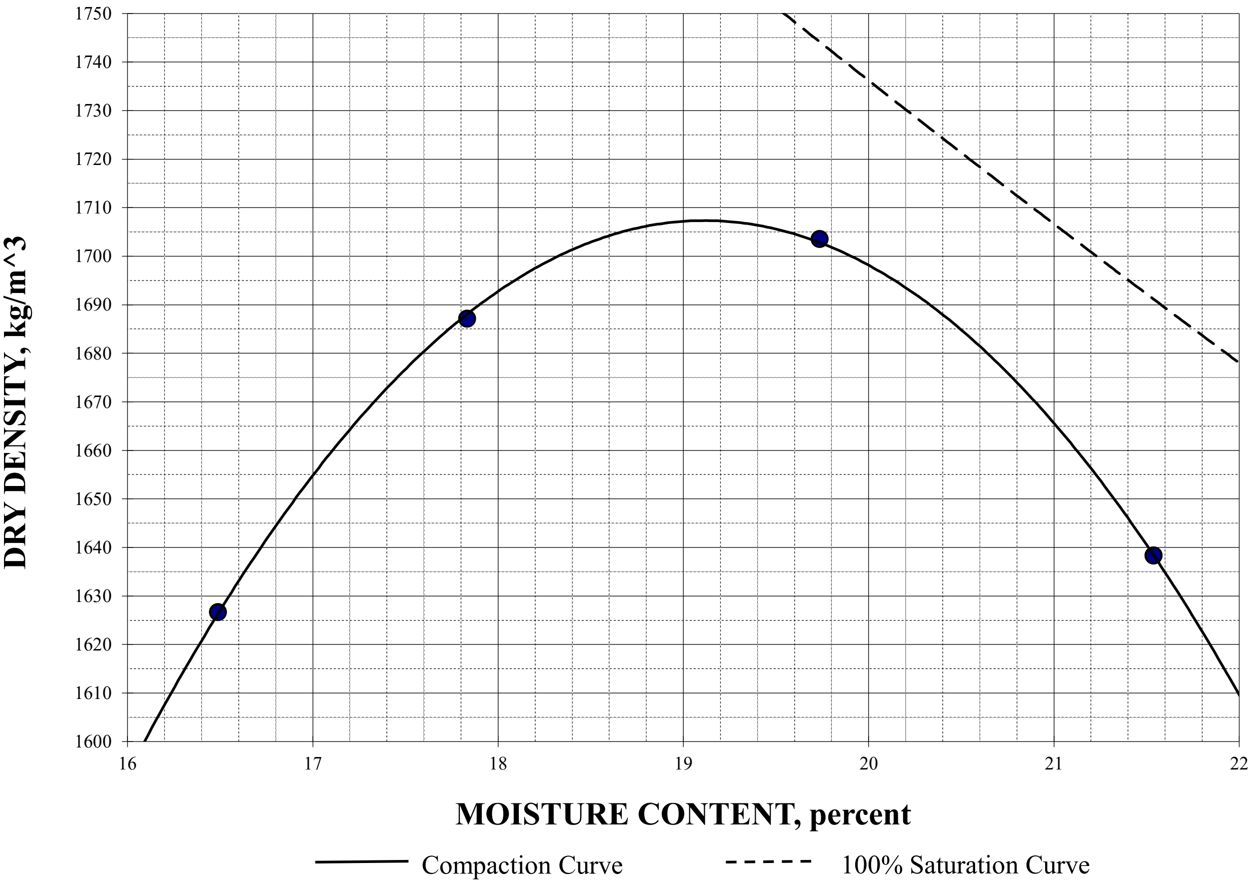
Approved by: German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

AECOM WINNIPEG GEOTECHNICAL LABORATORY
99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7
tel (204) 477-5381 **fax** (431) 800-1210

Client:	City of Winnipeg	**Job No:**	60721079
Project:	Winnipeg North Transit Garage	**Sample:**	TP24-18.21.22; B1
Description:	Black Fat Clay (CH)	**Supplier:**	AECOM
Date Tested:	24-Feb-24	**Source:**	Winnipeg, MB

ASTM D698

TRIAL NUMBER	1	2	3	4	5
Wet Unit Weight (kg/cu.m.)	1895	1988	2040	1991	
Dry Unit Weight (kg/cu.m.)	1627	1687	1704	1638	
Moisture Content (%)	16.5	17.8	19.7	21.5	



Description / Remarks:

As received moisture content (%)	N/A
Specific Gravity (Assumed)	2.66
Method Used	A
Method of Preparation	Moist
Type of Rammer	Manual

MAXIMUM DRY DENSITY**: 1707 KG/M^3**
OPTIMUM MOISTURE (%): **19.1**

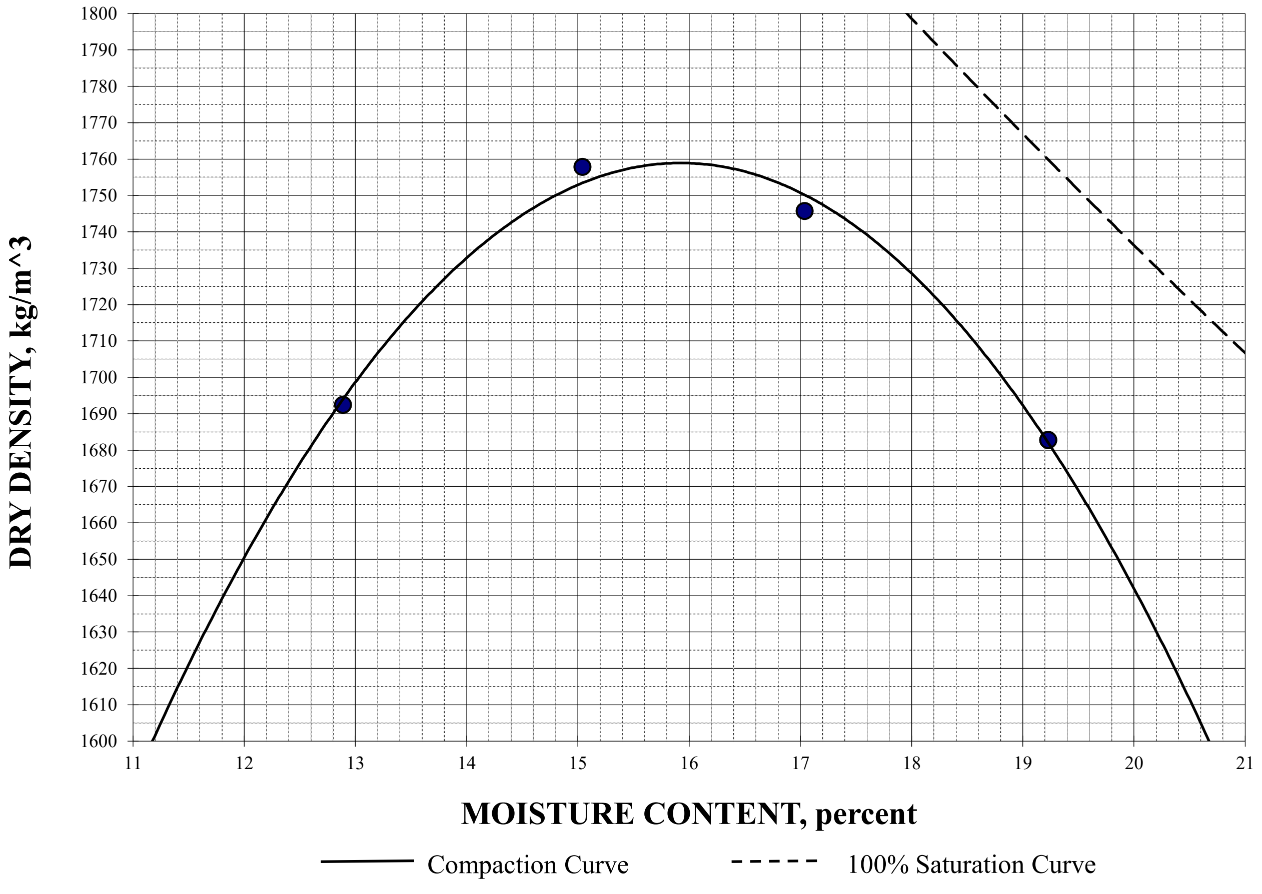
PROCTOR NO: **2401**

AECOM WINNIPEG GEOTECHNICAL LABORATORY
99 Commerce Drive, Winnipeg, Manitoba, R3P 0Y7
tel (204) 477-5381 **fax** (431) 800-1210

Client:	City of Winnipeg	**Job No:**	60721079
Project:	Winnipeg North Transit Garage	**Sample:**	TP24-19.20; B2
Description:	Black Fat Clay (CH)	**Supplier:**	AECOM
Date Tested:	29-Feb-24	**Source:**	Winnipeg, MB

ASTM D698

TRIAL NUMBER	1	2	3	4	5
Wet Unit Weight (kg/cu.m.)	1911	2022	2043	2006	
Dry Unit Weight (kg/cu.m.)	1692	1758	1746	1683	
Moisture Content (%)	12.9	15.0	17.0	19.2	



Description / Remarks:

As received moisture content (%)	N/A
Specific Gravity (Assumed)	2.66
Method Used	A
Method of Preparation	Moist
Type of Rammer	Manual

MAXIMUM DRY DENSITY**: 1759 KG/M^3**
OPTIMUM MOISTURE (%): **15.9**

PROCTOR NO: 2402

CALIFORNIA BEARING RATIO (CBR) TEST

ASTM D1883

AECOM

Client: City of Winnipeg
Project Name: Winnipeg North Transit Garage
Project Number: 60721079
Location: Winnipeg, MB

Test Hole ID: See Note
Sample ID: *TH24-18.21.22; B1*
Sample Depth (m): 0.30m to 1.50 m
Soil Description: Clay Fill (CH)
Tested By: LB
Tested Date: February 26, 2024

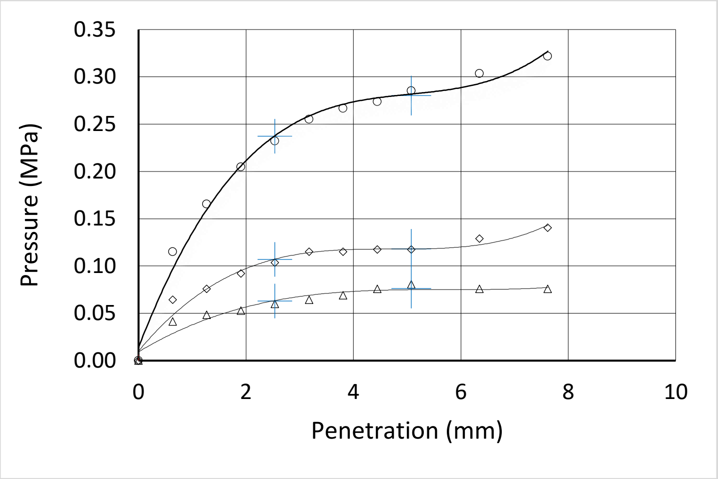
PROCTOR DATA	
Optimum Moisture Content (%)	19.1
Maximum Dry Density (kg/m3)	1707
Proctor Test Method	Standard
Tested by:	LB

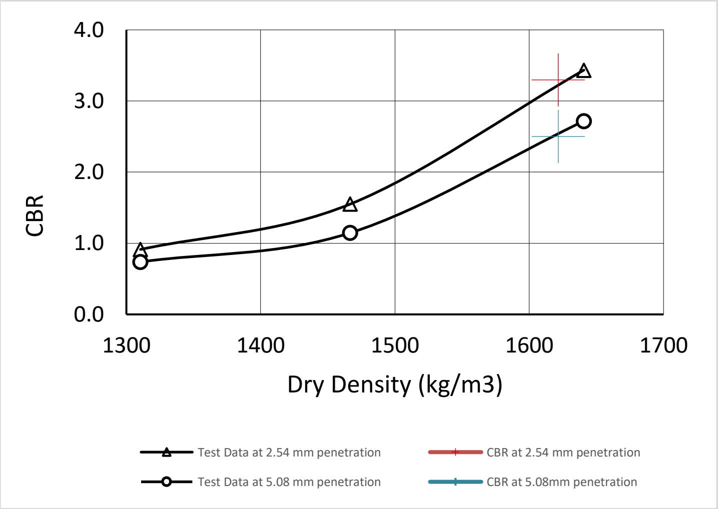
Remark:

Soaked CBR at 95% of SPMDD

CBR DATA	10 blows	25 blows	56 blows
Moisture Content, MC (%)	16.7%	16.8%	16.7%
Wet Density (kg/m3)	1529.8	1712.4	1914.8
Dry Density (kg/m3)	1310.5	1466.6	1640.7
Compaction Degree (%)	77%	86%	96%
Surcharge Weight (g)	4506	4506	4506
Soaked for (days)	4	4	4
Swell (%)	1.2%	0.9%	1.5%

PENETRATION DATA





Penetration (mm)	Pressure (MPa)		
0	0.0	0.0	0.0
0.635	0.04	0.06	0.11
1.27	0.05	0.08	0.17
1.905	0.05	0.09	0.20
2.54	**0.06**	**0.10**	**0.23**
3.175	0.06	0.11	0.26
3.81	0.07	0.11	0.27
4.445	0.08	0.12	0.27
5.08	**0.08**	**0.12**	**0.29**
6.35	0.08	0.13	0.30
7.62	0.08	0.14	0.32
10.16	0.08	0.16	0.37
12.7	0.09	0.17	0.40
Corrected Pressure (MPa)			
at 2.54 mm	0.06	0.11	0.24
at 5.08 mm	0.08	0.12	0.28
Corrected Bearing Ratio			
at 2.54 mm	0.9	1.6	3.4
at 5.08 mm	0.7	1.1	2.7

Standard pressure: 6.9 Mpa at 2.54 mm penetration

10.3 Mpa at 5.08mm penetration

CBR Value

CBR at **95 % of** **maximum dry density**
Dry density, kg/m3: **1622**
CBR at 2.54 mm: **3.3**
CBR at 5.08 mm: **2.5**

Note

PROCTOR NUMBER: 2401

Reviewed and Approved by:

German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

FORM: 606721079_CBR Lab Template_3P_CS1_TH24-18.21.22 B1.xlsx
DATE: 3/8/2024

CALIFORNIA BEARING RATIO (CBR) TEST

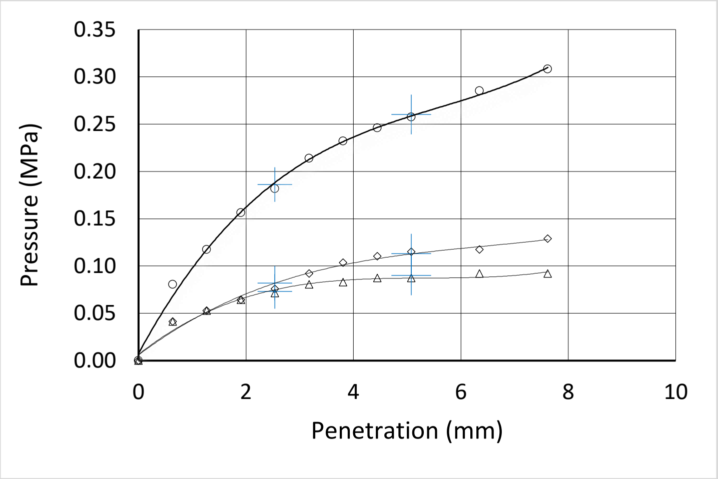
ASTM D1883

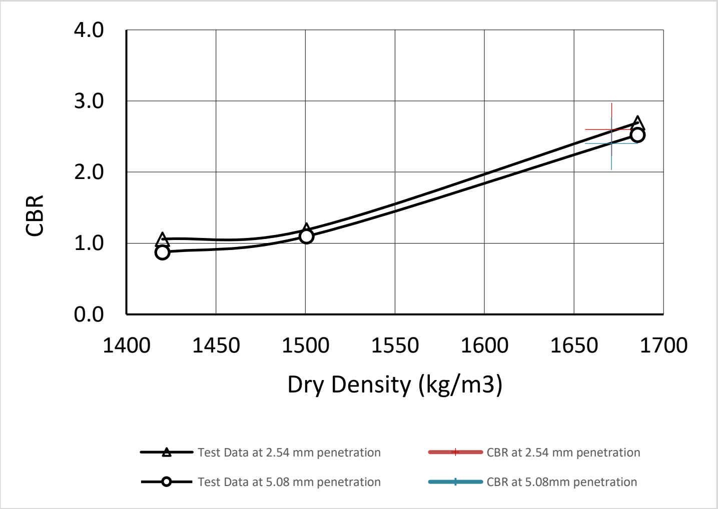
Client: City of Winnipeg
Test Hole ID: See Note
Project Name: Winnipeg North Transit Garage
Sample ID: *TH24-19.20; B2*
Sample Depth (m): 0.30m to 1.50 m
Project Number: 60721079
Soil Description: Clay Fill (CH)
Location: Winnipeg, MB
Tested By: LB
Tested Date: March 1, 2024

PROCTOR DATA	
Optimum Moisture Content (%)	15.9
Maximum Dry Density (kg/m3)	1759
Proctor Test Method	Standard
Tested by:	LB
Remark:	
Soaked CBR at 95% of SPMDD	

CBR DATA	10 blows	25 blows	56 blows
Moisture Content, MC (%)	12.6%	12.7%	12.7%
Wet Density (kg/m3)	1599.4	1691.8	1899.4
Dry Density (kg/m3)	1420.2	1500.6	1685.7
Compaction Degree (%)	81%	85%	96%
Surcharge Weight (g)	4506	4506	4506
Soaked for (days)	4	4	4
Swell (%)	3.2%	2.4%	1.8%

PENETRATION DATA





Penetration (mm)	Pressure (MPa)		
0	0.0	0.0	0.0
0.635	0.04	0.04	0.08
1.27	0.05	0.05	0.12
1.905	0.06	0.06	0.16
2.54	**0.07**	**0.08**	**0.18**
3.175	0.08	0.09	0.21
3.81	0.08	0.10	0.23
4.445	0.09	0.11	0.25
5.08	**0.09**	**0.11**	**0.26**
6.35	0.09	0.12	0.29
7.62	0.09	0.13	0.31
10.16	0.09	0.16	0.34
12.7	0.10	0.17	0.38
Corrected Pressure (MPa)			
at 2.54 mm	0.07	0.08	0.19
at 5.08 mm	0.09	0.11	0.26
Corrected Bearing Ratio			
at 2.54 mm	1.1	1.2	2.7
at 5.08 mm	0.9	1.1	2.5

Standard pressure: 6.9 Mpa at 2.54 mm penetration

10.3 Mpa at 5.08mm penetration

CBR Value

CBR at	**95 % of**	**maximum dry density**
Dry density, kg/m3:		**1671**
CBR at 2.54 mm:		**2.6**
CBR at 5.08 mm:		**2.4**

Note

PROCTOR NUMBER: 2402

Reviewed and Approved by:

German Leal, M.Eng., P.Eng.
Geotechnical Discipline Lead

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TESTING LABORATORY

Geo-Lab Report

Revision # 0

Report Date:	*March 8, 2024*
Client:	*AECOM Canada*
Address:	*99 Commerce Dr., Winnipeg, MB R3P 0Y7*
Attn:	*Colton Wooster / Linh Trinh / German Leal*
Project No:	*60721079*
Project Name:	*Winnipeg Transit North Garage Project*
Solum Job No.:	*06901240222(54)*

Sample Received Date: February 22, 2024

Sample Quantity: 6 ST

Test	Quantity	Destination
WATER CONTENT	5	D2216
ATTERBERG LIMITS	6	D4318
PARTICLE-SIZE ANALYSIS (FULL GRADATION)	6	D6913 & D7928
UNCONFINED COMPRESSIVE STRENGTH FOR SOIL	1	D2166
1-D SWELL (Method C)	3	D4546
1-D CONSOLIDATION	3	D2435

President: Saad Farag

SOLUM CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL
TESTING LABORATORY

Laboratory Analysis Summary Sheet

Project Info: *60721079 / Winnipeg Transit North Garage Project*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

Reviewed *S. F.*

* Note: Soil classification is for material less than 0.425 mm (material used for Atterberg Limits), this includes the fine sand, silt and clay fraction of the sample.

** Note: Soil classification is for the whole sample. Soil classification uses the Atterberg Limits results and the percent fines, percent sand and percent gravel as described in ASTM D2487.

Borehole ID	**Sample ID**	**Depth (ft)**	**MC as Received (%)**	**Atterberg Limits**				**Particle Size Analysis**					**Soil Classification** Group Symbols**
				Liquid Limit(%)	Plastic Limit(%)	Plastic Index(%)	Classification* (USCS)	Cobble Size (%) (75-300mm)	Gravel Size (%) (4.75-75mm)	Sand Size (%) (0.075-4.5mm)	Silt Size (%) (0.002-0.075 mm)	Clay Size (%) (<0.002mm)	
TH24-04	T7	10	54.8	92	34	58	CH	0.0	0.0	0.7	18.3	81.0	CH
TH24-05	T4	5	43.0	73	30	43	CH	0.0	0.0	1.6	19.5	78.9	CH
TH24-05	T5	7.5	50.3	81	32	49	CH	0.0	0.0	0.6	25.9	73.5	CH
TH24-08	T12	30	43.6	65	24	41	CH	0.0	0.0	6.7	29.8	63.5	CH
TH24-11	T10	20	51.3	81	31	50	CH	0.0	0.0	0.7	26.6	72.7	CH
TH24-14	T4	5	18.9	41	21	20	CL	0.0	8.7	29.7	31.1	30.5	CL

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Atterberg Limits (ASTM D4318 - Method A)

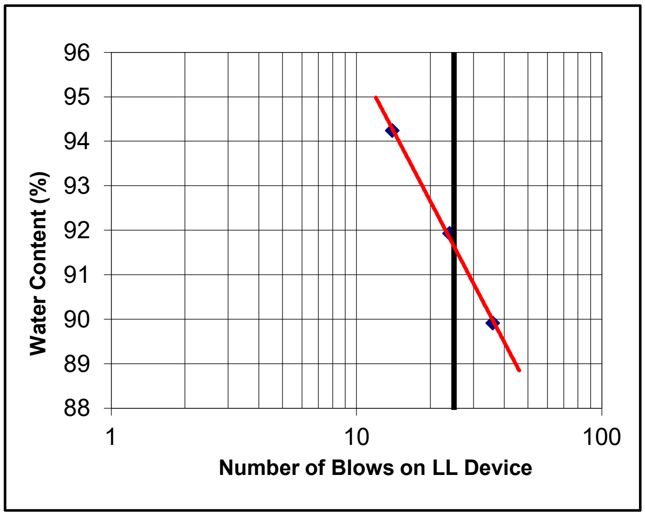
Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		
Sample Info:	***TH24-04 T7 10'***		

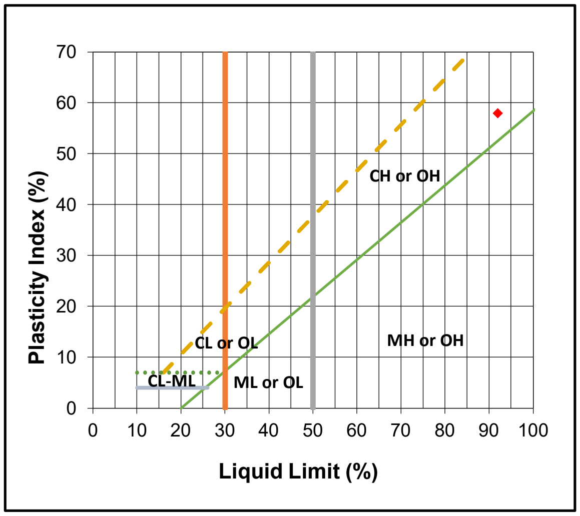
Atterberg Limits - ASTM D4318 (Method A)

	Liquid Limit (Air-Dried) - Multipoint Method			Water Content Received	
Container ID	1	2	3		
Number of Blows	14	24	36		
$W_{\text{Wet Soil}}$ + Tare (g)	22.45	25.77	25.03		
$W_{\text{Dry Soil}}$ + Tare (g)	14.27	16.09	15.85		
W_{Water} (g)	8.18	9.68	9.18		
Tare (g)	5.59	5.56	5.64		
$W_{\text{Dry Soil}}$ (g)	8.68	10.53	10.21	Water Content (%)	54.8
Water Content (%)	94.2	91.9	89.9		

	Plastic Limit	
Container ID	4	5
$W_{\text{Wet Soil}}$ + Tare (g)	14.74	16.69
$W_{\text{Dry Soil}}$ + Tare (g)	12.45	13.91
W_{Water} (g)	2.29	2.78
Tare (g)	5.64	5.56
$W_{\text{Dry Soil}}$ (g)	6.81	8.35
Water Content (%)	33.6	33.3
Average Mc (%)	33.5	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
92	**34**	**58**	**CH**





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TESTING LABORATORY

Atterberg Limits (ASTM D4318 - Method A)

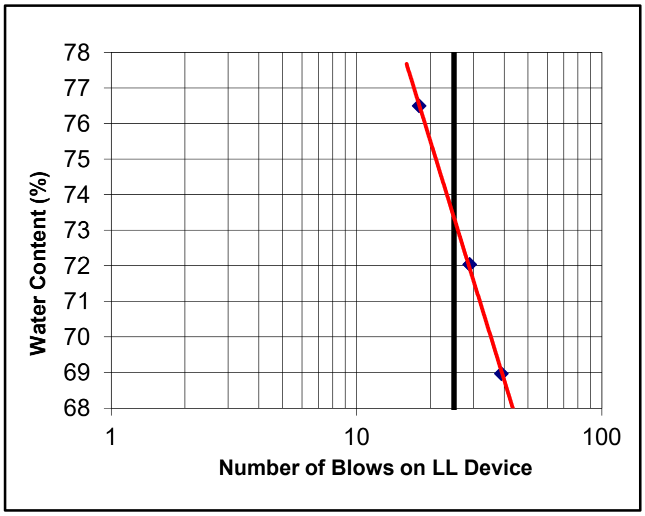
Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		
Sample Info:	***TH24-05 T4 5'***		

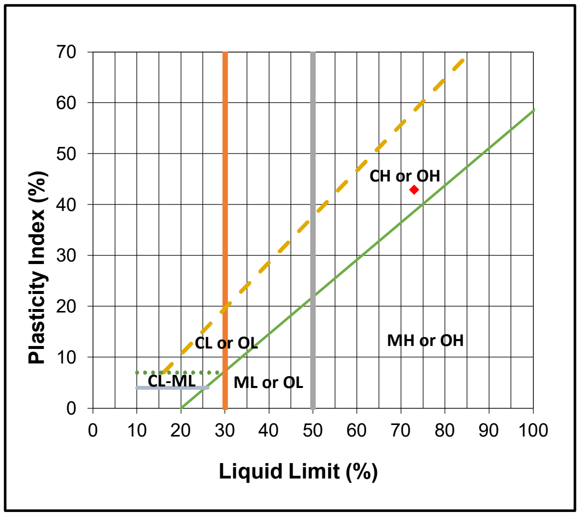
Atterberg Limits - ASTM D4318 (Method A)

	Liquid Limit (Air-Dried) - Multipoint Method			Water Content Received	
Container ID	1	2	3		
Number of Blows	18	29	39		
$W_{Wet\ Soil}$ + Tare (g)	30.75	19.71	23.81		
$W_{Dry\ Soil}$ + Tare (g)	19.85	13.81	16.41		
W_{Water} (g)	10.90	5.90	7.40		
Tare (g)	5.60	5.62	5.68		
$W_{Dry\ Soil}$ (g)	14.25	8.19	10.73	**Water Content (%)**	43.0
Water Content (%)	76.5	72.0	69.0		

	Plastic Limit	
Container ID	4	5
$W_{Wet\ Soil}$ + Tare (g)	13.23	19.10
$W_{Dry\ Soil}$ + Tare (g)	11.48	16.00
W_{Water} (g)	1.75	3.10
Tare (g)	5.68	5.62
$W_{Dry\ Soil}$ (g)	5.80	10.38
Water Content (%)	30.2	29.9
Average Mc (%)	30.0	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
73	**30**	**43**	**CH**





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GEOTECHNICAL & MATERIAL TESTING LABORATORY

Atterberg Limits (ASTM D4318 - Method A)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by:* *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-05 T5 7.5'***

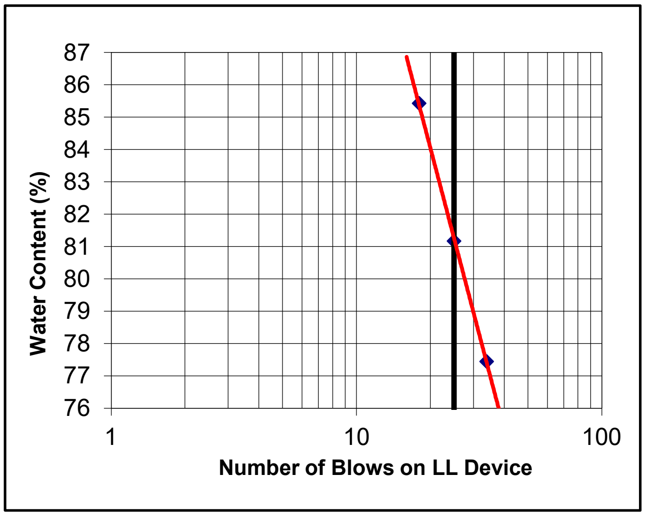
Atterberg Limits - ASTM D4318 (Method A)

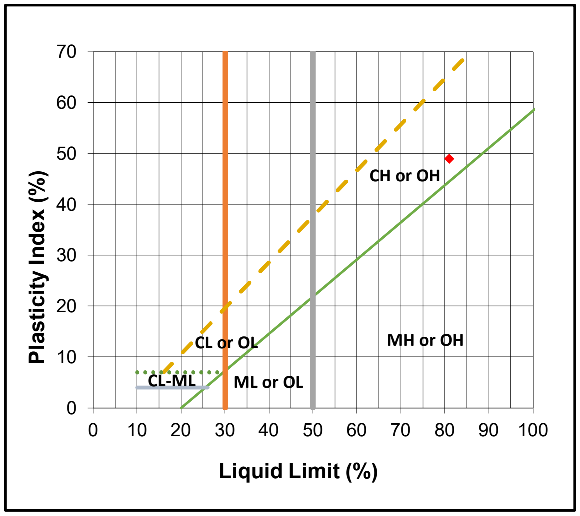
	Liquid Limit (Air-Dried) - Multipoint Method		
Container ID	1	2	3
Number of Blows	18	25	34
$W_{Wet\ Soil}$ + Tare (g)	18.57	19.64	19.76
$W_{Dry\ Soil}$ + Tare (g)	12.65	13.35	13.58
W_{Water} (g)	5.92	6.29	6.18
Tare (g)	5.72	5.60	5.60
$W_{Dry\ Soil}$ (g)	6.93	7.75	7.98
Water Content (%)	85.4	81.2	77.4

Water Content Received	
Water Content (%)	50.3

	Plastic Limit	
Container ID	4	5
$W_{Wet\ Soil}$ + Tare (g)	12.34	14.76
$W_{Dry\ Soil}$ + Tare (g)	10.71	12.52
W_{Water} (g)	1.63	2.24
Tare (g)	5.60	5.60
$W_{Dry\ Soil}$ (g)	5.11	6.92
Water Content (%)	31.9	32.4
Average Mc (%)	32.1	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
81	**32**	**49**	**CH**





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GEOTECHNICAL & MATERIAL
TESTING LABORATORY

Atterberg Limits
(ASTM D4318 - Method A)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by:* *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

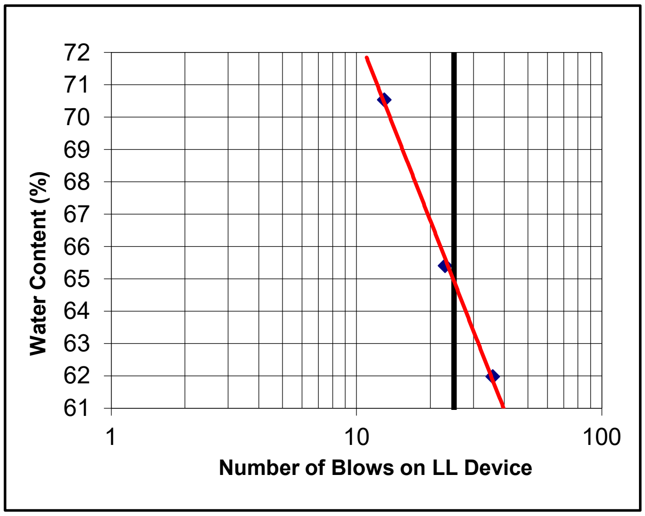
Sample Info: ***TH24-08*** ***T12*** ***30'***

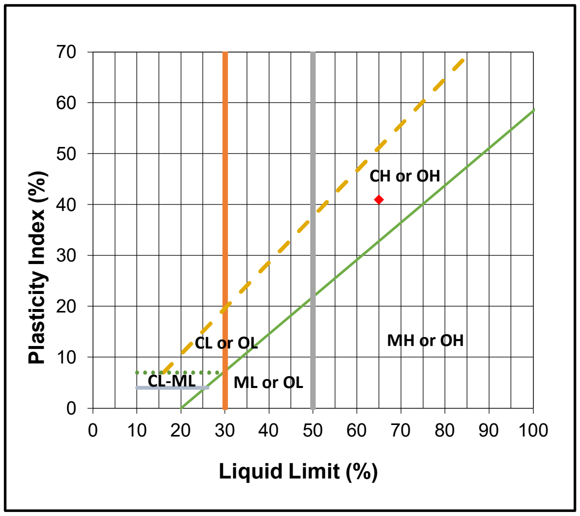
Atterberg Limits - ASTM D4318 (Method A)

	Liquid Limit (Air-Dried) - Multipoint Method			**Water Content Received**	
Container ID	1	2	3		
Number of Blows	13	23	36		
$W_{Wet\ Soil}$ + Tare (g)	21.19	20.40	17.89		
$W_{Dry\ Soil}$ + Tare (g)	14.75	14.54	13.18		
W_{Water} (g)	6.44	5.86	4.71		
Tare (g)	5.62	5.58	5.58		
$W_{Dry\ Soil}$ (g)	9.13	8.96	7.60	**Water Content (%)**	43.6
Water Content (%)	70.5	65.4	62.0		

	Plastic Limit	
Container ID	4	5
$W_{Wet\ Soil}$ + Tare (g)	12.90	14.95
$W_{Dry\ Soil}$ + Tare (g)	11.48	13.14
W_{Water} (g)	1.42	1.81
Tare (g)	5.58	5.58
$W_{Dry\ Soil}$ (g)	5.90	7.56
Water Content (%)	24.1	23.9
Average Mc (%)	24.0	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
65	**24**	**41**	**CH**





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Atterberg Limits
(ASTM D4318 - Method A)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by:* *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

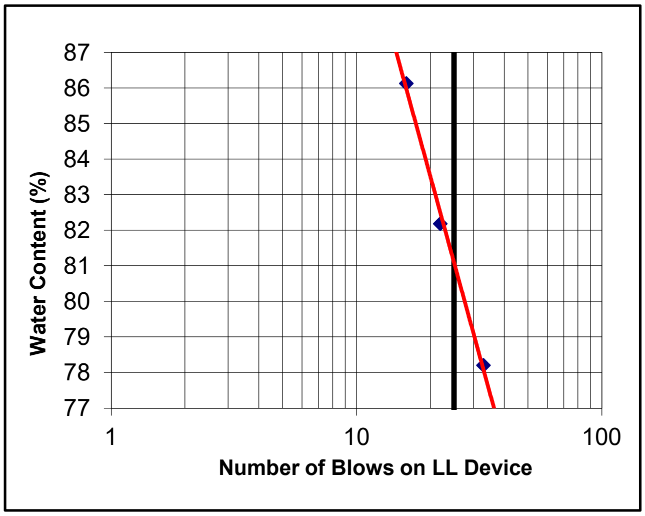
Sample Info: ***TH24-11*** ***T10*** ***20'***

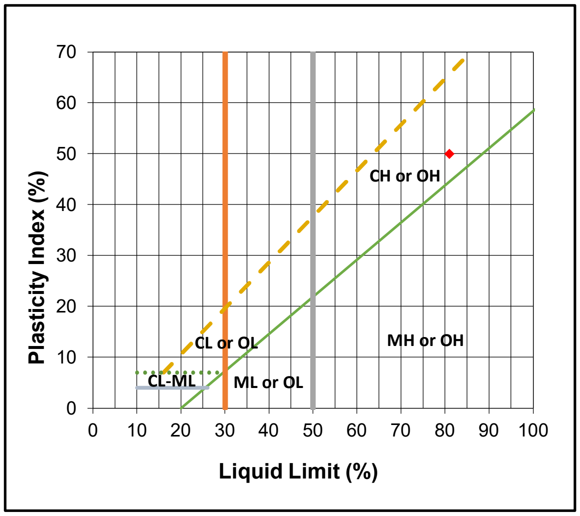
Atterberg Limits - ASTM D4318 (Method A)

	Liquid Limit (Air-Dried) - Multipoint Method			**Water Content Received**	
Container ID	1	2	3		
Number of Blows	16	22	33		
$W_{Wet\ Soil}$ + Tare (g)	26.15	26.41	28.54		
$W_{Dry\ Soil}$ + Tare (g)	16.65	17.00	18.46		
W_{Water} (g)	9.50	9.41	10.08		
Tare (g)	5.62	5.55	5.57		
$W_{Dry\ Soil}$ (g)	11.03	11.45	12.89	**Water Content (%)**	51.3
Water Content (%)	86.1	82.2	78.2		

	Plastic Limit	
Container ID	4	5
$W_{Wet\ Soil}$ + Tare (g)	12.80	15.60
$W_{Dry\ Soil}$ + Tare (g)	11.11	13.23
W_{Water} (g)	1.69	2.37
Tare (g)	5.57	5.55
$W_{Dry\ Soil}$ (g)	5.54	7.68
Water Content (%)	30.5	30.9
Average Mc (%)	30.7	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
81	**31**	**50**	**CH**





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TESTING LABORATORY

Atterberg Limits
(ASTM D4318 - Method A)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by:* *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

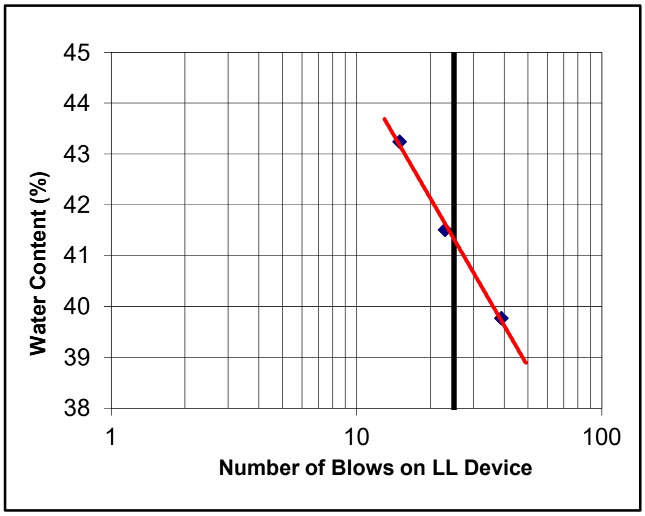
Sample Info: ***TH24-14 T4 5'***

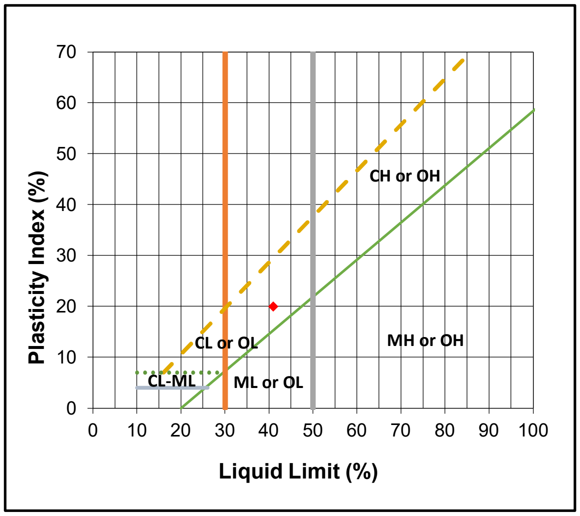
Atterberg Limits - ASTM D4318 (Method A)

	Liquid Limit (Air-Dried) - Multipoint Method			Water Content Received	
Container ID	1	2	3		
Number of Blows	15	23	39		
$W_{Wet\ Soil}$ + Tare (g)	32.91	35.01	21.47		
$W_{Dry\ Soil}$ + Tare (g)	24.66	26.38	16.96		
W_{Water} (g)	8.25	8.63	4.51		
Tare (g)	5.58	5.59	5.62		
$W_{Dry\ Soil}$ (g)	19.08	20.79	11.34	**Water Content (%)**	18.9
Water Content (%)	43.2	41.5	39.8		

	Plastic Limit	
Container ID	4	5
$W_{Wet\ Soil}$ + Tare (g)	15.25	16.05
$W_{Dry\ Soil}$ + Tare (g)	13.55	14.23
W_{Water} (g)	1.70	1.82
Tare (g)	5.62	5.59
$W_{Dry\ Soil}$ (g)	7.93	8.64
Water Content (%)	21.4	21.1
Average Mc (%)	21.3	

Results			
Liquid Limit (Air Dried)(%)	Plastic Limit (%)	Plastic Index (%)	USCS
41	**21**	**20**	**CL**





Particle Size Analysis
(ASTM D6913 & D7928)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by* *S. F.*

Client: *AECOM Canada*

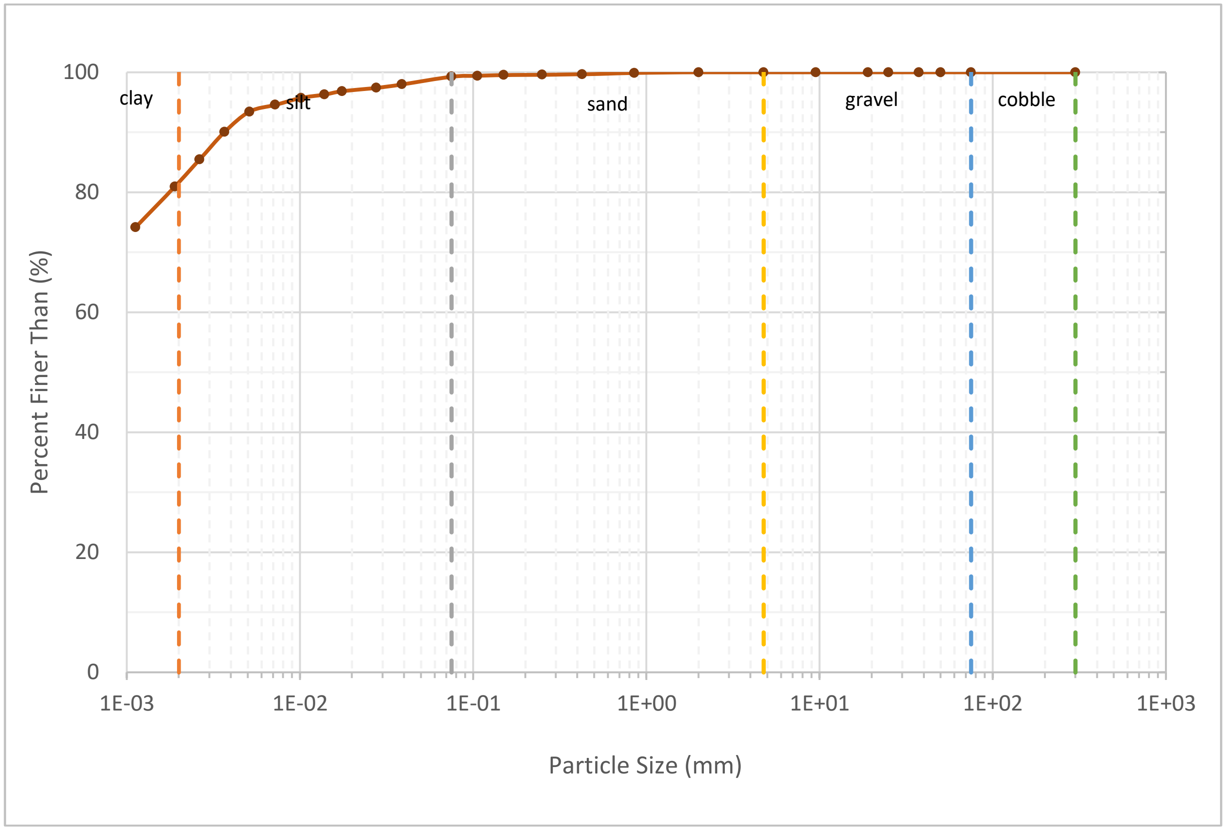
Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-04*** ***T7*** ***10'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	100.00
	4.750	100.00
SAND	2.000	100.00
	0.850	99.89
	0.425	99.66
	0.250	99.59
	0.150	99.55
	0.106	99.41
	0.075	99.27
HYDROMETER	0.0388	97.98
	0.0275	97.41
	0.0175	96.85
	0.0138	96.28
	0.0101	95.71
	0.0072	94.58
	0.0051	93.44
	0.0037	90.04
	0.0026	85.50
	0.0019	80.96
	0.0011	74.15

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**0.0**	**0.7**	**18.3**	**81.0**



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TESTING LABORATORY

Particle Size Analysis
(ASTM D6913 & D7928)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by* *S. F.*

Client: *AECOM Canada*

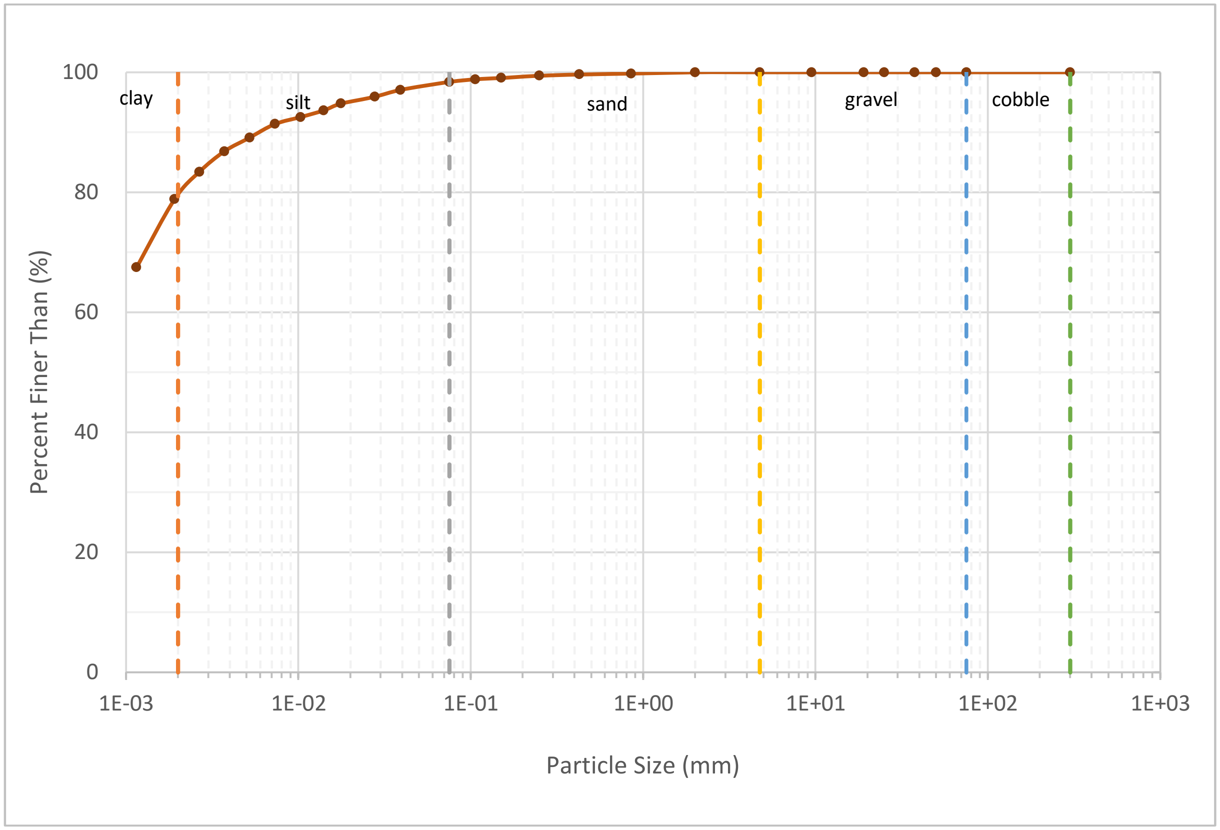
Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-05*** ***T4*** ***5'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	100.00
	4.750	100.00
SAND	2.000	100.00
	0.850	99.77
	0.425	99.64
	0.250	99.43
	0.150	99.07
	0.106	98.82
	0.075	98.39
HYDROMETER	0.0390	97.07
	0.0277	95.93
	0.0176	94.79
	0.0140	93.65
	0.0103	92.52
	0.0073	91.38
	0.0052	89.11
	0.0037	86.83
	0.0027	83.42
	0.0019	78.87
	0.0011	67.50

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**0.0**	**1.6**	**19.5**	**78.9**



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Particle Size Analysis
(ASTM D6913 & D7928)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by* *S. F.*

Client: *AECOM Canada*

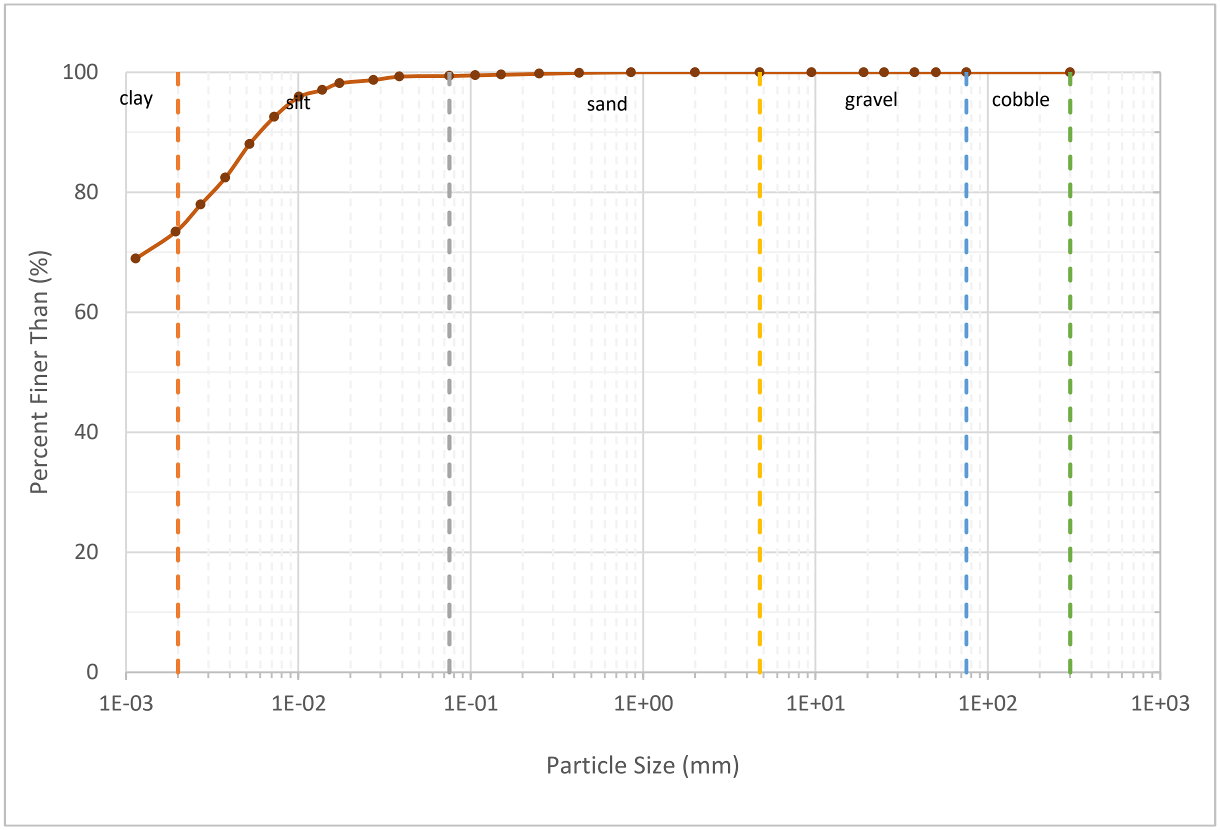
Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-05*** ***T5*** ***7.5'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	100.00
	4.750	100.00
SAND	2.000	100.00
	0.850	99.98
	0.425	99.89
	0.250	99.75
	0.150	99.60
	0.106	99.48
	0.075	99.37
HYDROMETER	0.0385	99.28
	0.0273	98.72
	0.0173	98.16
	0.0137	97.03
	0.0101	95.91
	0.0072	92.54
	0.0052	88.04
	0.0038	82.43
	0.0027	77.93
	0.0019	73.44
	0.0011	68.94

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**0.0**	**0.6**	**25.9**	**73.5**



Particle Size Analysis
(ASTM D6913 & D7928)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by* *S. F.*

Client: *AECOM Canada*

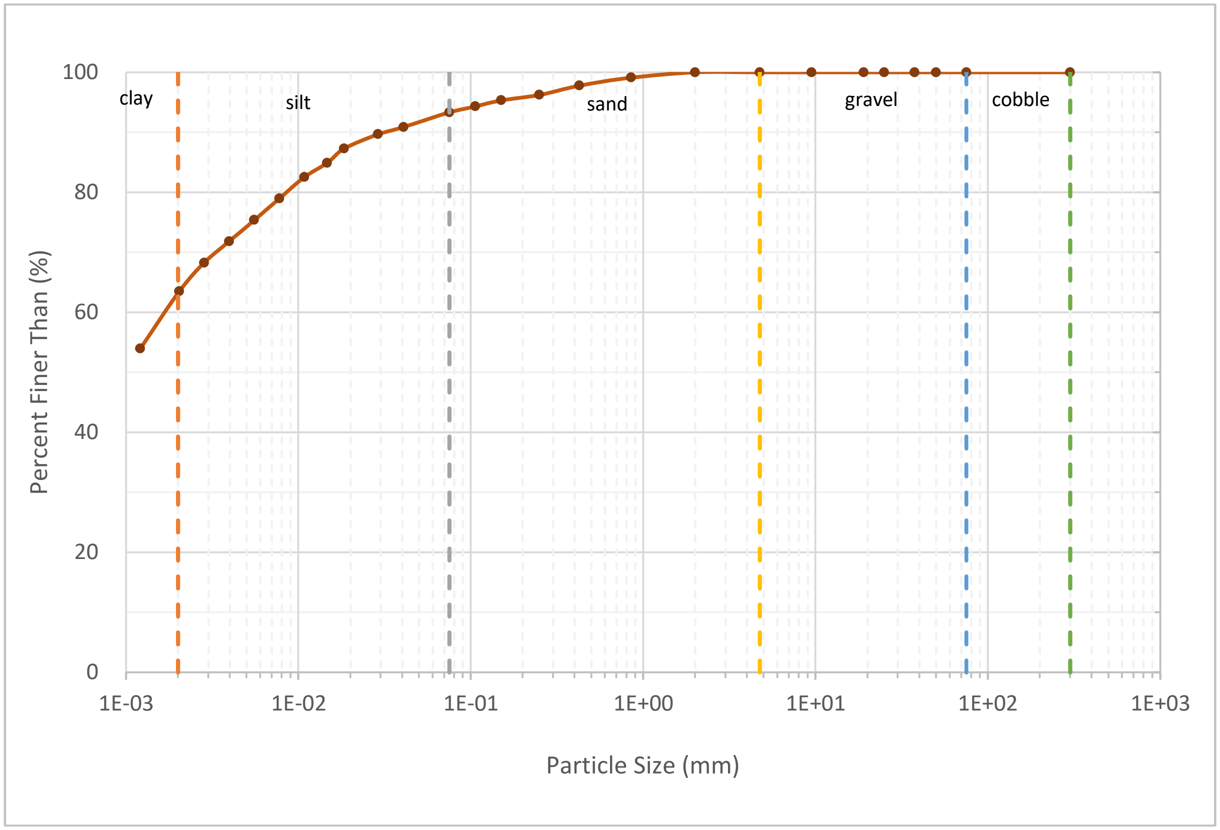
Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-08*** ***T12*** ***30'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	100.00
	4.750	100.00
SAND	2.000	100.00
	0.850	99.12
	0.425	97.79
	0.250	96.24
	0.150	95.34
	0.106	94.31
	0.075	93.31
HYDROMETER	0.0407	90.86
	0.0289	89.67
	0.0184	87.29
	0.0147	84.91
	0.0108	82.53
	0.0077	78.96
	0.0055	75.39
	0.0040	71.82
	0.0028	68.25
	0.0020	63.49
	0.0012	53.97

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**0.0**	**6.7**	**29.8**	**63.5**



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TESTING LABORATORY

Particle Size Analysis
(ASTM D6913 & D7928)

Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by* *S. F.*

Client: *AECOM Canada*

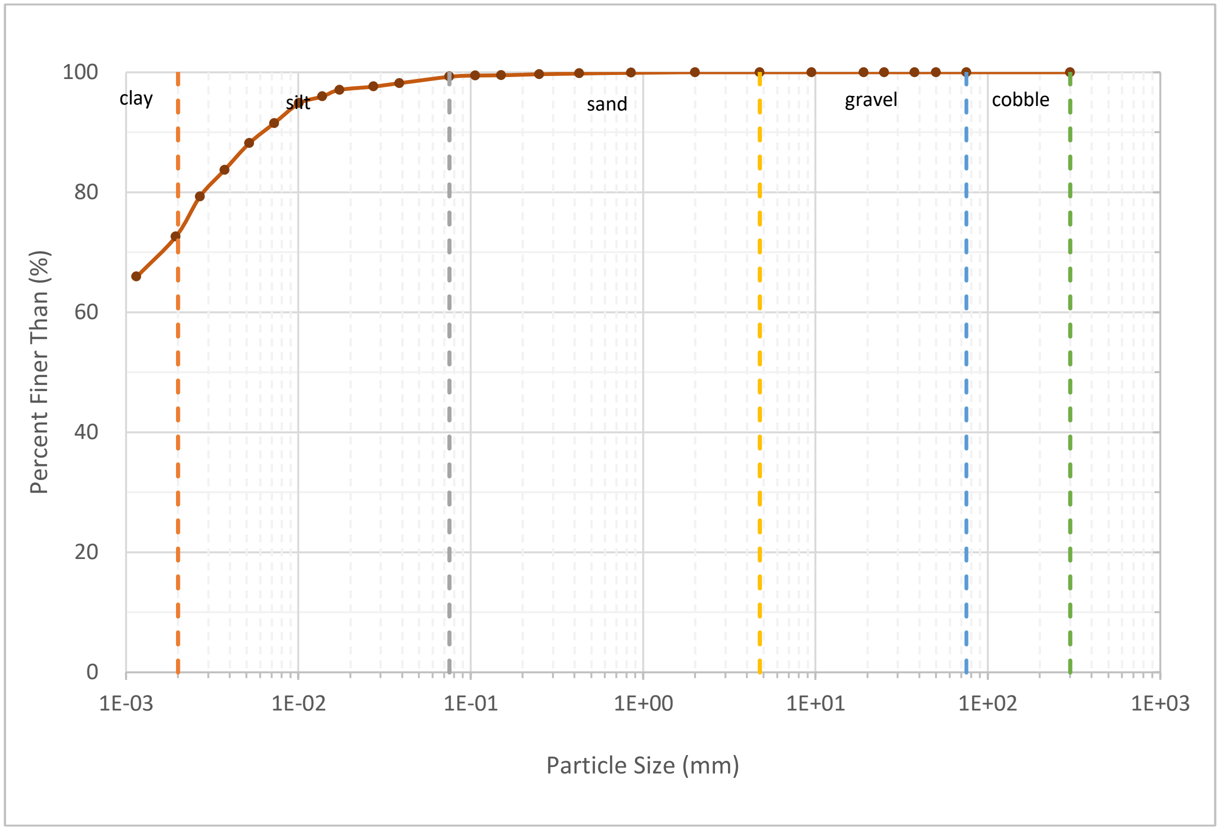
Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-11*** ***T10*** ***20'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	100.00
	4.750	100.00
SAND	2.000	100.00
	0.850	99.91
	0.425	99.80
	0.250	99.67
	0.150	99.51
	0.106	99.44
	0.075	99.27
HYDROMETER	0.0385	98.18
	0.0273	97.62
	0.0173	97.07
	0.0137	95.96
	0.0101	94.84
	0.0072	91.51
	0.0052	88.18
	0.0037	83.73
	0.0027	79.29
	0.0019	72.62
	0.0011	65.96

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**0.0**	**0.7**	**26.6**	**72.7**



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Particle Size Analysis
(ASTM D6913 & D7928)

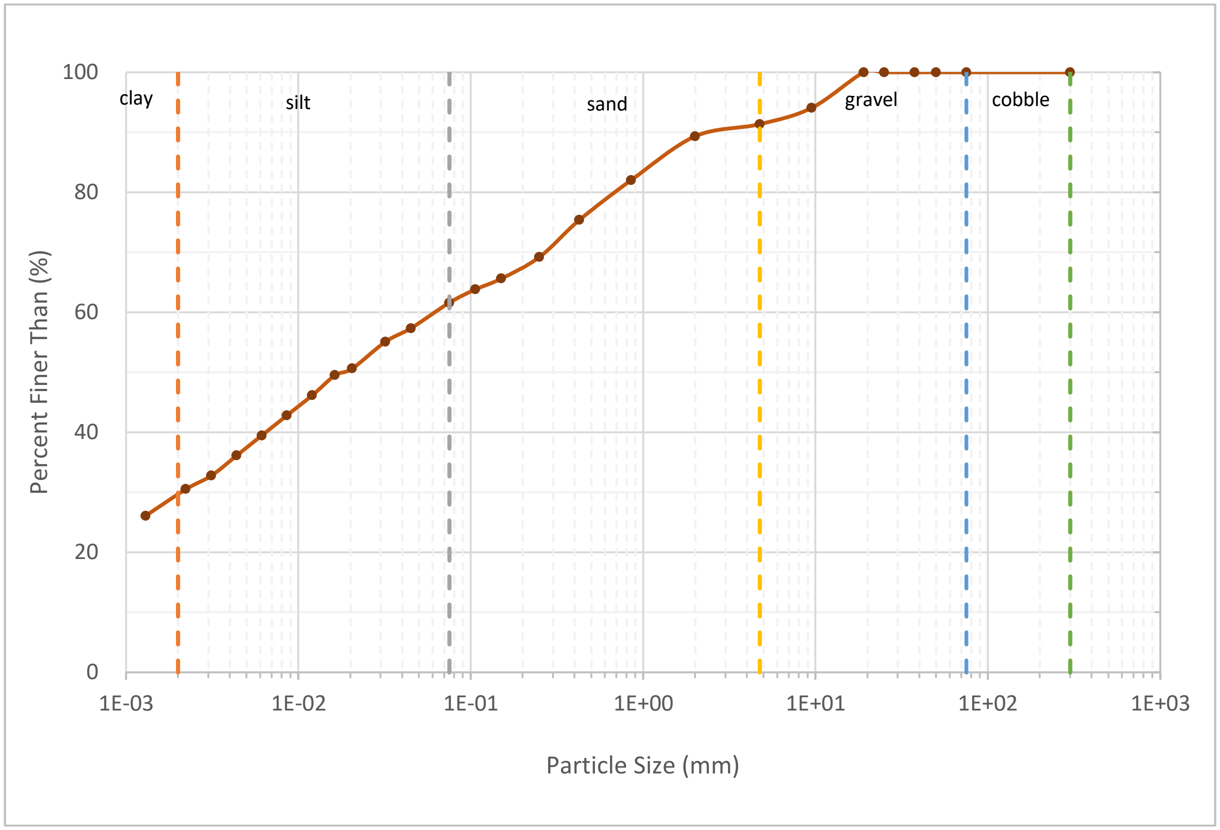
Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		

Sample Info: ***TH24-14*** ***T4*** ***5'***

	PARTICLE-SIZE (mm)	PERCENT FINER (%)
GRAVEL	300.000	100.00
	75.000	100.00
	50.000	100.00
	37.500	100.00
	25.000	100.00
	19.000	100.00
	9.500	94.08
	4.750	91.35
SAND	2.000	89.31
	0.850	82.01
	0.425	75.38
	0.250	69.22
	0.150	65.62
	0.106	63.82
	0.075	61.60
HYDROMETER	0.0449	57.34
	0.0320	55.11
	0.0205	50.64
	0.0163	49.52
	0.0120	46.18
	0.0086	42.83
	0.0061	39.48
	0.0044	36.13
	0.0031	32.78
	0.0022	30.55
	0.0013	26.08

Test Results

Cobbles (%) *(75-300mm)*	Gravel (%) *(4.75-75mm)*	Sand (%) *(0.075-4.75mm)*	Silt (%) *0.002-0.075mm*	Clay (%) *<0.002mm*
0.0	**8.7**	**29.7**	**31.1**	**30.5**



SOLUM™ CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL TESTING LABORATORY

Unconfined Compression Test (ASTM D2166)

Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		
Sample Info:	***TH24-08 T12 30'***		

Diameter (cm)	*7.24*	*Height (cm)*	*16.05*	*H/D Ratio*	*2.22*	*Mass (g)*	*1167.0*	*Shear Rate (mm/min)*	*1.5*
Sample Area (cm^2)	*41.16*	*Assumed Gs*	*2.69*	*Initial Void Ratio*	*1.19*	*Initial Sat. Degree (%)*	*98.8*		
MC as Received (%)	*43.6*	*Wet BD (kg/m^3)*	*1766*	*Dry BD (kg/m^3)*	*1230*	*Remarks*	*N/A*		

Vert. Displ. (cm)	*Load Cell (kN)*	*ε1*	*Corrected Area (cm^2)*	*σ1 (kPa)*	*σ1/2 (kPa)*
0.00	0.03	0.00	41.16	0.00	0.00
0.08	0.08	0.50	41.36	13.32	6.66
0.16	0.11	1.01	41.58	20.40	10.20
0.32	0.15	2.01	42.00	30.12	15.06
0.48	0.18	3.01	42.44	36.58	18.29
0.64	0.20	4.01	42.88	39.80	19.90
0.80	0.21	5.01	43.33	41.45	20.73
0.97	0.21	6.02	43.79	42.04	21.02
1.29	0.21	8.01	44.74	42.09	21.04
1.61	0.21	10.02	45.74	39.31	19.65
1.93	0.20	12.01	46.78	36.35	18.18
2.18	0.19	13.60	47.64	33.81	16.90

Test Results

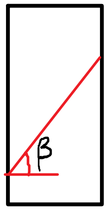
UCS q_u (kPa) **42.09**

Shear Strength s_u (kPa) **21.04**

Axial Fal. Strain (%) **8.01**

Failure Mode **Shear**

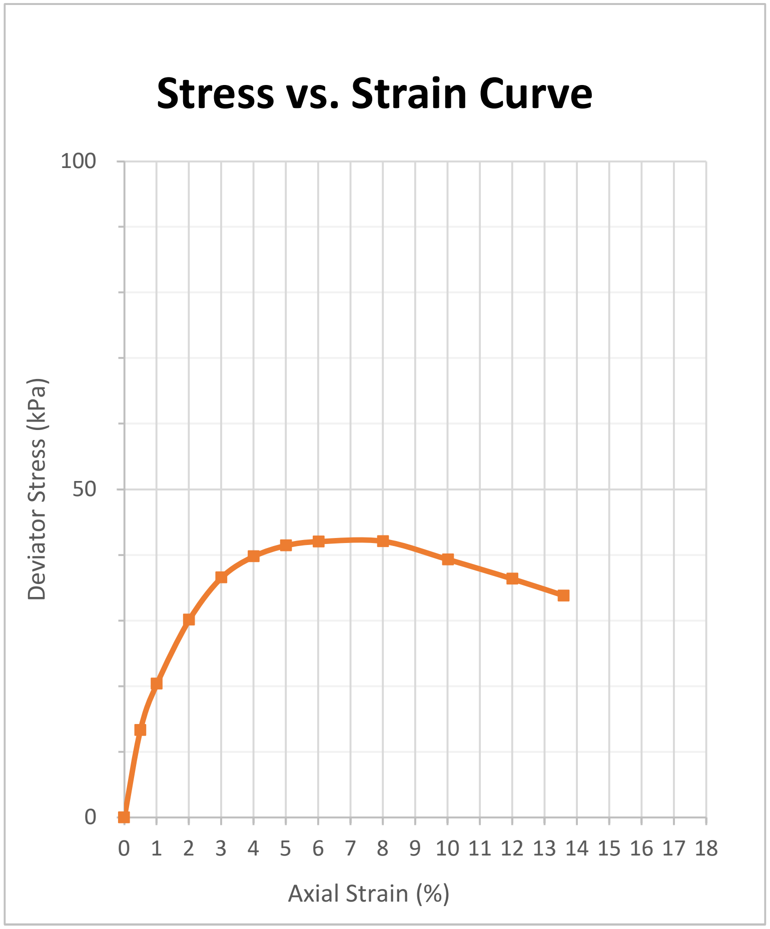
$\beta = 45^0 + \frac{\varphi}{2}$ **~ 60°**

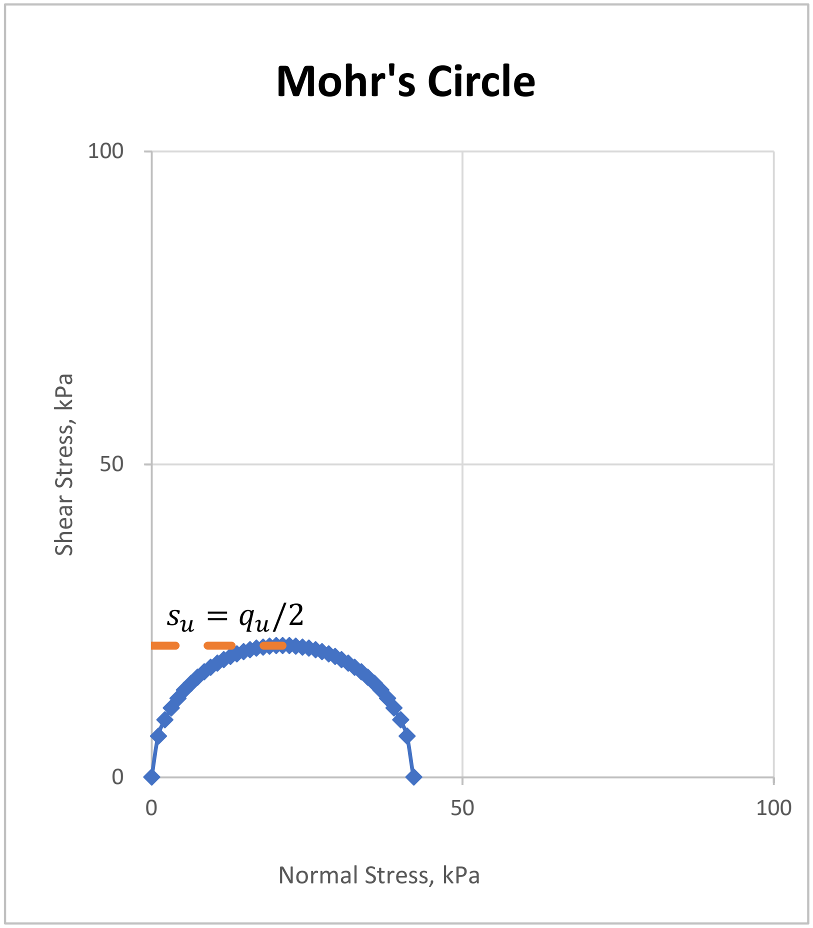


SOLUM CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL TESTING LABORATORY

Unconfined Compression Test (ASTM D2166)

Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		
Sample Info:	***TH24-08 T12 30'***		





Swell Test (Method C) (ASTM D4546)

Project Info: *60721079 / Winnipeg Transit North Garage Project*

Reviewed by: *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-05*** ***T4*** ***5'***

Specific Gravity Gs (Est) 2.70

Water for Inundate Specimens Distilled

in-situ Overburden Pressure (kPa) 37.5 *(estimated based on sample's depth)*

	Before Test		**After Test**
Height (cm)	2.00		
Diameter (cm)	6.18		
Area (cm^2)	30.00		
Volume (cm^3)	60.00		
Wt. (ring + wet soil)	148.65	Wt. (ring + wet soil)	148.12
Wt. (ring + dry soil)	116.88	Wt. (ring + dry soil)	116.88
Wt. of ring	43.00	Wt. of ring	43.00
Wt. of wet soil	105.65	Wt. of wet soil	105.12
Wt. of dry soil	73.88	Wt. of dry soil	73.88
Moisture Content (%)	43.0	Moisture Content (%)	42.3
Wet Density (kg/m^3)	1761		
Dry Density (kg/m^3)	1231		
Solid Height (cm)	0.9121	Solid Height (cm)	0.9121
Ht. of water(cm)	1.0590	Ht. of water(cm)	1.0413
Initial Void Ratio	1.193		
Degree of Saturation(%)	97.3		

SOLUM CONSULTANTS LTD.
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TESTING LABORATORY

Swell Test (Method C) (ASTM D4546)

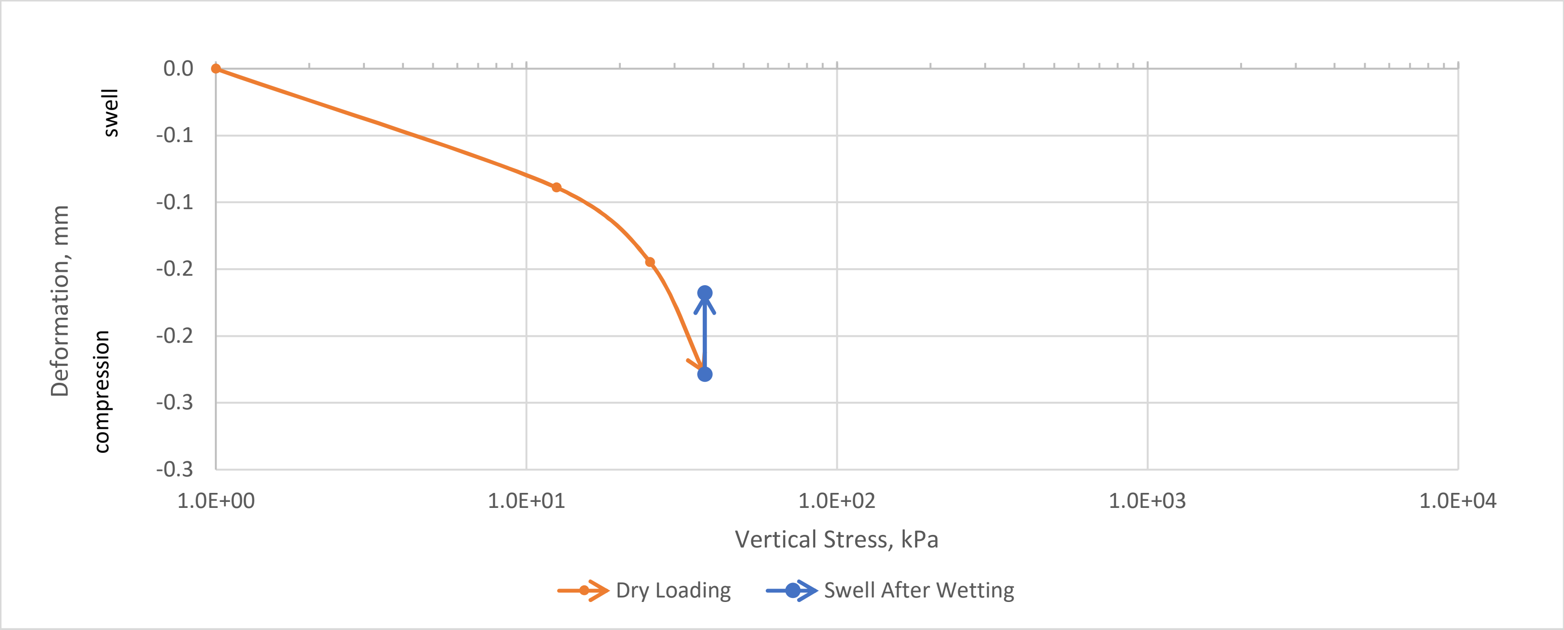
Project Info: *60721079 / Winnipeg Transit North Garage Project* *Reviewed by:* *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-05*** ***T4*** ***5'***

Stage No.	Load (kPa)	Deformation (mm)
1	1.0	0.0000
2	12.5	-0.0889
3	25.0	-0.1448
4	37.5	-0.2286
5 (wetting)	37.5	-0.1676



CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-05
Depth: 5'
Sample Number: T4

Test Specimen Data

NATURAL MOISTURE

Wet w+t = 96.71 g.
Dry w+t = 75.23 g.
Tare Wt. = 25.17 g.
Moisture = 42.9 %

VOID RATIO

Spec. Gr. = 2.7
Est. Ht. Solids = 0.913 cm.
Init. V.R. = 1.190
Init. Sat. = 97.4 %

AFTER TEST

Wet w+t = 148.12 g.
Dry w+t = 116.88 g.
Tare Wt. = 43.00 g.
Moisture = 42.3 %

Dry Wt. = 73.88 g.

UNIT WEIGHT

Height = 0.787 in.
Diameter = 2.433 in.
Weight = 105.65 g.
Dry Dens. = 1233 kg/m^3

TEST START

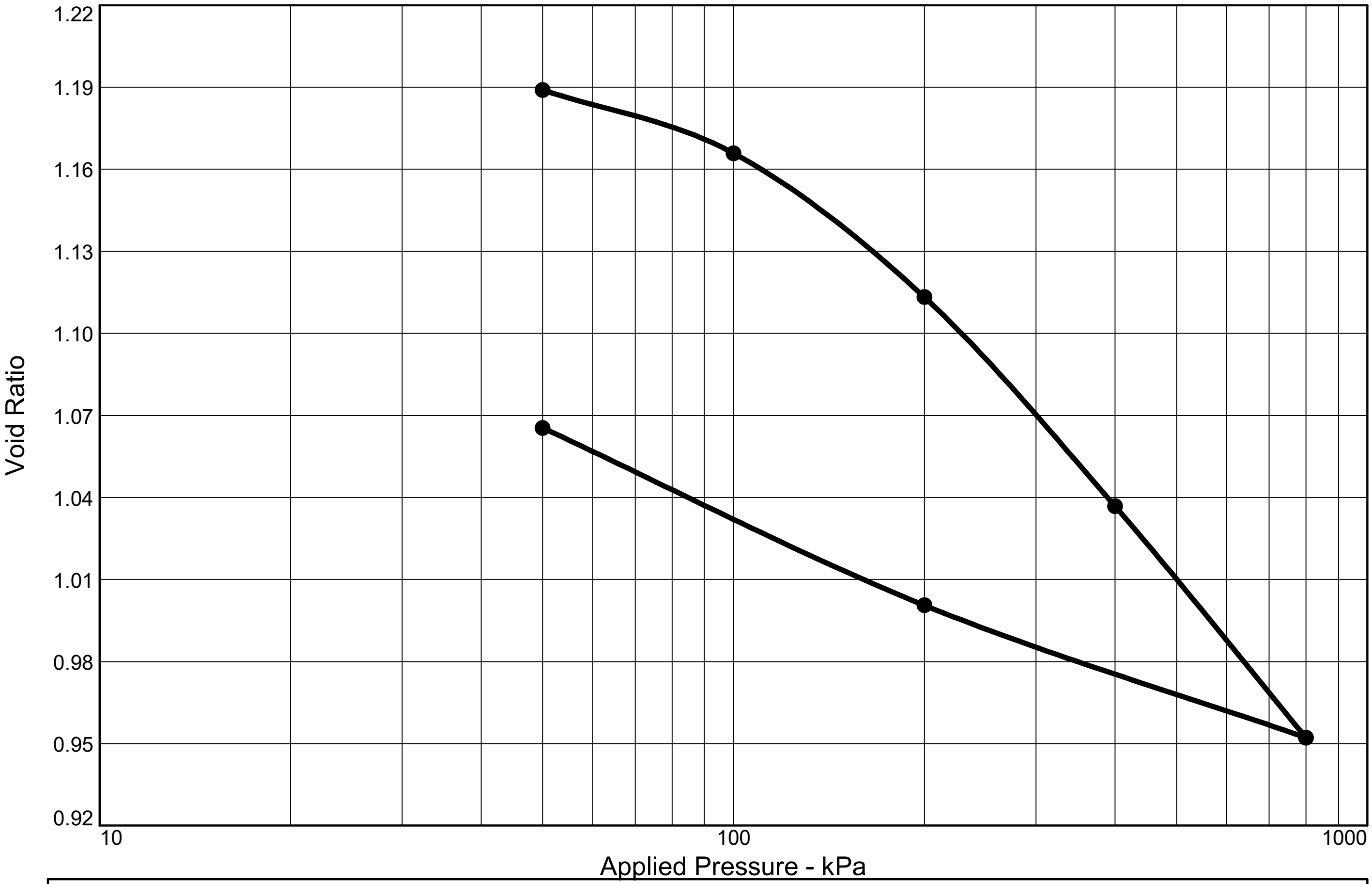
Height = 0.787 in.
Diameter = 2.433 in.

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	0.00000	0.00000			1.190	
50.0	-0.00030	0.00030	0.0016		1.189	0.0 Comprs.
100.0	-0.00860	0.00860	0.0007		1.166	1.1 Comprs.
200.0	-0.02750	0.02750	0.0003		1.113	3.5 Comprs.
400.0	-0.05500	0.05500	0.0001		1.037	7.0 Comprs.
800.0	-0.08540	0.08540	0.0001		0.952	10.9 Comprs.
200.0	-0.06800	0.06800	0.0001		1.001	8.6 Comprs.
50.0	-0.04470	0.04470	0.0000		1.065	5.7 Comprs.

Compression index (C_c), kPa = 0.28 **Preconsolidation pressure (P_p), kPa =** 153 **Void ratio at P_p (e_m) =** 1.137

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
1	50.0	0.0016									
2	100.0	0.0007									
3	200.0	0.0003									
4	400.0	0.0001									
5	800.0	0.0001									
6	200.0	0.0001									
7	50.0	0.0000									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.4 %	42.9 %	1233			2.7		153	0.28		1.190

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 **Depth:** 5' **Sample Number:** T4

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TESTING LABORATORY

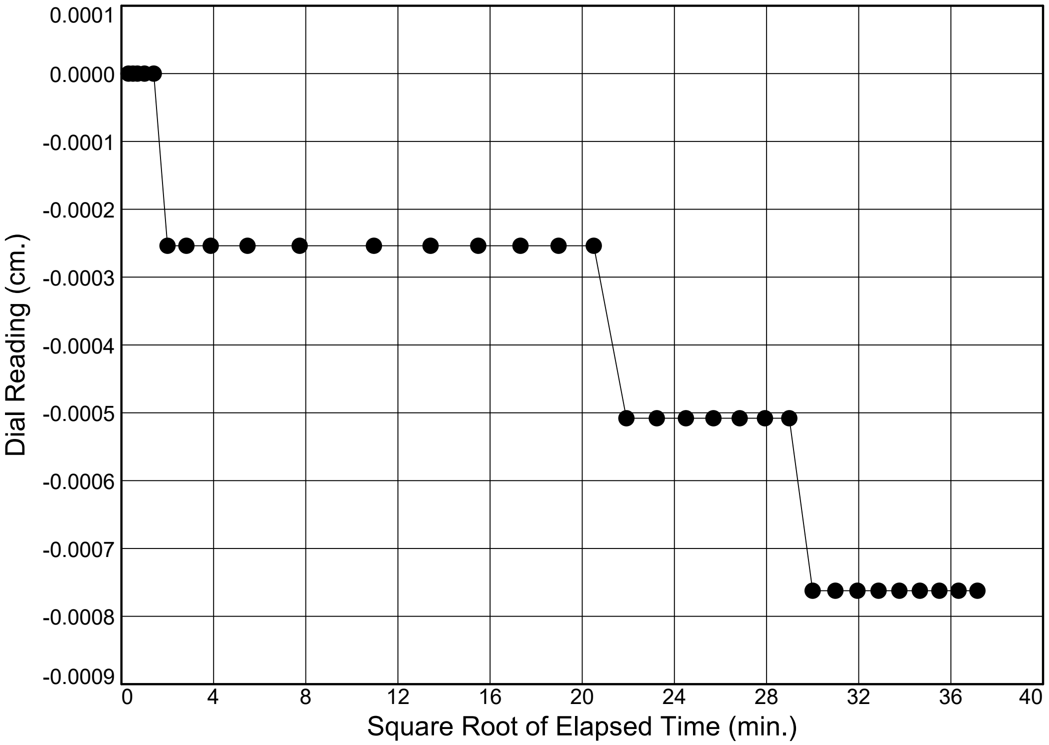
Remarks:

Figure

Dial Reading vs. Time

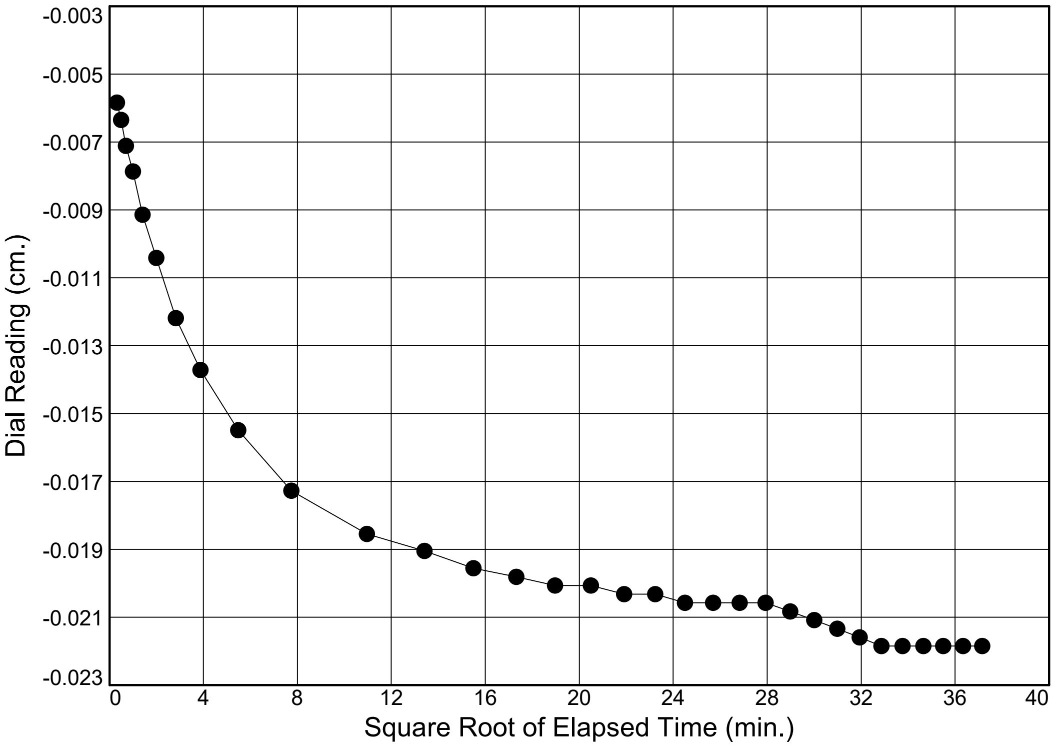
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 5' Sample Number: T4



Load No.= 1
Load= 50.0 kPa
D_0 = 0.0002
D_{90} = -0.0006
D_{100} = -0.0007
T_{90} = 9.08 min.

C_v @ T_{90}
0.0016 cm.^{2}/sec.



Load No.= 2
Load= 100.0 kPa
D_0 = -0.0140
D_{90} = -0.0368
D_{100} = -0.0394
T_{90} = 21.03 min.

C_v @ T_{90}
0.0007 cm.^{2}/sec.

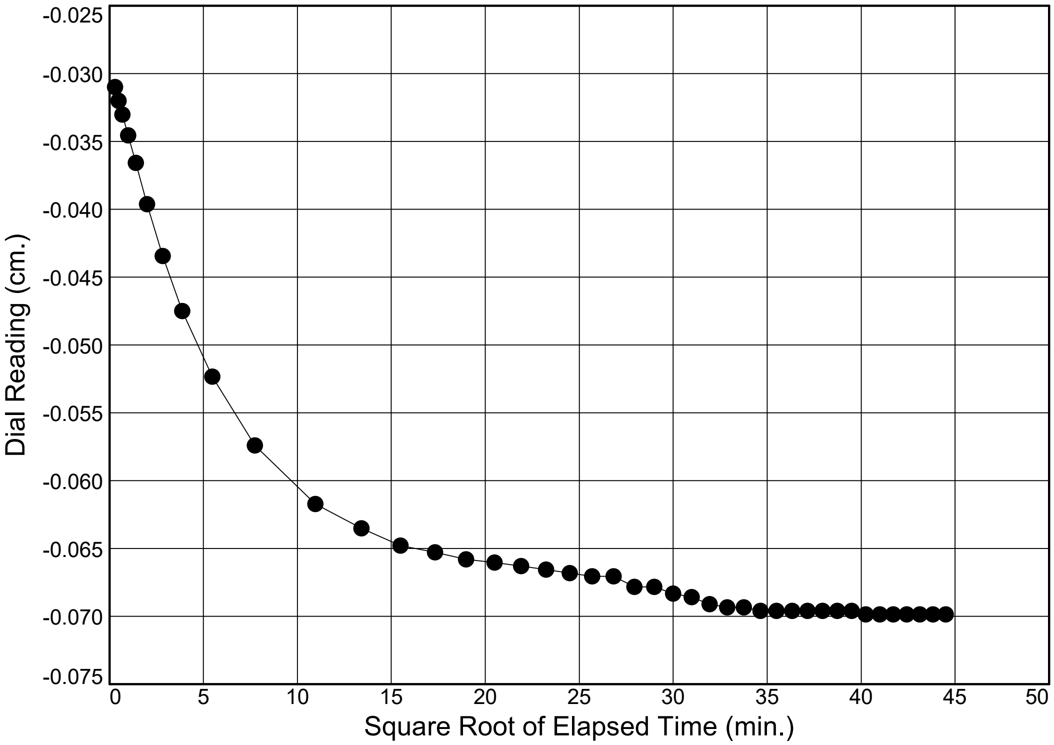
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

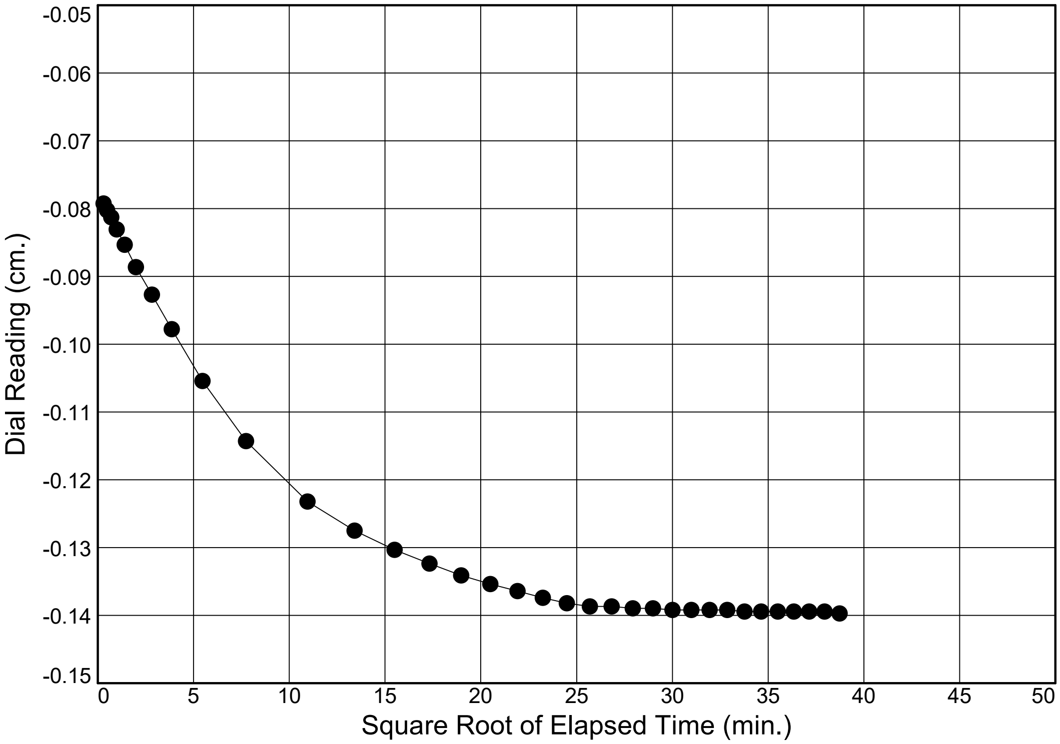
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 5' Sample Number: T4



Load No.= 3
Load= 200.0 kPa
D_0 = -0.0772
D_{90} = -0.1399
D_{100} = -0.1468
T_{90} = 44.90 min.

C_v @ T_{90}
0.0003 cm.^{2}/sec.



Load No.= 4
Load= 400.0 kPa
D_0 = -0.1991
D_{90} = -0.3083
D_{100} = -0.3204
T_{90} = 106.09 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.

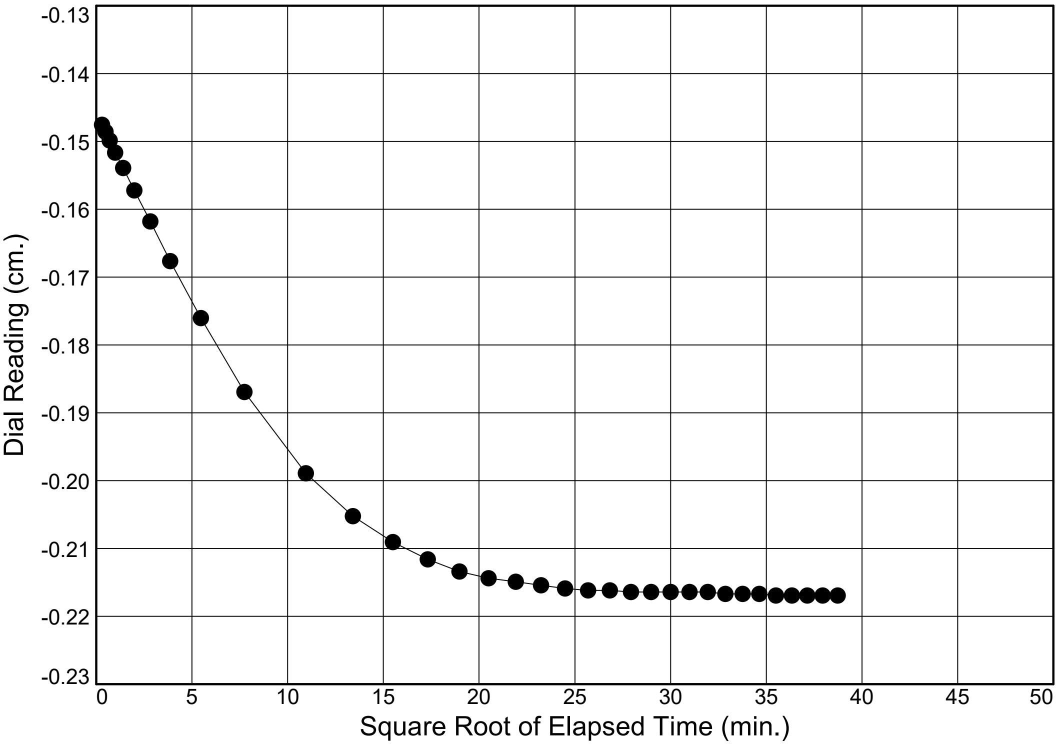
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

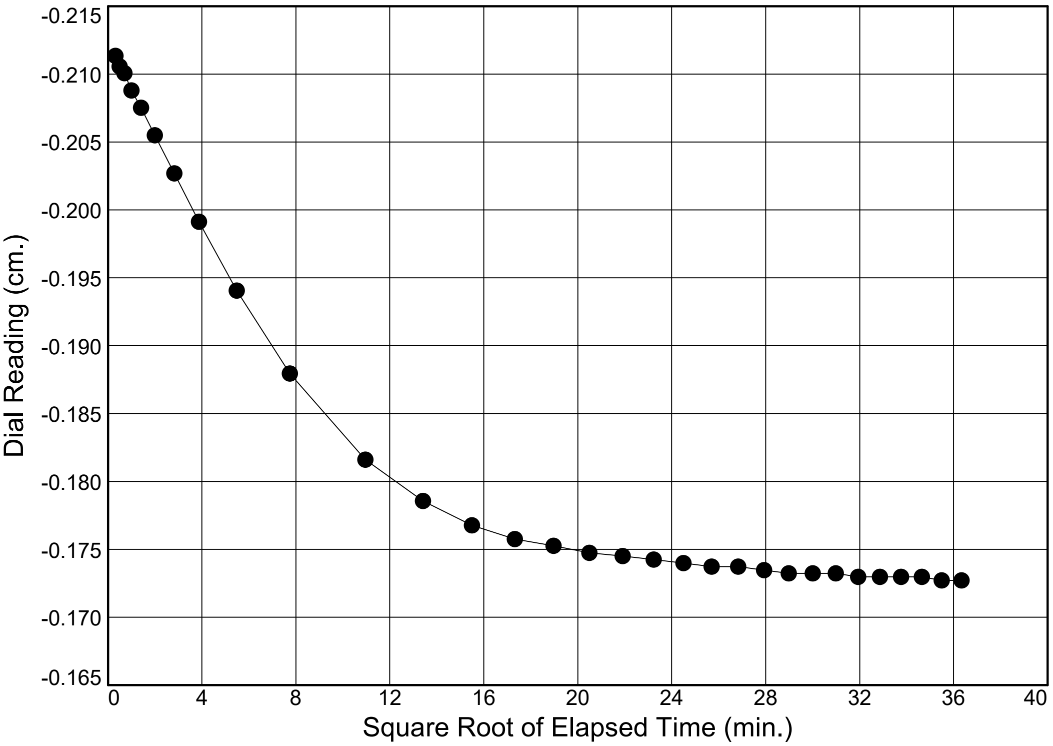
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 5' Sample Number: T4



Load No.= 5
Load= 800.0 kPa
D_0 = -0.3735
D_{90} = -0.5219
D_{100} = -0.5384
T_{90} = 183.40 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.



Load No.= 6
Load= 200.0 kPa
D_0 = -0.5385
D_{90} = -0.4614
D_{100} = -0.4528
T_{90} = 119.46 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.

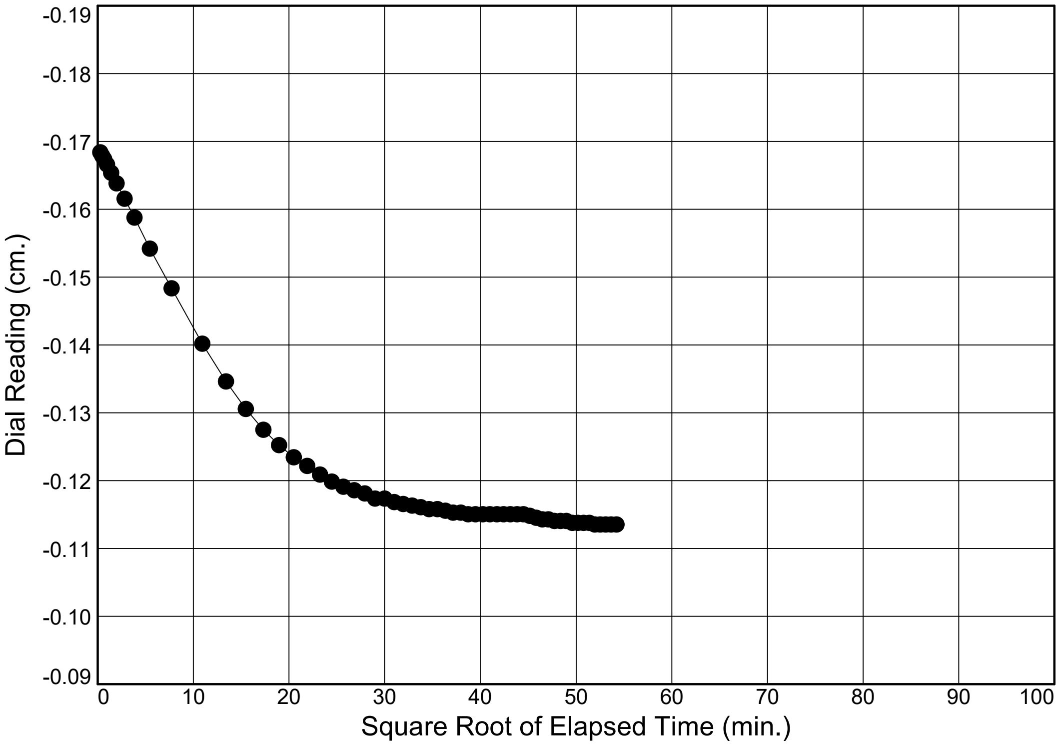
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 5' Sample Number: T4



Load No.= 7

Load= 50.0 kPa

D_0 = -0.4289

D_{90} = -0.3136

D_{100} = -0.3008

T_{90} = 419.57 min.

C_v @ T_{90}

0.0000 cm.^{2}/sec.

Figure

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Swell Test (Method C) (ASTM D4546)

Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		

Sample Info: ***TH24-05*** ***T5*** ***7.5'***

Specific Gravity Gs (Est)	2.70		Water for Inundate Specimens	Distilled
in-situ Overburden Pressure (kPa)	37.5	*(estimated based on sample's depth)*		

	Before Test		**After Test**
Height (cm)	2.00		
Diameter (cm)	6.18		
Area (cm^2)	30.00		
Volume (cm^3)	60.00		
Wt. (ring + wet soil)	145.39	Wt. (ring + wet soil)	144.31
Wt. (ring + dry soil)	111.12	Wt. (ring + dry soil)	111.12
Wt. of ring	43.00	Wt. of ring	43.00
Wt. of wet soil	102.39	Wt. of wet soil	101.31
Wt. of dry soil	68.12	Wt. of dry soil	68.12
Moisture Content (%)	50.3	Moisture Content (%)	48.7
Wet Density (kg/m^3)	1707		
Dry Density (kg/m^3)	1135		
Solid Height (cm)	0.8410	Solid Height (cm)	0.8410
Ht. of water(cm)	1.1423	Ht. of water(cm)	1.1063
Initial Void Ratio	1.378		
Degree of Saturation(%)	98.6		

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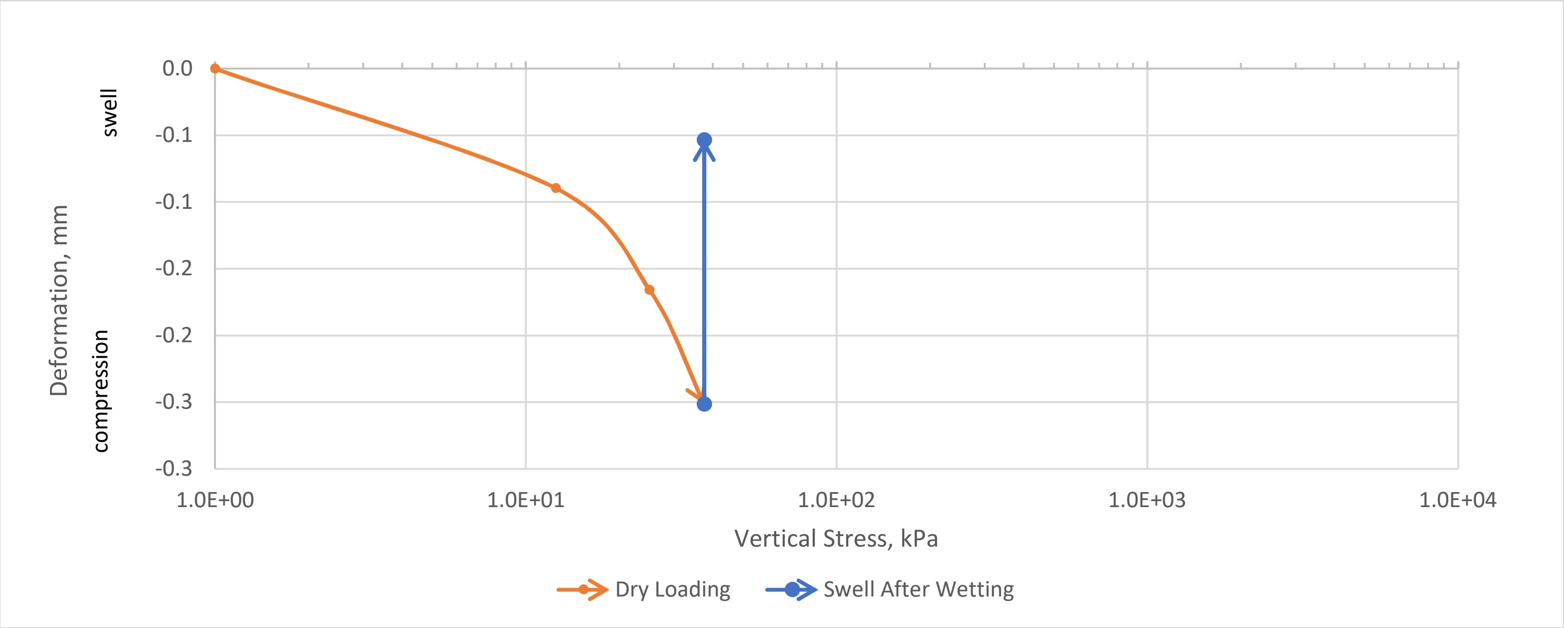
TESTING LABORATORY

Swell Test (Method C) (ASTM D4546)

Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		

Sample Info: ***TH24-05*** ***T5*** ***7.5'***

Stage No.	Load (kPa)	Deformation (mm)
1	1.0	0.0000
2	12.5	-0.0897
3	25.0	-0.1659
4	37.5	-0.2515
5 (wetting)	37.5	-0.0533



CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-05
Depth: 7.5'
Sample Number: T5

Test Specimen Data

NATURAL MOISTURE

Wet w+t = 118.53 g.
Dry w+t = 88.06 g.
Tare Wt. = 25.43 g.
Moisture = 48.7 %

VOID RATIO

Spec. Gr. = 2.7
Est. Ht. Solids = 0.851 cm.
Init. V.R. = 1.350
Init. Sat. = 97.3 %

AFTER TEST

Wet w+t = 144.31 g.
Dry w+t = 111.12 g.
Tare Wt. = 43.00 g.
Moisture = 48.7 %

UNIT WEIGHT

Height = 0.787 in.
Diameter = 2.433 in.
Weight = 102.39 g.
Dry Dens. = 1149 kg/m^3

TEST START

Height = 0.787 in.
Diameter = 2.433 in.

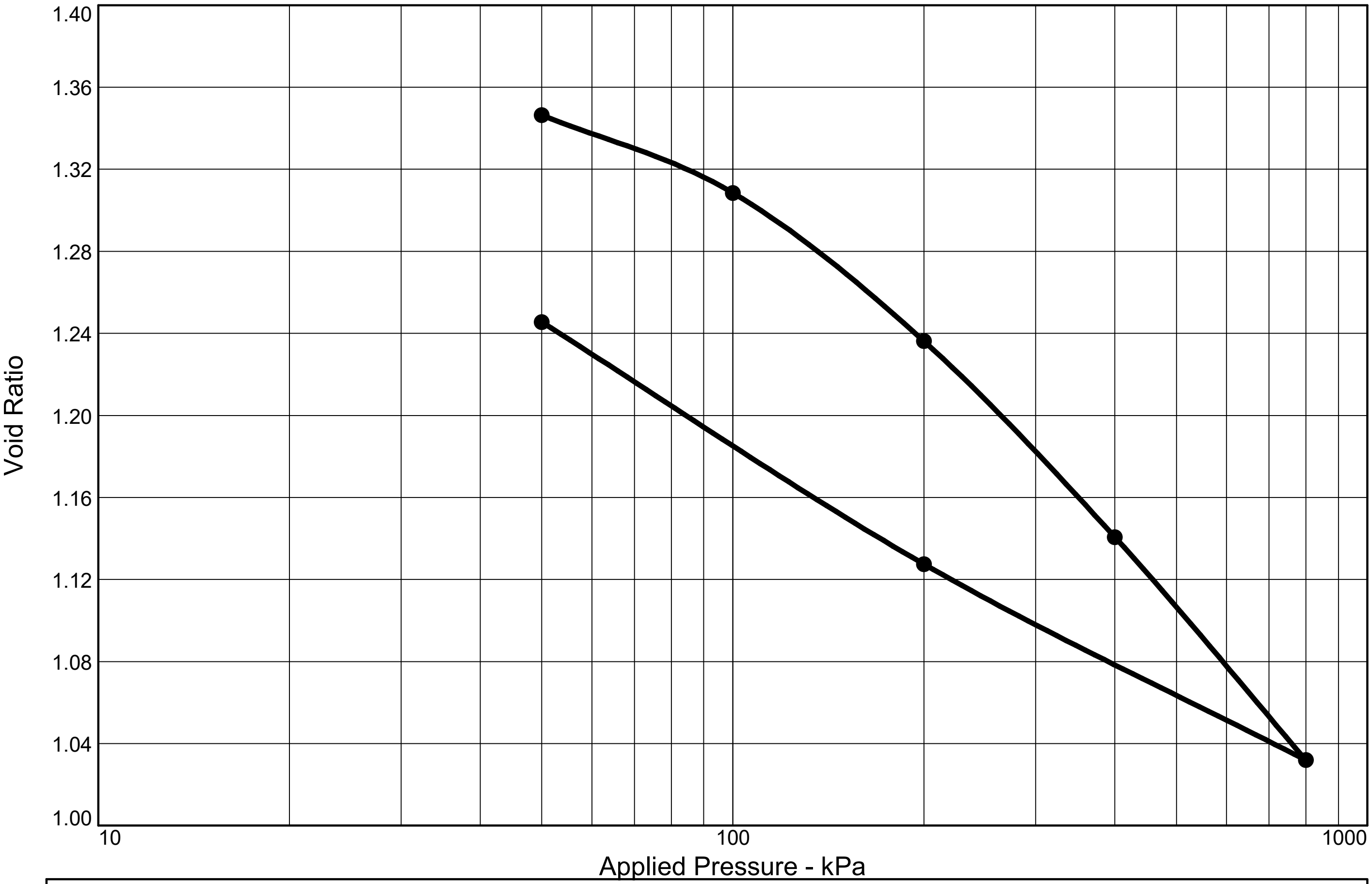
Dry Wt. = 68.12 g.

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	0.00000	0.00000			1.350	
50.0	-0.00130	0.00130	0.0007		1.346	0.2 Comprs.
100.0	-0.01400	0.01400	0.0003		1.308	1.8 Comprs.
200.0	-0.03820	0.03820	0.0001		1.236	4.9 Comprs.
400.0	-0.07020	0.07020	0.0000		1.141	8.9 Comprs.
800.0	-0.10660	0.10660	0.0000		1.032	13.5 Comprs.
200.0	-0.07460	0.07460	0.0000		1.128	9.5 Comprs.
50.0	-0.03510	0.03510	0.0000		1.245	4.5 Comprs.

Compression index (C_c), kPa = 0.36 **Preconsolidation pressure (P_p), kPa =** 154 **Void ratio at P_p (e_m) =** 1.267

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
1	50.0	0.0007									
2	100.0	0.0003									
3	200.0	0.0001									
4	400.0	0.0000									
5	800.0	0.0000									
6	200.0	0.0000									
7	50.0	0.0000									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.3 %	48.7 %	1149			2.7		154	0.36		1.350

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 **Depth:** 7.5' **Sample Number:** T5

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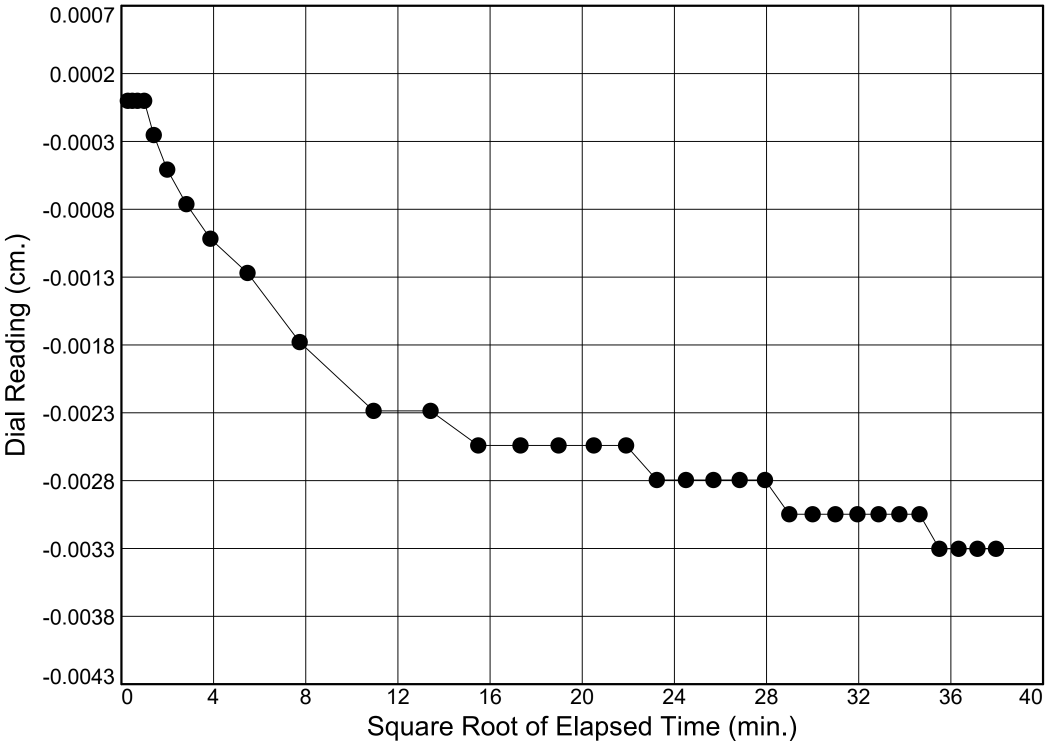
Remarks:

Figure

Dial Reading vs. Time

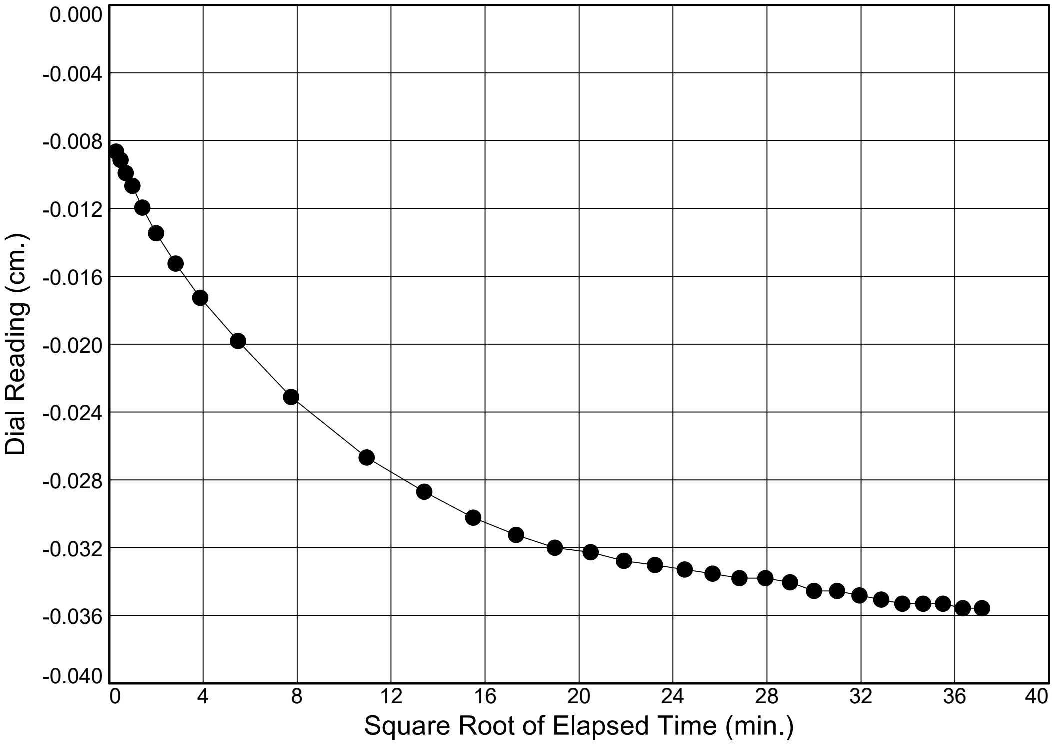
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 7.5' Sample Number: T5



Load No.= 1
Load= 50.0 kPa
D_0 = 0.0005
D_{90} = -0.0029
D_{100} = -0.0033
T_{90} = 21.42 min.

C_v @ T_{90}
0.0007 cm.^{2}/sec.



Load No.= 2
Load= 100.0 kPa
D_0 = -0.0216
D_{90} = -0.0574
D_{100} = -0.0614
T_{90} = 54.71 min.

C_v @ T_{90}
0.0003 cm.^{2}/sec.

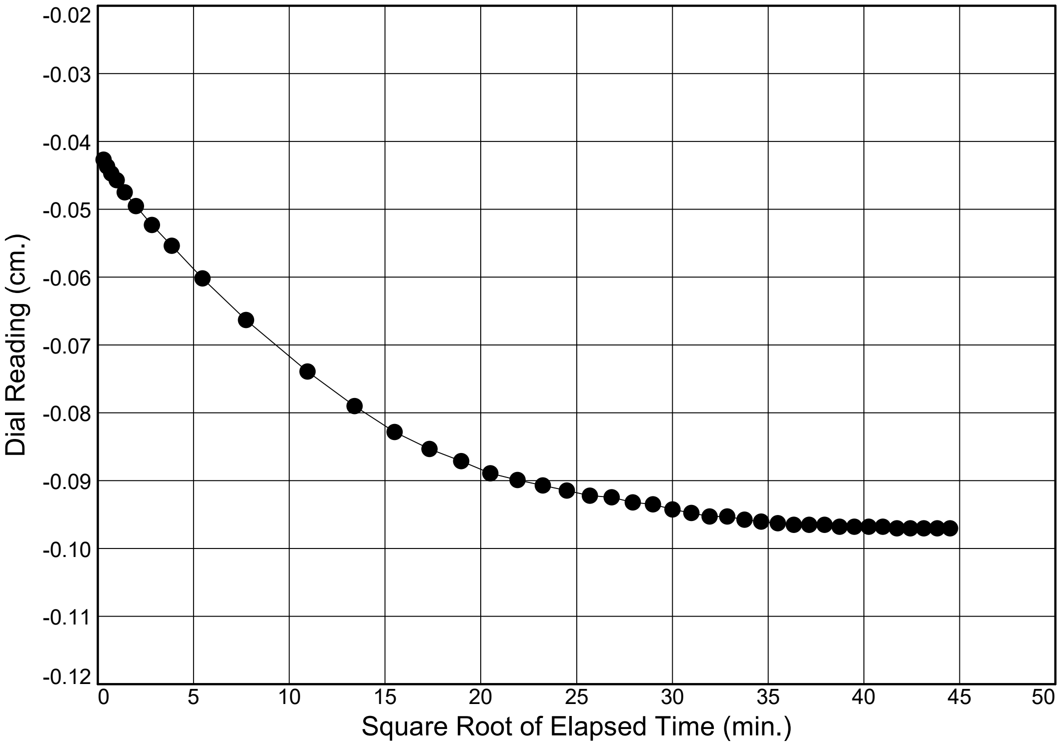
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 7.5' Sample Number: T5



Load No.= 3

Load= 200.0 kPa

D_0 = -0.1093

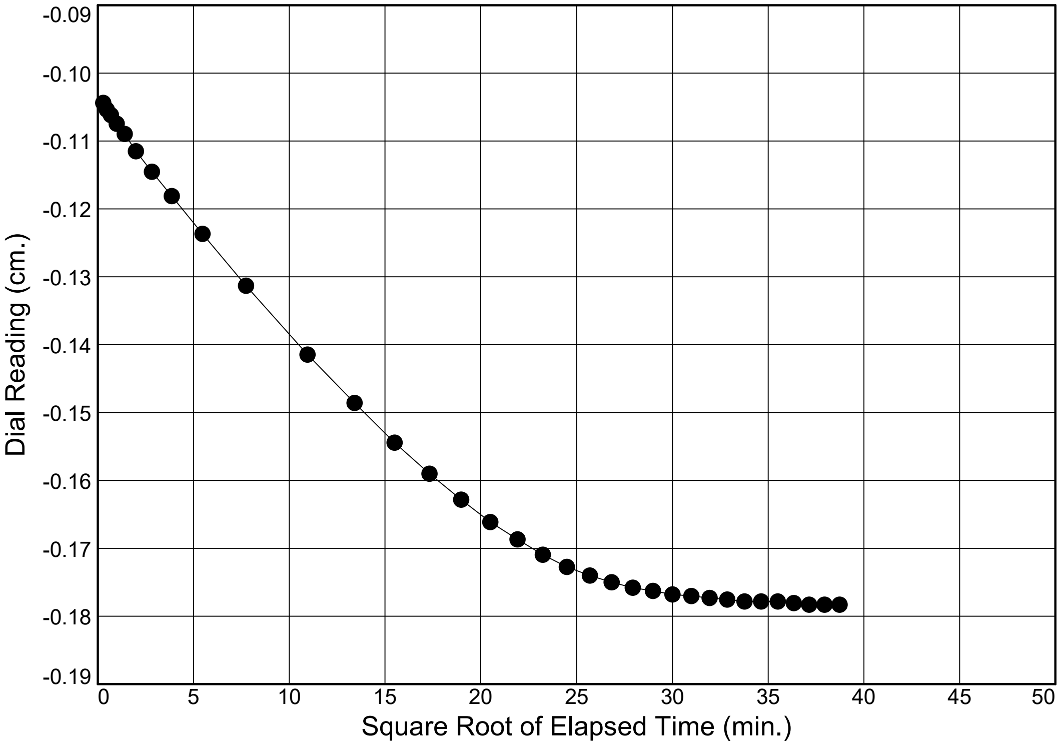
D_{90} = -0.2105

D_{100} = -0.2218

T_{90} = 241.80 min.

C_v @ T_{90}

0.0001 cm.^{2}/sec.



Load No.= 4

Load= 400.0 kPa

D_0 = -0.2655

D_{90} = -0.4324

D_{100} = -0.4509

T_{90} = 520.56 min.

C_v @ T_{90}

0.0000 cm.^{2}/sec.

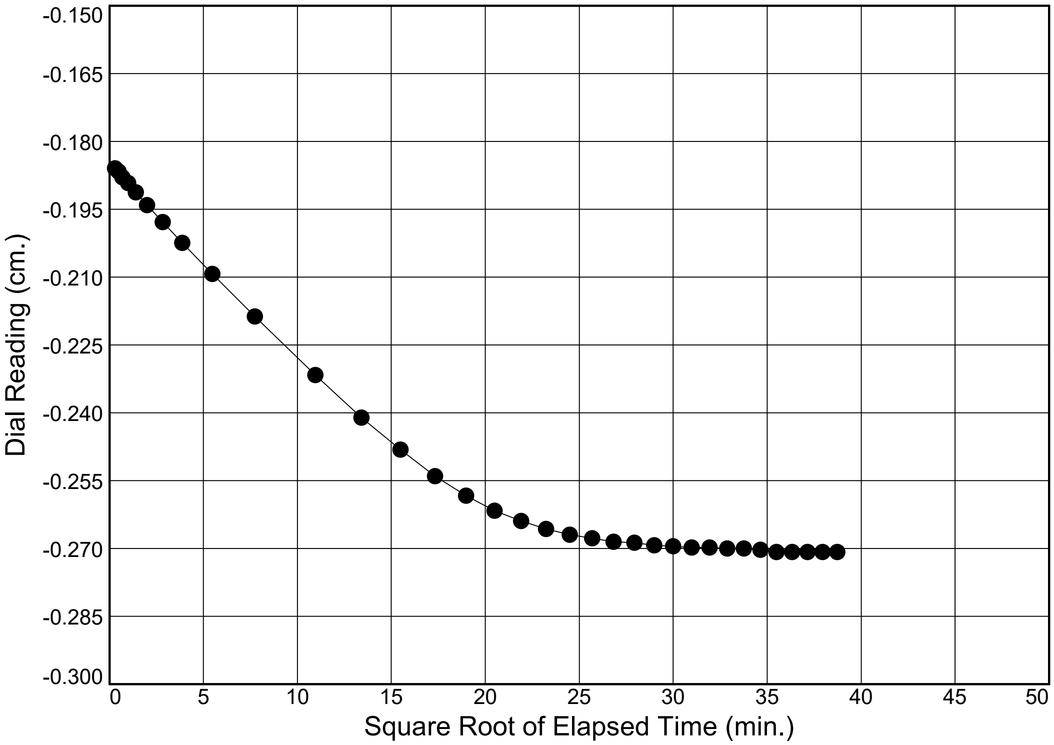
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

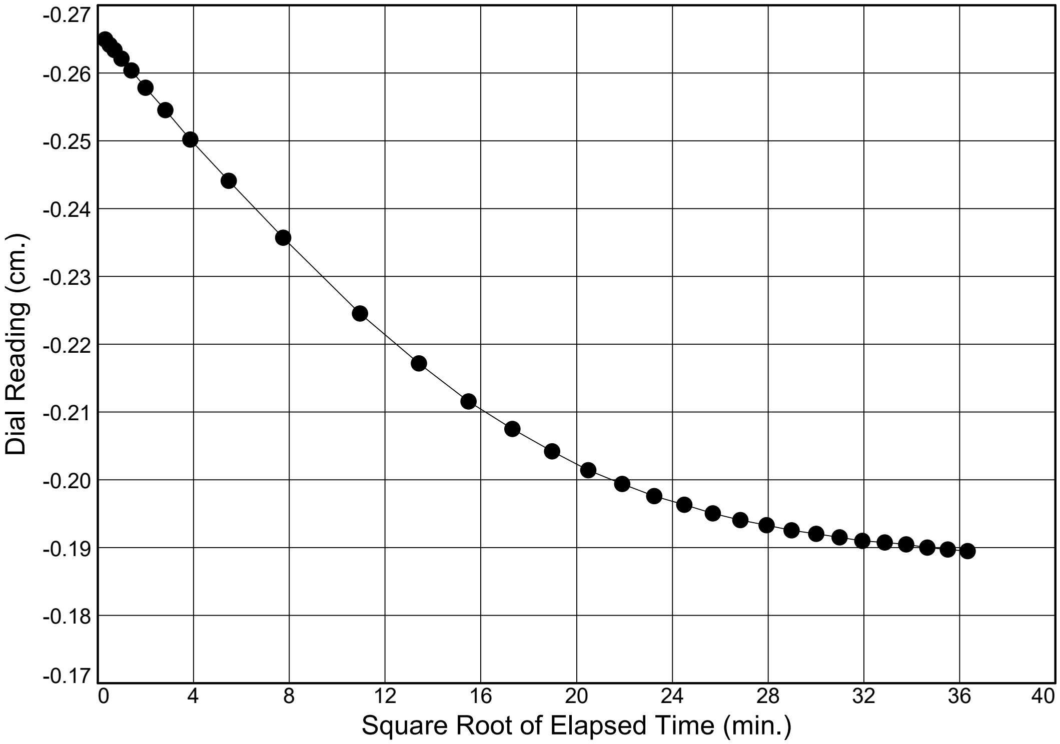
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 7.5' Sample Number: T5



Load No.= 5
Load= 800.0 kPa
D_0 = -0.4714
D_{90} = -0.6692
D_{100} = -0.6911
T_{90} = 467.74 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.



Load No.= 6
Load= 200.0 kPa
D_0 = -0.6742
D_{90} = -0.5186
D_{100} = -0.5013
T_{90} = 360.84 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.

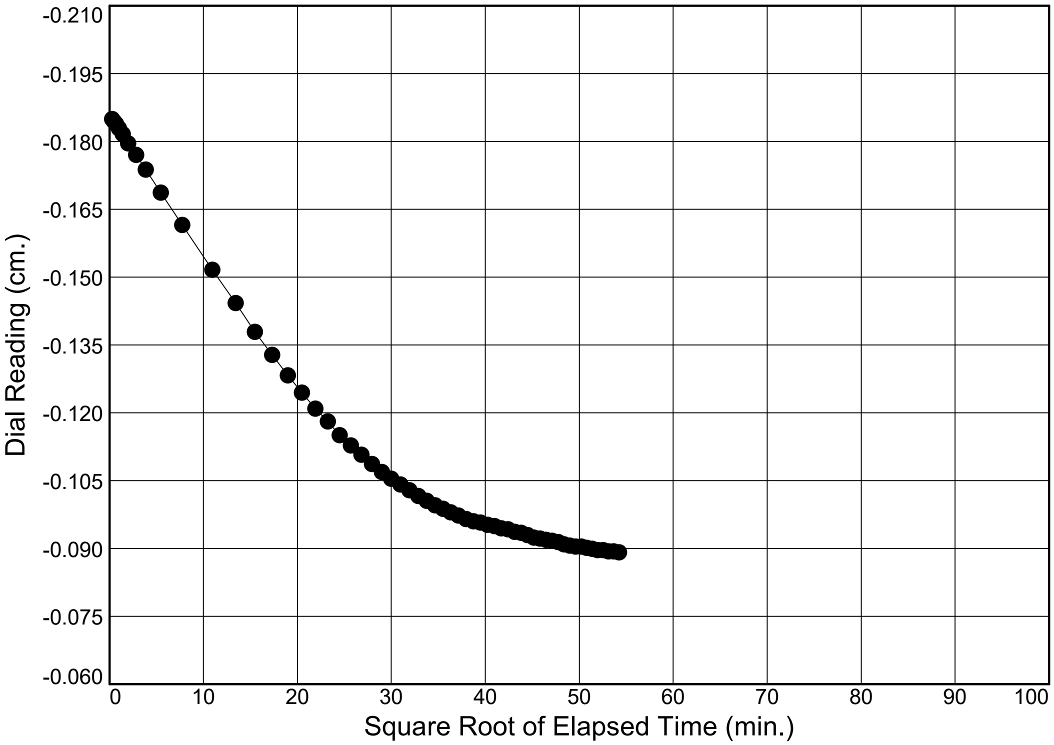
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-05 Depth: 7.5' Sample Number: T5



Load No.= 7

Load= 50.0 kPa

D_0 = -0.4712

D_{90} = -0.2642

D_{100} = -0.2412

T_{90} = 965.85 min.

C_v @ T_{90}

0.0000 cm.^{2}/sec.

Figure

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Swell Test (Method C) (ASTM D4546)

Project Info: *60721079 / Winnipeg Transit North Garage Project*

Reviewed by: *S. F.*

Client: *AECOM Canada*

Solum Job No.: *06901240222(54)*

Sample Info: ***TH24-14*** ***T4*** ***5'***

Specific Gravity Gs (Est) 2.70

Water for Inundate Specimens Distilled

in-situ Overburden Pressure (kPa) 37.5 *(estimated based on sample's depth)*

	Before Test		**After Test**
Height (cm)	2.00		
Diameter (cm)	6.18		
Area (cm^2)	30.00		
Volume (cm^3)	60.00		
Wt. (ring + wet soil)	167.73	Wt. (ring + wet soil)	168.10
Wt. (ring + dry soil)	147.90	Wt. (ring + dry soil)	147.90
Wt. of ring	43.00	Wt. of ring	43.00
Wt. of wet soil	124.73	Wt. of wet soil	125.10
Wt. of dry soil	104.90	Wt. of dry soil	104.90
Moisture Content (%)	18.9	Moisture Content (%)	19.3
Wet Density (kg/m^3)	2079		
Dry Density (kg/m^3)	1748		
Solid Height (cm)	1.2951	Solid Height (cm)	1.2951
Ht. of water(cm)	0.6610	Ht. of water(cm)	0.6733
Initial Void Ratio	0.544		
Degree of Saturation(%)	93.8		

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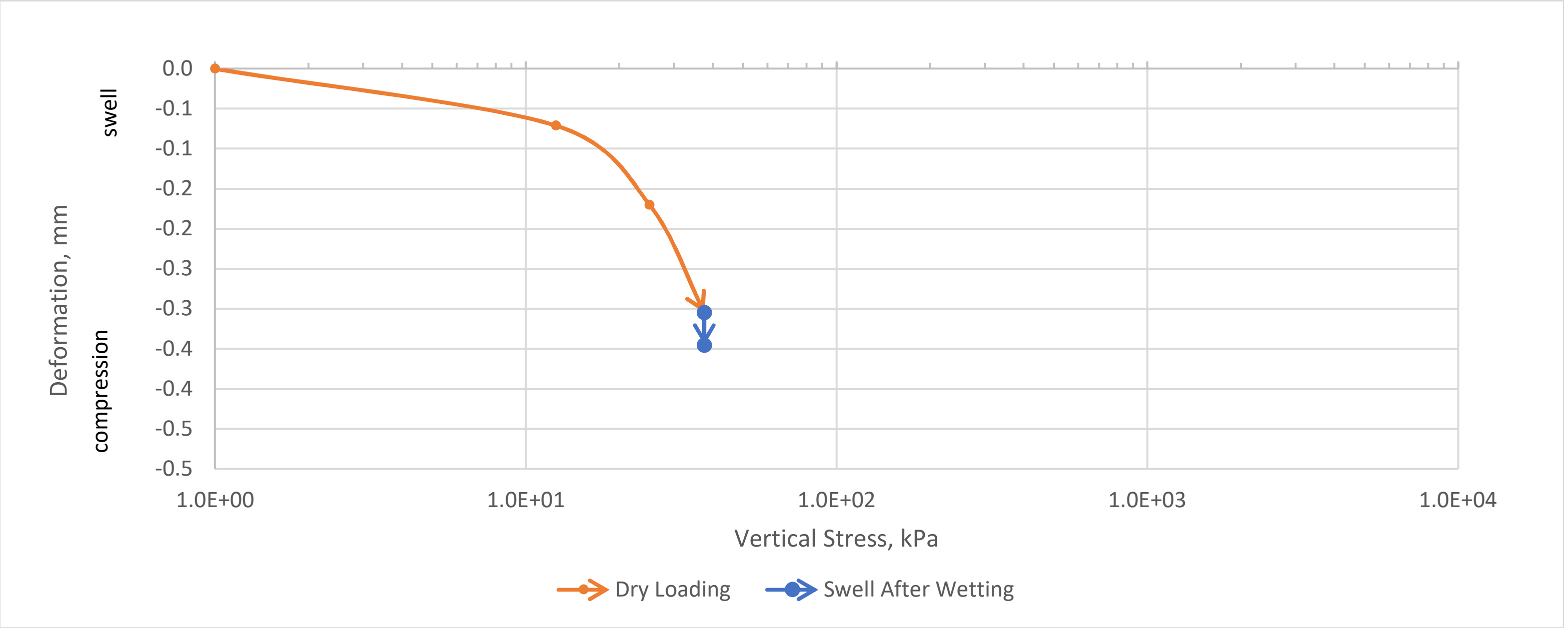
Swell Test (Method C) (ASTM D4546)

Project Info:	*60721079 / Winnipeg Transit North Garage Project*	*Reviewed by:*	*S. F.*
Client:	*AECOM Canada*		
Solum Job No.:	*06901240222(54)*		

Sample Info: ***TH24-14*** ***T4*** ***5'***

Stage No.	Load (kPa)	Deformation (mm)
1	1.0	0.0000
2	12.5	-0.0711
3	25.0	-0.1702
4	37.5	-0.3048
5 (wetting)	37.5	-0.3454



CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-14
Depth: 5'
Sample Number: T4

Test Specimen Data

NATURAL MOISTURE		VOID RATIO		AFTER TEST	
Wet w+t =	108.37 g.	**Spec. Gr.**	= 2.7	**Wet w+t** =	168.10 g.
Dry w+t =	94.12 g.	**Est. Ht. Solids**	= 1.287 cm.	**Dry w+t** =	147.90 g.
Tare Wt. =	21.78 g.	**Init. V.R.**	= 0.554	**Tare Wt.** =	43.00 g.
Moisture =	19.7 %	**Init. Sat.**	= 96.1 %	**Moisture** =	19.3 %

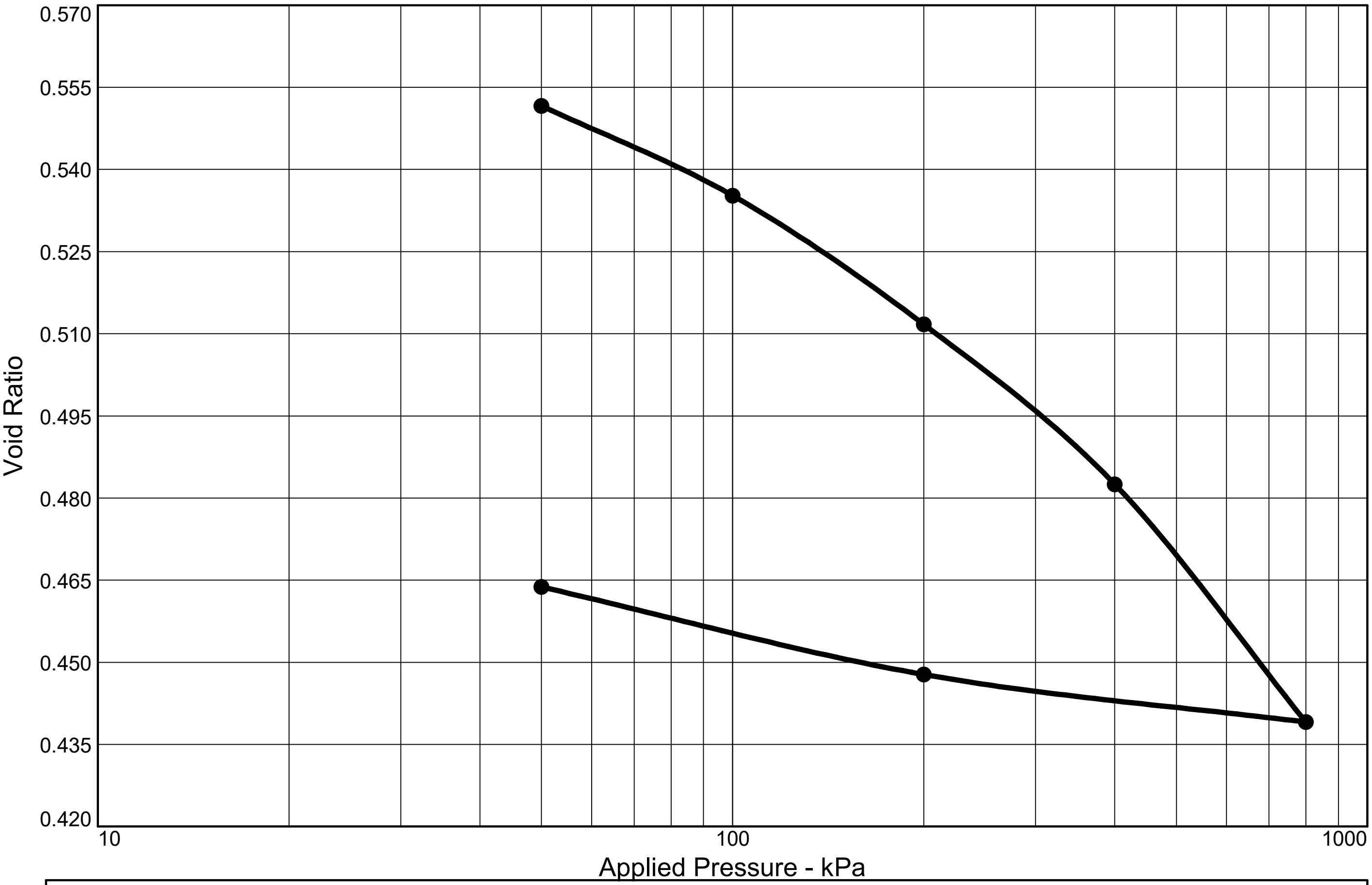
UNIT WEIGHT		TEST START			
Height =	0.787 in.	**Height**	= 0.787 in.	**Dry Wt.** =	104.90 g.
Diameter =	2.433 in.	**Diameter**	= 2.433 in.		
Weight =	124.73 g.				
Dry Dens. =	1738 kg/m^3				

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	0.00000	0.00000			0.554	
50.0	-0.00100	0.00100	0.0004		0.552	0.1 Comprs.
100.0	-0.00930	0.00930	0.0027		0.535	1.2 Comprs.
200.0	-0.02120	0.02120	0.0013		0.512	2.7 Comprs.
400.0	-0.03600	0.03600	0.0014		0.483	4.6 Comprs.
800.0	-0.05800	0.05800	0.0013		0.439	7.4 Comprs.
200.0	-0.05360	0.05360	0.0011		0.448	6.8 Comprs.
50.0	-0.04550	0.04550	0.0003		0.464	5.8 Comprs.

Compression index (C_c), kPa = 0.08 **Preconsolidation pressure (P_p), kPa =** 109 **Void ratio at P_p (e_m) =** 0.533

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation											
No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
1	50.0	0.0004									
2	100.0	0.0027									
3	200.0	0.0013									
4	400.0	0.0014									
5	800.0	0.0013									
6	200.0	0.0011									
7	50.0	0.0003									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.1 %	19.7 %	1738			2.7		109	0.08		0.554

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-14 **Depth:** 5' **Sample Number:** T4

SOLUM CONSULTANTS LTD
GEOTECHNICAL & MATERIAL TESTING LABORATORY

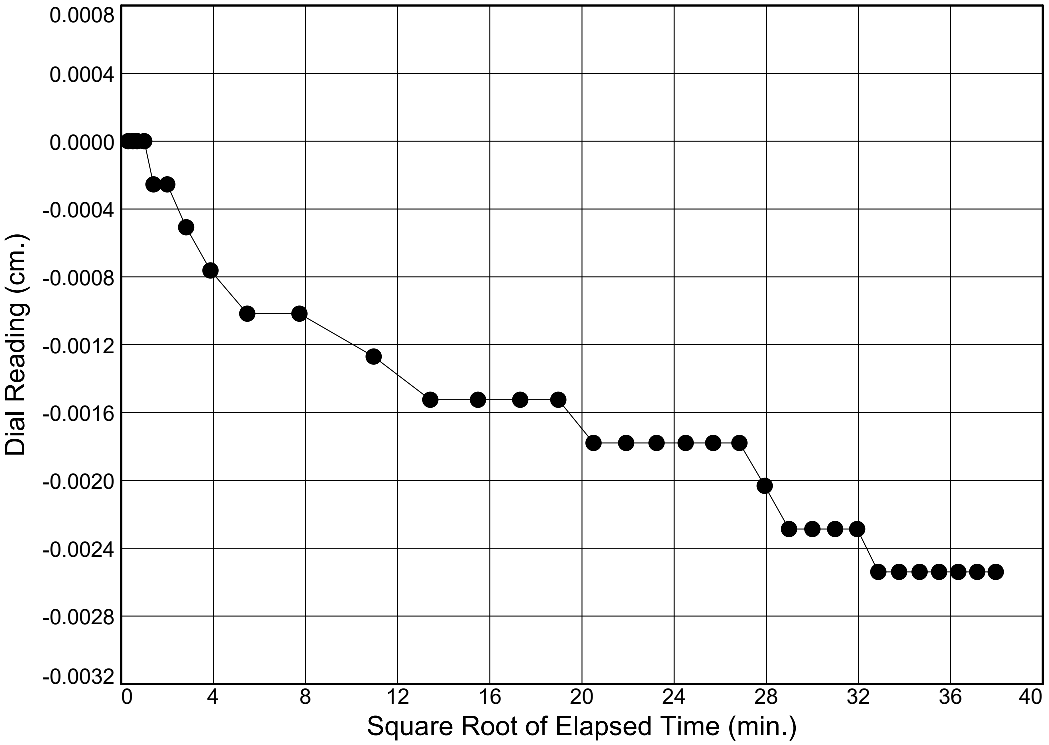
Remarks:

Figure

Dial Reading vs. Time

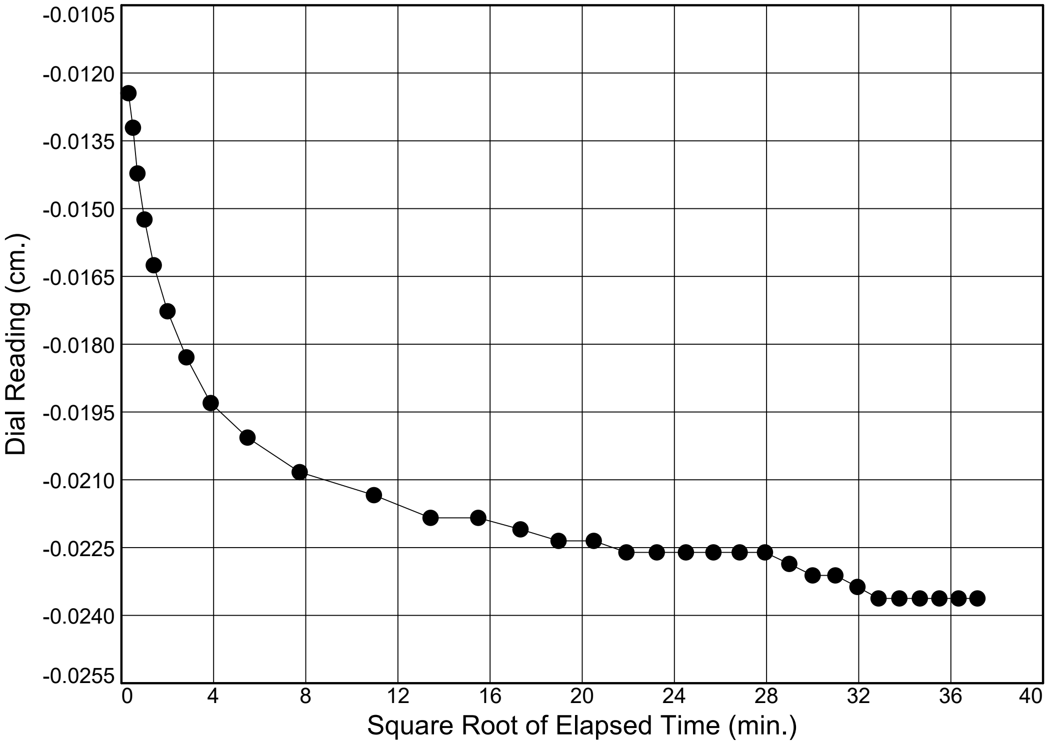
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-14 Depth: 5' Sample Number: T4



Load No.= 1
Load= 50.0 kPa
D_0 = 0.0003
D_{90} = -0.0026
D_{100} = -0.0029
T_{90} = 37.49 min.

C_v @ T_{90}
0.0004 cm.^{2}/sec.



Load No.= 2
Load= 100.0 kPa
D_0 = -0.0303
D_{90} = -0.0447
D_{100} = -0.0463
T_{90} = 5.20 min.

C_v @ T_{90}
0.0027 cm.^{2}/sec.

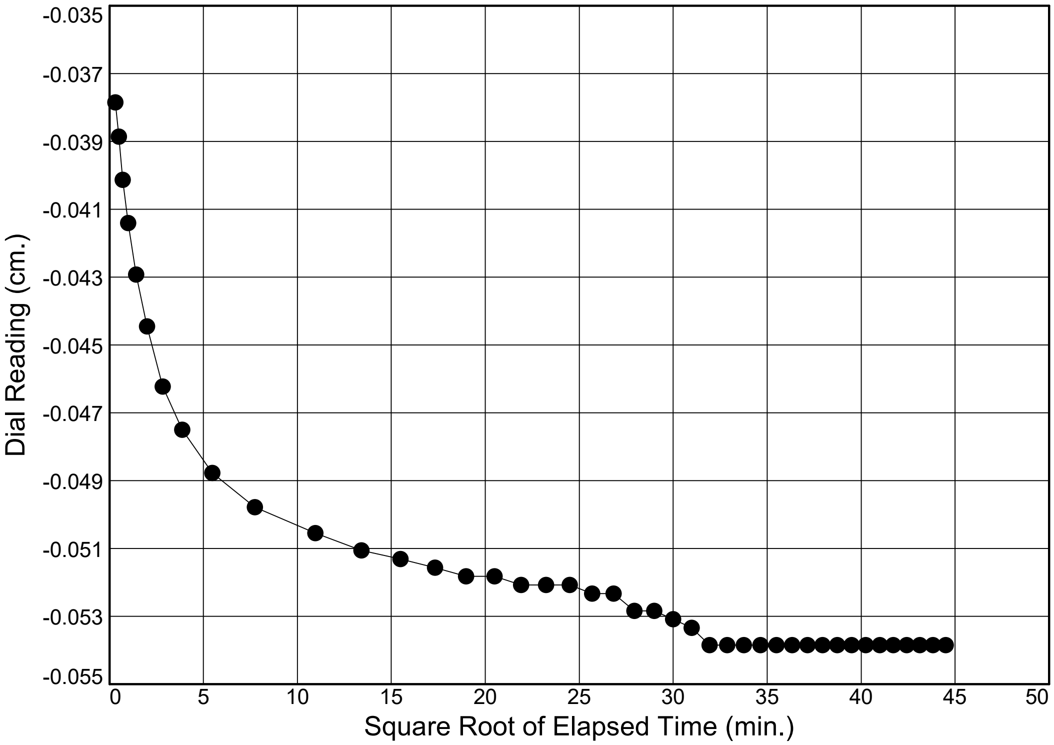
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

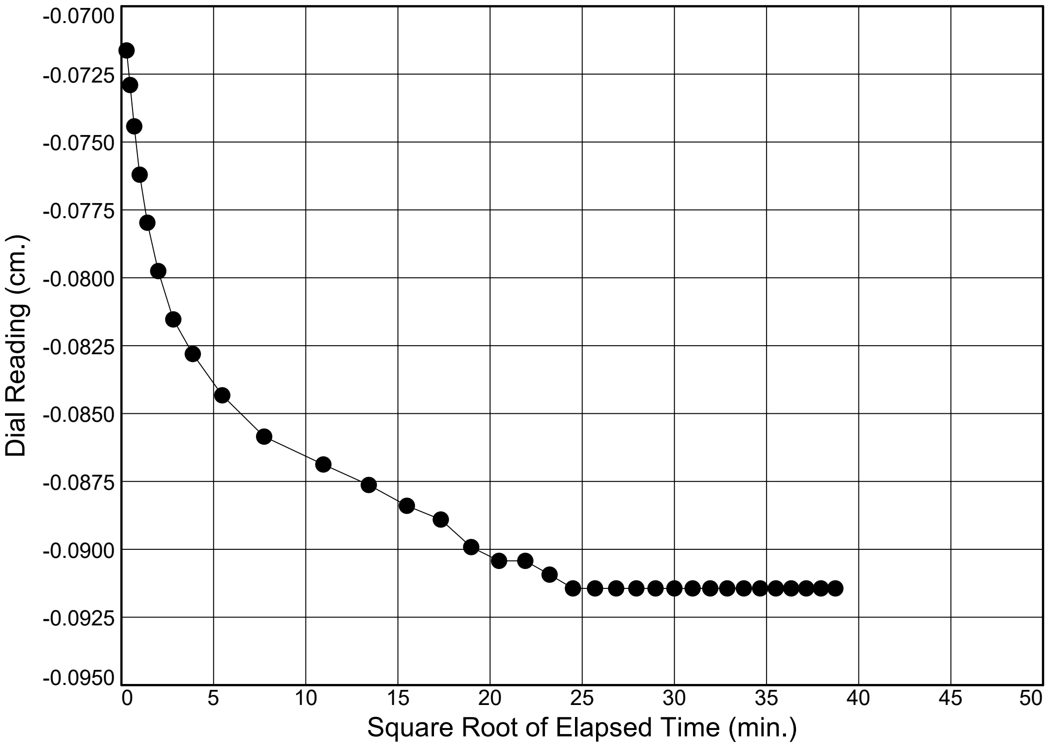
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-14 Depth: 5' Sample Number: T4



Load No.= 3
Load= 200.0 kPa
D_0 = -0.0954
D_{90} = -0.1185
D_{100} = -0.1210
T_{90} = 10.02 min.

C_v @ T_{90}
0.0013 cm.^{2}/sec.



Load No.= 4
Load= 400.0 kPa
D_0 = -0.1817
D_{90} = -0.2077
D_{100} = -0.2106
T_{90} = 9.22 min.

C_v @ T_{90}
0.0014 cm.^{2}/sec.

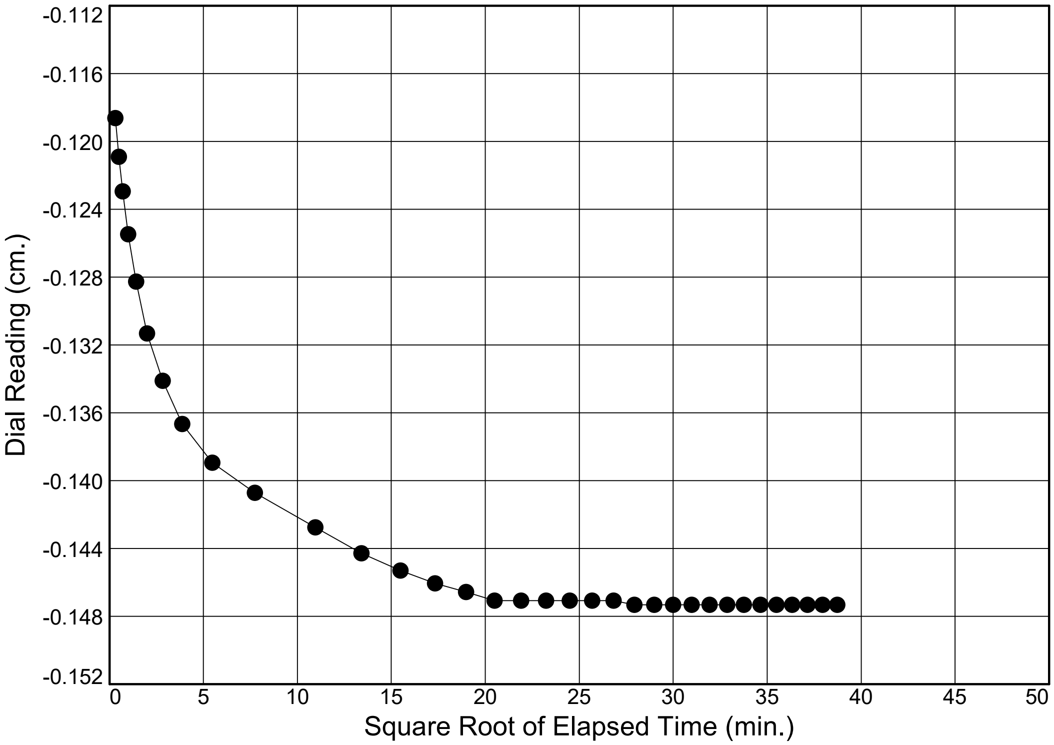
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-14 Depth: 5' Sample Number: T4



Load No.= 5

Load= 800.0 kPa

D_0 = -0.3005

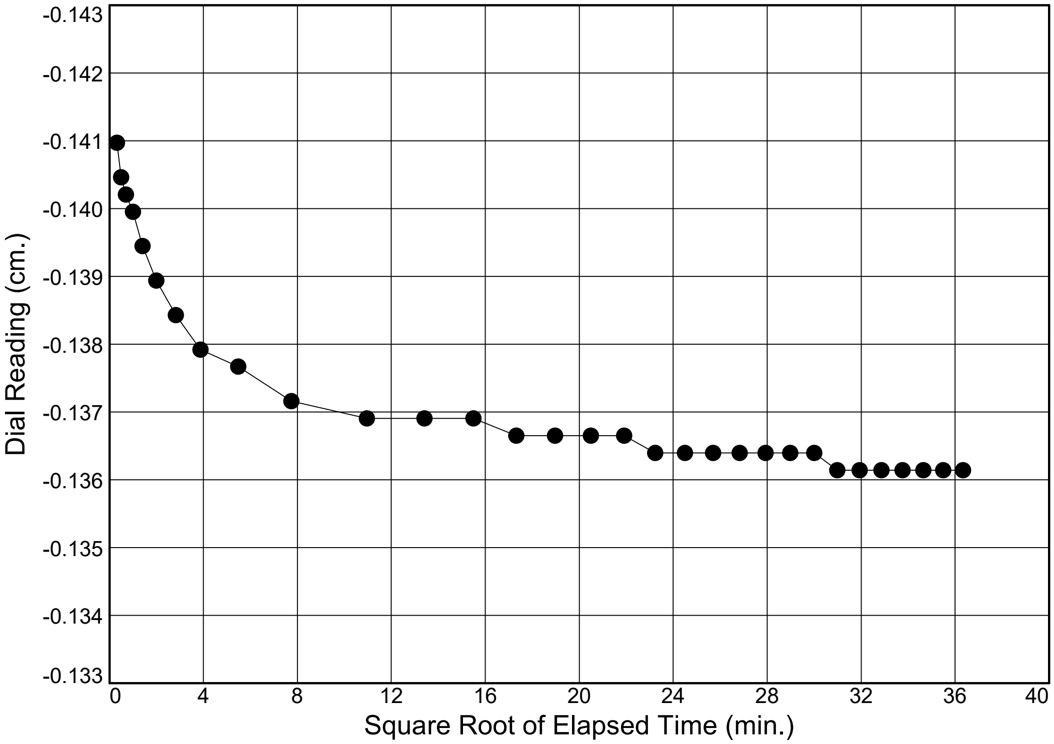
D_{90} = -0.3424

D_{100} = -0.3470

T_{90} = 9.68 min.

C_v @ T_{90}

0.0013 cm.^{2}/sec.



Load No.= 6

Load= 200.0 kPa

D_0 = -0.3581

D_{90} = -0.3510

D_{100} = -0.3502

T_{90} = 11.00 min.

C_v @ T_{90}

0.0011 cm.^{2}/sec.

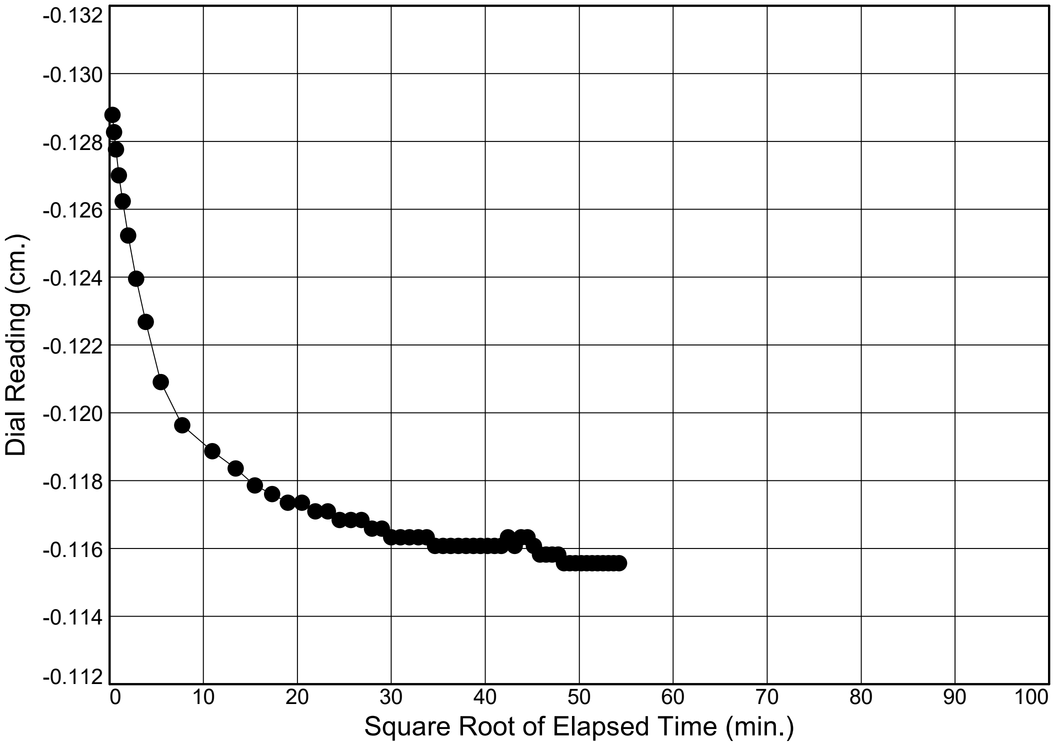
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-14 Depth: 5' Sample Number: T4



Load No.= 7

Load= 50.0 kPa

D_0 = -0.3269

D_{90} = -0.3061

D_{100} = -0.3037

T_{90} = 38.55 min.

C_v @ T_{90}

0.0003 cm.^{2}/sec.

Figure

Solum Consultants Ltd.

CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-04
Depth: 10'
Sample Number: T7

Test Specimen Data

NATURAL MOISTURE

Wet w+t = 164.36 g.
Dry w+t = 118.78 g.
Tare Wt. = 24.38 g.
Moisture = 48.3 %

VOID RATIO

Spec. Gr. = 2.7
Est. Ht. Solids = 1.085 cm.
Init. V.R. = 1.341
Init. Sat. = 97.3 %

AFTER TEST

Wet w+t = 178.50 g.
Dry w+t = 134.80 g.
Tare Wt. = 43.00 g.
Moisture = 47.6 %

UNIT WEIGHT

Height = 1.000 in.
Diameter = 2.500 in.
Weight = 137.60 g.
Dry Dens. = 1154 kg/m^3

TEST START

Height = 1.000 in.
Diameter = 2.500 in.

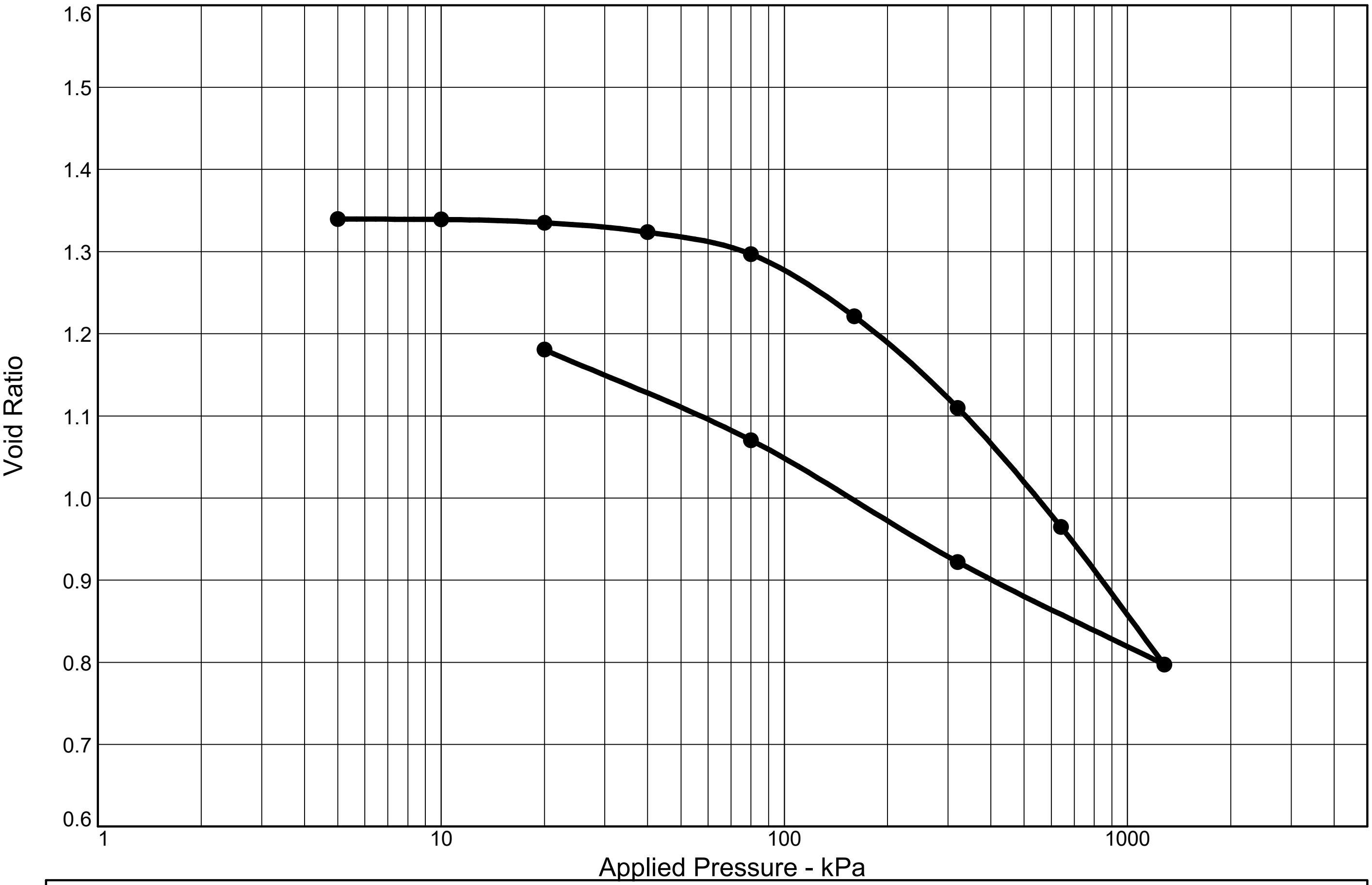
Dry Wt. = 91.80 g.

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	1.02991	0.00000			1.341	
5.0	1.03032	0.00041	0.0385		1.340	0.0 Comprs.
10.0	1.03051	0.00060	0.0081		1.339	0.1 Comprs.
20.0	1.03218	0.00227	0.0235		1.335	0.2 Comprs.
40.0	1.03714	0.00723	0.0330		1.324	0.7 Comprs.
80.0	1.04857	0.01866	0.0031		1.297	1.9 Comprs.
160.0	1.08094	0.05103	0.0002		1.221	5.1 Comprs.
320.0	1.12848	0.09857	0.0001		1.110	9.9 Comprs.
640.0	1.19052	0.16061	0.0001		0.965	16.1 Comprs.
1280.0	1.26203	0.23212	0.0001		0.797	23.2 Comprs.
320.0	1.20867	0.17876	0.0001		0.922	17.9 Comprs.
80.0	1.14534	0.11543	0.0000		1.070	11.5 Comprs.
20.0	1.09821	0.06830	0.0000		1.181	6.8 Comprs.

Compression index (C_c), kPa = 0.56 **Preconsolidation pressure (P_p), kPa =** 177 **Void ratio at P_p (e_m) =** 1.207

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
1	5.0	0.0385		8	640.0	0.0001					
2	10.0	0.0081		9	1280.0	0.0001					
3	20.0	0.0235		10	320.0	0.0001					
4	40.0	0.0330		11	80.0	0.0000					
5	80.0	0.0031		12	20.0	0.0000					
6	160.0	0.0002									
7	320.0	0.0001									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.3 %	48.3 %	1154			2.7		177	0.56		1.341

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 **Depth:** 10' **Sample Number:** T7

SOLUM CONSULTANTS LTD
GEOTECHNICAL & MATERIAL TESTING LABORATORY

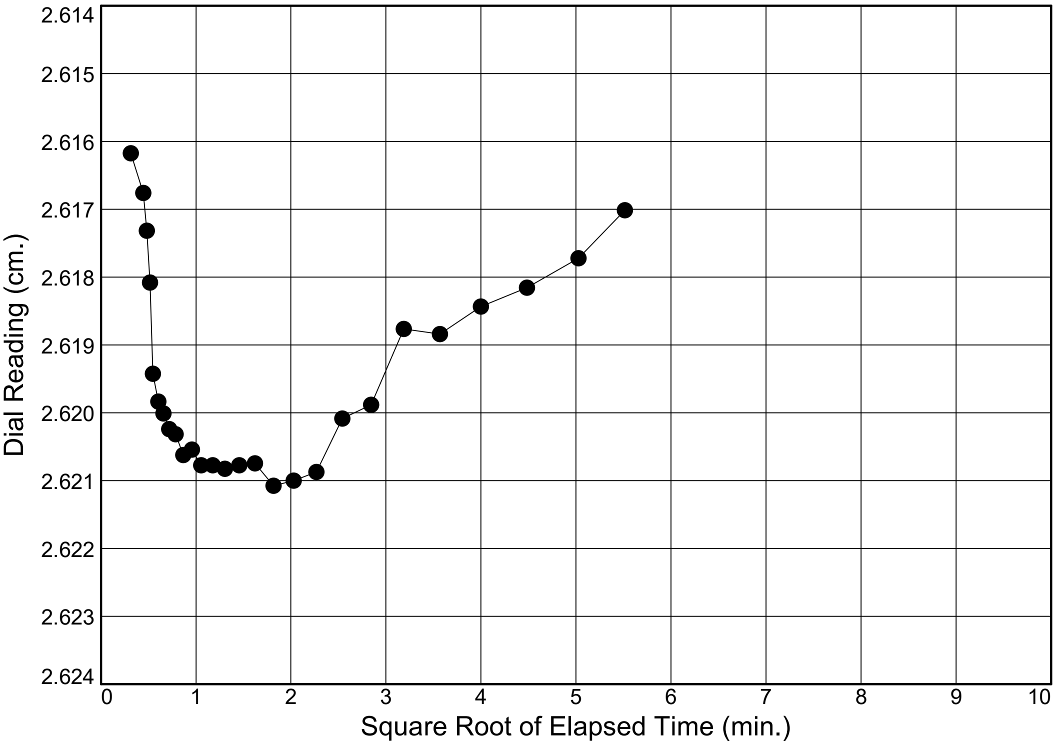
Remarks:

Figure

Dial Reading vs. Time

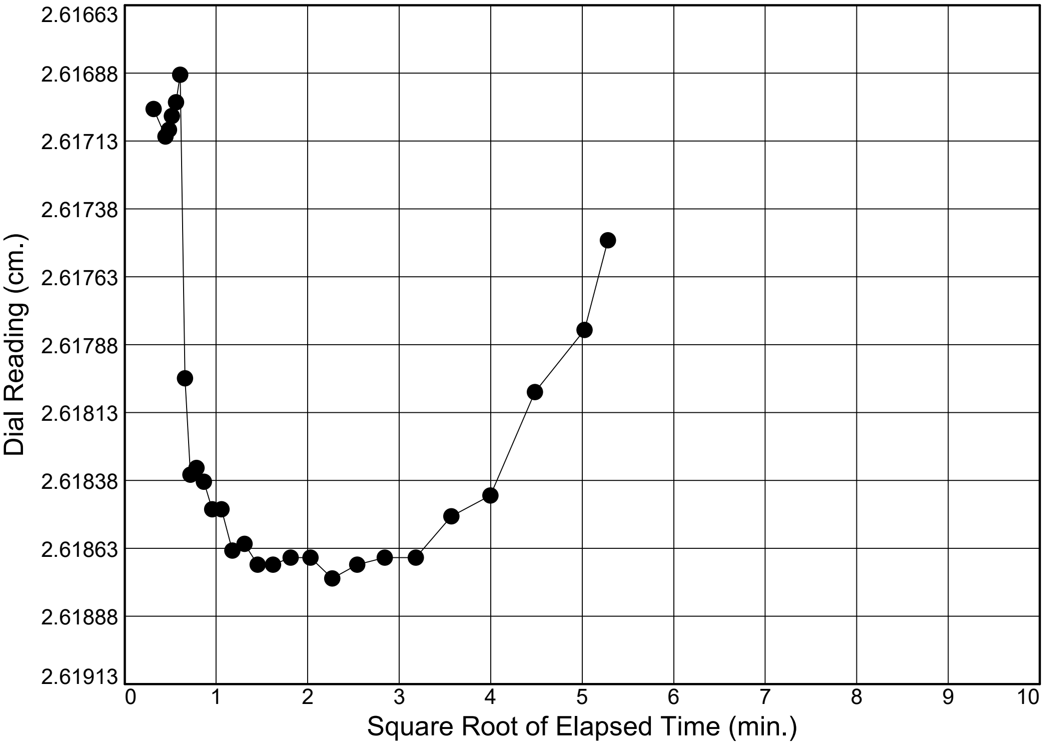
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 1
Load= 5.0 kPa
D_0 = 6.6334
D_{90} = 6.6556
D_{100} = 6.6580
T_{90} = 0.59 min.

C_v @ T_{90}
0.0385 cm.^{2}/sec.



Load No.= 2
Load= 10.0 kPa
D_0 = 6.6455
D_{90} = 6.6515
D_{100} = 6.6521
T_{90} = 2.82 min.

C_v @ T_{90}
0.0081 cm.^{2}/sec.

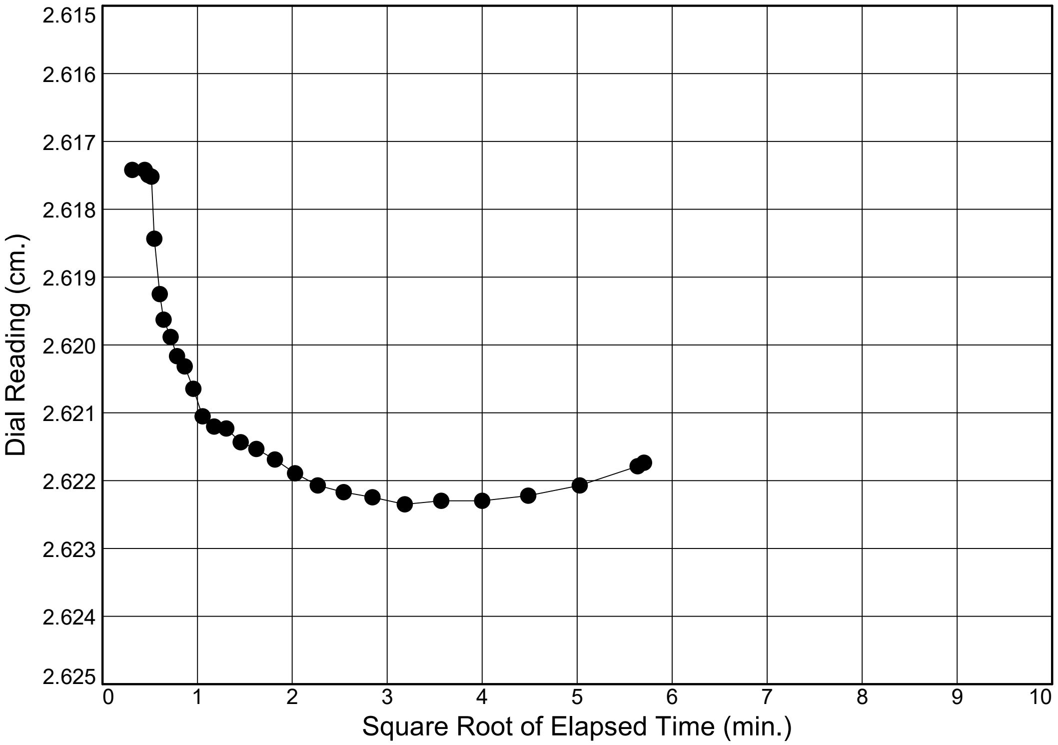
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

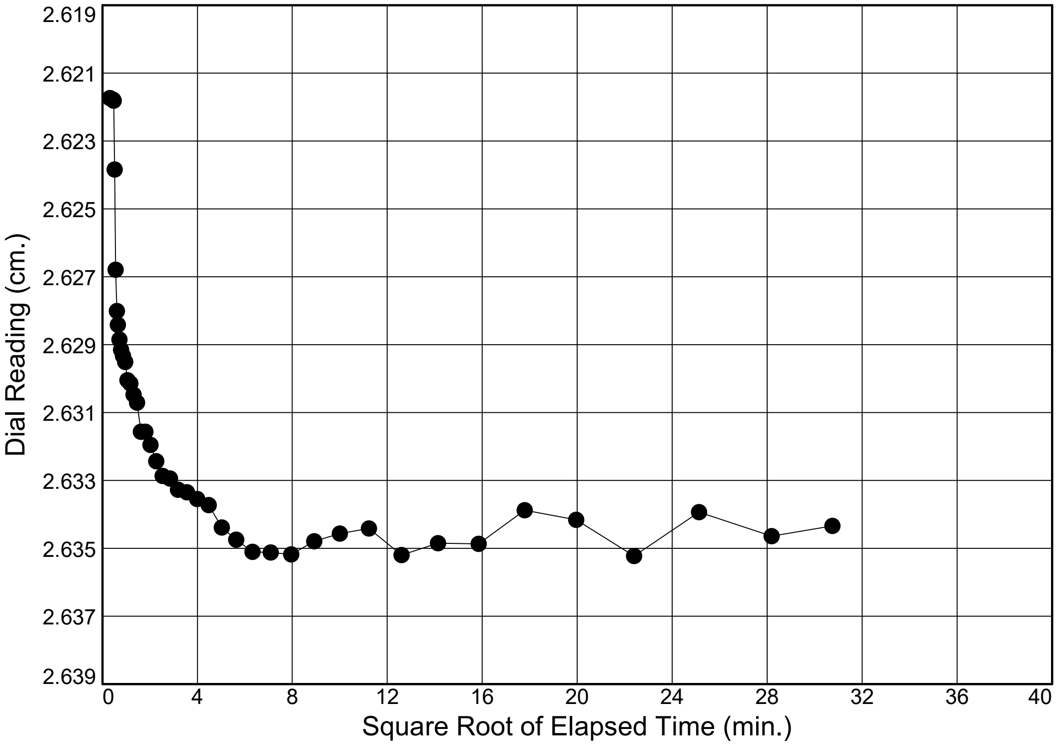
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 3
Load= 20.0 kPa
D_0 = 6.6406
D_{90} = 6.6567
D_{100} = 6.6585
T_{90} = 0.97 min.

C_v @ T_{90}
0.0235 $cm.^2$/sec.



Load No.= 4
Load= 40.0 kPa
D_0 = 6.6369
D_{90} = 6.6783
D_{100} = 6.6829
T_{90} = 0.68 min.

C_v @ T_{90}
0.0330 $cm.^2$/sec.

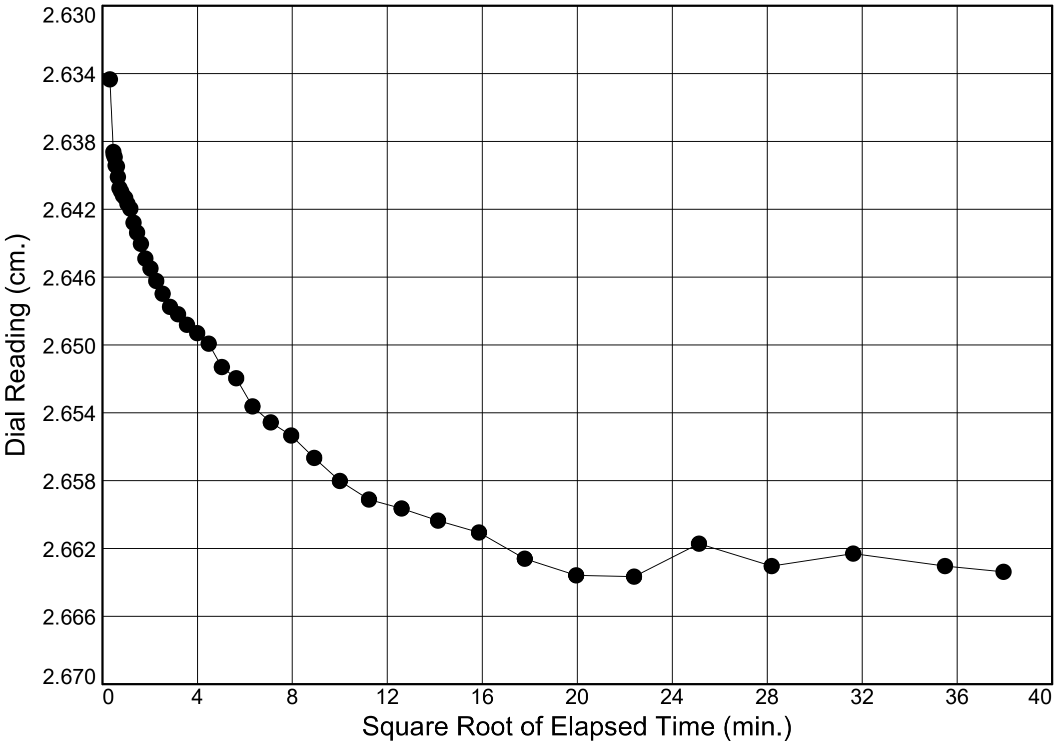
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

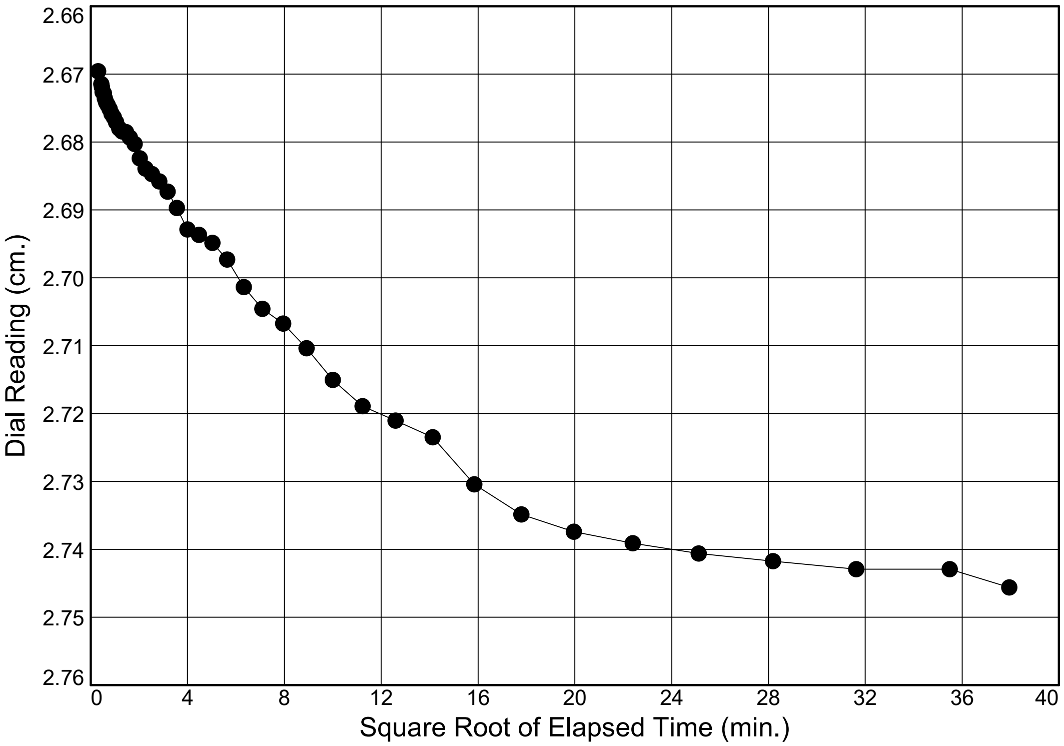
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 5
Load= 80.0 kPa
D_0 = 6.6966
D_{90} = 6.7242
D_{100} = 6.7273
T_{90} = 7.16 min.

C_v @ T_{90}
0.0031 cm.^{2}/sec.



Load No.= 6
Load= 160.0 kPa
D_0 = 6.7846
D_{90} = 6.9042
D_{100} = 6.9175
T_{90} = 120.97 min.

C_v @ T_{90}
0.0002 cm.^{2}/sec.

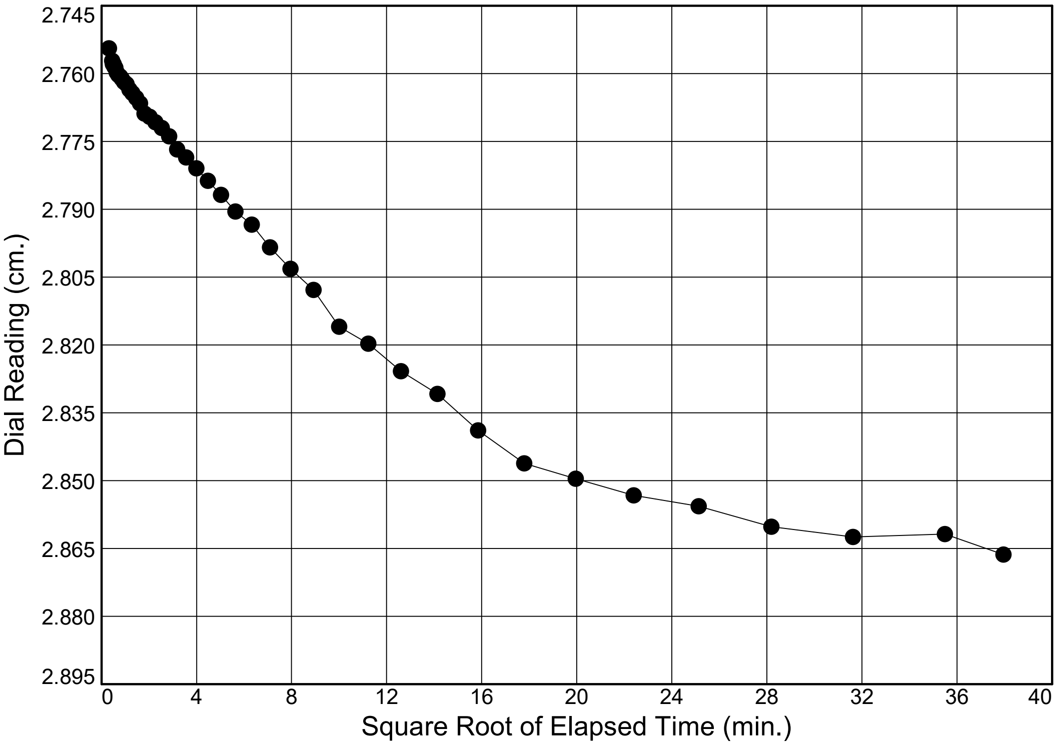
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

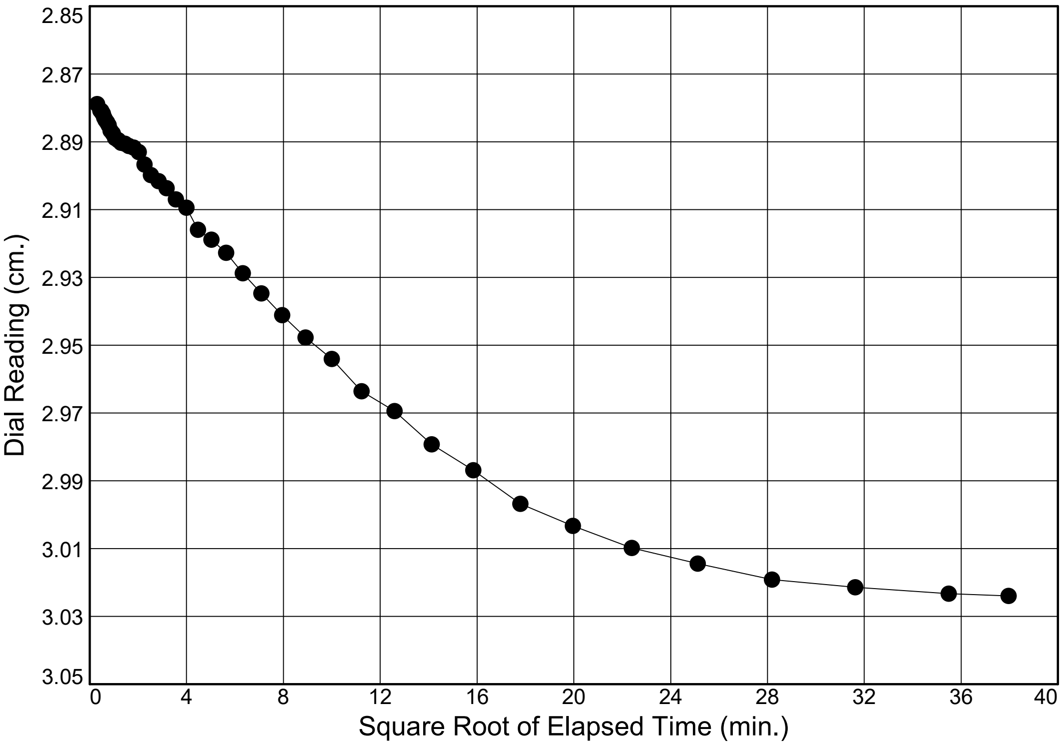
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 7
Load= 320.0 kPa
D_0 = 7.0003
D_{90} = 7.2077
D_{100} = 7.2308
T_{90} = 243.37 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.



Load No.= 8
Load= 640.0 kPa
D_0 = 7.3125
D_{90} = 7.5991
D_{100} = 7.6310
T_{90} = 282.51 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.

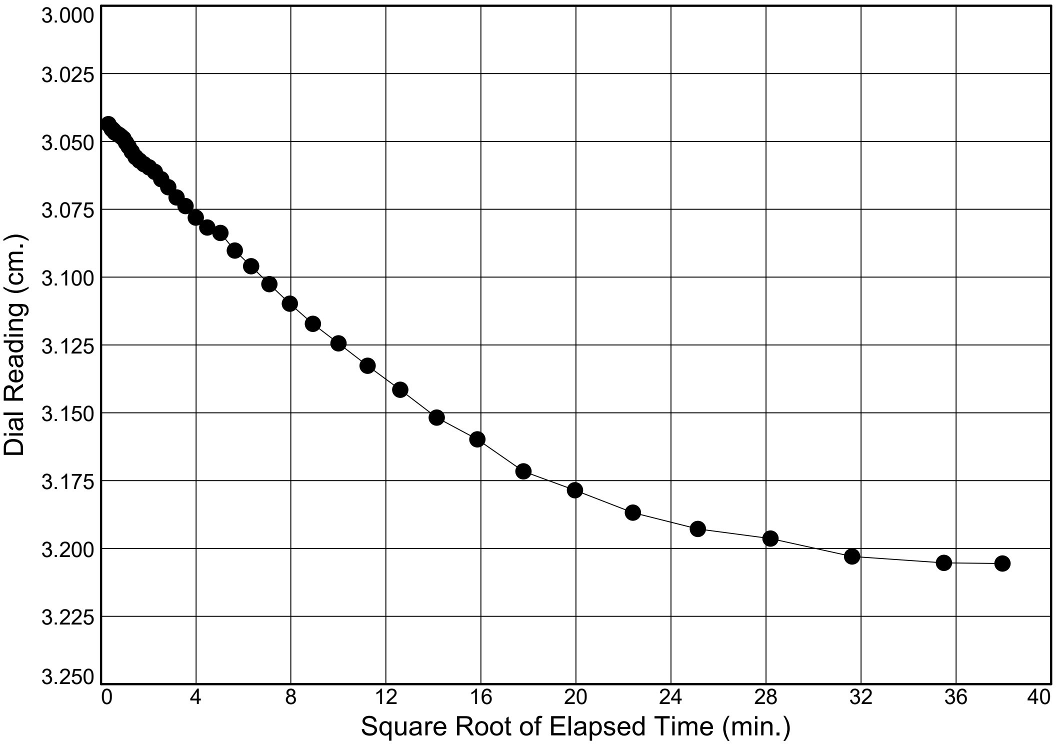
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 9

Load= 1280.0 kPa

D_0 = 7.7264

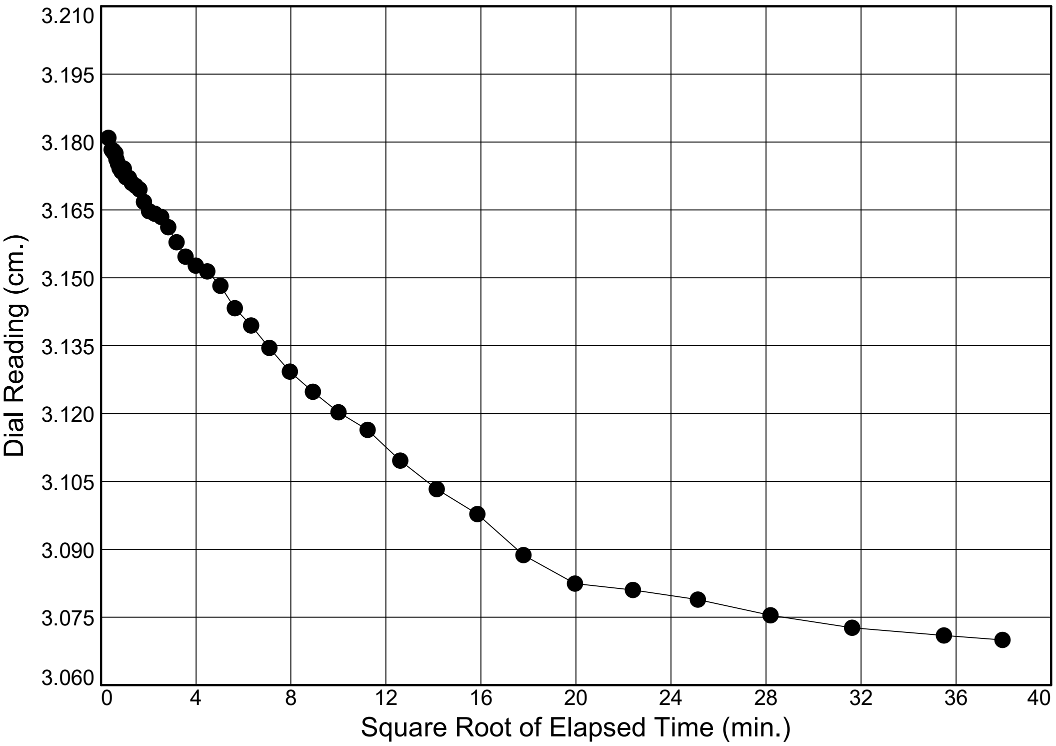
D_{90} = 8.0229

D_{100} = 8.0558

T_{90} = 243.87 min.

C_v @ T_{90}

0.0001 cm.^{2}/sec.



Load No.= 10

Load= 320.0 kPa

D_0 = 8.0774

D_{90} = 7.9162

D_{100} = 7.8983

T_{90} = 124.62 min.

C_v @ T_{90}

0.0001 cm.^{2}/sec.

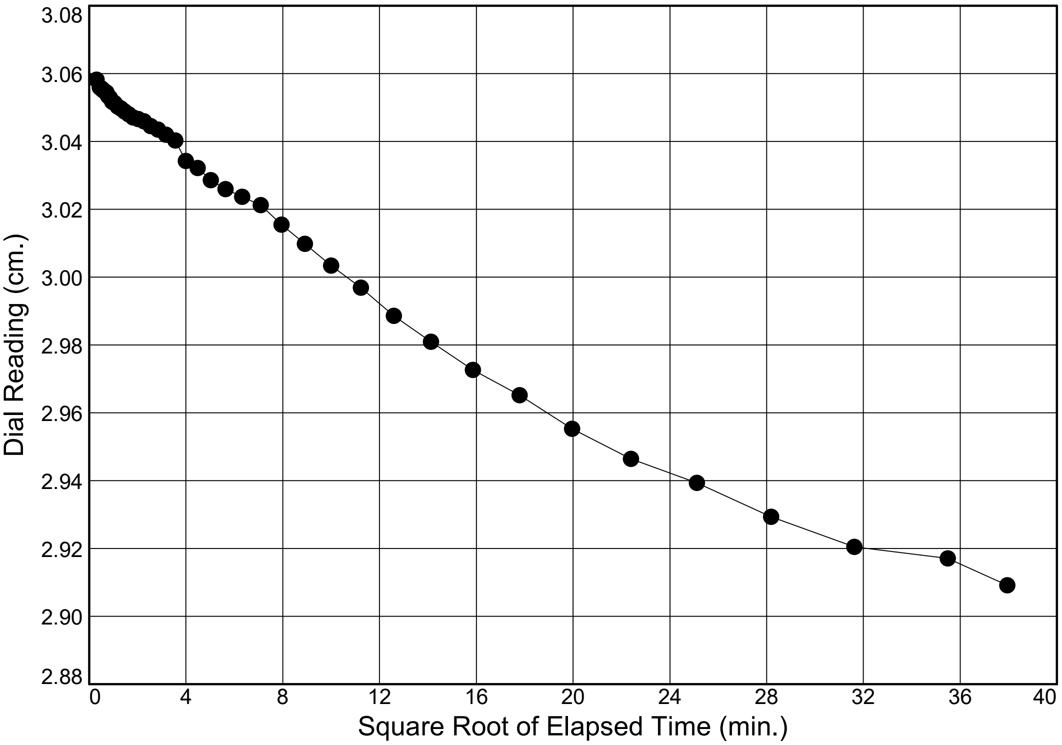
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-04 Depth: 10' Sample Number: T7



Load No.= 11

Load= 80.0 kPa

D_0 = 7.7670

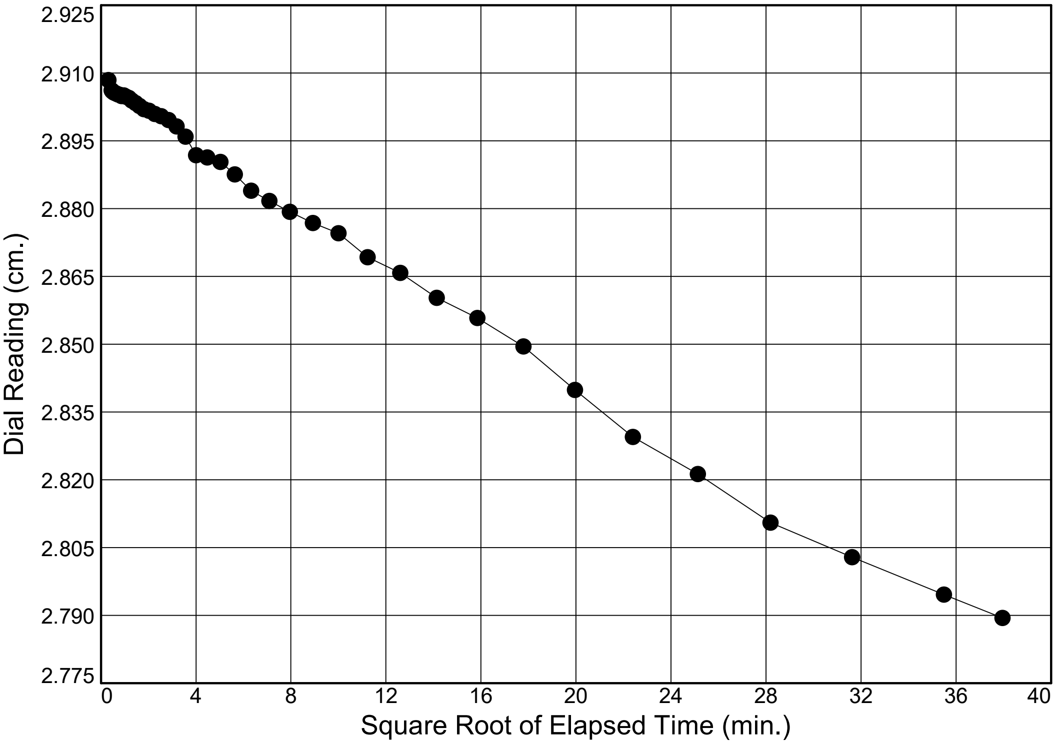
D_{90} = 7.4674

D_{100} = 7.4341

T_{90} = 621.19 min.

C_v @ T_{90}

0.0000 cm.^{2}/sec.



Load No.= 12

Load= 20.0 kPa

D_0 = 7.3873

D_{90} = 7.0934

D_{100} = 7.0608

T_{90} = 1325.14 min.

C_v @ T_{90}

0.0000 cm.^{2}/sec.

Figure

Solum Consultants Ltd.

CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-08
Depth: 30'
Sample Number: T12

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 105.33 g.
Dry w+t = 77.36 g.
Tare Wt. = 12.65 g.
Moisture = 43.2 %

VOID RATIO
Spec. Gr. = 2.7
Est. Ht. Solids = 1.161 cm.
Init. V.R. = 1.188
Init. Sat. = 98.2 %

AFTER TEST
Wet w+t = 145.38 g.
Dry w+t = 115.69 g.
Tare Wt. = 43.00 g.
Moisture = 40.8 %

UNIT WEIGHT
Height = 1.000 in.
Diameter = 2.500 in.
Weight = 142.15 g.
Dry Dens. = 1234 kg/m^3

TEST START
Height = 1.000 in.
Diameter = 2.500 in.

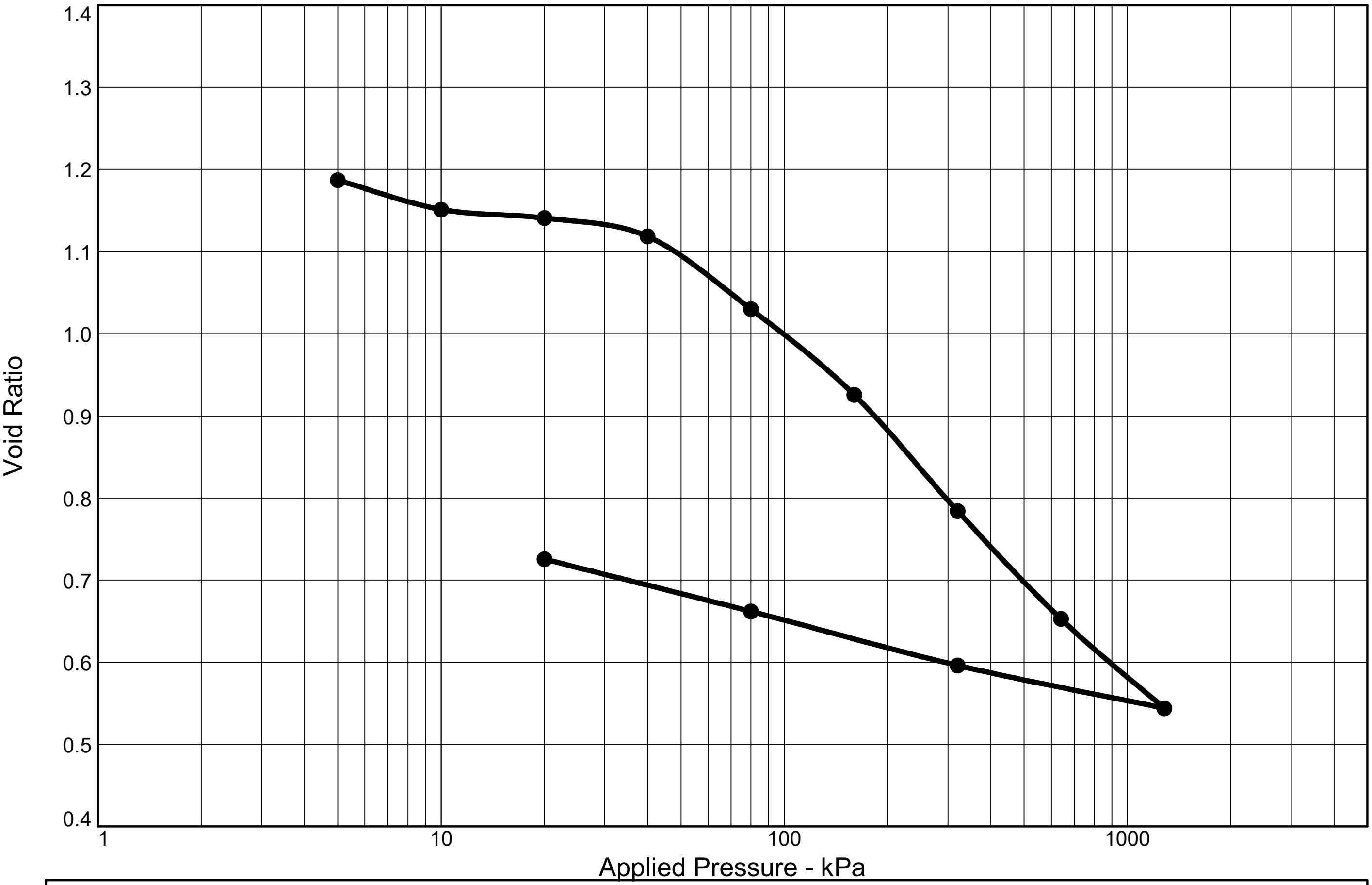
Dry Wt. = 72.69 g.

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	1.39742	0.00000			1.188	
5.0	1.39805	0.00063	0.0070		1.187	0.1 Comprs.
10.0	1.41438	0.01696	0.0156		1.151	1.7 Comprs.
20.0	1.41911	0.02169	0.0004		1.141	2.2 Comprs.
40.0	1.42935	0.03193	0.0007		1.118	3.2 Comprs.
80.0	1.46982	0.07240	0.0002		1.030	7.2 Comprs.
160.0	1.51744	0.12002	0.0002		0.926	12.0 Comprs.
320.0	1.58217	0.18475	0.0001		0.784	18.5 Comprs.
640.0	1.64217	0.24475	0.0001		0.653	24.5 Comprs.
1280.0	1.69183	0.29441	0.0001		0.544	29.4 Comprs.
320.0	1.66797	0.27055	0.0003		0.596	27.1 Comprs.
80.0	1.63797	0.24055	0.0001		0.662	24.1 Comprs.
20.0	1.60887	0.21145	0.0000		0.726	21.1 Comprs.

Compression index (C_c), kPa = 0.49 **Preconsolidation pressure (P_p), kPa =** 117 **Void ratio at P_p (e_m) =** 0.976

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
1	5.0	0.0070		8	640.0	0.0001					
2	10.0	0.0156		9	1280.0	0.0001					
3	20.0	0.0004		10	320.0	0.0003					
4	40.0	0.0007		11	80.0	0.0001					
5	80.0	0.0002		12	20.0	0.0000					
6	160.0	0.0002									
7	320.0	0.0001									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
98.2 %	43.2 %	1234			2.7		117	0.49		1.188

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 **Depth:** 30' **Sample Number:** T12

SOLUM™
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GEOTECHNICAL & MATERIAL TESTING LABORATORY

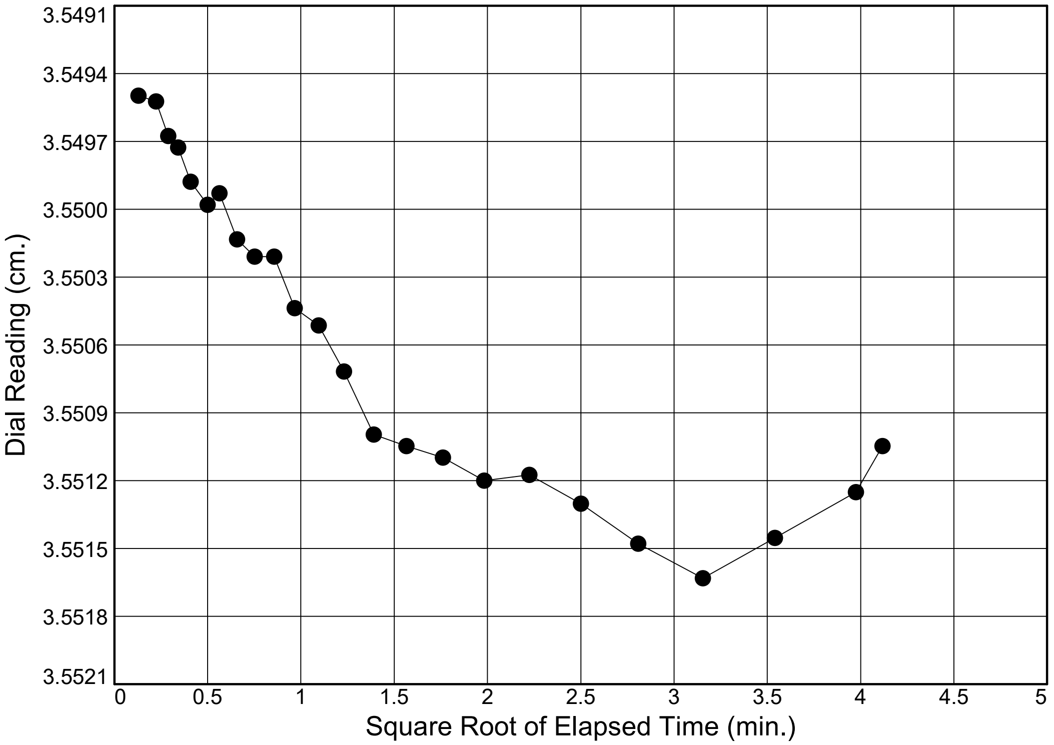
Remarks:

Figure

Dial Reading vs. Time

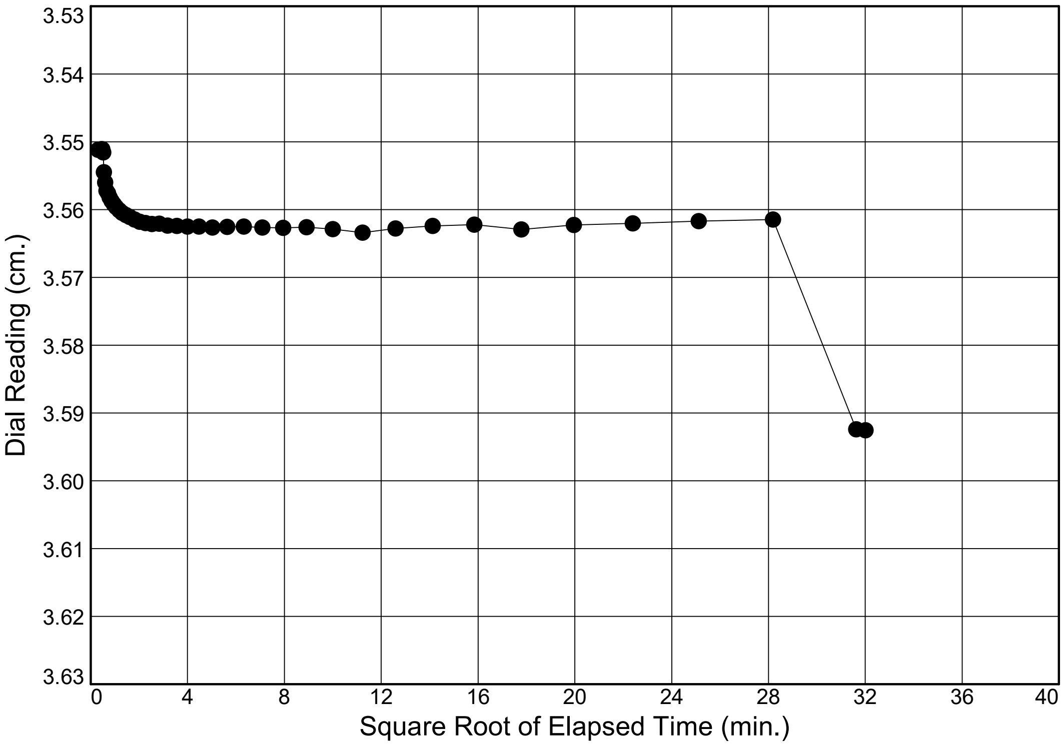
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 1
Load= 5.0 kPa
D_0 = 9.0153
D_{90} = 9.0198
D_{100} = 9.0203
T_{90} = 3.27 min.

C_v @ T_{90}
0.0070 cm.^{2}/sec.



Load No.= 2
Load= 10.0 kPa
D_0 = 9.0092
D_{90} = 9.0428
D_{100} = 9.0465
T_{90} = 1.43 min.

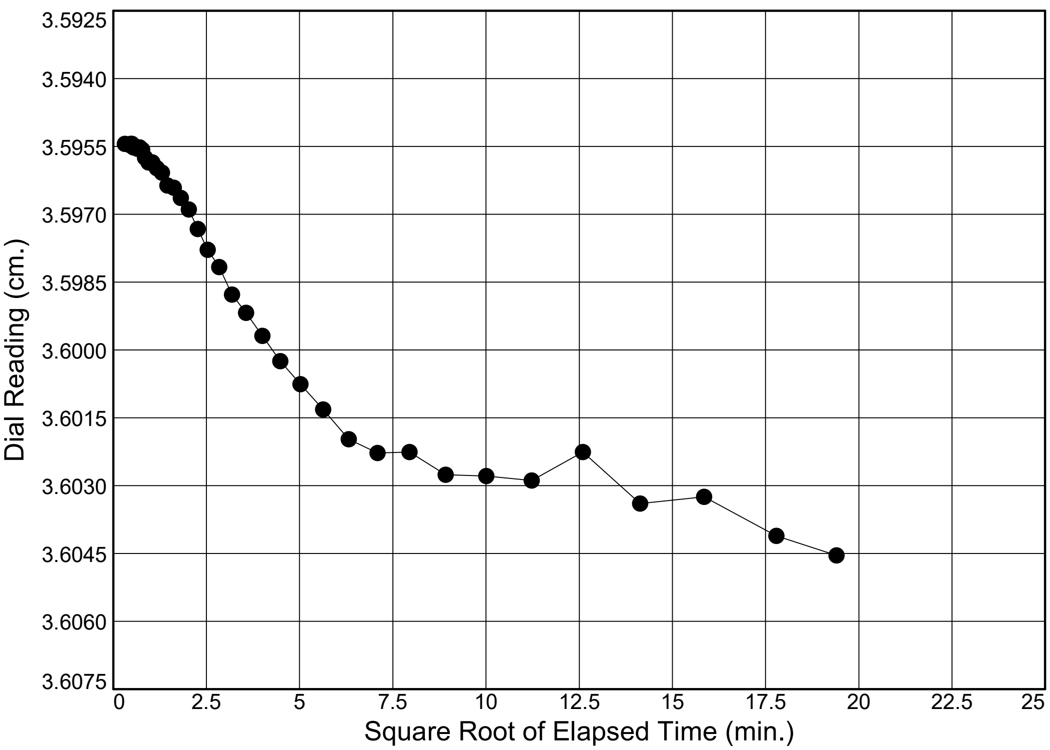
C_v @ T_{90}
0.0156 cm.^{2}/sec.

Figure

Dial Reading vs. Time

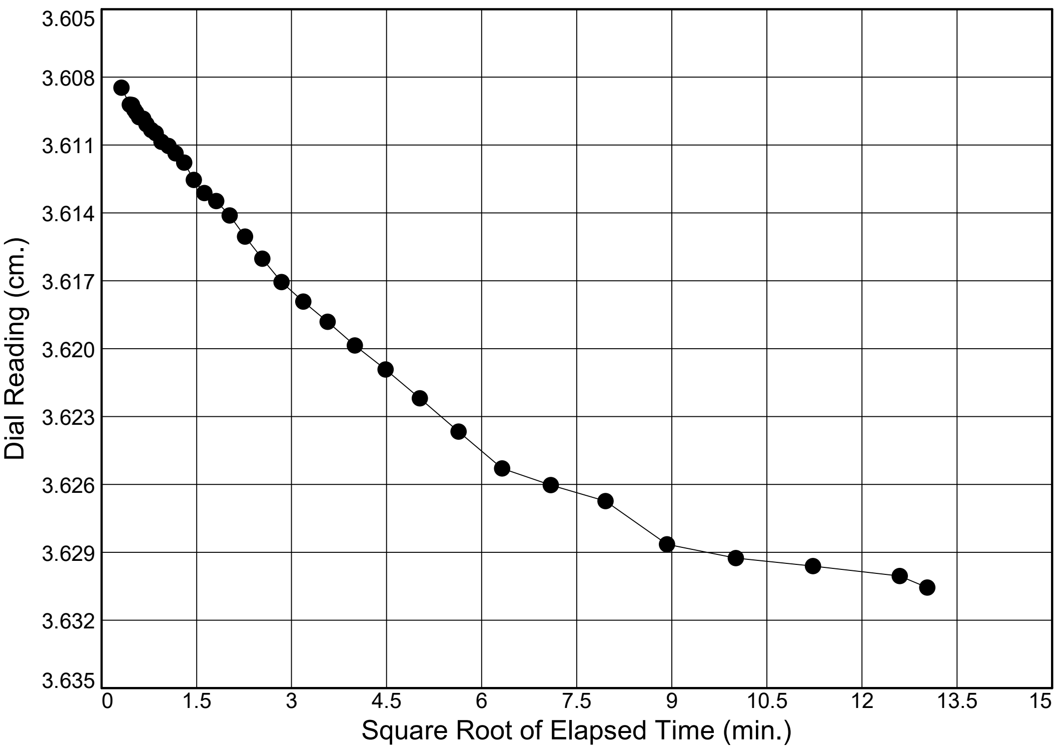
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 3
Load= 20.0 kPa
D_0 = 9.1309
D_{90} = 9.1498
D_{100} = 9.1519
T_{90} = 52.25 min.

C_v @ T_{90}
0.0004 cm.^{2}/sec.



Load No.= 4
Load= 40.0 kPa
D_0 = 9.1635
D_{90} = 9.2040
D_{100} = 9.2085
T_{90} = 31.60 min.

C_v @ T_{90}
0.0007 cm.^{2}/sec.

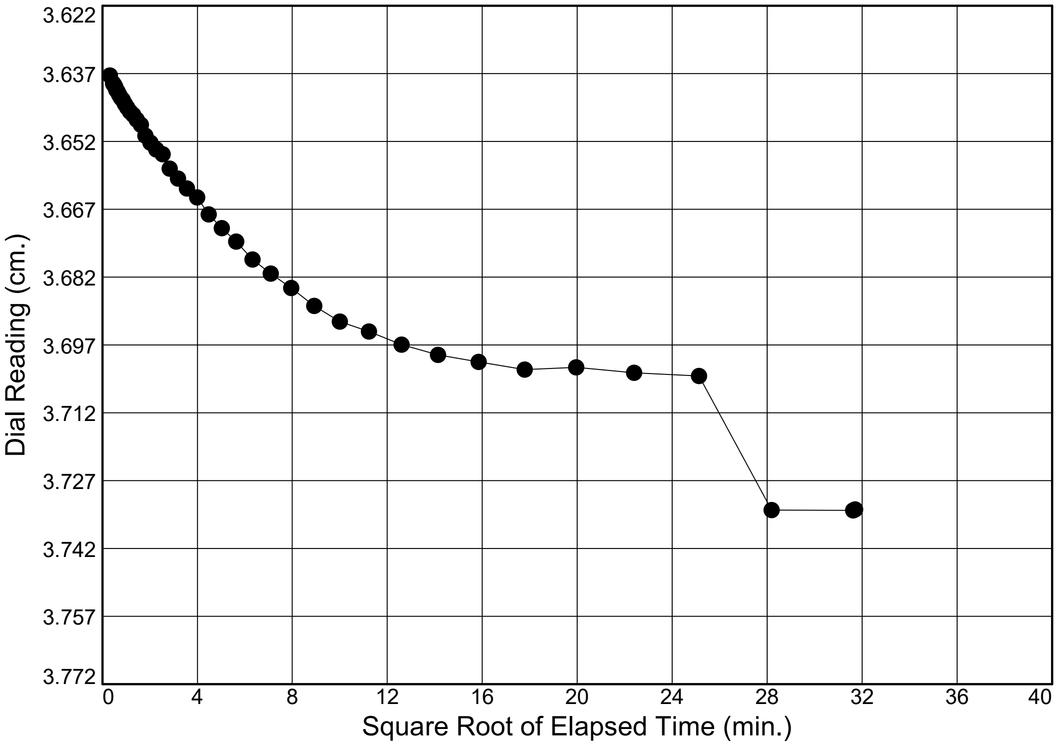
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 5

Load= 80.0 kPa

D_0 = 9.2398

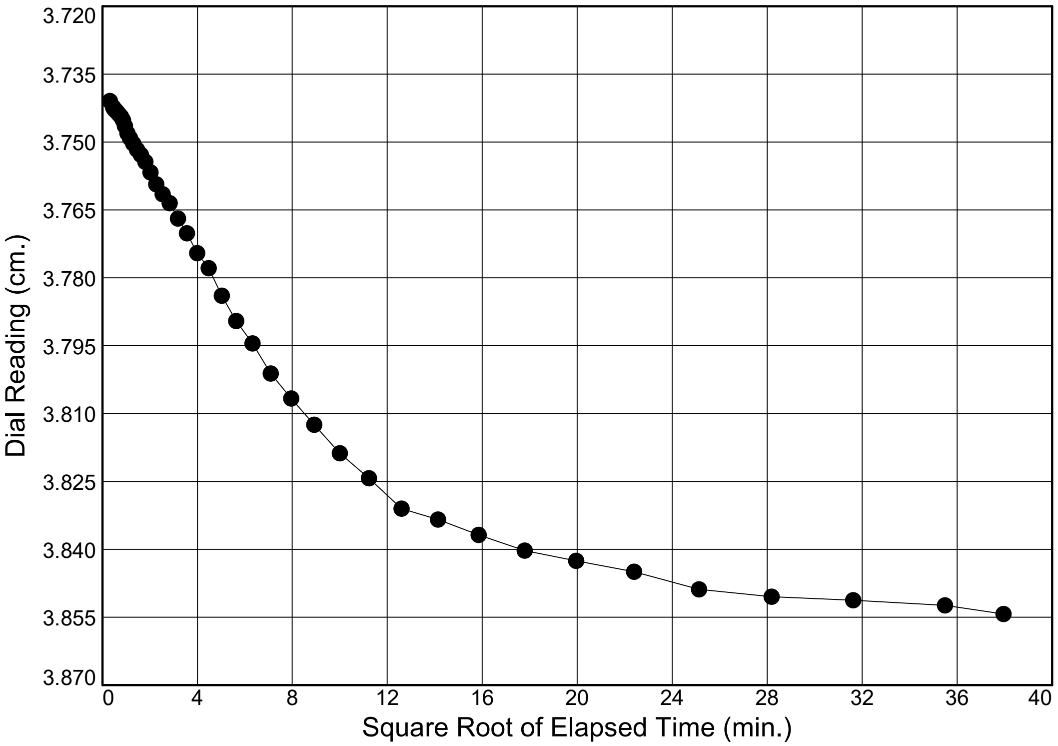
D_{90} = 9.3717

D_{100} = 9.3864

T_{90} = 87.00 min.

C_v @ T_{90}

0.0002 cm.^{2}/sec.



Load No.= 6

Load= 160.0 kPa

D_0 = 9.4949

D_{90} = 9.7077

D_{100} = 9.7313

T_{90} = 114.58 min.

C_v @ T_{90}

0.0002 cm.^{2}/sec.

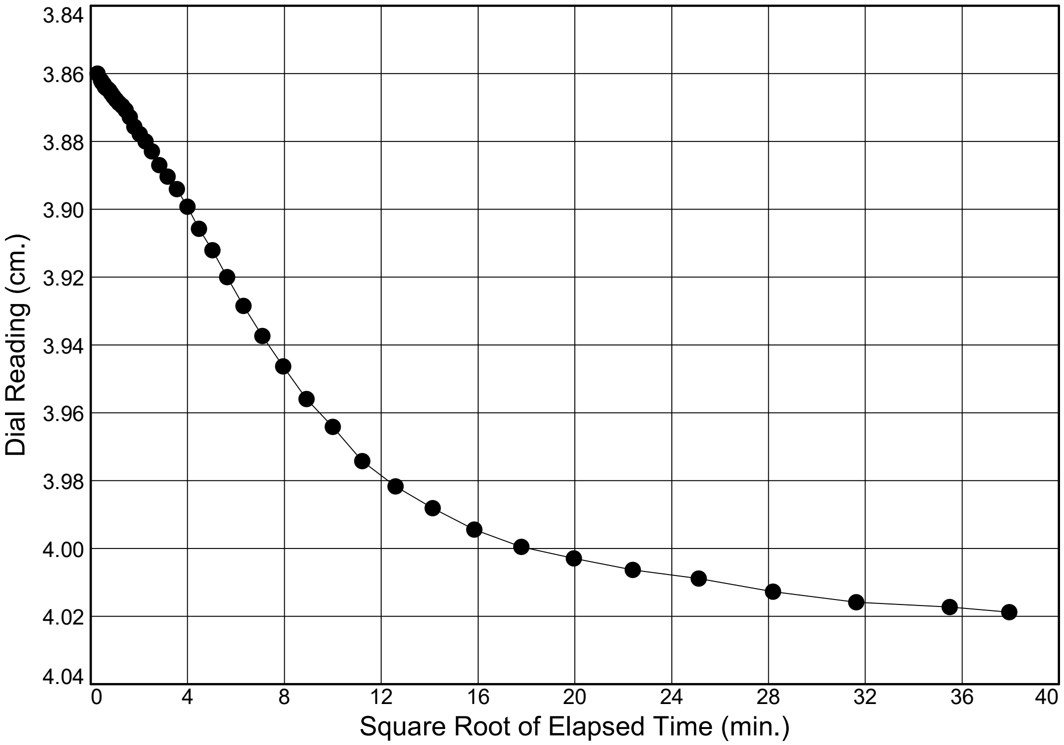
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

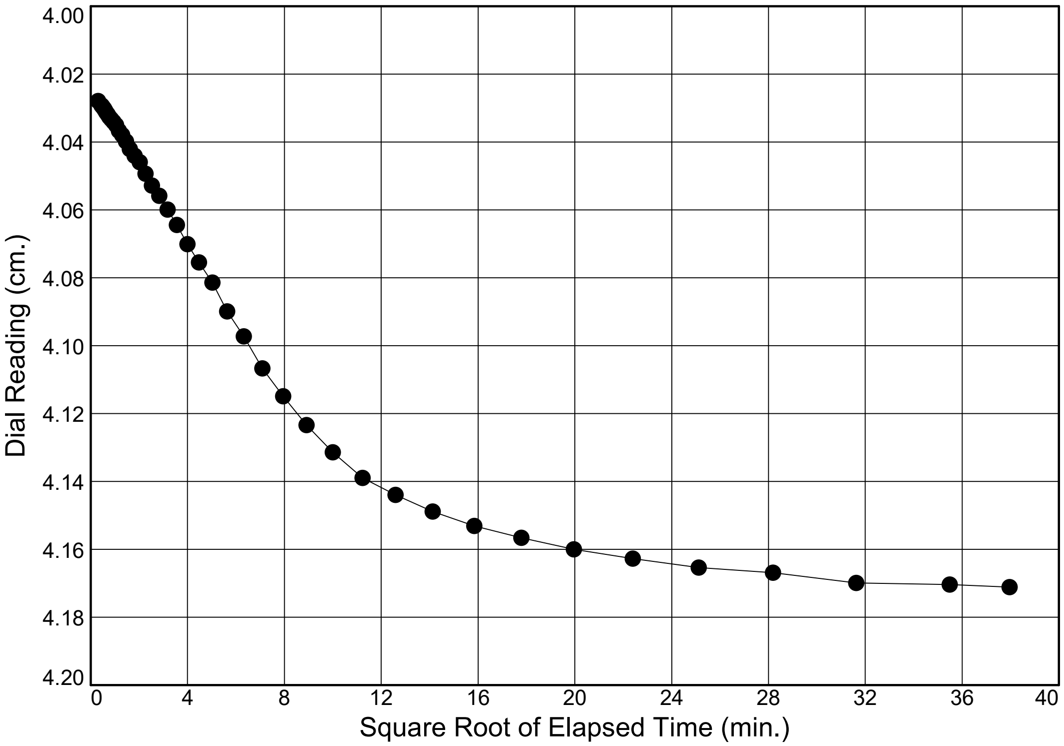
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 7
Load= 320.0 kPa
D_0 = 9.7956
D_{90} = 10.1244
D_{100} = 10.1609
T_{90} = 185.72 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.



Load No.= 8
Load= 640.0 kPa
D_0 = 10.2200
D_{90} = 10.5176
D_{100} = 10.5507
T_{90} = 137.66 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.

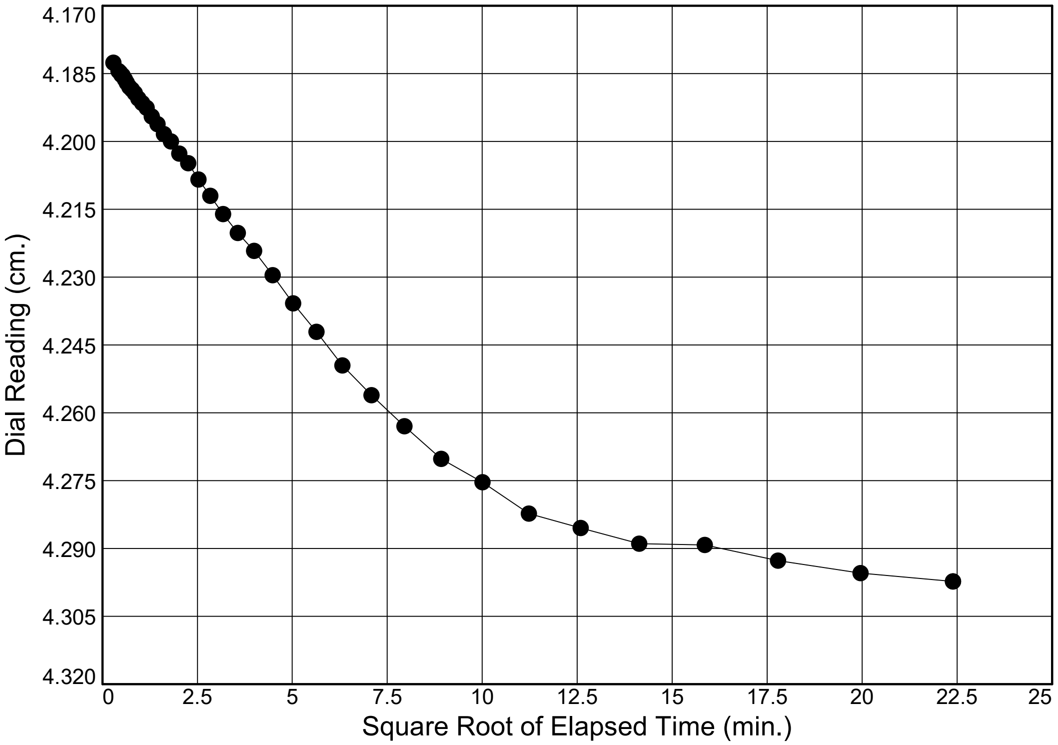
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

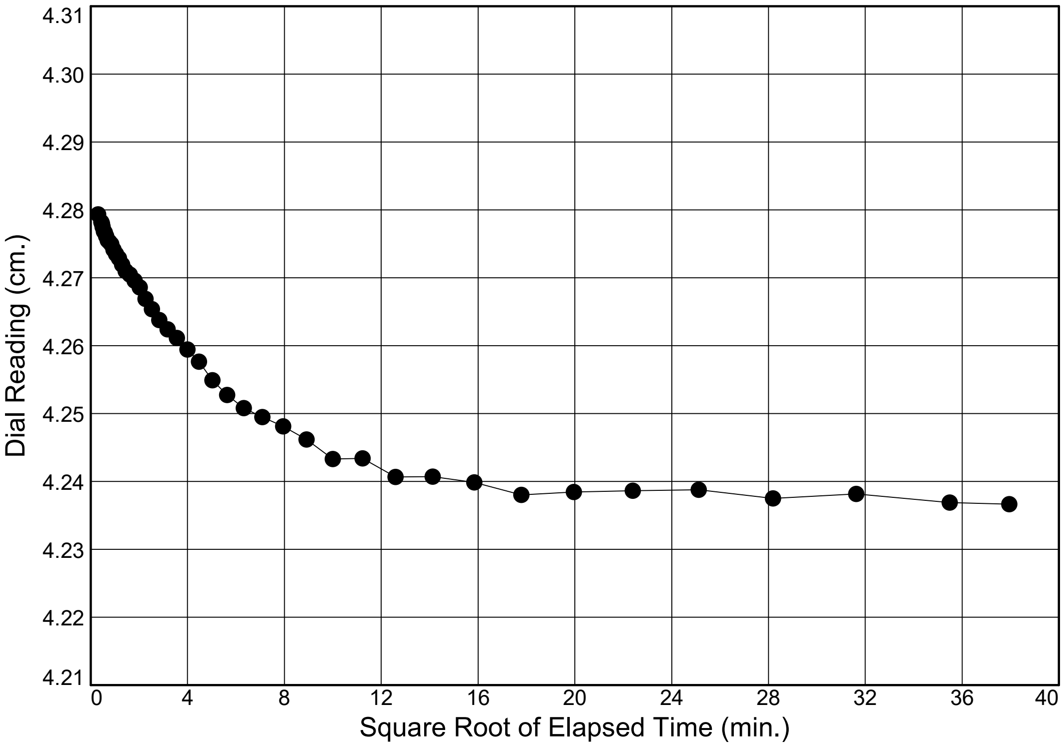
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 9
Load= 1280.0 kPa
D_0 = 10.6174
D_{90} = 10.8583
D_{100} = 10.8851
T_{90} = 98.35 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.



Load No.= 10
Load= 320.0 kPa
D_0 = 10.8695
D_{90} = 10.7963
D_{100} = 10.7882
T_{90} = 42.07 min.

C_v @ T_{90}
0.0003 cm.^{2}/sec.

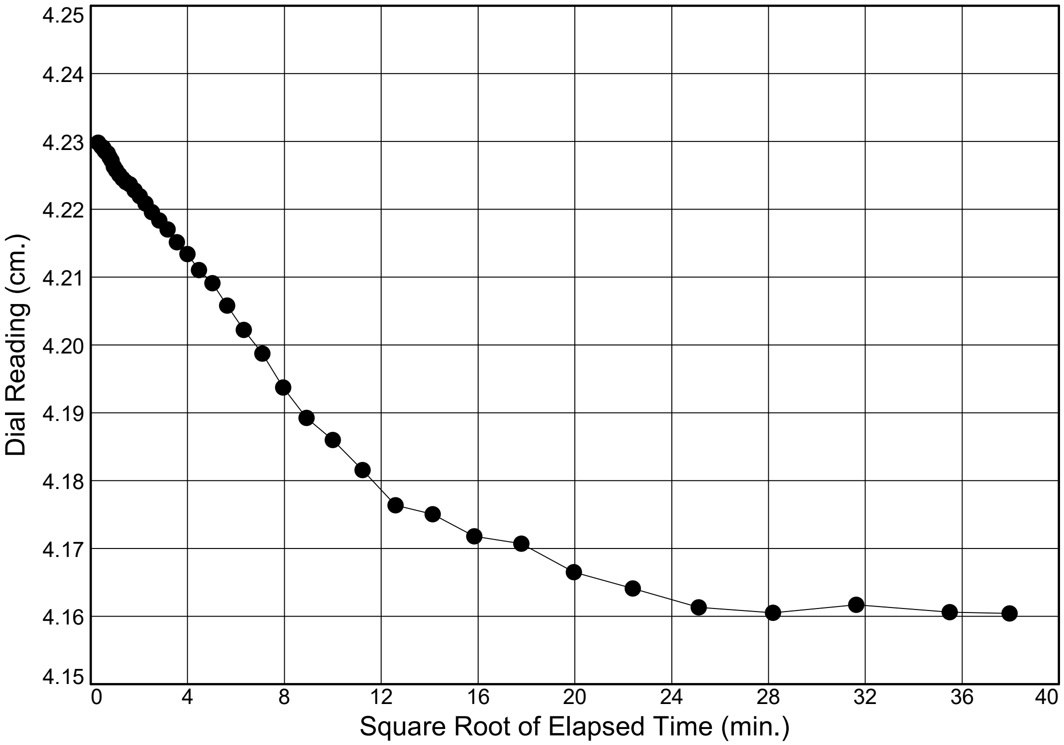
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

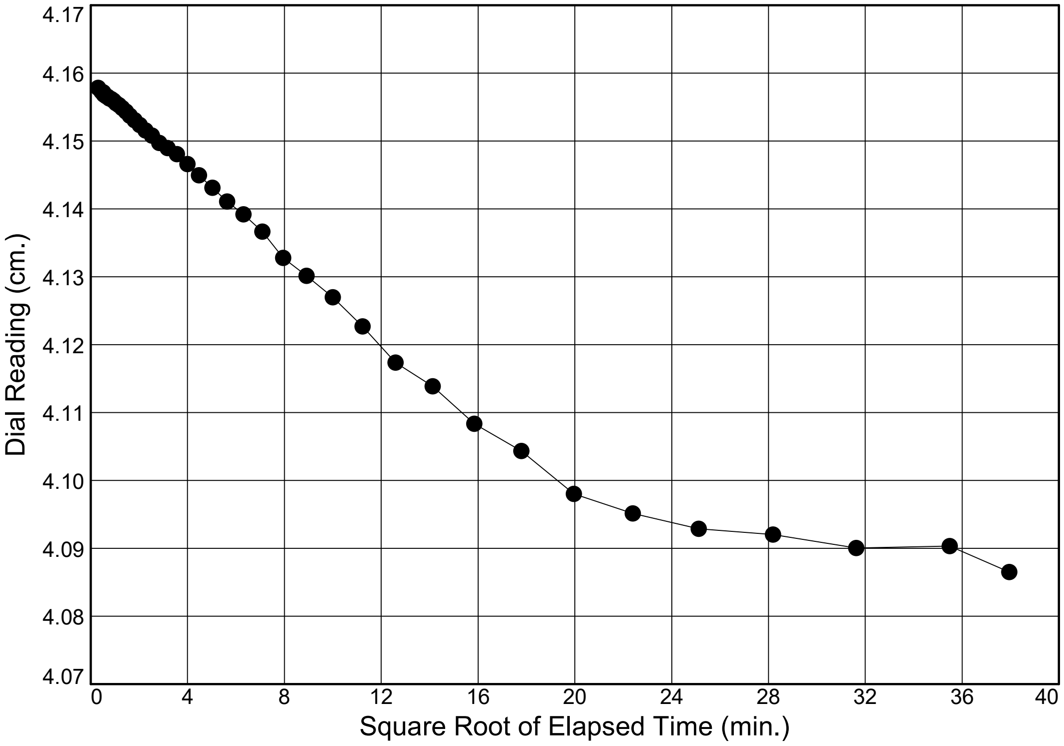
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-08 Depth: 30' Sample Number: T12



Load No.= 11
Load= 80.0 kPa
D_0 = 10.7466
D_{90} = 10.6025
D_{100} = 10.5864
T_{90} = 212.91 min.

C_v @ T_{90}
0.0001 cm.^{2}/sec.



Load No.= 12
Load= 20.0 kPa
D_0 = 10.5637
D_{90} = 10.4002
D_{100} = 10.3821
T_{90} = 532.68 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.

Figure

Solum Consultants Ltd.

CONSOLIDATION TEST DATA

2024-03-08

Client: AECOM
Project: Winnipeg Transit North Garage Project
Project Number: 60721079
Location: TH24-11
Depth: 20'
Sample Number: T10

Test Specimen Data

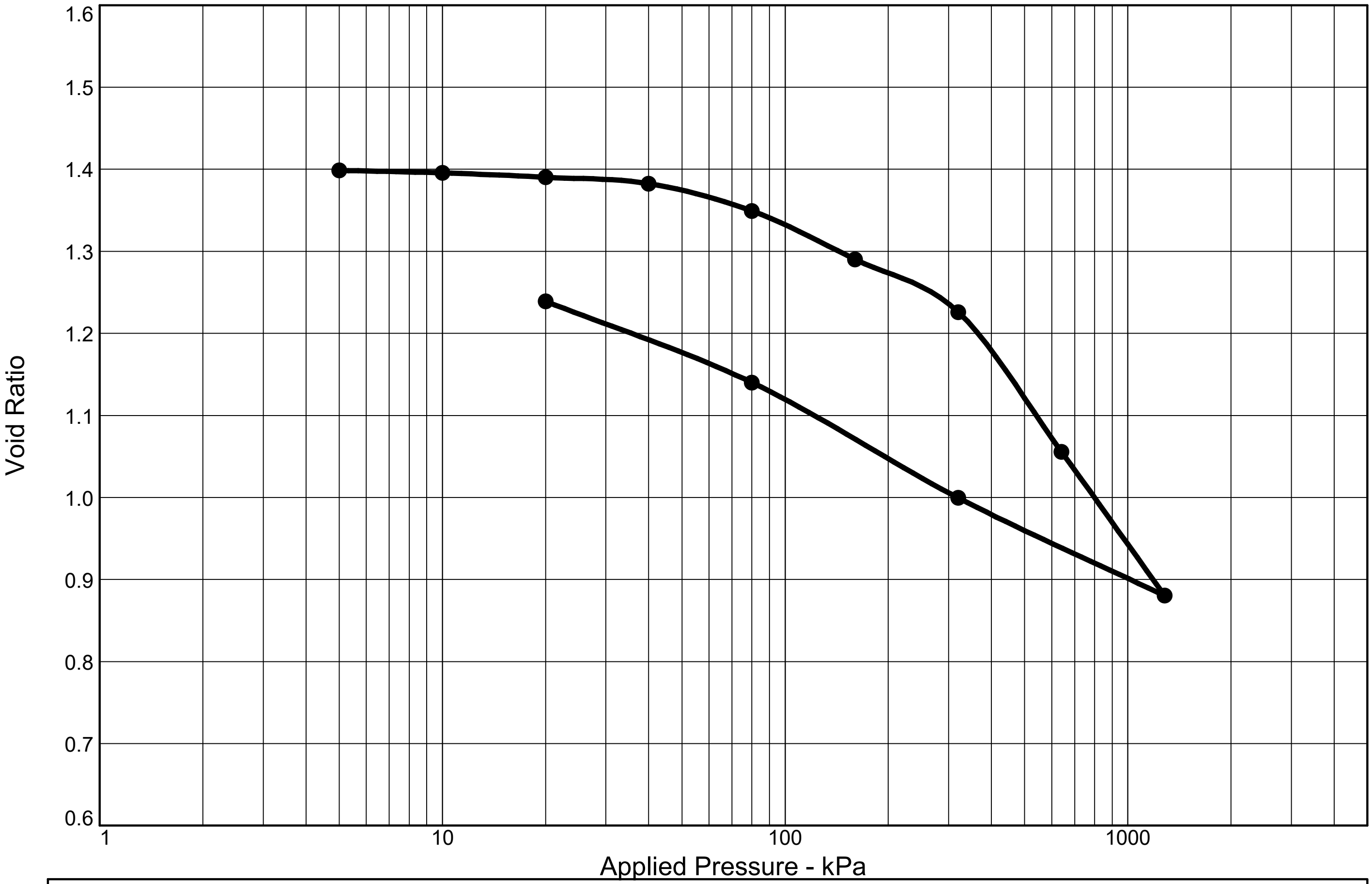
NATURAL MOISTURE		VOID RATIO		AFTER TEST	
Wet w+t =	117.36 g.	**Spec. Gr.**	= 2.7	**Wet w+t** =	142.86 g.
Dry w+t =	86.54 g.	**Est. Ht. Solids**	= 1.060 cm.	**Dry w+t** =	110.32 g.
Tare Wt. =	25.33 g.	**Init. V.R.**	= 1.395	**Tare Wt.** =	43.00 g.
Moisture =	50.4 %	**Init. Sat.**	= 97.4 %	**Moisture** =	48.3 %
UNIT WEIGHT		**TEST START**		**Dry Wt.** =	67.32 g.
Height =	1.000 in.	**Height**	= 1.000 in.		
Diameter =	2.500 in.	**Diameter**	= 2.500 in.		
Weight =	136.33 g.				
Dry Dens. =	1127 kg/m^3				

End-Of-Load Summary

Pressure (kPa)	Final Dial (in.)	Deformation (in.)	C_v (cm.^{2}/sec.)	C_α	Void Ratio	% Strain
start	0.98085	0.00000			1.395	
5.0	0.97940	-0.00145			1.399	0.1 Swell
10.0	0.98071	-0.00014			1.396	0.0 Swell
20.0	0.98294	0.00209	0.0172		1.390	0.2 Comprs.
40.0	0.98620	0.00535	0.0078		1.382	0.5 Comprs.
80.0	1.00007	0.01922	0.0112		1.349	1.9 Comprs.
160.0	1.02469	0.04384	0.0010		1.290	4.4 Comprs.
320.0	1.05152	0.07067			1.226	7.1 Comprs.
640.0	1.12261	0.14176			1.056	14.2 Comprs.
1280.0	1.19583	0.21498	0.0000		0.880	21.5 Comprs.
320.0	1.14606	0.16521	0.0003		1.000	16.5 Comprs.
80.0	1.08737	0.10652	0.0000		1.140	10.7 Comprs.
20.0	1.04602	0.06517	0.0000		1.239	6.5 Comprs.

Compression index (C_c), kPa = 0.63 **Preconsolidation pressure (P_p), kPa =** 217 **Void ratio at P_p (e_m) =** 1.270

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α	No.	Load (kPa)	C_v (cm.^{2}/sec.)	C_α
3	20.0	0.0172		12	20.0	0.0000					
4	40.0	0.0078									
5	80.0	0.0112									
6	160.0	0.0010									
9	1280.0	0.0000									
10	320.0	0.0003									
11	80.0	0.0000									

Natural		Dry Dens. (kg/m^3)	LL	PI	Sp. Gr.	Overburden (kPa)	P_c (kPa)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
97.4 %	50.4 %	1127			2.7		217	0.63		1.395

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 60721079 **Client:** AECOM

Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-11 **Depth:** 20' **Sample Number:** T10

SOLUM™
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GEOTECHNICAL & MATERIAL TESTING LABORATORY

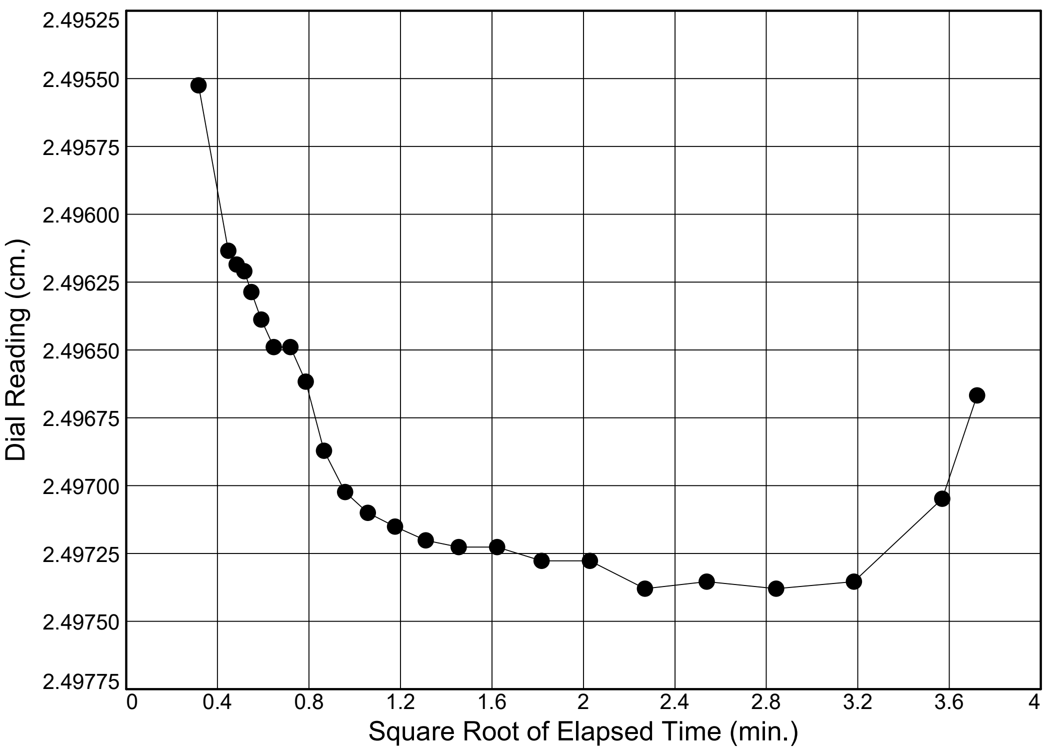
Remarks:

Figure

Dial Reading vs. Time

Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-11 Depth: 20' Sample Number: T10



Load No.= 3

Load= 20.0 kPa

D_0 = 6.3376

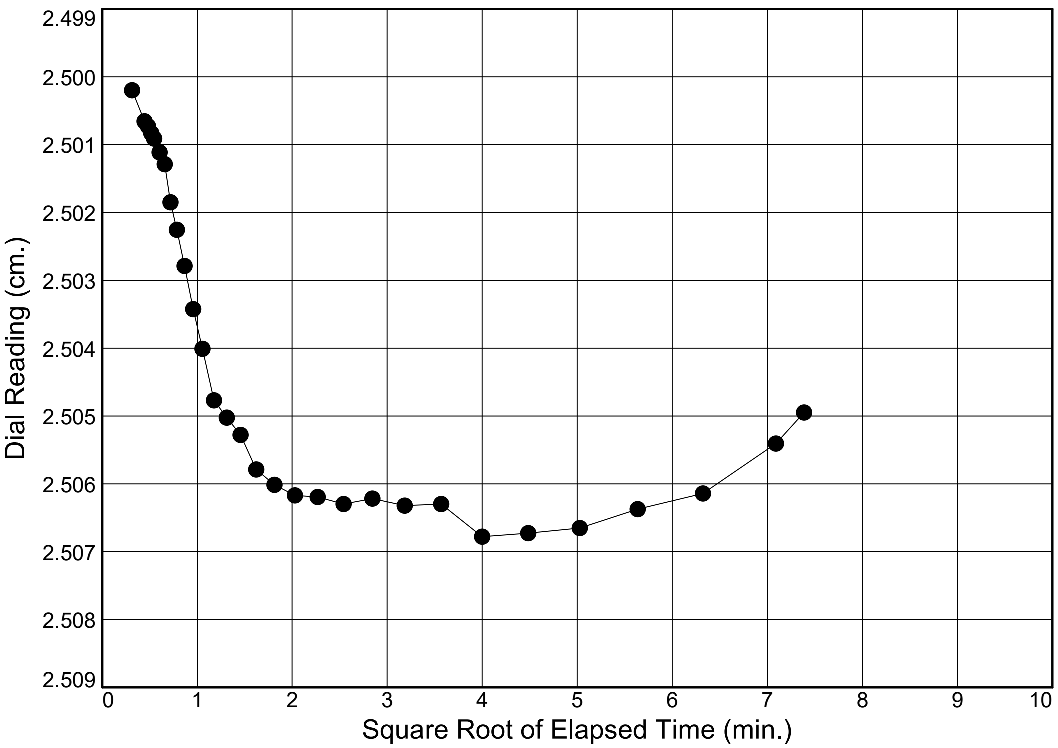
D_{90} = 6.3427

D_{100} = 6.3433

T_{90} = 1.32 min.

C_v @ T_{90}

0.0172 cm.^{2}/sec.



Load No.= 4

Load= 40.0 kPa

D_0 = 6.3456

D_{90} = 6.3649

D_{100} = 6.3671

T_{90} = 2.90 min.

C_v @ T_{90}

0.0078 cm.^{2}/sec.

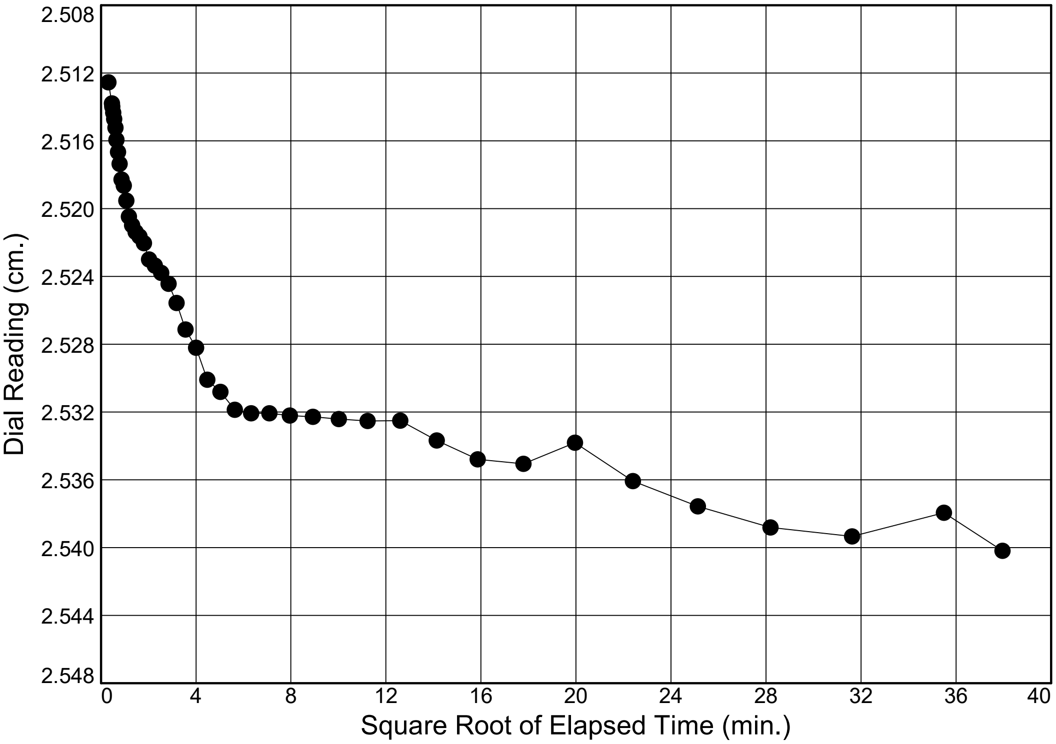
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

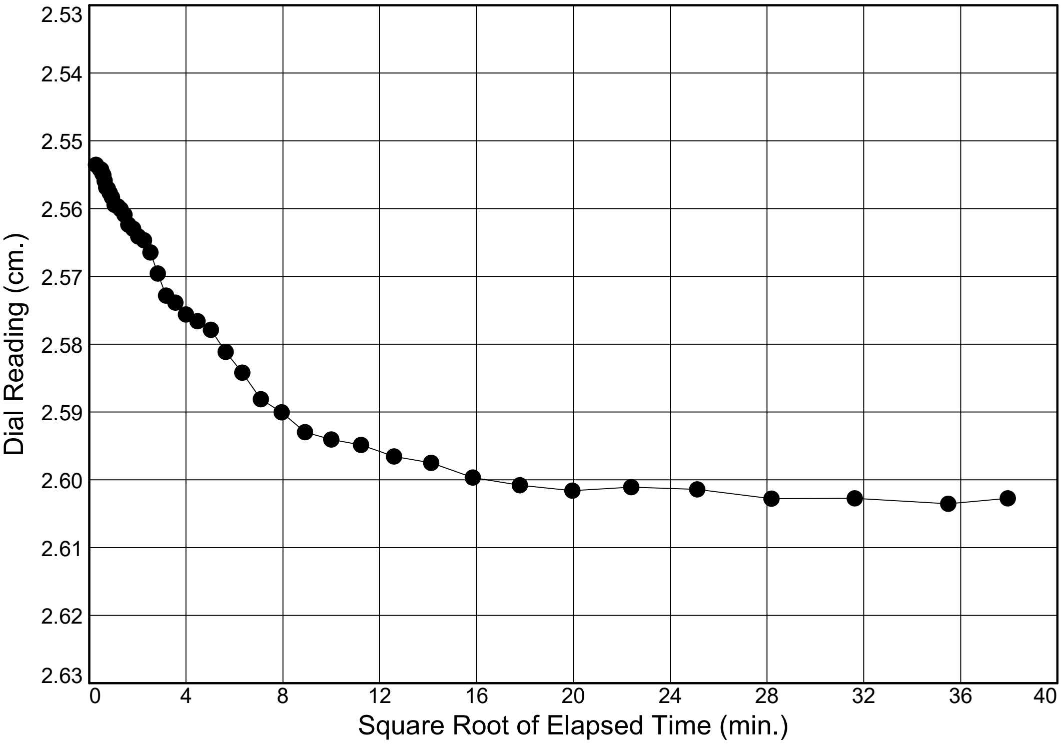
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-11 **Depth:** 20' **Sample Number:** T10



Load No.= 5
Load= 80.0 kPa
D_0 = 6.3741
D_{90} = 6.4040
D_{100} = 6.4073
T_{90} = 1.99 min.

C_v @ T_{90}
0.0112 cm.^{2}/sec.



Load No.= 6
Load= 160.0 kPa
D_0 = 6.4816
D_{90} = 6.5455
D_{100} = 6.5526
T_{90} = 21.52 min.

C_v @ T_{90}
0.0010 cm.^{2}/sec.

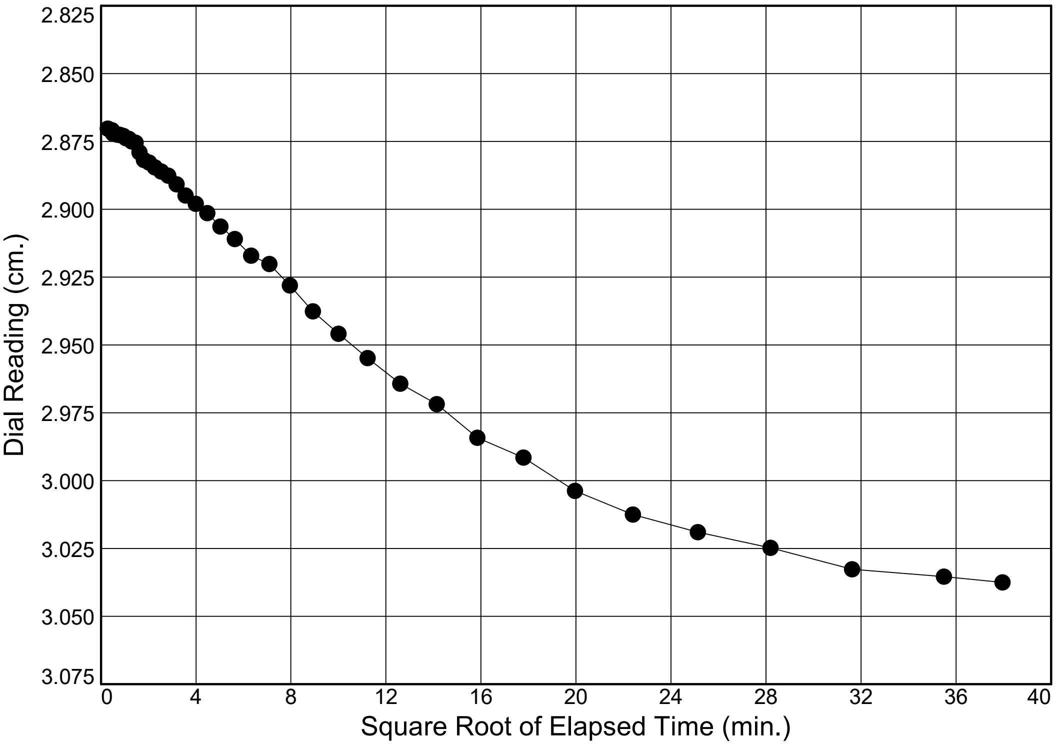
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

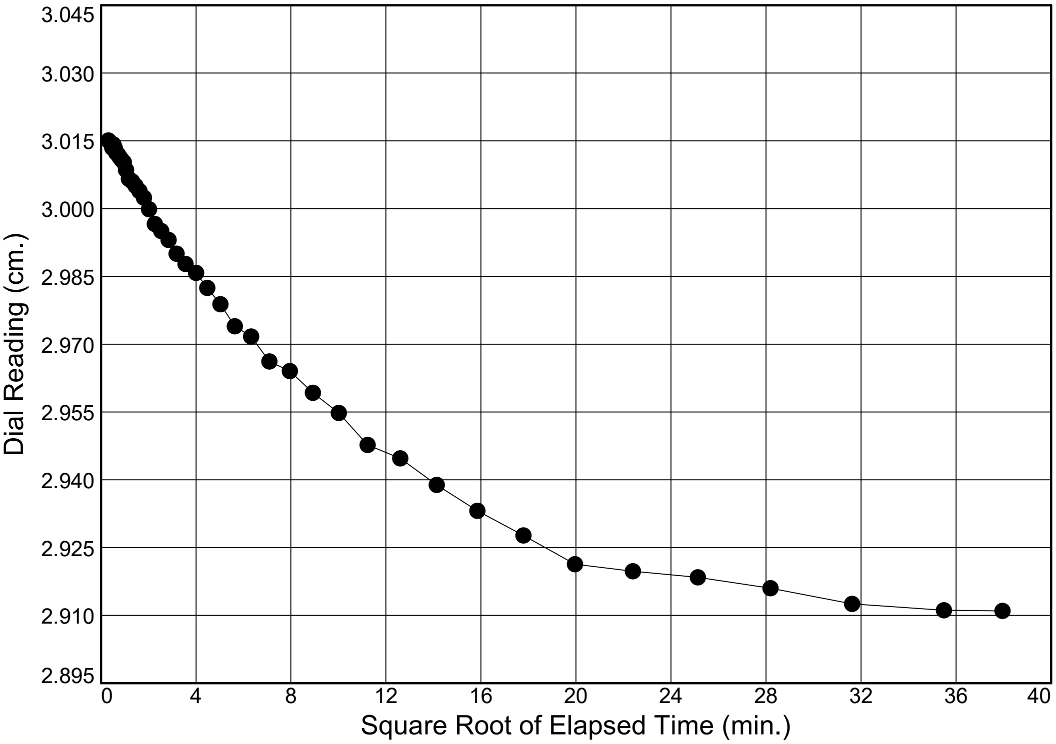
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-11 Depth: 20' Sample Number: T10



Load No.= 9
Load= 1280.0 kPa
D_0 = 7.2812
D_{90} = 7.6341
D_{100} = 7.6733
T_{90} = 418.18 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.



Load No.= 10
Load= 320.0 kPa
D_0 = 7.6634
D_{90} = 7.5315
D_{100} = 7.5168
T_{90} = 56.41 min.

C_v @ T_{90}
0.0003 cm.^{2}/sec.

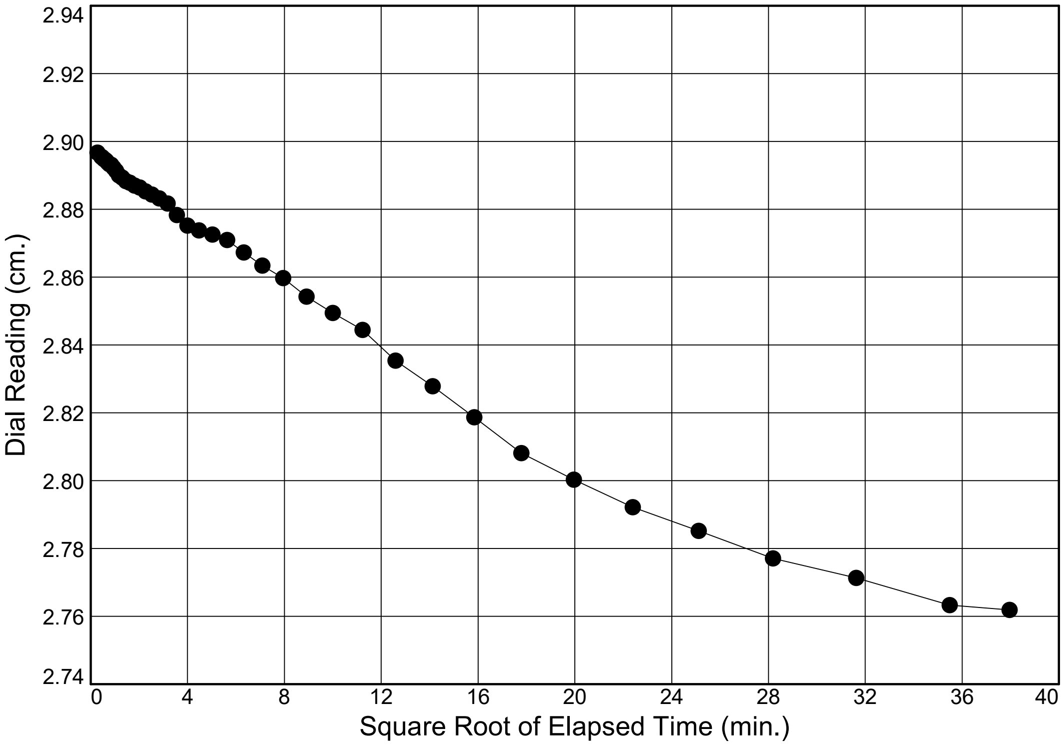
Figure

Solum Consultants Ltd.

Dial Reading vs. Time

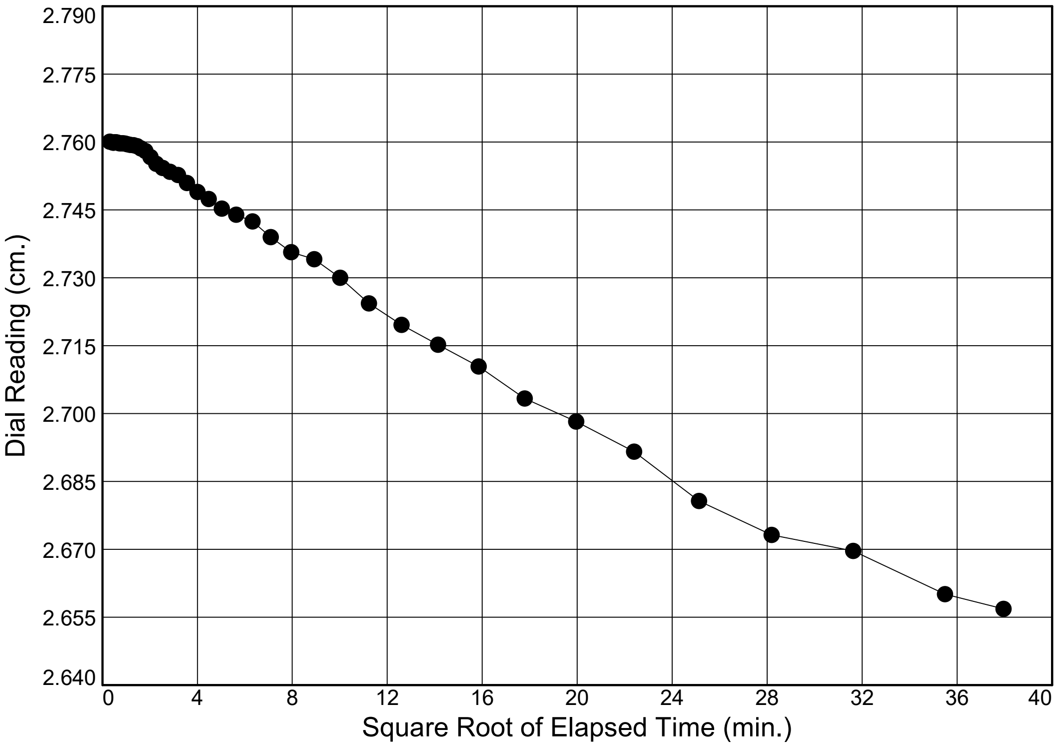
Project No.: 60721079
Project: Winnipeg Transit North Garage Project

Source of Sample: TH24-11 Depth: 20' Sample Number: T10



Load No.= 11
Load= 80.0 kPa
D_0 = 7.3581
D_{90} = 7.0531
D_{100} = 7.0192
T_{90} = 805.22 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.



Load No.= 12
Load= 20.0 kPa
D_0 = 7.0163
D_{90} = 6.7530
D_{100} = 6.7237
T_{90} = 1339.21 min.

C_v @ T_{90}
0.0000 cm.^{2}/sec.

Figure

SOLUM™
CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL
TESTING LABORATORY

Standard Laboratory Terms and Conditions

1.0 Description of Services to be Performed by Solum Consultants Ltd. (Solum)

Solum shall provide geotechnical and material laboratory testing services on samples in general conformance with these terms and conditions and excuted Laboratory Testing Requested Forms. Solum shall perform its work in accordance with accepted laboratory standards and accepted standard operating procedures as well as in-house developed procedures. Solum reserves the right to modify methods as necessary based upon experience and/or current scientific literature. If the Client requests a manner of analysis that varies from standard operating or recommanded procedures, the Client shall not hold Solum responsible for the results. Solum reserves the right to subcontract laboratory testing (especially chemical related testing) if a particular test cannot be performed by Solum after liason with the Client.

2.0 Reports, Confidentiality and Third Parties

Laboratory reports provided by Solum will be composed of a cover page, tables and figures if applicable. Reports will be emailed in PDF format to the individual(s) specified on the Laboratory Testing Request Forms. Laboratory reports may also be faxed or mailed to the Client upon request. Except as required by law, Solum shall not disclose testing results or reports to any party other than the Client, unless the Client, in writing, requests information to be provided to a third party. Solum shall abide by any additional confidentiality requirements requested by the Client provided that such requirements are provided to Solum at or before execution of the testing.

Indormation provided by Solum is inteded for Client use only. Any use by a third party, of reports or documents authored by Solum, or any reliance on or decisions made by a third party based on the findings described in said documents, are the sole responsibility of such third parties, and Solum accepts no responsibility of damages suffered by any third party as a result of decisions made or actions conducted.

3.0 Laboratory Testing Request Form (Chain of Custody)

The laboratory testing request form must be completed by the Client and be accompanied with the samples. Other form of COC may be accepted; however, the condition of Solum COC is still applied. Testing will not commence until the laboratory testing request form has been completed. If requested by the Client, Solum shall provide a copy of the laboratory testing request form with the report.

No persons other than the designated representitives for each Laboratory Testing Request Form are authorized to act regarding changes to the testing request form. Any changes or amendments of the laboratory testing request form must be in writing and be completed by the originator.

4.0 Acceptance, Contamination and Disposal of Samples

Loss or damages to samples remains the responsibility of the Client until Solum representitives acceptance of samples by notation on the laboratory testing request form.

As to any samples that are suspected of containing hazardous substances, the Client will specify the suspected or known substance and level of contamination. This information is to be stated on the laboratory testing request form and be accompanied with the samples before testing can commence.

Solum may refuse acceptance of samples if it determines they present a risk to health and safety.

Samples accepted by Solum shall remain the property and liability of the Client while in the custody of Solum. Solum will discard all non-contaiminated samples after two weeks of submitting lab report or a month from the date of receiving the samples without additional retention period at a fixed disposal charge, or if requested by the Client, samples may be returned to the Client at no cost to Solum. If requested by Client, Solum will store samples provided the Client agrees to pay for the storage charge. Contaminated material may be returned/shipped to the Client at the Client's expense or Solum will discard samples with disposal rates varying for samples containing higher levels of contamination, refer to price list.

Soil samples will be discarded upon the expiration date of the storage period unless the Client requests either extending storage period or return samples back to client at no cost to Solum.

5.0 Indemnification / Hold Harmless

Solum shall protect, indemnify and save harmless Client, and its directors, officers, employees, agents, represensitives, invitees and subcontractors, and at Client's request, investigate and defend such entities form and against all claims, demands and causes of action, of every kind and character, without limitation, arising in favor of or made by third parties, on account of bodily injury, death or damage to or loss of their property resulting from any negligent act or wilful misconduct of Solum.

The client shall protect, indemnify and save harmness Solum, and its directors, officers, employees, agents, represensitives, invitees and subcontractors, and at Solum's request, investigate and defend such entities form and against all claims, demands and causes of action, of every kind and character, without limitation, arising in favor of or made by third parties, on account of bodily injury, death or damage to or loss of their property resulting from any negligent act or wilful misconduct of Client.

6.0 Limitation of Liability

The total liability of Solum or its staff whether based in contract or tort, will be limited to the lesser of the fees paid or actual damages incurred by the Client.

Solum will not be responsible for any consequencial or indirect damages even if caused by negligence of Solum. Solum will only be liable for damages resulting from negligence of Solum. All claims by the client shall be deemed relinquished if not made within three months after lab report submittal date. No warranty is either expressed or implied, or intended by any agreement or by furnishing oral or written reports or findings.

7.0 Termination of Testing Work Order

The client may order work suspended or terminated upon seven days advance written notice. If work suspended, Solum shall receive, upon resumption, and adjustment in the cost of services to compensate for additional costs incurred due to the interruption of services. Upon suspension or termination, Solum shall preserve samples provided that the Client agrees to pay the sample storage charge.

8.0 Pricing, Payments and Invoicing

Invoices will be based on most current Solum laboratory testing rates or a quote provided to the Client whichever is less; rates may change without notice. Solum invoices shall be paid within thirty(30) days of receipt of the invoice. Amounts not paid when due shall bear interest at the rate of 18% per annual from the date due until the date of payment.

ENG-TECH
CONSULTING LIMITED

420 Turenne Street
Winnipeg, Manitoba
R2J 3W8
engtech@mymts.net
www.eng-tech.ca

"Engineering and Testing Solutions That Work for You"

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS

AECOM Canada Inc.
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7

File No.: 24-027-01

Ref. No.: 24-27-1-1

Attention: Colton Wooster, E.I.T.

Project: PROJECT NO. 60721079, WINNIPEG NORTH BUS GARAGE, WINNIPEG, MANITOBA

Submitted By: Client
Date Cored: -
Received By: ENG-TECH (Jessica Bauer)
Specimen Condition: As received moisture
Specimen Temperature: Room temperature

Page: 1 of 1
Date Received: Feb 23/24 & Mar 7/24
Tested By: ENG-TECH (Kyle Zebiere)
Method: ASTM D2938-95

Core No.	Client I.D.	Location	Length		Average Diameter (mm)	Rate of Loading (kN/s)	Compressive Strength (MPa)	Date Tested (m/d/y)
			Cored (mm)	Tested (mm)				
1	C16	TH 24-01, 52.5' – 53.7'	223	-	62.00	-	-	-
2	C17	TH 24-03, 60' – 60'10"	260	-	63.00	-	-	-
3	C19	TH 24-15, 78' – 78.6'	195	-	62.00	-	-	-
4	C11	TH 24-03, 33.5' – 35.5'	225	132.25	63.00	0.7	94	03/15/24
5	C16	TH 24-03, 55'8" – 56'5"	185	-	63.00	-	-	-
6	C18	TH 24-01, 60' – 61'	325	155.00	63.00	0.7	34	03/15/24

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.
*Denotes core Length/Diameter ratio not between 2.0 and 2.5.

Comments: Core No.'s 1, 2 and 3 contained multiple horizontal and vertical cracks rendering the cores not testable. Cores were returned to AECOM and replaced by Colton (AECOM) on March 7, 2024. Core No. 5 contained multiple horizontal cracks that fractured during end preparations. No segments remained of sufficient length to test. Core No. 4 contained a slight bow along the length of the core. Core No. 6 contained a slight fracture along the outer edge of the core. The end surface was prepared to the required planeness except at the fracture area to avoid damage to the core prior to testing.

Deviation from test procedure: Core No. 4 did not meet the 0.5mm side straightness requirement along the length. Core No. 6 did not meet the 0.025mm planeness requirement over entire end surface. Cores were not visually assessed for lithology and formation. Direction of load was not known to include.

Email: colton.wooster@aecom.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
Operations Manager - Laboratory
Ph: (204) 233-1694 Fx: (204) 235-1579

Enclosure: Photographs (3 pages)
Unconfined Compressive Strength Of Intact Rock Core Specimen Reports
Ref. No.'s 24-27-1-2 and 3

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Rock core specimens received February 23, 2024

Client ID: C16
TH 24-01
52.5' to 53.7"

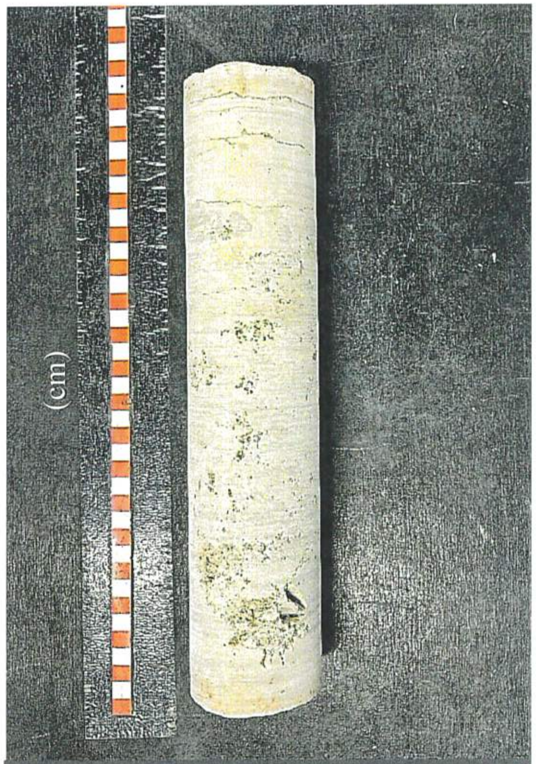
Client ID: C17
TH 24-03
60' to 60'10"

Client ID: C19
TH 24-15
78' to 78.6'

Rock core specimens received March 7, 2024

Client ID: C11
TH 24-03
33.5' to 35.5'

Client ID: C16
TH 24-03
55' 8" to 56' 5"



Client ID: C18
TH 24-01
60' to 61'

Rock core specimens after failure

Client ID: C11
TH 24-03
33.5' to 35.5'

Client ID: C18
TH 24-01
60' to 61'

420 Turenne Street
Winnipeg, Manitoba
R2J 3W8
engtech@mymts.net
www.eng-tech.ca

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS

"Engineering and Testing Solutions That Work for You"

AECOM Canada Inc.
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7

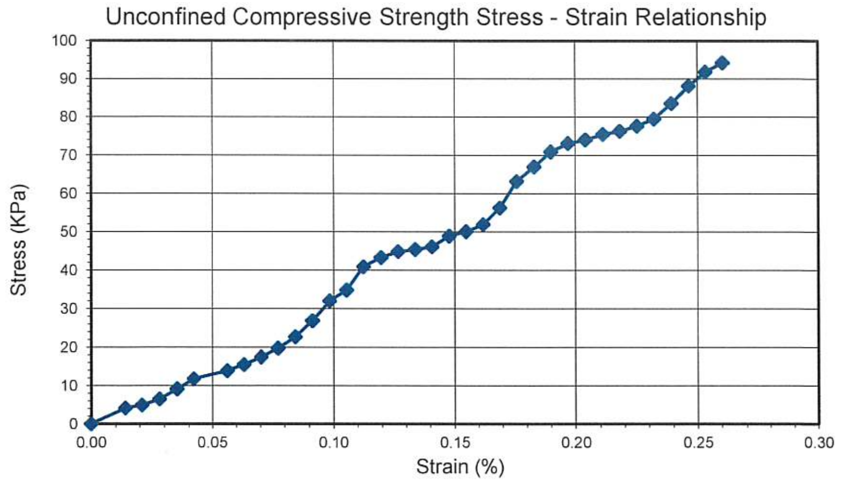
File No.: 24-027-01

Ref. No.: 24-27-1-2

Attention: Colton Wooster, E.I.T.

Project: PROJECT NO. 60721079, WINNIPEG NORTH BUS GARAGE, WINNIPEG, MANITOBA

Source / Location:	TH 24-03, 33.5' – 35.5'		
Client I.D.	C11	Submitted By:	Client
Date Cored:	-	Date Tested:	Mar 15/24
Date Received:	Mar 7/24	Tested By:	ENG-TECH (Kyle Zebiere)
Compression Machine Model:	Soil Test CT-710	Method:	ASTM D2938-95



Test Data

Specimen Condition:	As received moisture	Specimen Temperature:	Room temperature
Average Length of Specimen:	132.25 mm	Average Diameter of Specimen:	63.00 mm
Load Rate: 0.7 kN/s	Maximum Load: 293.4 kN	Compressive Strength:	94 MPa

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.
*Denotes core Length/Diameter ratio not between 2.0 and 2.5.

Comments: Core contained a slight bow along the length of the core.

Deviation from test procedure: Core did not meet the 0.5mm side straightness requirement along the length. Cores were not visually assessed for lithology and formation. Direction of load was not known to include.

Email: colton.wooster@aecom.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
Operations Manager - Laboratory
Ph: (204) 233-1694 Fx: (204) 235-1579

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ENG-TECH
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engtech@mymts.net
www.eng-tech.ca

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS

"Engineering and Testing Solutions That Work for You"

AECOM Canada Inc.
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7

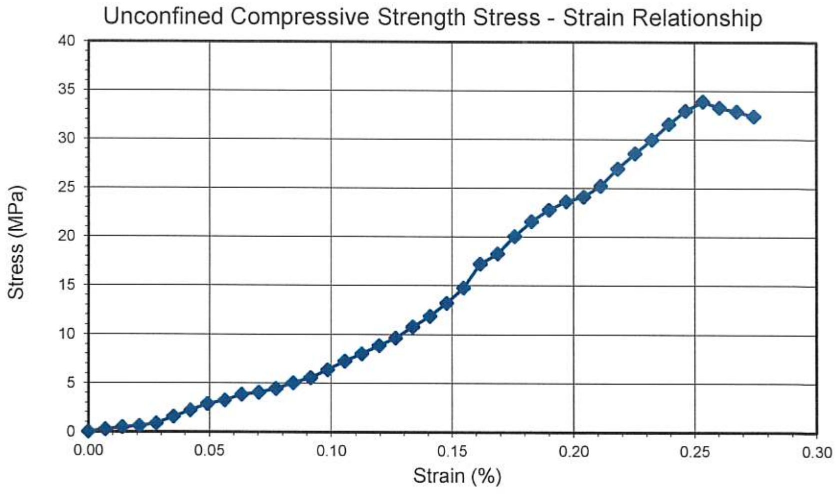
File No.: 24-027-01
Ref. No.: 24-27-1-3

Attention: Colton Wooster, E.I.T.

Project: PROJECT NO. 60721079, WINNIPEG NORTH BUS GARAGE, WINNIPEG, MANITOBA

Source / Location: TH 24-01, 60' – 61'
Client I.D. C18
Date Cored: -
Date Received: Mar 7/24
Compression Machine Model: Soil Test CT-710

Submitted By: Client
Date Tested: Mar 15/24
Tested By: ENG-TECH (Kyle Zebiere)
Method: ASTM D2938-95



Test Data

Specimen Condition: As received moisture
Specimen Temperature: Room temperature
Average Length of Specimen: 155.00 mm
Average Diameter of Specimen: 63.00 mm
Load Rate: 0.7 kN/s
Maximum Load: 106.6 kN
Compressive Strength: 34 MPa

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.
*Denotes core Length/Diameter ratio not between 2.0 and 2.5.

Comments: Core contained a slight fracture along the outer edge of the core. End surface was prepared to the required planeness except at the fracture area to avoid damage to the core prior to testing.

Deviation from test procedure: Core did not meet 0.025mm planeness requirement over entire end surface. Cores were not visually assessed for lithology and formation. Direction of load was not known to include.

Email: colton.wooster@aecom.com

ENG-TECH Consulting Limited

Per

Darci Babisky, C.E.T.
Operations Manager - Laboratory
Ph: (204) 233-1694 Fx: (204) 235-1579

CERTIFICATE OF ANALYSIS

Work Order	: **WP2404448**	Page	: 1 of 3
Client	: **AECOM Canada Ltd.**	Laboratory	: ALS Environmental - Winnipeg
Contact	: Colton Wooster	Account Manager	: Craig Riddell
Address	: 99 Commerce Drive Winnipeg MB Canada R3P 0Y7	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4
Telephone	: ----	Telephone	: +1 204 255 9720
Project	: ----	Date Samples Received	: 23-Feb-2024 11:48
PO	: 12473	Date Analysis Commenced	: 04-Mar-2024
C-O-C number	: ----	Issue Date	: 08-Mar-2024 15:39
Sampler	: ----		
Site	: ----		
Quote number	: 2024 - AECOM , ph, Cond, Resist, Tot & Sol Sulphate CSA		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Katarzyna Glinka	Analyst	Inorganics, Calgary, Alberta
Nik Perkio	Inorganics Analyst	Inorganics, Waterloo, Ontario

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
%	percent
mS/cm	millisiemens per centimetre
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Soil**

(Matrix: **Soil/Solid)**

				Client sample ID	**TH24-8 G3**	**TH24-10 G8**	**TH24-11 G11**	----	----
				Client sampling date / time	09-Feb-2024 00:00	09-Feb-2024 00:00	09-Feb-2024 00:00	----	----
Analyte	*CAS Number*	*Method/Lab*	*LOR*	*Unit*	**WP2404448-001**	**WP2404448-002**	**WP2404448-003**	--------	--------
					Result	Result	Result	----	----
Physical Tests									
Conductivity (1:2 leachate)	----	E100-L/WT	0.00500	mS/cm	1.08	8.57	1.24	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	7.97	8.10	8.25	----	----
Resistivity	----	EC100R/WT	100	ohm cm	920	120	810	----	----
Inorganics									
Sulfate, total, ion content	14808-79-8	E246.SO4/CG	0.050	%	0.118	3.16	0.119	----	----
Sulfate, soluble ion content	14808-79-8	E246A.SO4/CG	0.05	%	NR	----	NR	----	----
Sulfate, soluble ion content	14808-79-8	E246A.SO4/CG	0.050	%	----	3.14	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order : **WP2404448**

Client : **AECOM Canada Ltd.**

Contact : Colton Wooster

Address : 99 Commerce Drive
Winnipeg MB Canada R3P 0Y7

Telephone : ----

Project : ----

PO : 12473

C-O-C number : ----

Sampler : ----

Site : ----

Quote number : 2024 - AECOM , ph, Cond, Resist, Tot & Sol Sulphate CSA

No. of samples received : 3

No. of samples analysed : 3

Page : 1 of 7

Laboratory : ALS Environmental - Winnipeg

Account Manager : Craig Riddell

Address : 1329 Niakwa Road East, Unit 12
Winnipeg, Manitoba Canada R2J 3T4

Telephone : +1 204 255 9720

Date Samples Received : 23-Feb-2024 11:48

Issue Date : 08-Mar-2024 15:39

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
Container / Client Sample ID(s)			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Inorganics : Soluble Sulfate ion in soil by boiling water extraction, IC.										
LDPE bag TH24-10 G8	E246A.SO4	09-Feb-2024	06-Mar-2024	180 days	26 days	✓	06-Mar-2024	28 days	0 days	✓
Inorganics : Soluble Sulfate ion in soil by boiling water extraction, IC.										
LDPE bag TH24-11 G11	E246A.SO4	09-Feb-2024	05-Mar-2024	180 days	26 days	✓	05-Mar-2024	28 days	0 days	✓
Inorganics : Soluble Sulfate ion in soil by boiling water extraction, IC.										
LDPE bag TH24-8 G3	E246A.SO4	09-Feb-2024	05-Mar-2024	180 days	26 days	✓	05-Mar-2024	28 days	0 days	✓
Inorganics : Total Sulfate ion in soil by acidic boiling water extraction, IC										
LDPE bag TH24-10 G8	E246.SO4	09-Feb-2024	04-Mar-2024	180 days	25 days	✓	05-Mar-2024	28 days	1 days	✓
Inorganics : Total Sulfate ion in soil by acidic boiling water extraction, IC										
LDPE bag TH24-11 G11	E246.SO4	09-Feb-2024	04-Mar-2024	180 days	25 days	✓	05-Mar-2024	28 days	1 days	✓
Inorganics : Total Sulfate ion in soil by acidic boiling water extraction, IC										
LDPE bag TH24-8 G3	E246.SO4	09-Feb-2024	04-Mar-2024	180 days	25 days	✓	05-Mar-2024	28 days	1 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap TH24-10 G8	E100-L	09-Feb-2024	07-Mar-2024	30 days	27 days	✓	07-Mar-2024	30 days	27 days	✓

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method **Container / Client Sample ID(s)**	*Method*	*Sampling Date*	*Extraction / Preparation*				*Analysis*			
			Preparation Date	*Holding Times*		*Eval*	*Analysis Date*	*Holding Times*		*Eval*
				Rec	*Actual*			*Rec*	*Actual*	
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap TH24-8 G3	E100-L	09-Feb-2024	07-Mar-2024	30 days	27 days	✓	07-Mar-2024	30 days	27 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap TH24-11 G11	E100-L	09-Feb-2024	08-Mar-2024	30 days	29 days	✓	08-Mar-2024	30 days	29 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap TH24-10 G8	E108A	09-Feb-2024	06-Mar-2024	30 days	26 days	✓	06-Mar-2024	30 days	27 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap TH24-11 G11	E108A	09-Feb-2024	06-Mar-2024	30 days	26 days	✓	06-Mar-2024	30 days	27 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap TH24-8 G3	E108A	09-Feb-2024	06-Mar-2024	30 days	26 days	✓	06-Mar-2024	30 days	27 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1356731	2	25	8.0	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1355343	2	32	6.2	5.0	✓
Soluble Sulfate ion in soil by boiling water extraction, IC.	E246A.SO4	1355400	1	16	6.2	5.0	✓
Total Sulfate ion in soil by acidic boiling water extraction, IC	E246.SO4	1353166	1	11	9.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1356731	4	25	16.0	10.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1355343	2	32	6.2	5.0	✓
Soluble Sulfate ion in soil by boiling water extraction, IC.	E246A.SO4	1355400	4	16	25.0	10.0	✓
Total Sulfate ion in soil by acidic boiling water extraction, IC	E246.SO4	1353166	2	11	18.1	10.0	✓
Method Blanks (MB)							
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1356731	2	25	8.0	5.0	✓
Soluble Sulfate ion in soil by boiling water extraction, IC.	E246A.SO4	1355400	2	16	12.5	5.0	✓
Total Sulfate ion in soil by acidic boiling water extraction, IC	E246.SO4	1353166	1	11	9.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by “mod”).

Analytical Methods	*Method / Lab*	*Matrix*	*Method Reference*	*Method Descriptions*
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
Total Sulfate ion in soil by acidic boiling water extraction, IC	E246.SO4 ALS Environmental - Calgary	Soil/Solid	CSA-A23.2-3B	The dried solid is mixed with water and acid then heated. After filtration the liquid is ready for analysis by IC with conductivity detector.
Soluble Sulfate ion in soil by boiling water extraction, IC.	E246A.SO4 ALS Environmental - Calgary	Soil/Solid	CSA-A23.2-3B	The dried solid is mixed with water at a specified ratio then heated. After filtration the liquid is ready for analysis by IC with conductivity detector. A result of "NR" indicates that the total sulfate analysis was <0.2% and based on CSA-A23.2-3B no analysis for soluble sulfate is required.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.

Preparation Methods	*Method / Lab*	*Matrix*	*Method Reference*	*Method Descriptions*
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl2 - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Soluble ion Sulfate in soil or concrete preparation.	EP246.S ALS Environmental - Calgary	Soil/Solid	CSA-A23.2B	The dried solid is mixed with water then heated. After filtration the liquid is ready for analysis.

Preparation Methods	*Method / Lab*	*Matrix*	*Method Reference*	*Method Descriptions*
Total ion Sulfate in soil or concrete preparation	EP246.T ALS Environmental - Calgary	Soil/Solid	CSA-A23.2B	The dried solid is mixed with water and acid then heated. After filtration the liquid is ready for analysis.

QUALITY CONTROL REPORT

Work Order	: **WP2404448**	Page	: 1 of 5
Client	: AECOM Canada Ltd.	Laboratory	: ALS Environmental - Winnipeg
Contact	: Colton Wooster	Account Manager	: Craig Riddell
Address	: 99 Commerce Drive Winnipeg MB Canada R3P 0Y7	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	:	Telephone	: +1 204 255 9720
Project	: ----	Date Samples Received	: 23-Feb-2024 11:48
PO	: 12473	Date Analysis Commenced	: 04-Mar-2024
C-O-C number	: ----	Issue Date	: 08-Mar-2024 15:39
Sampler	: ---- ----		
Site	: ----		
Quote number	: 2024 - AECOM , ph, Cond, Resist, Tot & Sol Sulphate CSA		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Katarzyna Glinka	Analyst	Calgary Inorganics, Calgary, Alberta
Nik Perkio	Inorganics Analyst	Waterloo Inorganics, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 1353700)											
WT2404536-004	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.773 mS/cm	764	1.17%	20%	----
Physical Tests (QC Lot: 1355128)											
WP2404448-001	TH24-8 G3	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.97	7.98	0.125%	5%	----
Physical Tests (QC Lot: 1355343)											
WP2404448-003	TH24-11 G11	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	8.25	8.32	0.845%	5%	----
Physical Tests (QC Lot: 1356731)											
WT2404680-012	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.552 mS/cm	575	4.08%	20%	----
Inorganics (QC Lot: 1353166)											
CG2402259-001	Anonymous	Sulfate, total, ion content	14808-79-8	E246.SO4	500	mg/kg	<0.050 %	<500	0	Diff <2x LOR	----
Inorganics (QC Lot: 1355400)											
SK2400820-001	Anonymous	Sulfate, soluble ion content	14808-79-8	E246A.SO4	500	mg/kg	0.722 %	6840	5.39%	30%	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Result*	*Qualifier*
Physical Tests (QCLot: 1353700)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1356731)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Inorganics (QCLot: 1353166)						
Sulfate, total, ion content	14808-79-8	E246.SO4	500	mg/kg	<500	----
Inorganics (QCLot: 1354956)						
Sulfate, soluble ion content	14808-79-8	E246A.SO4	500	mg/kg	NR	----
Inorganics (QCLot: 1355400)						
Sulfate, soluble ion content	14808-79-8	E246A.SO4	500	mg/kg	<500	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	*Recovery (%)*	*Recovery Limits (%)*		
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*	*Concentration*	*LCS*	*Low*	*High*	*Qualifier*
Physical Tests (QCLot: 1353700)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 1355128)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1355343)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1356731)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	97.7	90.0	110	----
Inorganics (QCLot: 1353166)									
Sulfate, total, ion content	14808-79-8	E246.SO4	500	mg/kg	10000 mg/kg	104	90.0	110	----
Inorganics (QCLot: 1355400)									
Sulfate, soluble ion content	14808-79-8	E246A.SO4	500	mg/kg	200 mg/kg	95.6	60.0	140	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	*Recovery (%)*	*Recovery Limits (%)*		
Laboratory sample ID	*Reference Material ID*	*Analyte*	*CAS Number*	*Method*	*Concentration*	*RM*	*Low*	*High*	*Qualifier*
Physical Tests (QCLot: 1353700)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1384 µS/cm	98.3	70.0	130	----
Physical Tests (QCLot: 1356731)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1384 µS/cm	94.1	70.0	130	----
Inorganics (QCLot: 1353166)									
	RM	Sulfate, total, ion content	14808-79-8	E246.SO4	33400 mg/kg	97.2	80.0	120	----
Inorganics (QCLot: 1355400)									
	RM	Sulfate, soluble ion content	14808-79-8	E246A.SO4	2600 mg/kg	110	80.0	120	----

12 - 1329 Niakwa Rd. E.
Winnipeg, Manitoba R2J 3T4
Tel: (204) 255-9720
Fax: (204) 255-9721
Toll Free: 1 800 607 7555

Chain of Custody / Analytical Request Form

WORK ORDER NO:

FOR LABORATORY USE ONLY (SHADED AREAS)

Sample Condition Upon Receipt: ☐ ACCEPTABLE ☐ NON ACCEPTABLE

☐ Frozen ☐ Cold ☐ Ambient ☐ Broken ☐ Leakage ☐ Incorrect Sample Container

COMMENT:

LAB NO.:
DATE RECEIVED: FEB 23 2024
TIME RECEIVED: 11:48
BY:
TEMP: 17.3

Date Sampled: JAN 29 - FEB 9 2024 Time: : A.M. ☐ P.M. ☐

Location:
(Town, Community, City)

Community Code Number:

Date Required:
Submitter's Name Printed:
Sample Submitted By:
Rural Municipality/LGC/UVD:

SAMPLE TYPE

PLEASE PRINT & PRESS FIRMLY

DRINKING WATER
- ☐ Untreated Well
- ☐ Treated Well
- ☐ Treated Municipal
- ☐ Non-Treated Municipal
- ☐ Water-Surface-Raw
- ☐ Water-Surface-Treated

PURPOSE OF TEST
☐ Private ☐ Real Estate ☐ Water Main

NON-DRINKING WATER
- ☐ Sewage/Waste Water
- ☐ Lake/River
- ☐ Swimming Pool
- ☐ Whirl Pool
- ☐ Other:

NOTES & CONDITIONS
1. Quote number **MUST BE** provided to insure proper pricing.
2. Failure to properly complete all portions of this form may delay analysis.
3. ALS's liability limited to cost of analysis.

SERVICE REQUESTED
☑ **REGULAR** ☐ **PRIORITY** (50% SURCHARGE) ☐ **EMERGENCY** (100% SURCHARGE) ☐ **SAME DAY** (200% SURCHARGE)

LAB NUMBER	SAMPLE IDENTIFICATION
	TH24-08 G3
	TH24-10 G8
	TH24-11 G11

ALS CUSTOMER #: QUOTE #:

REPORT TO BE SENT TO

NAME: COLTON WOOSTER
COMPANY: AECOM CANADA LTD
ADDRESS: 99 COMMERCE DR.
CITY/TOWN: WINNIPEG, / PROV.: MANITOBA
POSTAL CODE: R3P 0Y7
PHONE: 204-477-5381/204-583-8797
BY: *MAIL* ☐ *FAX* ☐ (FAX NUMBER)
E-MAIL ☑ COLTON.WOOSTER@AECOM.COM (EMAIL ADDRESS)

CC
NAME:
ADDRESS:
CITY/TOWN: / PROV.:
POSTAL CODE:
PHONE:
BY: *MAIL* ☐ *FAX* ☐ (FAX NUMBER)
E-MAIL ☐ (EMAIL ADDRESS)

Analyses required pH, COND, RESIST, TOT & SOL SULPHATE CSA

Environmental Division
Winnipeg
Work Order Reference
WP2404448
Telephone : +1 204 255 9720

SAMPLING INSTRUC
ALS EN
12 - 1329 Niakwa Rd. E
Phone: +1 204 255 9720 Fax
A Campbell B

SUBMITT

BILLING ADDRESS **SAME AS REPORT TO** ☐
NAME:
COMPANY:
ADDRESS:
CITY/TOWN: / PROV:
POSTAL CODE:

PAYMENT PARTICULARS (CASH NOT ACCEPTED)
- ☐ INVOICE NEEDED / CLIENT'S P.O. NO.
- ☐ INTERAC
- ☐ CHEQUE
- ☐ VISA
- ☐ MASTERCARD

Subtotal $
G.S.T. $
Total $

* OUR POLICY IS NOT TO ACCEPT SAMPLES FROM THE PRIVATE CITIZEN WITHOUT PREPAYMENT

ENTERED IN LIMS BY:

Sample Intake

Client: AECOM

Cheque Enclosed with CoC: Yes [✓ No]

Priority/Emergency Required (circle one): Yes [✓ No]

Time Sensitive Hold Time (circle one): Yes [✓ No]

Matrix (circle one): Water [✓ Soil/solid] Air Biota Other

# of Bottles received: 3

Green/White		Yellow/Black	
Purple/White		Light blue/White	
Warm red/White		Orange/Black	
Dark Green/White		Dark Blue/White	
Grey/black		Black/white	

Other: 3 x bags

Additional Comments:

Check yes if you have verified the following:

Login Check	Yes	N/A
Received date/time	✓	
Project/PO/LSD	✓	
Quote/Office match CoC	✓	
Sample IDs/Description	✓	
Sample Date/time	✓	
Sales Items as per CoC	✓	
Express Due Dates		✓
Client due date matches ALS Due date	✓	
Client recipient emails	✓	
Guidelines/thresholds added		✓
Billing/payment recorded		✓
Field data entered		✓
Sub-contracting Forms Printed		✓
SUBCO/Chromatograph added to client contacts for required analysis		✓
Are sub-samples required?		✓
Has a SIF been submitted for this WO?		✓
Has the SIF been resolved?		✓

Appendix E

Seismic Hazard Calculation

Government of Canada
Gouvernement du Canada

Canada.ca › Natural Resources Canada › Earthquakes Canada

2020 National Building Code of Canada Seismic Hazard Tool

This application provides seismic values for the design of buildings in Canada under Part 4 of the National Building Code of Canada (NBC) 2020 as prescribed in Article 1.1.3.1. of Division B of the NBC 2020.

Seismic Hazard Values

User requested values

Code edition	NBC 2020
Site designation X_S	X_E
Latitude (°)	49.931
Longitude (°)	-97.215

Please select one of the tabs below.

NBC 2020
Additional Values
Plots
API
Background Information

The 5%-damped spectral acceleration ($S_a(T,X)$, where T is the period, in s, and X is the site designation) and peak ground acceleration (PGA(X)) values are given in units of acceleration due to gravity (g, 9.81 m/s^2). Peak ground velocity (PGV(X)) values are given in m/s. Probability is expressed in terms of percent exceedance in 50 years. Further information on the calculation of seismic hazard is provided under the *Background Information* tab.

The 2%-in-50-year seismic hazard values are provided in accordance with Article 4.1.8.4. of the NBC 2020. The 5%- and 10%-in-50-year values are provided for additional performance checks in accordance with Article 4.1.8.23. of the NBC 2020.

See the *Additional Values* tab for additional seismic hazard values, including values for other site designations, periods, and probabilities not defined in the NBC 2020.

NBC 2020 - 2%/50 years (0.000404 per annum) probability

$S_a(0.2, X_E)$	$S_a(0.5, X_E)$	$S_a(1.0, X_E)$	$S_a(2.0, X_E)$	$S_a(5.0, X_E)$	$S_a(10.0, X_E)$	$PGA(X_E)$	$PGV(X_E)$
0.113	0.106	0.0548	0.0216	0.00433	0.00126	0.0677	0.0542

The log-log interpolated 2%/50 year $S_a(4.0, X_E)$ value is : **0.0064**

▼ Tables for 5% and 10% in 50 year values

NBC 2020 - 5%/50 years (0.001 per annum) probability

$S_a(0.2, X_E)$	$S_a(0.5, X_E)$	$S_a(1.0, X_E)$	$S_a(2.0, X_E)$	$S_a(5.0, X_E)$	$S_a(10.0, X_E)$	$PGA(X_E)$	$PGV(X_E)$
0.0589	0.0563	0.0279	0.0104	0.00192	0.00055	0.0338	0.0269

The log-log interpolated 5%/50 year $S_a(4.0, X_E)$ value is : **0.0029**

NBC 2020 - 10%/50 years (0.0021 per annum) probability

$S_a(0.2, X_E)$	$S_a(0.5, X_E)$	$S_a(1.0, X_E)$	$S_a(2.0, X_E)$	$S_a(5.0, X_E)$	$S_a(10.0, X_E)$	$PGA(X_E)$	$PGV(X_E)$

$S_a(0.2, X_E)$	$S_a(0.5, X_E)$	$S_a(1.0, X_E)$	$S_a(2.0, X_E)$	$S_a(5.0, X_E)$	$S_a(10.0, X_E)$	$PGA(X_E)$	$PGV(X_E)$
0.0332	0.0315	0.0148	0.00515	0.000877	0.000241	0.0183	0.0142

The log-log interpolated 10%/50 year $S_a(4.0, X_E)$ value is : **0.0013**

Download CSV

← Go back to the seismic hazard calculator form

Date modified: 2021-04-06

Appendix F

TREK Geotechnical Factual Report 2023

Quality Engineering | Valued Relationships

Dillion Consulting Ltd.

City of Winnipeg North Transit Garage
Geotechnical Factual Report

Prepared for:
Taran Peters, P.Eng
Dillion Consulting Ltd.
1558 Willson Place
Winnipeg, MB
R3T 0Y4

Project Number: 0022-186-00

Date: November 14, 2023

TREK GEOTECHNICAL
Quality Engineering | Valued Relationships

November 14, 2023

Our File No. 0022-186-00

Taran Peters, P.Eng
Dillion Consulting Ltd.
1558 Willson Place
Winnipeg, MB
R3T 0Y4

RE: **City of Winnipeg North Transit Garage**
Geotechnical Factual Report

TREK Geotechnical Inc. is pleased to submit our final report for the geotechnical investigation for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

Michael Van Helden, Ph.D., P.Eng.
Senior Geotechnical Engineer

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	TC	November 14, 2023	Final Report

Authorization Signatures

Prepared By:

PROVINCE OF MANITOBA
2023/11/14
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Senior Geotechnical Engineer

ENGINEERS
GEOSCIENTISTS
MANITOBA
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877

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1.0 Introduction

This factual report summarizes the results of the geotechnical exploration completed by TREK Geotechnical Inc. (TREK) for the proposed City of Winnipeg North Transit Garage in Winnipeg, Manitoba. The terms of reference for the investigation are included in our proposal to Dillion Consulting Ltd. dated August 3, 2023. The scope of work includes a sub-surface investigation, laboratory testing, test hole logs, and this factual report.

2.0 Field Program

2.1 Sub-surface Investigation

The sub-surface investigation was completed between October 11 to 13, 2023, under the supervision of TREK personnel to determine the soil stratigraphy and groundwater conditions at the site. Three shallow test holes were drilled and sampled along Oak Point Highway including two in the southbound curb lane and one in the median just outside the northbound median lane. Six deep test holes were drilled and sampled within the Transit Garage site. Prior to the completion of TH23-07 and TH23-08, several locations (probe holes) were attempted for test holes and abandoned due to early power auger refusal. This refusal is suspected to have occurred on buried concrete rubble as concrete dust was observed on the auger bit and surficial concrete pieces were observed across the site. Pictures of the rubble found across the site are shown in Appendix A. Test hole locations are shown on Figure 01.

The test holes were drilled by Paddock Drilling Ltd. with a track-mounted Mobile B48 geotechnical drill rig equipped with 125 mm solid stem augers. TH23-09 was advanced using casing and HQ coring equipment. Test holes were backfilled with auger cuttings and bentonite to surface except in TH23-05 which was backfilled with only bentonite, and TH23-09 where bedrock was cored, and the hole was backfilled with grout to surface. Where standpipe piezometers were installed, holes were backfilled with bentonite chips, as well as silica sand around the piezometer tip. Sub-surface soils encountered during drilling were visually classified based on the Unified Soil Classification System (USCS). Disturbed (auger cutting and split spoon) samples were taken at regular intervals and relatively undisturbed (Shelby Tube) samples were collected at select depths. Standard Penetration Tests (SPTs) were completed at depths where split spoon samples were taken.

All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all disturbed samples. Bulk unit weight measurements and unconfined compression tests were also completed on Shelby tube and core samples. Atterberg limits and grain size analysis (hydrometer method) tests were also completed on select samples. Laboratory testing results are included in Appendix B.

Test hole coordinates and elevations were recorded using an RTK GPS. The test hole logs include a description of the soil units encountered and other pertinent information such as groundwater, sloughing conditions, and a summary of the laboratory testing results.

2.2 Soil Stratigraphy

A brief description of the soil units encountered during drilling is provided below. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole logs.

The soil stratigraphy encountered in the shallow test holes along Oak Point Highway consists of 350 mm thick concrete pavement overlying sand and gravel fill (TH's 23-01 and 23-02), and clay fill (TH23-01). In TH23-03 clay fill was encountered at ground surface. The sand and gravel fill contains some clay, trace to some silt, is loose and poorly graded. The clay fill is silty and contains trace to some sand, trace to some gravel, is stiff to very stiff and low to intermediate plastic (TH23-01) or high plastic (TH23-03).

The soil stratigraphy within the Transit Garage site (TH's 23-04 to 23-09) generally consists of variable near-surface layers of topsoil, organics and fill to depths ranging from 1.0 and 3.5 m. Fill soils ranged from loose to compact sand fill or firm to stiff, low to intermediate plastic clay fill. TH's 23-07 and 23-08 required several attempts to advance through debris; probe holes PR23-08A, PR23-07A to 07C were drilled without sampling to the depths provided in Table 1. The fill is underlain by thin layers of clay, organic clay or silt to a depth ranging from 3.0 to 3.8 m (TH's 23-04, 07 and 08). The silt contains trace clay, trace sand, is dry to wet, soft or compact, and non plastic to low plastic. Clay extends below the fill or silt to silt till or the depth of exploration in all test holes. The clay is silty, contains trace sand, is high plastic, and is stiff becoming very soft to soft with depth. Silt till was encountered at depths of 10.0 to 12.3 m in TH's 23-04 to 07, and 09. The silt till is sandy to containing some sand, contains trace to some gravel, trace to some clay, is dry to moist, dense and non to low plastic. In TH23-07, the silt till contains some clay, is stiff and low plastic below 12.6 m depth. The silt till extends to the depth of exploration in TH's 23-04 to 06, and is underlain by sand (TH23-07) or clay mudstone (TH23-09). The sand is silty and contains some clay, is moist to wet, dense, fine grained and poorly graded. The clay mudstone is of the Gunn Member and is medium to coarse grained, grey to pink, moderately laminated with discontinuous wavy non-parallel bedding, platey, has some carbonation inclusions, and extends to a depth of 14.3 m in TH23-09. The mudstone is underlain by dolomite bedrock of the Lower Fort Garry Member, and is cream to beige to red in colour, massive, has fracturing on argillaceous layers perpendicular to the drill axis, is hard (R3), vuggy at 21.0 m, and extends to the depth of exploration in TH23-09 (21.6 m).

Table 1. Summary of Probe Hole Depths

Probe Hole	Refusal Depth (m)	Notes
PR23-07A	1.5	Refused on concrete debris
PR23-07B	1.5	Refused on concrete debris
PR23-07C	1.4	Refused on concrete debris
PR23-08A	1.4	Refused on concrete debris

2.3 Power Auger Refusal

Table 2 summarizes the depth and elevation of power auger refusal in the test holes.

Table 2. Summary of Test Hole Depths

Test Hole	Power Auger Refusal Depth (m)	Power Auger Refusal Elevation (m)
TH23-01 to 03	Not observed	Not observed
TH23-04	11.7	224.8
TH23-05	12.3	224.9
TH23-06	12.6	225.7
TH23-07	18.0	218.9
TH23-08	Not observed	Not observed
TH23-09	11.2	224.4

2.4 Groundwater and Sloughing Conditions

Groundwater seepage, sloughing and squeezing was observed at the time of the subsurface investigation and is outlined in Table 3 below.

Table 3. Summary of Seepage and Sloughing

Test Hole	Depth (m)			
	Observed Seepage	Water Level After Drilling	Observed Sloughing	Test Hole Open to After Drilling
TH23-01 to 03	N/A			3.0
TH23-04	Below 11.0	dry	Between 2.7 to 3.4	3.4
TH23-05	Between 1.5 to 3.5	9.3	Between 1.5 to 3.5	12.2
TH23-06	4.6	4.9	N/A	12.6
TH23-07	3.5	10.7	Between 2.7 to 3.8 & below 13.4	11.0
TH23-08	Between 2.4 to 3.0	3.4	Between 2.4 to 3.0	3.4
TH23-09	Not available due to drilling method used			

Standpipes installed into till (deep) in TH23-05 to TH23-07 and into silt layers (shallow) were monitored between October 13 to November 9, 2023, using a water level meter and ongoing using a level logger. Manual readings are shown below in Table 4. A graph of the recorded water level results is also included in Appendix C.

Table 4. Summary Manual Standpipe Water Readings

Standpipe	Water Level Elevation (m)					
	Stratum / Tip El.	Oct. 12, 2023	Oct. 13, 2023	Oct. 18, 2023	Nov. 6, 2023	Nov. 9, 2023
SP23-05	Silt Till / 224.84	225.93	225.99	226.29	227.30	227.43
SP23-06	Silt Till / 225.33	226.99	227.42	228.66	230.02	230.26
SP23-07A	Silt Till / 223.80	223.04	223.28	224.23	227.12	227.48
SP23-07B	Silt / 233.81	dry	dry	234.00	234.08	dry
SP23-08	Silt / 232.82	dry	233.64	233.77	233.72	233.68

These observations are short-term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period of time to determine. It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

3.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Dillion Consulting Ltd. and the City of Winnipeg (the Clients) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figures

TREK GEOTECHNICAL

0022 186 00
Dillon Consulting
City of Winnipeg Transit Garage

Z:\Projects\0022 Dillon Consulting Ltd\0022 186 00 CoW N Transit Garage\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 2023-10-23 COW Transit Garage 0_A 0022-186-00.dwg, 2023-10-23 9:56:06 AM

0 25 50 75 m
SCALE = 1 : 1 500 (279 mm x 432 mm)

LEGEND:
● TEST HOLE (TREK, 2023)
⊕ PROBE HOLE (TREK, 2023)

NOTES:
1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2021).
2. TEST HOLE LOCATIONS WERE ESTABLISHED USING A RTK GPS UNIT.

Figure 01
Test Hole Location Plan

TREK GEOTECHNICAL

City of Winnipeg North Transit Garage
Bedrock Core Photograph
TH23-09 – C98 & C99

Top @ 52'0" (15.8 m)

***Some Mudstone taken for testing**

Btm @ 57'0" (17.4 m)

Top @ 57'0" (17.4 m)

Limestone Bedrock @ 59'6" (18.1 m)

Btm @ 62'0" (18.9 m)

Project Number: 0022 186 00	**Date:** October 13, 2023	Local Coordinates: UTM N-5532407.259, E-628235.579	Depth relative to Existing ground	**Created By:** TC	**Reviewed By:** MVH

City of Winnipeg North Transit Garage
Bedrock Core Photograph
TH23-09 – C100 & C101

Top @ 62'0" (18.9 m)

Btm @ 67'0" (20.4 m)

Top @ 67'0" (20.4 m)

Btm @ 71'0" (21.6 m)

Project Number: 0022 186 00	**Date:** October 13, 2023	Local Coordinates: UTM N-5532407.259, E-628235.579	Depth relative to Existing ground	**Created By:** TC	**Reviewed By:** MVH

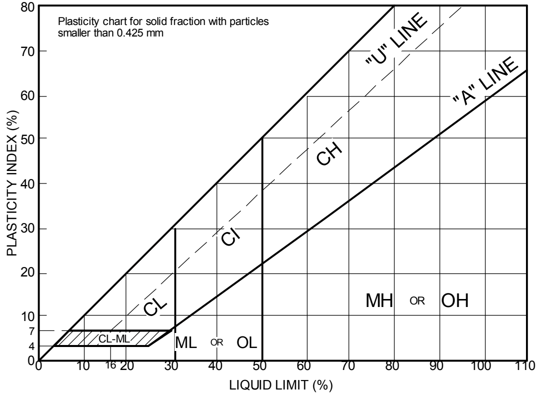
Sub-Surface Logs

TREK
GEOTECHNICAL

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classi- fication	Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW	●	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent...... GW, GP, SW, SP More than 12 percent...... GM, GC, SM, SC 6 to 12 percent...... Borderline case4s requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	○	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	▥	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▨	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW	∴	Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	⁚	Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	▥	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	▥	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart  		
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	☰	Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH	▥	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts			
			CH	▨	Inorganic clays of high plasticity, fat clays			
			OH	≋	Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		Pt	⁂	Peat and other highly organic soils	Von Post Classification Limit	Strong colour or odour, and often fibrous texture	

Material		Particle Size	
		ASTM Sieve sizes	mm
Sand	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
Silt or Clay		< #200	< 0.075

Material		Particle Size	
		ASTM Sieve Sizes	mm
Boulders		> 12 in.	> 300
Cobbles		3 in. to 12 in.	75 to 300
Gravel	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols.
For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

■	Asphalt	▧	Bedrock (undifferentiated)	○	Cobbles
⁙	Concrete	⊞	Limestone Bedrock	●	Boulders and Cobbles
▩	Fill	☰	Cemented Shale	▥	Silt Till
		▧	Non-Cemented Shale	▨	Clay Till

TREK GEOTECHNICAL

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD- Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength

VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling
▼ Water Level at End of Drilling
▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent
with *	with silt, with sand	> 35 percent

* Used when the material is classified based on behaviour as a cohesive material

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

EXPLANATION OF ROCK CLASSIFICATION

(Canadian Foundation Engineering Manual, 4th Edition, 2006)

Grade*	**Term**	**Uniaxial Comp. Strength (MPa)**	**Point Load Index (MPa)**	**Field Estimate of Strength**	**Examples**
R6	Extremely strong	>250	>10	Specimen can only be chipped with a geological hammer	Fresh basalt, chert, diabase, gneiss, granite, quartzite
R5	Very strong	100-250	4-10	Specimen requires many blows of a geological hammer to fracture it	Amphibolite, sandstone, basalt, gabbro, gneiss, granodiorite, peridotite, rhyolite, tuff
R4	Strong	50-100	2-4	Specimen requires more than one blow of a geological hammer to fracture it	Limestone, marble, sandstone, schist
R3	Medium Strong	25-50	1-2	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow from a geological hammer	Concrete, phyllite, schist, siltstone
R2	Weak	5-25	***	Can be peeled with a pocket knife with difficulty, shallow indentation made by a firm blow with the point of a geological hammer	Chalk, claystone, potash, marl, siltstone, shale, rocksalt
R1	Very weak	1-5	***	Crumbles under firm blows with point of a geological hammer, can be peeled with a pocket knife	Highly weathered or altered rock, shale
R0	Extremely weak	0.25-1	***	Indented by thumbnail	Stiff fault gouge

* Grade according to ISRM (1981).

** All rock types exhibit a broad range of uniaxial comprehensive strengths reflecting heterogeneity in composition and anisotropy in structure. Strong rocks are characterized by well-interlocked crystal fabric and few voids.

*** Rocks with a uniaxial compressive strength below 25 MPa are likely to yield highly ambiguous results under point load testing.

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH23-01

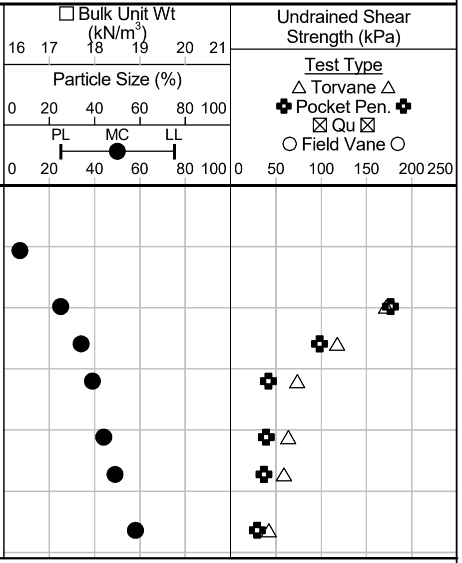
1 of 1

Client:	Dillion Consulting Ltd.	**Project Number:**	0022-186-00
Project Name:	City of Winnipeg Transit Garage	**Location:**	UTM N-5532581.361, E-628199.774
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	234.40 m (geodetic)
Method:	125 mm Solid Stem Auger, Mobile B48 Track Mount	**Date Drilled:**	October 11, 2023

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⛬ Sand ● Gravel ◌ Cobbles ■ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
234.0		⛬	CONCRETE - 350 mm thick			
233.6		☒	SAND AND GRAVEL (FILL) - some clay, some silt, dark grey and brown, dry, loose, poorly graded	◢	G01	
233.2	1	☒	CLAY (FILL) - silty, trace sand, trace gravel, mottled brown and grey, dry to moist, very stiff, high plasticity	◢	G02	
231.3	2 3	▨	CLAY - silty, trace sand, trace silt inclusions (<10 mm dia.) - grey and brown - moist, stiff - high plasticity - trace precipitates (<5 mm dia.) below 1.7 m depth	◢ ◢ ◢ ◢ ◢	G03 G04 G05 G06 G07	



END OF TEST HOLE AT 3.0 m IN CLAY

Notes:

1) No seepage or sloughing observed.
2) Test hole open and dry to 3.0 m one minute after drilling.
3) Test hole backfilled with bentonite, granular fill, and asphalt cold patch to surface.
4) Test hole located 1.7 m offset north-east of southbound curb.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH23-02

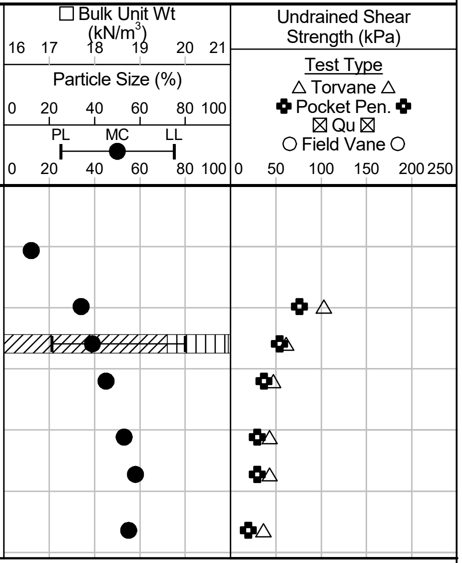
1 of 1

Client: Dillion Consulting Ltd.
Project Name: City of Winnipeg Transit Garage
Contractor: Paddock Drilling Ltd.
Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount
Project Number: 0022-186-00
Location: UTM N-5532481.435, E-628333.598
Ground Elevation: 233.88 m (geodetic)
Date Drilled: October 11, 2023

Sample Type: ◢ Grab (G) ◨ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ◨ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ░ Sand ● Gravel ▢ Cobbles ■ Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5		░	CONCRETE - 350 mm thick			
233.0		☒	SAND AND GRAVEL (FILL) - some clay, trace to some silt, grey, dry to moist, loose, poorly graded	◢	G08	
	1	▨	CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.) - grey and brown - moist, stiff - high plasticity	◢ ◢ ◢	G09 G10 G11	
	2	▨	- trace precipitates (<5 mm dia.) below 1.8 m depth	◢ ◢	G12 G13	
230.8	3	▨		◢	G14	



END OF TEST HOLE AT 3.0 m IN CLAY
Notes:
1) No seepage or sloughing observed.
2) Test hole open and dry to 3.0 m one minute after drilling.
3) Test hole backfilled with bentonite, granular fill, and asphalt cold patch to surface.
4) Test hole located 1.7 m offset north-east of southbound curb.

Logged By: Tyler Chapko
Reviewed By: Kent Bannister
Project Engineer: Michael Van Helden

TREK GEOTECHNICAL

Sub-Surface Log

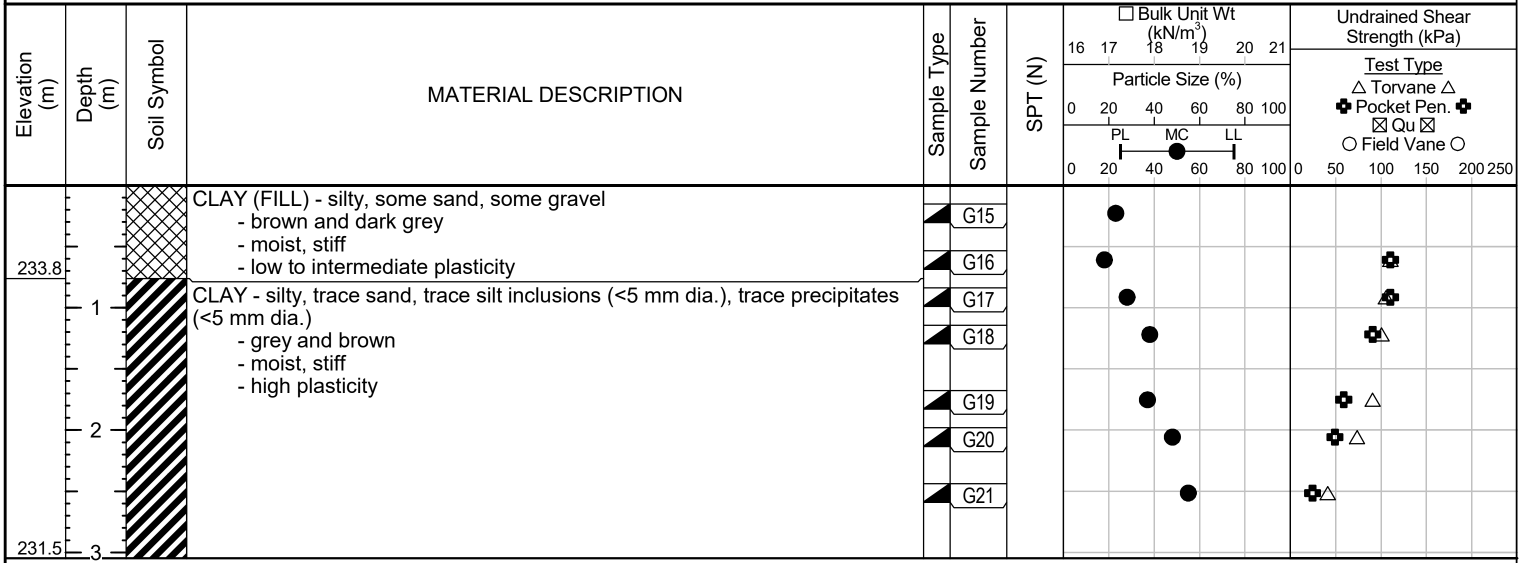
Test Hole TH23-03

1 of 1

Client:	Dillion Consulting Ltd.	**Project Number:**	0022-186-00
Project Name:	City of Winnipeg Transit Garage	**Location:**	UTM N-5532442.25, E-628419.774
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	234.52 m (geodetic)
Method:	125 mm Solid Stem Auger, Mobile B48 Track Mount	**Date Drilled:**	October 11, 2023

Sample Type: ◪ Grab (G) ◫ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ◫ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



CLAY (FILL) - silty, some sand, some gravel
- brown and dark grey
- moist, stiff
- low to intermediate plasticity

CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.), trace precipitates (<5 mm dia.)
- grey and brown
- moist, stiff
- high plasticity

END OF TEST HOLE AT 3.0 m IN CLAY

Notes:

1) No seepage or sloughing observed.
2) Test hole open and dry to 3.0 m one minute after drilling.
3) Test hole backfilled with bentonite and auger cuttings to surface
4) Test hole located 0.3 m offset south-west of northbound median curb inside the median.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-04

1 of 2

Client: Dillion Consulting Ltd.

Project Name: City of Winnipeg Transit Garage

Contractor: Paddock Drilling Ltd.

Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount

Project Number: 0022-186-00

Location: UTM N-5532343.95, E-628344.992

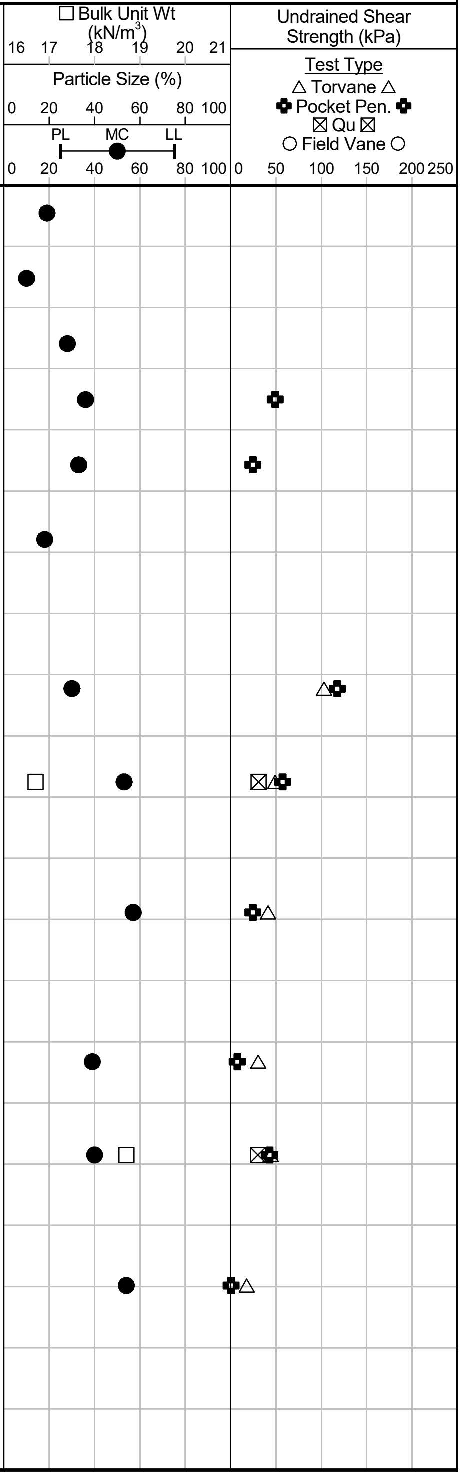
Ground Elevation: 236.52 m (geodetic)

Date Drilled: October 11, 2023

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
236.1		TOPSOIL - clayey, sandy, some sand, some organics, grey, dry to moist, stiff, intermediate plasticity	Grab	G22	
235.4	1	SAND (FILL) - silty, trace gravel, trace clay, brown, moist, loose	Grab	G23	
234.4	2	CLAY (FILL) - silty, trace to some sand - brown - moist, stiff - high plasticity	Grab Grab	G24 G25	
233.8		CLAY (ORGANIC) - silty, trace to some sand, black, moist, stiff, intermediate plasticity	Grab	G26	
233.2	3	SILT - trace clay, trace sand, light brown, moist, soft, low plasticity	Grab	G27	
226.3	4 5 6 7 8 9 10	CLAY - silty, trace sand, trace silt inclusions (<10 mm dia.), trace precipitates (<5 mm dia.) - brown - moist, stiff - high plasticity - grey, firm below 4.3 m depth	Grab Shelby Tube Grab Grab Shelby Tube Grab	G28 T29 G30 G31 T32 G33	
		SILT - trace to some sand, trace clay, grey, moist, dense, no to low plasticity	Grab		



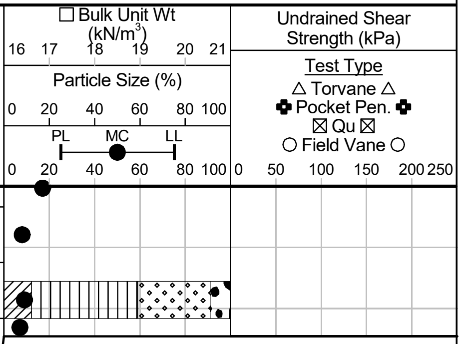
Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-04

2 of 2

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
225.8					G34	
	11		SILT (TILL) - sandy, trace to some gravel, trace clay - grey - dry to moist, dense - no to low plasticity		SS35	37
					G36	
224.8					SS37	50 / 146mm



END OF TEST HOLE AT 11.7 m IN SILT TILL

Notes:

1) Power auger refusal at 11.7 m depth.
2) Seepage observed below 11.0 m depth IN SILT TILL.
3) Sloughing observed between 2.7 to 3.4 m depth in SILT.
4) Test hole open and dry to 3.4 m depth one minute after drilling.
5) Test hole backfilled with bentonite to surface.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

SUB-SURFACE LOG LOGS 2023-10-16 COW TRANSIT GARAGE 0_A_TC 0022-186-00.GPJ TREK.GDT 11/15/23

Sub-Surface Log

Test Hole TH23-05

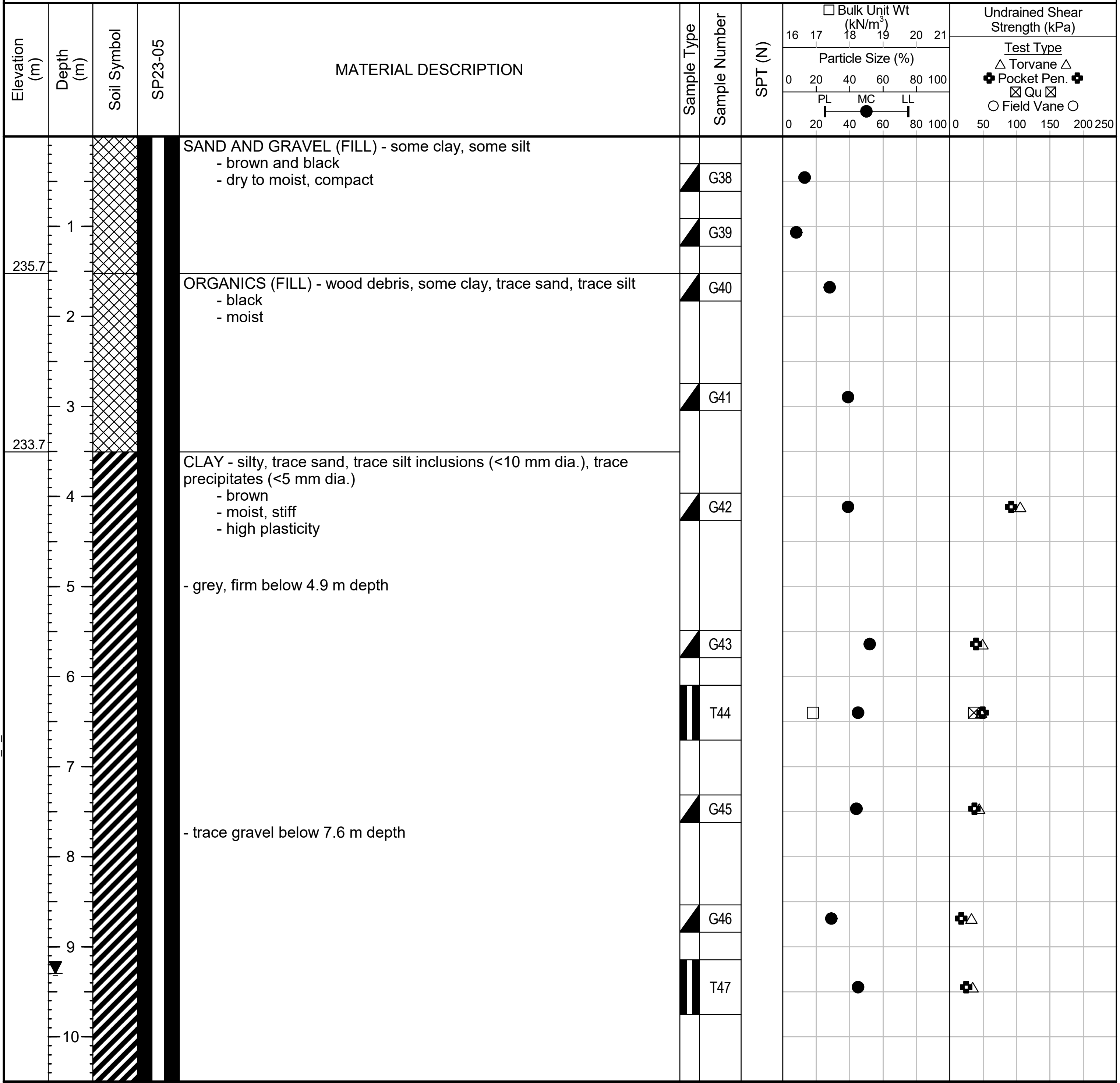
1 of 2

Client: Dillion Consulting Ltd.
Project Number: 0022-186-00
Project Name: City of Winnipeg Transit Garage
Location: UTM N-5532277.873, E-628206.773
Contractor: Paddock Drilling Ltd.
Ground Elevation: 237.25 m (geodetic)
Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount
Date Drilled: October 12, 2023

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⛆ Sand ▩ Gravel ▢ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▧ Cement ▨ Drill Cuttings ░ Filter Pack Sand ▩ Grout ▦ Slough



SAND AND GRAVEL (FILL) - some clay, some silt
- brown and black
- dry to moist, compact

ORGANICS (FILL) - wood debris, some clay, trace sand, trace silt
- black
- moist

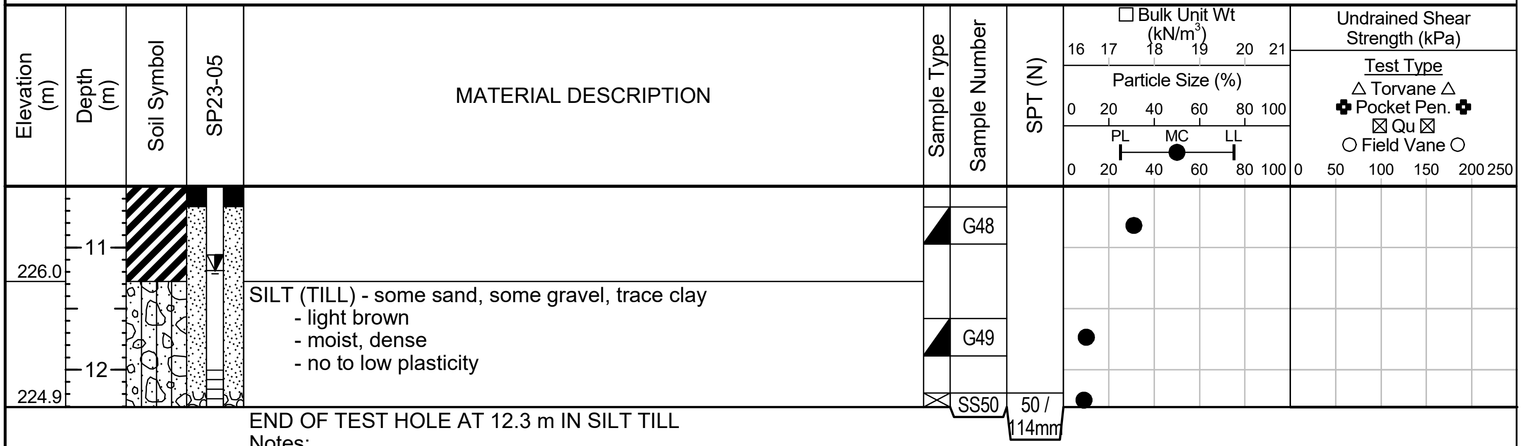
CLAY - silty, trace sand, trace silt inclusions (<10 mm dia.), trace precipitates (<5 mm dia.)
- brown
- moist, stiff
- high plasticity

- grey, firm below 4.9 m depth

- trace gravel below 7.6 m depth

Logged By: Tyler Chapko
Reviewed By: Kent Bannister
Project Engineer: Michael Van Helden

Sub-Surface Log



SILT (TILL) - some sand, some gravel, trace clay
- light brown
- moist, dense
- no to low plasticity

END OF TEST HOLE AT 12.3 m IN SILT TILL
Notes:
1) Power auger refusal at 12.3 m depth.
2) Seepage and sloughing observed between 1.5 to 3.5 m depth in ORAGANICS (FILL).
3) Test hole open to 12.2 m depth one minute after drilling.
4) Water level in test hole at 9.3 m depth one minute after drilling
5) Standpipe SP23-05 installed in test hole with silica sand from 10.7 to 12.2 m and bentonite to ground surface.
7) Water level in standpipe at 11.3 m below ground surface 2 days after drilling.

Logged By: Tyler Chapko
Reviewed By: Kent Bannister
Project Engineer: Michael Van Helden

Sub-Surface Log

Test Hole TH23-06

1 of 2

Client: Dillion Consulting Ltd.

Project Number: 0022-186-00

Project Name: City of Winnipeg Transit Garage

Location: UTM N-5532354.935, E-628121.82

Contractor: Paddock Drilling Ltd.

Ground Elevation: 238.36 m (geodetic)

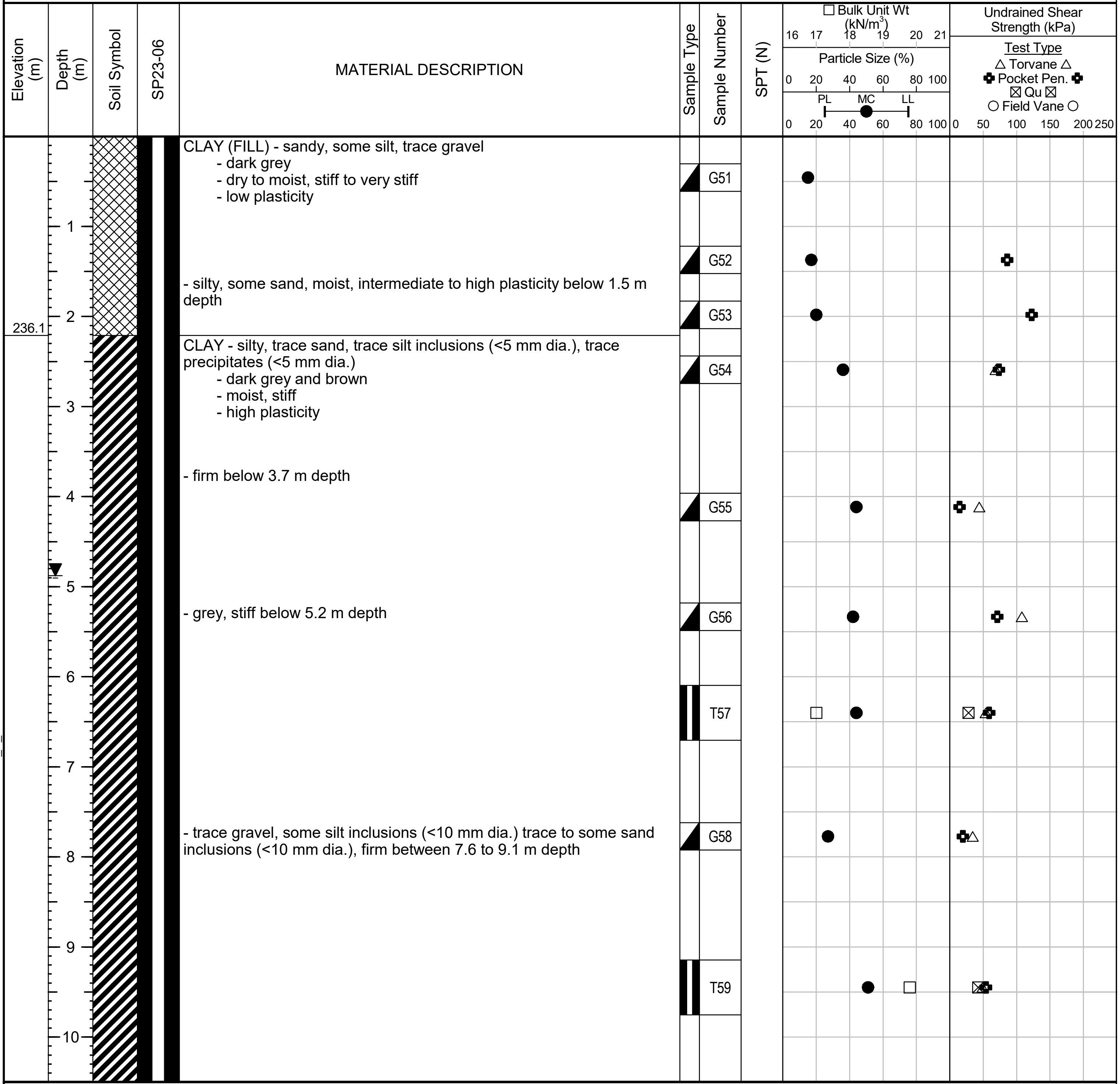
Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount

Date Drilled: October 12, 2023

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite | Cement | Drill Cuttings | Filter Pack Sand | Grout | Slough



CLAY (FILL) - sandy, some silt, trace gravel
- dark grey
- dry to moist, stiff to very stiff
- low plasticity

- silty, some sand, moist, intermediate to high plasticity below 1.5 m depth

CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.), trace precipitates (<5 mm dia.)
- dark grey and brown
- moist, stiff
- high plasticity

- firm below 3.7 m depth

- grey, stiff below 5.2 m depth

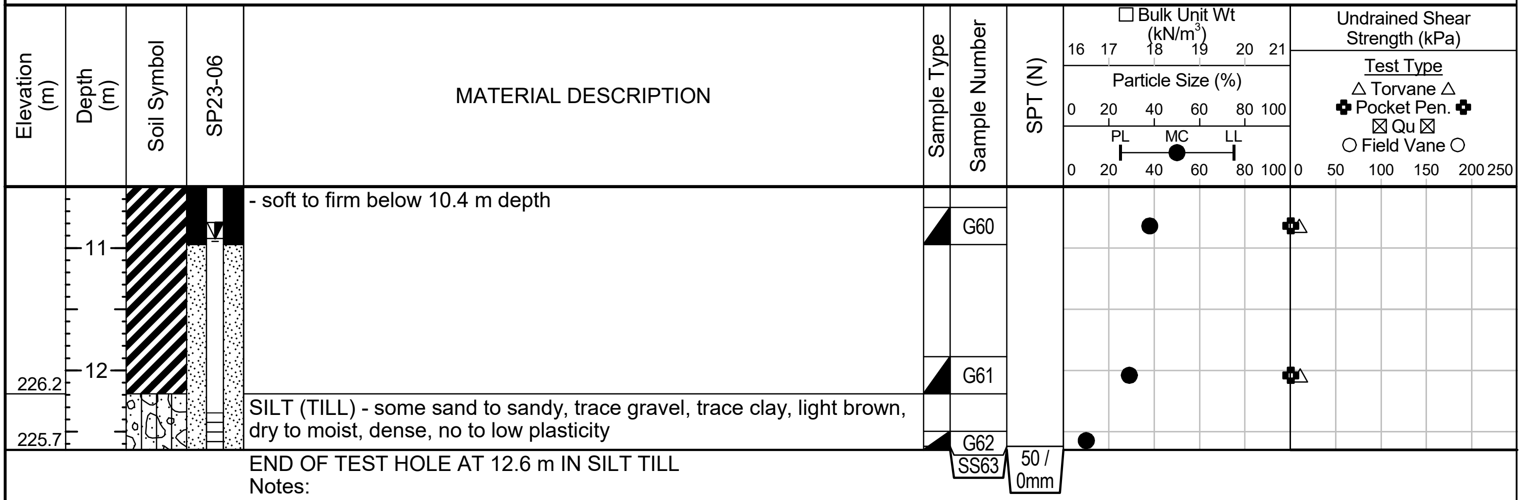
- trace gravel, some silt inclusions (<10 mm dia.) trace to some sand inclusions (<10 mm dia.), firm between 7.6 to 9.1 m depth

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-06

2 of 2



- soft to firm below 10.4 m depth

SILT (TILL) - some sand to sandy, trace gravel, trace clay, light brown, dry to moist, dense, no to low plasticity

END OF TEST HOLE AT 12.6 m IN SILT TILL

Notes:

1) Power auger refusal at 12.6 m depth.
2) Seepage observed at 4.6 m depth. No sloughing observed.
3) Test hole open to 12.6 m depth one minute after drilling.
4) Water level in test hole at 4.9 m depth one minute after drilling
5) Standpipe SP23-06 installed in test hole with silica sand from 11.0 to 12.6 m and bentonite to ground surface.
6) Water level in standpipe at 10.9 m below ground surface 1.5 days after drilling.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

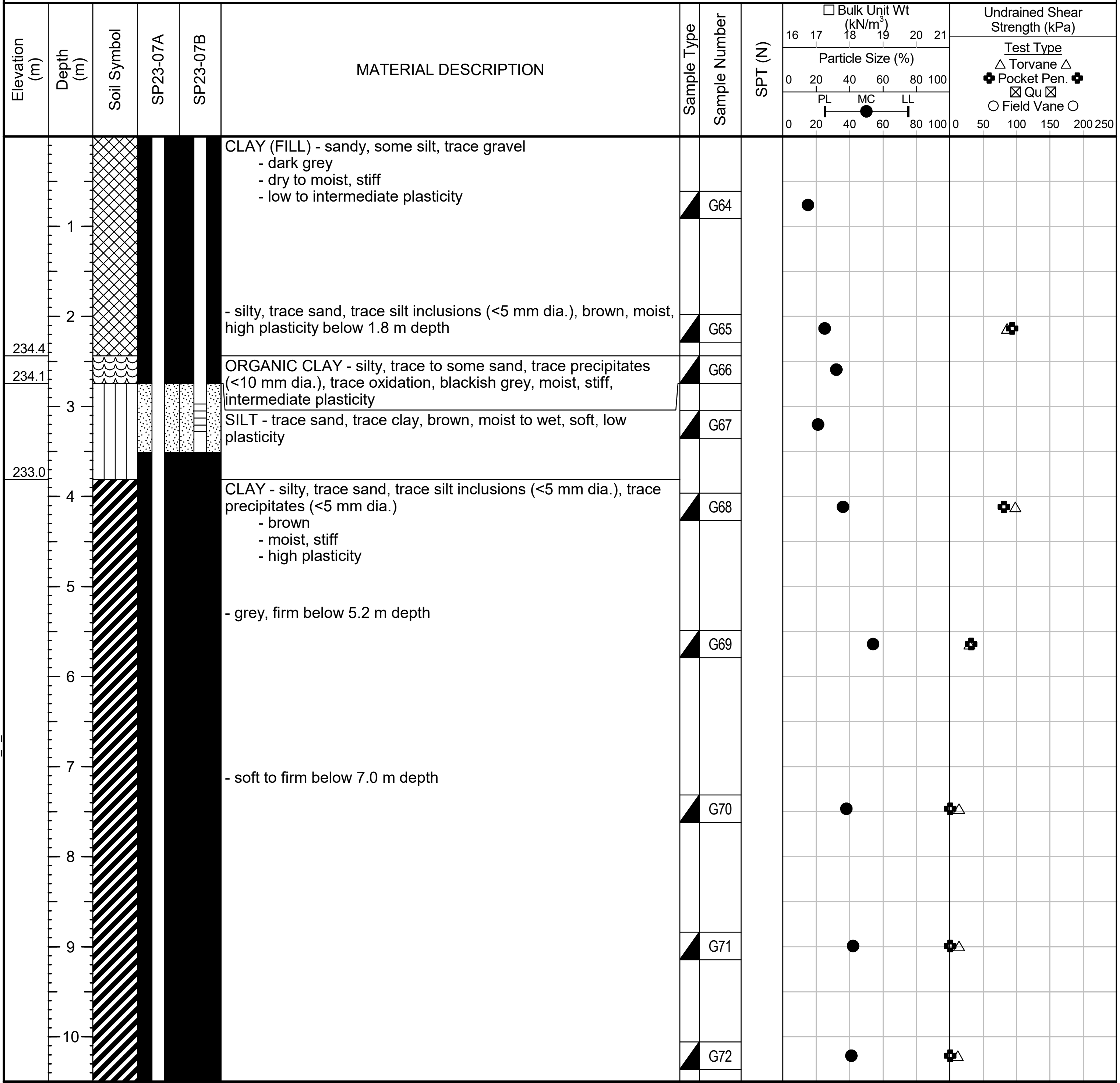
Test Hole TH23-07

Client: Dillion Consulting Ltd.
Project Number: 0022-186-00
Project Name: City of Winnipeg Transit Garage
Location: UTM N-5532501.961, E-628161.341
Contractor: Paddock Drilling Ltd.
Ground Elevation: 236.83 m (geodetic)
Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount
Date Drilled: October 12, 2023

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▥ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▩ Cement ▨ Drill Cuttings ⁘ Filter Pack Sand ⁘ Grout ▩ Slough



CLAY (FILL) - sandy, some silt, trace gravel
- dark grey
- dry to moist, stiff
- low to intermediate plasticity

- silty, trace sand, trace silt inclusions (<5 mm dia.), brown, moist, high plasticity below 1.8 m depth

ORGANIC CLAY - silty, trace to some sand, trace precipitates (<10 mm dia.), trace oxidation, blackish grey, moist, stiff, intermediate plasticity

SILT - trace sand, trace clay, brown, moist to wet, soft, low plasticity

CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.), trace precipitates (<5 mm dia.)
- brown
- moist, stiff
- high plasticity

- grey, firm below 5.2 m depth

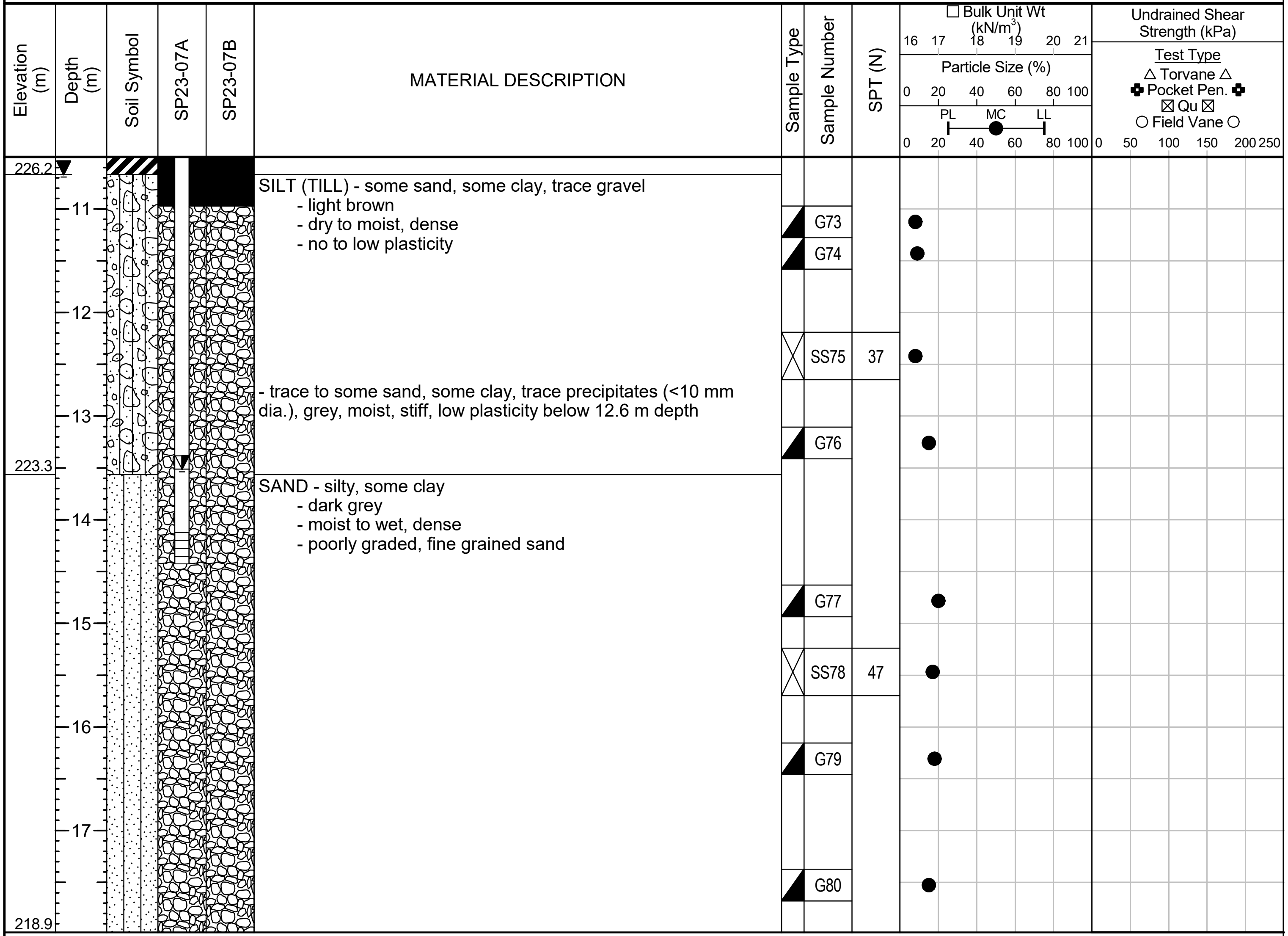
- soft to firm below 7.0 m depth

Sample Type	Sample Number
◩	G64
◩	G65
◩	G66
◩	G67
◩	G68
◩	G69
◩	G70
◩	G71
◩	G72

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-07



SILT (TILL) - some sand, some clay, trace gravel
- light brown
- dry to moist, dense
- no to low plasticity

- trace to some sand, some clay, trace precipitates (<10 mm dia.), grey, moist, stiff, low plasticity below 12.6 m depth

SAND - silty, some clay
- dark grey
- moist to wet, dense
- poorly graded, fine grained sand

Sample Number	SPT (N)
G73	
G74	
SS75	37
G76	
G77	
SS78	47
G79	
G80	

END OF TEST HOLE AT 18.0 m IN SAND

Notes:

1) Power auger refusal at 18.0 m depth.
2) Seepage observed at 3.5 m depth in SILT.
3) Sloughing observed from 2.7 to 3.8 m depth in SILT and below 13.4 m depth in SAND.
4) Test hole open to 11.0 m depth one minute after drilling.
5) Water level in test hole at 10.7 m depth one minute after drilling
6) Standpipe SP23-07A installed in test hole in sloughed material and bentonite to 3.5 m depth.
7) Standpipe SP23-07B installed in test hole with silica sand from 2.7 to 3.5 m and bentonite to ground surface.
8) Water level in standpipe 23-07A at 13.5 m below ground surface 1 day after drilling.
9) Water level in standpipe 23-07B dry 1 day after drilling.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-08

1 of 1

Client: Dillion Consulting Ltd.

Project Name: City of Winnipeg Transit Garage

Contractor: Paddock Drilling Ltd.

Method: 125 mm Solid Stem Auger, Mobile B48 Track Mount

Project Number: 0022-186-00

Location: UTM N-5532407.69, E-628230.756

Ground Elevation: 236.17 m (geodetic)

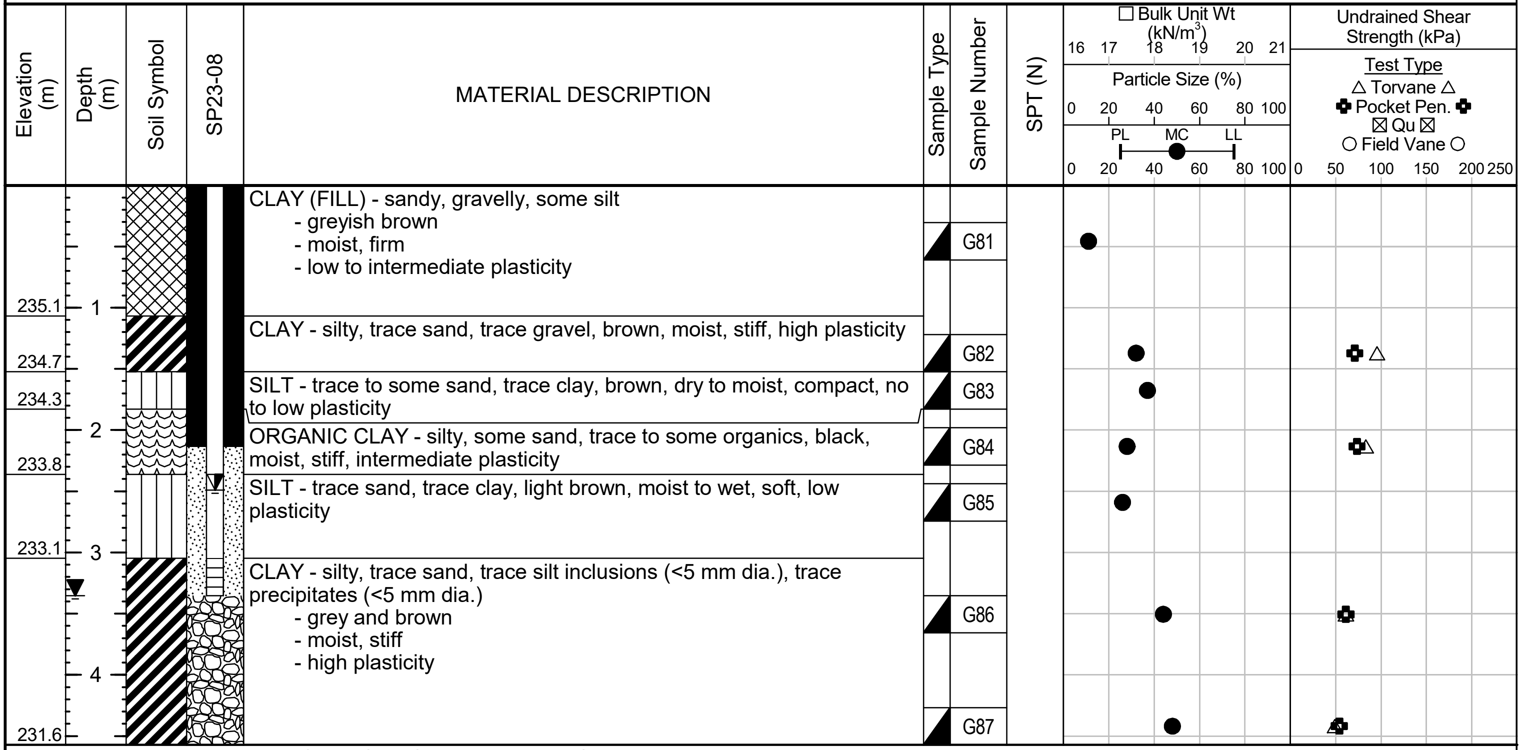
Date Drilled: October 12, 2023

Sample Type: ◪ Grab (G) ◫ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧓ Split Barrel (SB) / LPT ◫ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ▩ Sand ▩ Gravel ▩ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▩ Cement ▨ Drill Cuttings ▩ Filter Pack Sand ▩ Grout ▩ Slough

Elevation (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
235.1	CLAY (FILL) - sandy, gravelly, some silt - greyish brown - moist, firm - low to intermediate plasticity	G	G81
234.7	CLAY - silty, trace sand, trace gravel, brown, moist, stiff, high plasticity	G	G82
234.3	SILT - trace to some sand, trace clay, brown, dry to moist, compact, no to low plasticity	G	G83
233.8	ORGANIC CLAY - silty, some sand, trace to some organics, black, moist, stiff, intermediate plasticity	G	G84
233.1	SILT - trace sand, trace clay, light brown, moist to wet, soft, low plasticity	G	G85
231.6	CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.), trace precipitates (<5 mm dia.) - grey and brown - moist, stiff - high plasticity	G G	G86 G87



END OF TEST HOLE AT 4.6 m IN CLAY

Notes:

1) Seepage and sloughing observed from 2.4 to 3.0 m depth in SILT.
2) Test hole open to 3.4 m depth one minute after drilling.
3) Water level in test hole at 3.4 m depth one minute after drilling
4) Standpipe SP23-08 installed in test hole with silica sand from 2.1 to 3.3 m and bentonite to ground surface.
5) Water level in standpipe at 2.6 m below ground surface 1 day after drilling.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

TREK GEOTECHNICAL

Sub-Surface Log

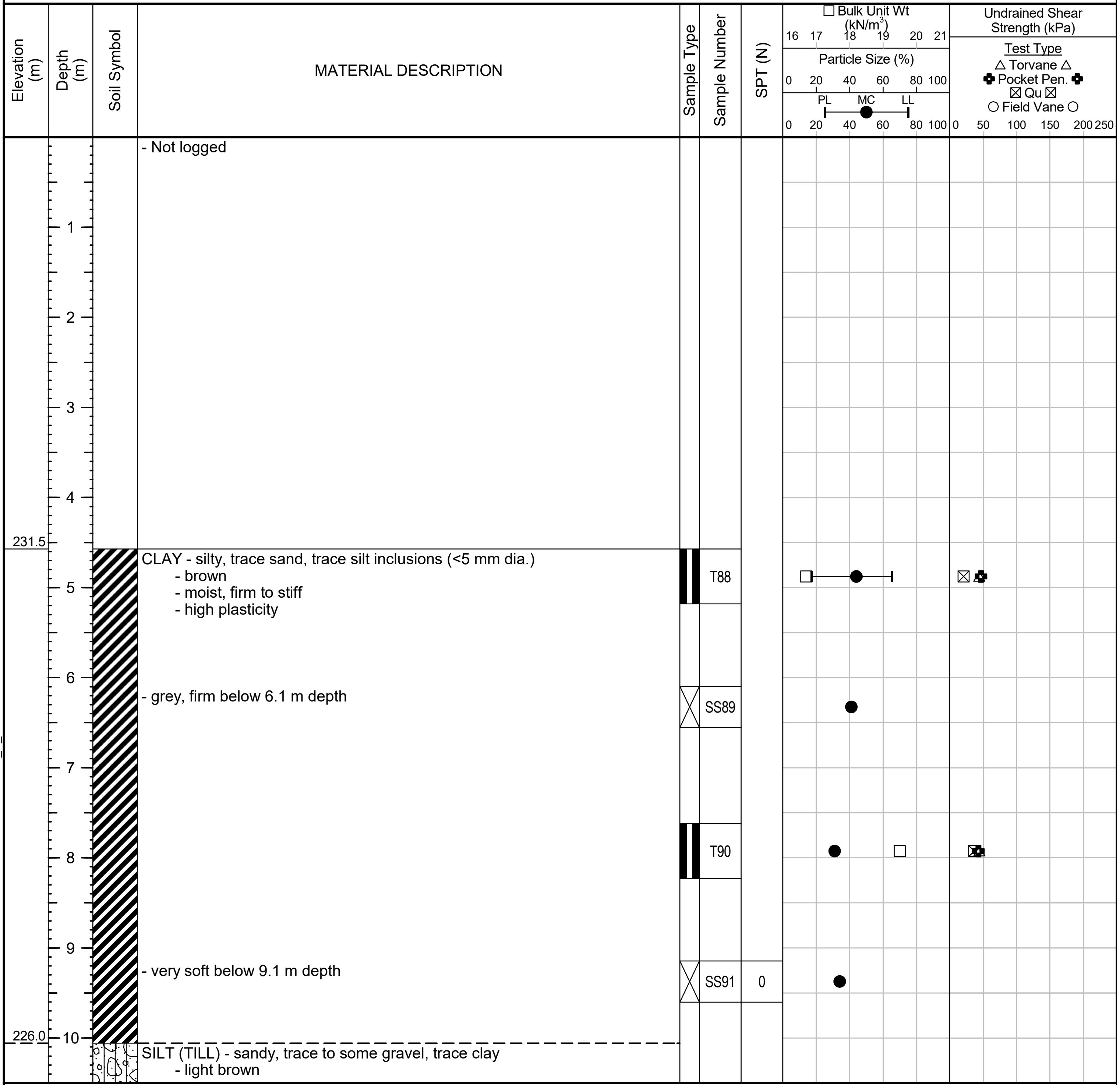
Test Hole TH23-09

1 of 2

Client: Dillion Consulting Ltd.
Project Name: City of Winnipeg Transit Garage
Contractor: Paddock Drilling Ltd.
Method: 125 mm Solid Stem Auger / HQ Coring, Mobile B48 Track Mount
Project Number: 0022-186-00
Location: UTM N-5532407.259, E-628235.579
Ground Elevation: 236.08 m (geodetic)
Date Drilled: October 13, 2023

Sample Type: Grab (G) Shelby Tube (T) ☒ Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt Sand Gravel Cobbles Boulders



Elevation (m)	MATERIAL DESCRIPTION	Sample Number	SPT (N)
	- Not logged		
231.5	CLAY - silty, trace sand, trace silt inclusions (<5 mm dia.) - brown - moist, firm to stiff - high plasticity	T88	
	- grey, firm below 6.1 m depth	SS89	
		T90	
	- very soft below 9.1 m depth	SS91	0
226.0	SILT (TILL) - sandy, trace to some gravel, trace clay - light brown		

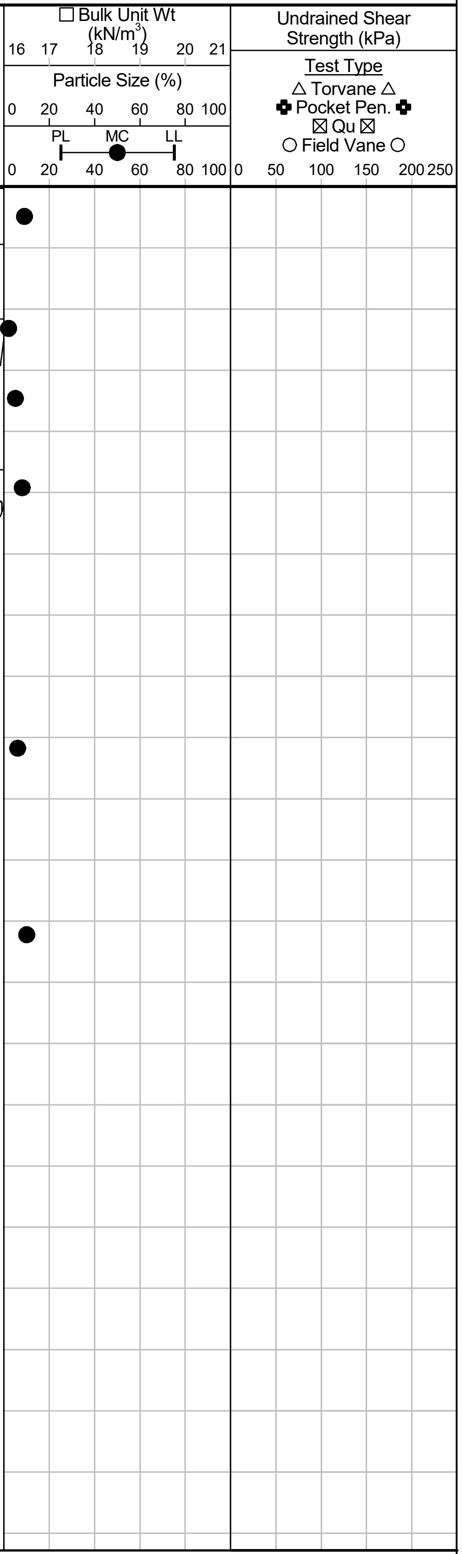
Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH23-09

2 of 2

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
		- moist, dense - no to low plasticity	☒	SS92	24
	11				
		- trace to some cobbles below 11.6 m depth	☒	SS93	50 / 0mm
	12			C94	
	13		☒	SS95	50 / 140mm
				C96	
	14				
221.8		CLAY MUDSTONE (Gunn Member) - some corbonate inclusions - medium to oarse grained - grey to pink - moderately laminated with discontinuous wavy non-parallel bedding - platey		C97	
	15				
	16	- unconfined compressive strength of 1221 kPa at 16.0 m depth		C98	
	17				
		- unconfined compressive strength of 5055 kPa at 17.5 m depth		C99	
217.9	18	DOLOMITE (Red River Formation, Lower Fort Gary Member) - argillaceous dolomite - cream to beige to red colour - hard, R3 - massive - fracturing on argillaceous layers perpendicular to drill axis			
	19				
		- unconfined compressive strength of 35.2 MPa at 19.7 m depth		C100	
	20				
	21	- vuggy at 21.0 m depth		C101	
214.4					



END OF TEST HOLE AT 21.6 m IN LIMESTONE BEDROCK

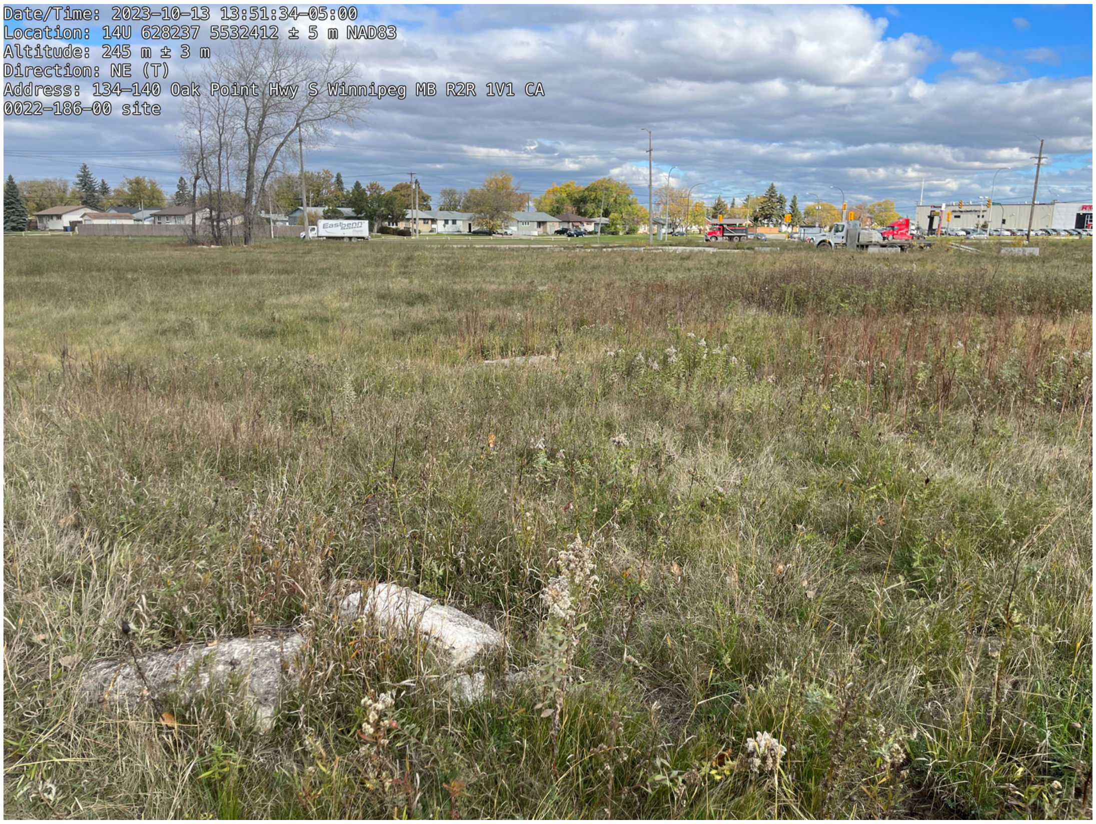
Notes:

1) Seepage and sloughing not observed due to use of coring methods.
2) Water level unavailable due to use of coring methods.
3) Test hole backfilled with grout and bentonite to surface.

Logged By: Tyler Chapko **Reviewed By:** Kent Bannister **Project Engineer:** Michael Van Helden

Appendix A

Site Pictures


Date/Time: 2023-10-13 13:51:34-05:00
Location: 14U 628237 5532412 ± 5 m NAD83
Altitude: 245 m ± 3 m
Direction: NE (T)
Address: 134-140 Oak Point Hwy S Winnipeg MB R2R 1V1 CA
0022-186-00 site


Date/Time: 2023-10-13 13:51:44-05:00
Location: 14U 628244 5532410 ± 5 m NAD83
Altitude: 243 m ± 3 m
Direction: SE (T)
Address: 134-140 Oak Point Hwy S Winnipeg MB R2R 1V1 CA
0022-186-00 site


Date/Time: 2023-10-13 13:52:10-05:00
Location: 14U 628252 5532421 ± 5 m NAD83
Altitude: 241 m ± 3 m
Direction: SE (T)
Address: 100 Oak Point Hwy S Winnipeg MB R2R 1T8 CA
0022-186-00 site


Date/Time: 2023-10-13 13:53:09-05:00
Location: 14U 628236 5532426 ± 4 m NAD83
Altitude: 244 m ± 3 m
Direction: W (T)
Address: 134-140 Oak Point Hwy S Winnipeg MB R2R 1V1 CA
0022-186-00 site


Date/Time: 2023-10-13 13:54:48-05:00
Location: 14U 628258 5532466 ± 5 m NAD83
Altitude: 241 m ± 3 m
Direction: NE (T)
Address: 134-140 Oak Point Hwy S Winnipeg MB R2R 1V1 CA
0022-186-00 site


Date/Time: 2023-10-13 13:56:04-05:00
Location: 14U 628223 5532353 ± 5 m NAD83
Altitude: 237 m ± 3 m
Direction: W (T)
Address: Hyde Ave Winnipeg MB CA
0022-186-00 site

Appendix B

Laboratory Testing

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	November 13, 2023
To	Tyler Chapko, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0022-186-02
Project	City of Winnipeg Transit Garage
Subject	Laboratory Testing Results – Lab Req. R23-530
Distribution	Michael Van Helden

Attached are the laboratory testing results for the above noted project. The testing included moisture content determinations, Atterberg Limits, particle size distribution (Hydrometer method), Standard Proctor, CBR and unconfined compressive strength and related testing on Shelby tube sample.

Regards,

Angela Fidler-Kliewer, C.Tech.

Attach.

Review Control:

Prepared By: AFK	*Reviewed By:* *KF*	*Checked By:* NJF

AD

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Dillion Consulting Ltd.

PROJECT NAME City of Winnipeg Transit Garage

PROJECT NO: 0022-186-00

FIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILARY TESTS				Soil Description/Comments
TH23-01	G01	1.5 - 2.0		X										Sand + Gravel
TH23-01	G02	3.0 - 3.5		X										Clay (fill)
TH23-01	G03	4.0 - 4.5		X										Clay
TH23-01	G04	5.0 - 5.5		X										↓
TH23-01	G05	6.5 - 7.0		X										
TH23-01	G06	7.5 - 8.0		X										
TH23-01	G07	9.0 - 9.5		X										
TH23-02	G08	1.5 - 2.0		X										Sand + Gravel
TH23-02	G09	3.0 - 3.5		X										Clay
TH23-02	G10	4.0 - 4.5		X		X	X							↓
TH23-02	G11	5.0 - 5.5		X										
TH23-02	G12	6.5 - 7.0		X										
TH23-02	G13	7.5 - 8.0		X										
TH23-02	G14	9.0 - 9.5		X										
TH23-03	G15	0.5 - 1.0		X										Clay (fill)
TH23-03	G16	1.8 - 2.3		X										↓
TH23-03	G17	2.8 - 3.3		X										Clay
TH23-03	G18	3.8 - 4.3		X										↓
TH23-03	G19	5.5 - 6.0		X										
TH23-03	G20	6.5 - 7.0		X										
TH23-03	G21	8.0 - 8.5		X										
TH23-04	G22	0.5 - 1.0		X										Topsoil
TH23-04	G23	2.0 - 3.0		X										Sand (fill)
TH23-04	G24	4.0 - 4.5		X										Clay
TH23-04	G25	5.5 - 6.0		X										↓
TH23-04	G26	7.0 - 8.0		X										Clay (organic)
TH23-04	G27	9.0 - 10.0		X										Silt
TH23-04	G28	13.0 - 14.0		X										Clay
TH23-04	T29	15.0 - 17.0		X						X				↓
TH23-04	G30	19.0 - 20.0		X										
TH23-04	G31	23.0 - 24.0		X										
TH23-04	T32	25.0 - 27.0		X						X				
TH23-04	G33	29.0 - 30.0		X										
TH23-04	G34	34.0 - 35.0		X										Silt
TH23-04	SS35	35.0 - 36.5		X										Silt till

REQUESTED BY: Tyler Chapko

REPORT TO: TC, MVH

REQUISITION DATE: Oct. 16/23

DATE REQUIRED:

COMMENTS:

REQUISITION NO. R23-530

PAGE 1 OF 3

TREK LABORATORY REQUISITION LOGS 2023-10-16 COW TRANSIT GARAGE 0_A_TC 0022-186-00.GPJ TREK GEOTECHNICAL.GDT 10/16/23

Also need CBR on Bulk sample from TH23-02 + TH23-01
↳ combined if
959

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Dillion Consulting Ltd.

PROJECT NAME City of Winnipeg Transit Garage

PROJECT NO: 0022-186-00

FIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILIARY TESTS					Soil Description/Comments
TH23-04	G36	37.0 - 38.0		X			X								Silt fill
TH23-04	SS37	38.0 - 38.5		X											↓
TH23-05	G38	1.0 - 2.0		X											Sand + Gravel
TH23-05	G39	3.0 - 4.0		X											↓
TH23-05	G40	5.0 - 6.0		X											organics
TH23-05	G41	9.0 - 10.0		X											↓
TH23-05	G42	13.0 - 14.0		X											Clay
TH23-05	G43	18.0 - 19.0		X											
TH23-05	T44	20.0 - 22.0		/						X					
TH23-05	G45	24.0 - 25.0		X											
TH23-05	G46	28.0 - 29.0		X											
TH23-05	T47	30.0 - 32.0		X						X					UNABLE TO DO BULK/QU MOSTLY SLOUGH
TH23-05	G48	35.0 - 36.0		X											↓
TH23-05	G49	38.0 - 39.0		X											silt fill
TH23-05	SS50	40.0 - 40.4		X											↓
TH23-06	G51	1.0 - 2.0		X											Clay (fill)
TH23-06	G52	4.0 - 5.0		X											
TH23-06	G53	6.0 - 7.0		X											↓
TH23-06	G54	8.0 - 9.0		X											Clay
TH23-06	G55	13.0 - 14.0		X											
TH23-06	G56	17.0 - 18.0		X											
TH23-06	T57	20.0 - 22.0		/						X					
TH23-06	G58	25.0 - 26.0		X											
TH23-06	T59	30.0 - 32.0		/						X					
TH23-06	G60	35.0 - 36.0		X											
TH23-06	G61	39.0 - 40.0		X											↓
TH23-06	G62	41.0 - 41.5		X											Silt fill
TH23-06	SS63	41.5 - 41.5													↓ * No recovery
TH23-07	G64	2.0 - 3.0		X											Clay (fill)
TH23-07	G65	6.5 - 7.5		X											Clay
TH23-07	G66	8.0 - 9.0		X											organic Clay
TH23-07	G67	10.0 - 11.0		X											Silt
TH23-07	G68	13.0 - 14.0		X											Clay
TH23-07	G69	18.0 - 19.0		X											↓
TH23-07	G70	24.0 - 25.0		X											

REQUESTED BY: Tyler Chapko

REPORT TO: TC / MVH

REQUISITION DATE: Oct. 16 /23

DATE REQUIRED:

COMMENTS:

REQUISITION NO.

PAGE 2 OF 3

TREK LABORATORY REQUISITION LOGS 2023-10-16 COW TRANSIT GARAGE 0_A_TC 0022-186-00.GPJ TREK GEOTECHNICAL.GDT 10/16/23

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Dillion Consulting Ltd.
PROJECT NO: 0022-186-00
PROJECT NAME City of Winnipeg Transit Garage
FIELD TECHNICIAN: Tyler Chapko

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS	Qu				Soil Description/Comments
TH23-07	G71	29.0 - 30.0		X											Clay
TH23-07	G72	33.0 - 34.0		X											↓
TH23-07	G73	36.0 - 37.0		X											Silt fill
TH23-07	G74	37.0 - 38.0		X											
TH23-07	SS75	40.0 - 41.5		X											
TH23-07	G76	43.0 - 44.0		X											↓
TH23-07	G77	48.0 - 49.0		X											Sand
TH23-07	SS78	50.0 - 51.5		X											
TH23-07	G79	53.0 - 54.0		X											
TH23-07	G80	57.0 - 58.0		X											↓
TH23-08	G81	1.0 - 2.0		X											Clay (fill)
TH23-08	G82	4.0 - 5.0		X											Clay
TH23-08	G83	5.0 - 6.0		X											Silt
TH23-08	G84	6.5 - 7.5		X											organic Clay
TH23-08	G85	8.0 - 9.0		X											Silt
TH23-08	G86	11.0 - 12.0		X											Clay
TH23-08	G87	14.0 - 15.0		X											
TH23-09	T88	15.0 - 17.0		/		X				X					
TH23-09	SS89	20.0 - 21.5		X											
TH23-09	T90	25.0 - 27.0		/						X					
TH23-09	SS91	30.0 - 31.5		X											↓
TH23-09	SS92	34.5 - 36.0		X											Silt fill
TH23-09	SS93	38.0 - 38.5		X											
TH23-09	C94	38.2 - 42.0		X											
TH23-09	SS95	42.0 - 43.0		X											
TH23-09	C96	42.0 - 47.0		/											↓ missing
TH23-09	C97	47.0 - 52.0		X											Shale
TH23-09	C98	52.0 - 57.0		X											↓
TH23-09	C99	57.0 - 62.0													Shale /Bedrock
TH23-09	C100	62.0 - 67.0													Bedrock
TH23-09	C101	67.0 - 71.0													Bedrock
TH23-09	C98A	52.5-53													Shale
TH23-09	C98 B	53-53.5													Shale
TH23-09	C99A	57.5-58									/				Shale

↳ take one (Best) of these three, Preferably 1/2 of the Smaller ones (C98A or B)

REQUESTED BY: Tyler Chapko
REPORT TO: TC, MVH
REQUISITION DATE: Oct. 16/23
DATE REQUIRED:
COMMENTS:

REQUISITION NO.

TREK GEOTECHNICAL
www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report
ASTM D2216-98

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician LL

Test Hole	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01	TH23-01
Depth (m)	0.5 - 0.6	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	2.0 - 2.1	2.3 - 2.4
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	M70	M49	L14	E32	E64	M56
Mass of tare	6.9	6.8	6.8	6.8	6.8	6.8
Mass wet + tare	212.2	215.8	211.7	213.3	213.1	211.7
Mass dry + tare	198.4	174.4	159.6	155.7	149.9	144.4
Mass water	13.8	41.4	52.1	57.6	63.2	67.3
Mass dry soil	191.5	167.6	152.8	148.9	143.1	137.6
Moisture %	7.2%	24.7%	34.1%	38.7%	44.2%	48.9%

Test Hole	TH23-01	TH23-02	TH23-02	TH23-02	TH23-02	TH23-02
Depth (m)	2.7 - 2.9	0.5 - 0.6	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	2.0 - 2.1
Sample #	G07	G08	G09	G10	G11	G12
Tare ID	E57	E02	M59	Q68	Q69	E16
Mass of tare	6.9	6.7	6.8	6.9	6.8	6.7
Mass wet + tare	214.1	227.5	211.5	414.9	209.2	213.7
Mass dry + tare	137.7	204.2	159.7	299.7	146.3	142.3
Mass water	76.4	23.3	51.8	115.2	62.9	71.4
Mass dry soil	130.8	197.5	152.9	292.8	139.5	135.6
Moisture %	58.4%	11.8%	33.9%	39.3%	45.1%	52.7%

Test Hole	TH23-02	TH23-02	TH23-03	TH23-03	TH23-03	TH23-03
Depth (m)	2.3 - 2.4	2.7 - 2.9	0.1 - 0.3	0.5 - 0.7	0.9 - 1.0	1.2 - 1.3
Sample #	G13	G14	G15	G16	G17	G18
Tare ID	J94	M14	M33	M28	N53	M36
Mass of tare	6.8	6.8	6.8	7.0	6.9	6.7
Mass wet + tare	211.6	211.2	213.3	214.7	212.0	219.0
Mass dry + tare	136.5	138.5	175.0	182.6	167.5	160.7
Mass water	75.1	72.7	38.3	32.1	44.5	58.3
Mass dry soil	129.7	131.7	168.2	175.6	160.6	154.0
Moisture %	57.9%	55.2%	22.8%	18.3%	27.7%	37.9%

Moisture Content Report
ASTM D2216-98

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician LL

Test Hole	TH23-03	TH23-03	TH23-03	TH23-04	TH23-04	TH23-04
Depth (m)	1.7 - 2.0	2.0 - 2.1	2.4 - 2.6	0.2 - 0.3	0.6 - 0.9	1.2 - 1.4
Sample #	G19	G20	G21	G22	G23	G24
Tare ID	E85	M13	K16	M85	M54	M82
Mass of tare	6.8	6.9	6.7	6.8	6.9	6.7
Mass wet + tare	215.2	211.8	211.2	213.3	211.9	213.0
Mass dry + tare	158.5	145.3	138.3	180.6	192.8	168.0
Mass water	56.7	66.5	72.9	32.7	19.1	45.0
Mass dry soil	151.7	138.4	131.6	173.8	185.9	161.3
Moisture %	37.4%	48.0%	55.4%	18.8%	10.3%	27.9%

Test Hole	TH23-04	TH23-04	TH23-04	TH23-04	TH23-04	TH23-04
Depth (m)	1.7 - 1.8	2.1 - 2.4	2.7 - 3.0	4.0 - 4.3	5.8 - 6.1	7.0 - 7.3
Sample #	G25	G26	G27	G28	G30	G31
Tare ID	E84	M92	H20	M89	E01	M57
Mass of tare	6.7	6.9	6.7	6.9	6.8	6.7
Mass wet + tare	211.9	214.4	213.6	213.6	214.2	213.2
Mass dry + tare	160.4	163.5	181.5	165.4	138.8	155.3
Mass water	51.5	50.9	32.1	48.2	75.4	57.9
Mass dry soil	153.7	156.6	174.8	158.5	132.0	148.6
Moisture %	33.5%	32.5%	18.4%	30.4%	57.1%	39.0%

Test Hole	TH23-04	TH23-04	TH23-04	TH23-04	TH23-04	TH23-05
Depth (m)	8.8 - 9.1	10.4 - 10.7	10.7 - 11.1	11.3 - 11.6	11.6 - 11.7	0.3 - 0.6
Sample #	G33	G34	SS35	G36	SS37	G38
Tare ID	H72	M66	P05	E89	M39	M21
Mass of tare	6.8	6.8	6.8	6.8	6.8	6.8
Mass wet + tare	211.9	217.8	211.5	207.3	207.4	234.3
Mass dry + tare	139.6	185.9	196.3	190.3	193.9	208.4
Mass water	72.3	31.9	15.2	17.0	13.5	25.9
Mass dry soil	132.8	179.1	189.5	183.5	187.1	201.6
Moisture %	54.4%	17.8%	8.0%	9.3%	7.2%	12.8%

Moisture Content Report
ASTM D2216-98

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician LL

Test Hole	TH23-05	TH23-05	TH23-05	TH23-05	TH23-05	TH23-05
Depth (m)	0.9 - 1.2	1.5 - 1.8	2.7 - 3.0	4.0 - 4.3	5.5 - 5.8	7.3 - 7.6
Sample #	G39	G40	G41	G42	G43	G45
Tare ID	M62	M22	E56	M63	M35	E80
Mass of tare	6.9	6.7	6.8	6.9	6.9	6.8
Mass wet + tare	230.0	208.4	209.5	208.0	214.4	211.1
Mass dry + tare	213.5	164.9	152.4	151.6	143.8	149.0
Mass water	16.5	43.5	57.1	56.4	70.6	62.1
Mass dry soil	206.6	158.2	145.6	144.7	136.9	142.2
Moisture %	8.0%	27.5%	39.2%	39.0%	51.6%	43.7%

Test Hole	TH23-05	TH23-05	TH23-05	TH23-05	TH23-06	TH23-06
Depth (m)	8.5 - 8.8	10.7 - 11.0	11.6 - 11.9	12.2 - 12.3	0.3 - 0.6	1.2 - 1.5
Sample #	G46	G48	G49	SS50	G51	G52
Tare ID	H69	F13	E48	M37	M08	N09
Mass of tare	6.8	6.8	6.7	6.8	6.8	8.6
Mass wet + tare	227.3	214.6	218.0	178.2	206.1	206.8
Mass dry + tare	177.6	165.0	199.0	163.8	180.1	178.5
Mass water	49.7	49.6	19.0	14.4	26.0	28.3
Mass dry soil	170.8	158.2	192.3	157.0	173.3	169.9
Moisture %	29.1%	31.4%	9.9%	9.2%	15.0%	16.7%

Test Hole	TH23-06	TH23-06	TH23-06	TH23-06	TH23-06	TH23-06
Depth (m)	1.8 - 2.1	2.4 - 2.7	4.0 - 4.3	5.2 - 5.5	7.6 - 7.9	10.7 - 11.0
Sample #	G53	G54	G55	G56	G58	G60
Tare ID	F91	C14	F97	Z28	N44	H114
Mass of tare	8.4	8.4	8.5	8.5	8.6	8.6
Mass wet + tare	224.6	210.6	210.9	218.4	219.6	220.7
Mass dry + tare	188.6	157.4	148.9	155.9	174.5	162.3
Mass water	36.0	53.2	62.0	62.5	45.1	58.4
Mass dry soil	180.2	149.0	140.4	147.4	165.9	153.7
Moisture %	20.0%	35.7%	44.2%	42.4%	27.2%	38.0%

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report
ASTM D2216-98

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician LL

Test Hole	TH23-06	TH23-06	TH23-07	TH23-07	TH23-07	TH23-07
Depth (m)	11.9 - 12.2	12.5 - 12.6	0.6 - 0.9	2.0 - 2.3	2.4 - 2.7	3.0 - 3.4
Sample #	G61	G62	G64	G65	G66	G67
Tare ID	AB95	D37	AB64	AC26	C10	E31
Mass of tare	6.8	8.5	6.9	6.8	6.8	6.6
Mass wet + tare	219.4	156.7	210.3	207.4	213.9	214.0
Mass dry + tare	171.2	143.9	184.2	166.8	163.3	177.4
Mass water	48.2	12.8	26.1	40.6	50.6	36.6
Mass dry soil	164.4	135.4	177.3	160.0	156.5	170.8
Moisture %	29.3%	9.5%	14.7%	25.4%	32.3%	21.4%

Test Hole	TH23-07	TH23-07	TH23-07	TH23-07	TH23-07	TH23-07
Depth (m)	4.0 - 4.3	5.5 - 5.8	7.3 - 7.6	8.8 - 9.1	10.1 - 10.4	11.0 - 11.3
Sample #	G68	G69	G70	G71	G72	G73
Tare ID	Z94	M88	F89	Z37	AB12	C27
Mass of tare	8.5	6.9	8.5	8.3	6.9	8.6
Mass wet + tare	214.2	210.4	212.4	214.1	206.8	225.1
Mass dry + tare	160.1	139.3	156.0	152.9	149.1	209.8
Mass water	54.1	71.1	56.4	61.2	57.7	15.3
Mass dry soil	151.6	132.4	147.5	144.6	142.2	201.2
Moisture %	35.7%	53.7%	38.2%	42.3%	40.6%	7.6%

Test Hole	TH23-07	TH23-07	TH23-07	TH23-07	TH23-07	TH23-07
Depth (m)	11.3 - 11.6	12.2 - 12.6	13.1 - 13.4	14.6 - 14.9	15.2 - 15.7	16.2 - 16.5
Sample #	G74	SS75	G76	G77	SS78	G79
Tare ID	E102	P31	E19	H65	Z118	P04
Mass of tare	8.7	8.5	8.5	8.5	8.4	8.6
Mass wet + tare	223.8	216.5	220.1	217.9	212.5	212.2
Mass dry + tare	205.7	201.7	192.0	182.8	182.1	180.8
Mass water	18.1	14.8	28.1	35.1	30.4	31.4
Mass dry soil	197.0	193.2	183.5	174.3	173.7	172.2
Moisture %	9.2%	7.7%	15.3%	20.1%	17.5%	18.2%

Moisture Content Report
ASTM D2216-98

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician LL

Test Hole	TH23-07	TH23-08	TH23-08	TH23-08	TH23-08	TH23-08
Depth (m)	17.4 - 17.7	0.3 - 0.6	1.2 - 1.5	1.5 - 1.8	2.0 - 2.3	2.4 - 2.7
Sample #	G80	G81	G82	G83	G84	G85
Tare ID	W53	E29	N15	A23	F14	H3
Mass of tare	8.5	6.8	8.6	88.6	9.0	8.6
Mass wet + tare	214.3	225.1	215.1	211.3	210.1	224.4
Mass dry + tare	187.5	202.9	164.6	178.1	166.4	179.9
Mass water	26.8	22.2	50.5	33.2	43.7	44.5
Mass dry soil	179.0	196.1	156.0	89.5	157.4	171.3
Moisture %	15.0%	11.3%	32.4%	37.1%	27.8%	26.0%

Test Hole	TH23-08	TH23-08	TH23-09	TH23-09	TH23-09	TH23-09
Depth (m)	3.4 - 3.7	4.3 - 4.6	6.1 - 6.6	9.1 - 9.6	10.5 - 11.0	11.6 - 11.7
Sample #	G86	G87	SS89	SS91	SS92	SS93
Tare ID	AB74	P09	W32	N04	E115	N80
Mass of tare	6.8	8.6	8.5	8.6	8.7	8.6
Mass wet + tare	211.3	208.9	223.7	210.1	210.8	128.7
Mass dry + tare	149.2	144.4	161.5	159.1	194.7	126.3
Mass water	62.1	64.5	62.2	51.0	16.1	2.4
Mass dry soil	142.4	135.8	153.0	150.5	186.0	117.7
Moisture %	43.6%	47.5%	40.7%	33.9%	8.7%	2.0%

Test Hole	TH23-09	TH23-09	TH23-09	TH23-09		
Depth (m)	12.8 - 13.1	11.6 - 12.8	14.3 - 15.8	15.8 - 17.4		
Sample #	SS95	C94	C97	C98		
Tare ID	F153	W44	F37	Z102		
Mass of tare	8.5	8.6	8.3	8.7		
Mass wet + tare	209.6	224.8	674.3	254.9		
Mass dry + tare	195.6	214.3	636.6	232.5		
Mass water	14.0	10.5	37.7	22.4		
Mass dry soil	187.1	205.7	628.3	223.8		
Moisture %	7.5%	5.1%	6.0%	10.0%		

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Atterberg Limits
ASTM D4318-10e1

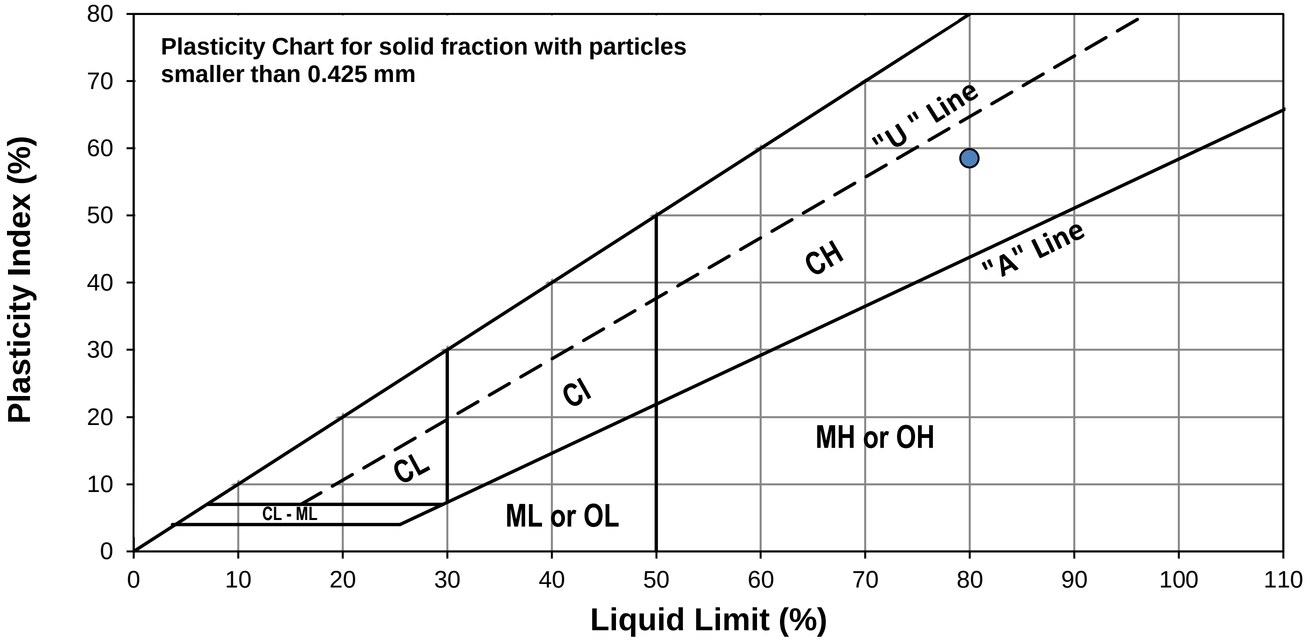
Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	City of Winnipeg Transit Garage
Test Hole	TH23-02
Sample #	G10
Depth (m)	1.2 - 1.4
Sample Date	11-Oct-23
Test Date	08-Nov-23
Technician	DS

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Liquid Limit	80
Plastic Limit	21
Plasticity Index	58

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	18	24	35		
Mass Tare (g)	14.097	14.045	14.202		
Mass Wet Soil + Tare (g)	22.575	22.027	22.394		
Mass Dry Soil + Tare (g)	18.744	18.467	18.826		
Mass Water (g)	3.831	3.560	3.568		
Mass Dry Soil (g)	4.647	4.422	4.624		
Moisture Content (%)	82.440	80.507	77.163		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.959	13.919			
Mass Wet Soil + Tare (g)	23.006	22.815			
Mass Dry Soil + Tare (g)	21.426	21.226			
Mass Water (g)	1.580	1.589			
Mass Dry Soil (g)	7.467	7.307			
Moisture Content (%)	21.160	21.746			

Note: Additional information recorded/measured for this test is available upon request.

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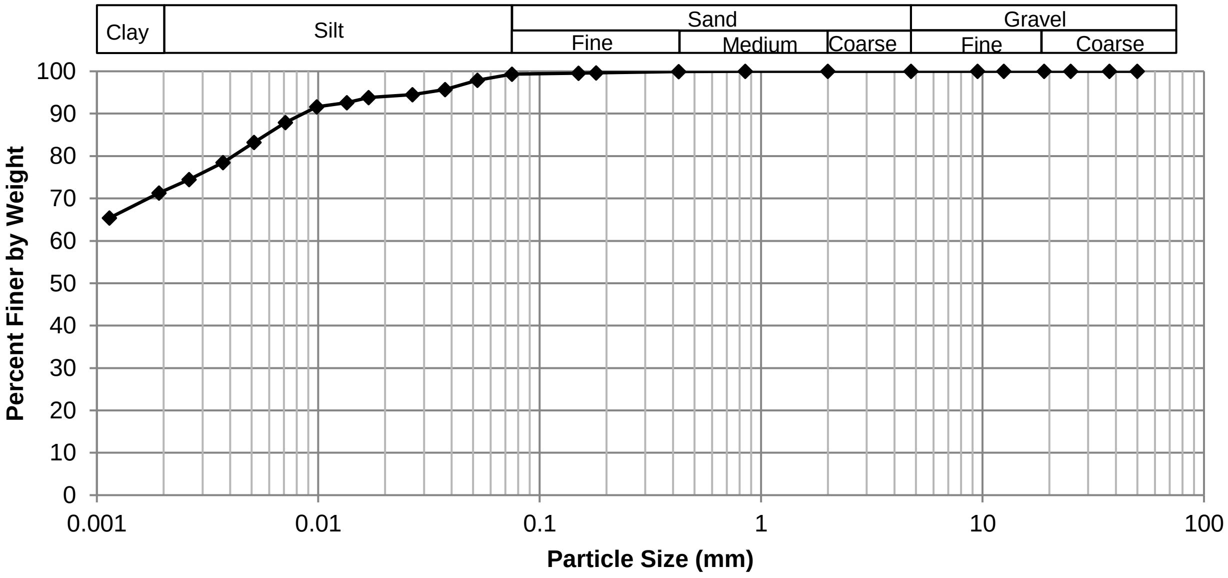
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-02
Sample #	G10
Depth (m)	1.2 - 1.4
Sample Date	02-Oct-23
Test Date	07-Nov-23
Technician	DS

Gravel	0.0%
Sand	0.6%
Silt	27.6%
Clay	71.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	99.36
37.5	100.00	2.00	100.00	0.0524	97.90
25.0	100.00	0.850	100.00	0.0375	95.71
19.0	100.00	0.425	99.96	0.0267	94.46
12.5	100.00	0.180	99.64	0.0169	93.84
9.50	100.00	0.150	99.58	0.0135	92.59
4.75	100.00	0.075	99.36	0.0099	91.65
				0.0071	87.90
				0.0051	83.21
				0.0037	78.47
				0.0026	74.45
				0.0019	71.33
				0.0011	65.39

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-04
Sample #	T29
Depth (m)	4.6 - 5.2
Sample Date	11-Oct-23
Test Date	02-Nov-23
Technician	PC

Tube Extraction

Recovery (mm) 530

Bottom **Top**

5.10 m	5.07 m	4.91 m	4.75 m	4.65 m	4.57 m
Toss	Keep	Bulk Qu	Moisture Content PP/TV Visual	Toss	
30 mm	160 mm	160 mm	100 mm	80 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<5 mm diam.)	
trace precipitates (sulphate <5 mm diam.)	
trace oxidation	
Color	grey
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.50
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	49.0

Pocket Penetrometer

Reading	**1**	1.20
	2	1.20
	3	1.10
	Average	1.17
Undrained Shear Strength (kPa)		57.2

Moisture Content

Tare ID	E13
Mass tare (g)	6.8
Mass wet + tare (g)	231.2
Mass dry + tare (g)	153.8
Moisture %	52.7%

Unit Weight

Bulk Weight (g)		1047.6
Length (mm)	**1**	150.02
	2	149.60
	3	150.42
	4	149.65
Average Length (m)		0.150
Diam. (mm)	**1**	72.12
	2	72.34
	3	72.29
	4	72.18
Average Diameter (m)		0.072
Volume (m^3)		6.14E-04
Bulk Unit Weight (kN/m^3)		16.7
Bulk Unit Weight (pcf)		106.5
Dry Unit Weight (kN/m^3)		11.0
Dry Unit Weight (pcf)		69.7

Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-04
Sample #	T29
Depth (m)	4.6 - 5.2
Sample Date	11-Oct-23
Test Date	02-Nov-23
Technician	PC

Unconfined Strength

	kPa	**ksf**
Max q_u	61.6	1.3
Max S_u	30.8	0.6

Specimen Data

Description CLAY - silty, trace silt inclusions (<5 mm diam.), trace precipitates (sulphate <5 mm diam.), trace oxidation, grey, moist, stiff, high plasticity

Length	149.9	(mm)	**Moisture %**	53%	
Diameter	72.2	(mm)	**Bulk Unit Wt.**	16.7	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	11.0	(kN/m^3)
Initial Area	0.00410	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.50	49.0	1.02
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	1.20	58.9	1.23
	1.20	58.9	1.23
	1.10	54.0	1.13
Average	**1.17**	**57.2**	**1.20**

Failure Geometry

Sketch:

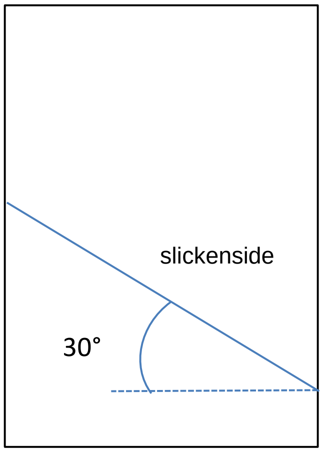

Photo:

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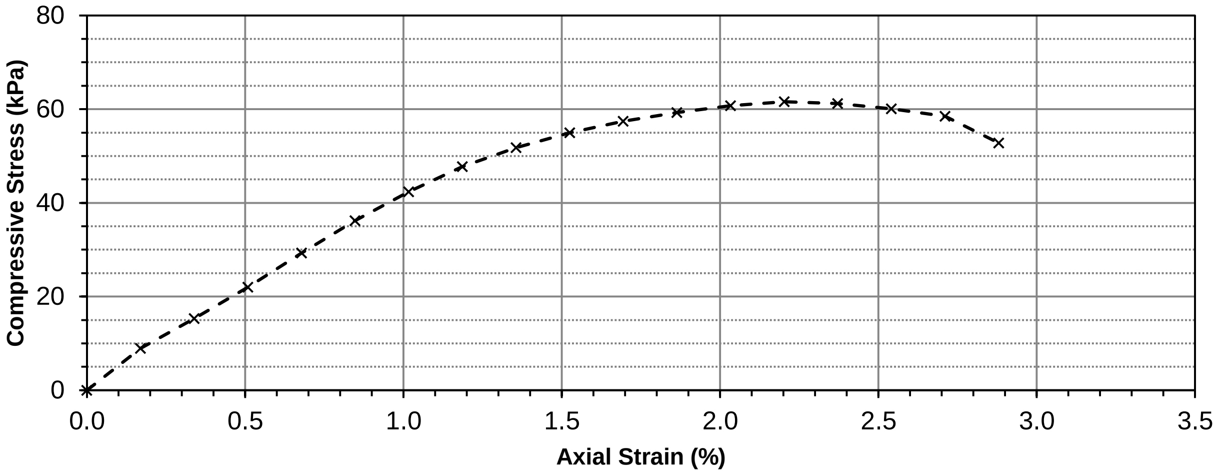
Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.71	0.0000	0.00	0.004098	0.0	0.00	0.00
10	1.44	0.2540	0.17	0.004105	36.8	8.96	4.48
20	1.96	0.5080	0.34	0.004112	63.0	15.32	7.66
30	2.51	0.7620	0.51	0.004119	90.7	22.03	11.01
40	3.11	1.0160	0.68	0.004126	121.0	29.32	14.66
50	3.68	1.2700	0.85	0.004133	149.7	36.22	18.11
60	4.19	1.5240	1.02	0.004140	175.4	42.37	21.18
70	4.64	1.7780	1.19	0.004147	198.1	47.77	23.88
80	4.98	2.0320	1.36	0.004154	215.2	51.81	25.90
90	5.25	2.2860	1.52	0.004161	228.8	54.99	27.50
100	5.46	2.5400	1.69	0.004168	239.4	57.43	28.72
110	5.62	2.7940	1.86	0.004176	247.5	59.27	29.63
120	5.75	3.0480	2.03	0.004183	254.0	60.73	30.37
130	5.83	3.3020	2.20	0.004190	258.1	61.59	30.79
140	5.81	3.5560	2.37	0.004197	257.1	61.24	30.62
150	5.72	3.8100	2.54	0.004205	252.5	60.06	30.03
160	5.60	4.0640	2.71	0.004212	246.5	58.52	29.26
170	5.13	4.3180	2.88	0.004219	222.8	52.80	26.40

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-04
Sample #	T32
Depth (m)	7.6 - 8.2
Sample Date	11-Oct-23
Test Date	03-Nov-23
Technician	PC

Tube Extraction

Recovery (mm) 600

Bottom **Top**

8.22 m – 8.19 m	8.19 m – 8.01 m	8.01 m – 7.85 m	7.85 m – 7.75 m	7.75 m – 7.62 m
Toss	Keep	Bulk Qu	Moisture Content PP/TV Visual	Toss
30 mm	180 mm	160 mm	100 mm	130 mm

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<30 mm diam.)	
trace rootlets	
trace silt inclusions (<10 mm diam.)	
trace precipitates (sulphate <10 mm diam.)	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	**1**	0.90
	2	0.90
	3	0.80
	Average	0.87
Undrained Shear Strength (kPa)		42.5

Moisture Content

Tare ID	H49
Mass tare (g)	8.6
Mass wet + tare (g)	242.2
Mass dry + tare (g)	175.4
Moisture %	40.0%

Unit Weight

Bulk Weight (g)		1194.8
Length (mm)	**1**	151.64
	2	151.32
	3	151.68
	4	151.48
Average Length (m)		0.152
Diam. (mm)	**1**	73.00
	2	72.60
	3	72.46
	4	72.36
Average Diameter (m)		0.073
Volume (m^3)		6.27E-04
Bulk Unit Weight (kN/m^3)		18.7
Bulk Unit Weight (pcf)		118.9
Dry Unit Weight (kN/m^3)		13.3
Dry Unit Weight (pcf)		84.9

Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-04
Sample #	T32
Depth (m)	7.6 - 8.2
Sample Date	11-Oct-23
Test Date	03-Nov-23
Technician	PC

Unconfined Strength

	kPa	**ksf**
Max q_u	60.2	1.3
Max S_u	30.1	0.6

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<30 mm diam.), trace rootlets, trace silt inclusions (<10 mm diam.), trace precipitates (sulphate <10 mm diam.), brown, moist, stiff, high plasticity

Length	151.5	(mm)	**Moisture %**	40%	
Diameter	72.6	(mm)	**Bulk Unit Wt.**	18.7	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	13.3	(kN/m^3)
Initial Area	0.00414	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	0.90	44.1	0.92
	0.90	44.1	0.92
	0.80	39.2	0.82
Average	**0.87**	**42.5**	**0.89**

Failure Geometry

Sketch:

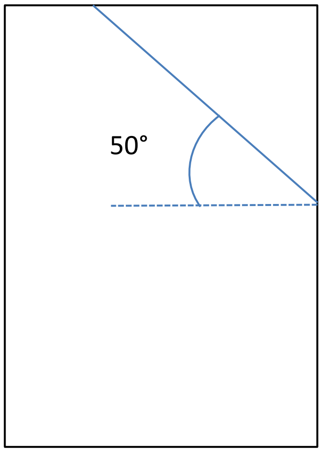
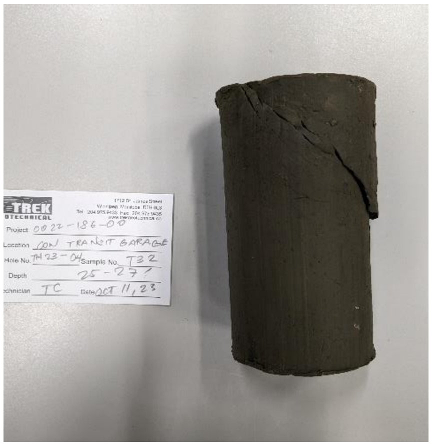


Photo:



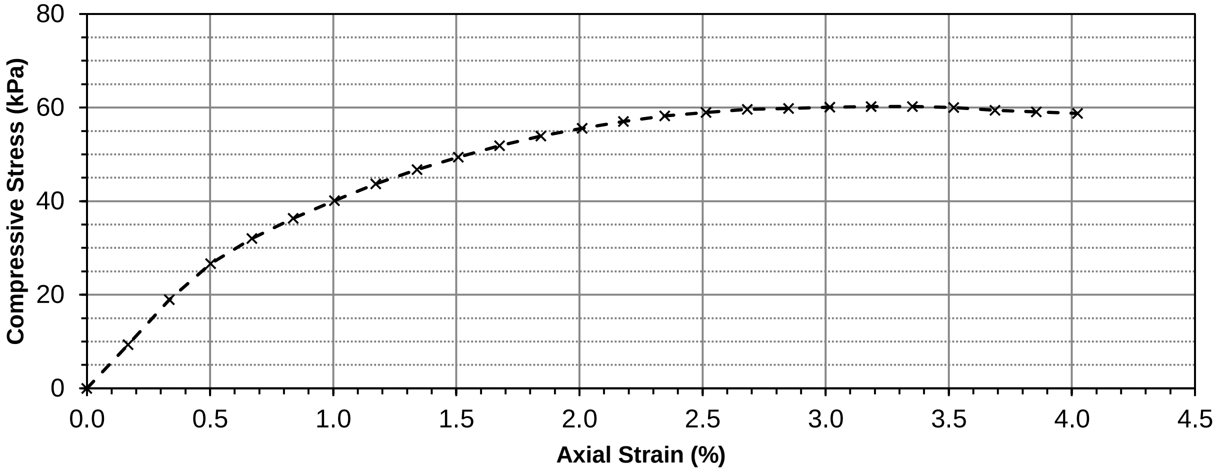
Project 0022-186-00
Location COW TRANSIT GARAGE
Hole No. TH23-04 Sample No. T32
Depth 25-27'
Technician TC Date OCT 11, 23

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.72	0.0000	0.00	0.004140	0.0	0.00	0.00
10	1.49	0.2540	0.17	0.004147	38.8	9.36	4.68
20	2.28	0.5080	0.34	0.004154	78.6	18.93	9.46
30	2.92	0.7620	0.50	0.004161	110.9	26.65	13.32
40	3.37	1.0160	0.67	0.004168	133.6	32.04	16.02
50	3.73	1.2700	0.84	0.004175	151.7	36.34	18.17
60	4.05	1.5240	1.01	0.004182	167.8	40.13	20.07
70	4.35	1.7780	1.17	0.004189	183.0	43.67	21.84
80	4.61	2.0320	1.34	0.004196	196.1	46.72	23.36
90	4.84	2.2860	1.51	0.004204	207.7	49.40	24.70
100	5.05	2.5400	1.68	0.004211	218.2	51.83	25.91
110	5.23	2.7940	1.84	0.004218	227.3	53.89	26.95
120	5.38	3.0480	2.01	0.004225	234.9	55.59	27.79
130	5.51	3.3020	2.18	0.004232	241.4	57.04	28.52
140	5.62	3.5560	2.35	0.004240	247.0	58.25	29.13
150	5.69	3.8100	2.51	0.004247	250.5	58.98	29.49
160	5.75	4.0640	2.68	0.004254	253.5	59.59	29.80
170	5.78	4.3180	2.85	0.004262	255.0	59.85	29.92

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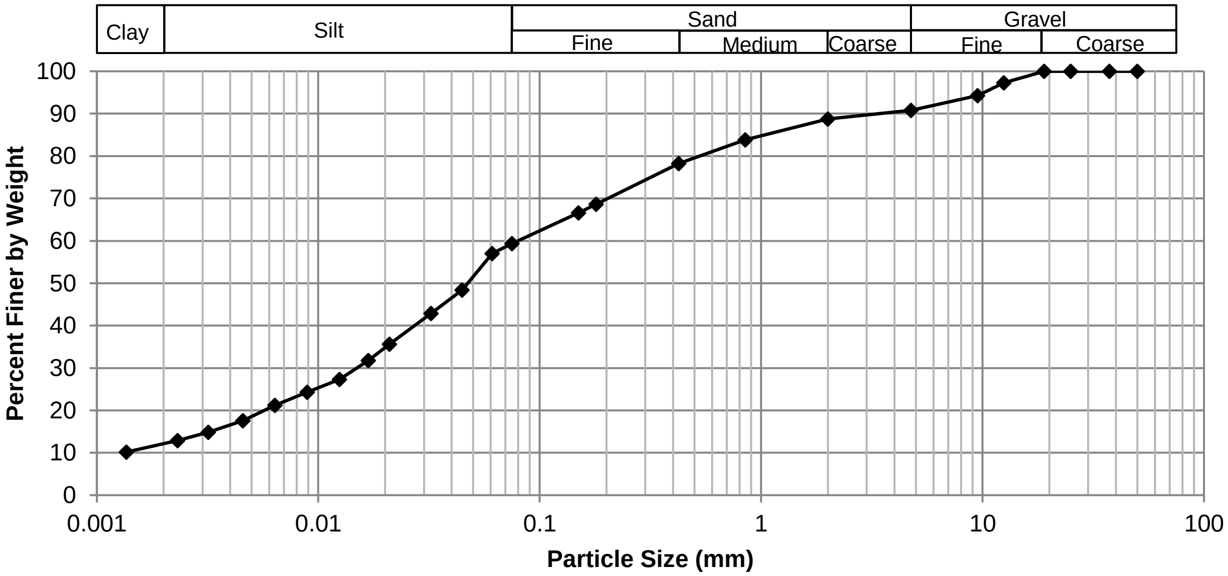
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Test Hole TH23-04
Sample # G36
Depth (m) 8.2 - 8.5
Sample Date 02-Oct-23
Test Date 07-Nov-23
Technician DS

Gravel	9.2%
Sand	31.4%
Silt	47.4%
Clay	12.0%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	90.80	0.0750	59.38
37.5	100.00	2.00	88.75	0.0610	57.02
25.0	100.00	0.850	83.81	0.0447	48.42
19.0	100.00	0.425	78.27	0.0323	42.87
12.5	97.28	0.180	68.62	0.0210	35.66
9.50	94.24	0.150	66.58	0.0168	31.77
4.75	90.80	0.075	59.38	0.0125	27.33
				0.0089	24.28
				0.0064	21.23
				0.0046	17.58
				0.0032	14.85
				0.0023	12.90
				0.0014	10.17

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-05
Sample #	T44
Depth (m)	6.1 - 6.7
Sample Date	11-Oct-23
Test Date	09-Nov-23
Technician	AD

Tube Extraction

Recovery (mm) 400

Bottom **Top**

6.50 m 6.47 m 6.35 m 6.18 m 6.10 m

Moisture Content PP/TV Visual	Keep	Bulk Qu	Toss Slough
30 mm	120 mm	170 mm	80 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
trace rootlets	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	**1**	1.10
	2	0.90
	3	1.10
	Average	1.03
Undrained Shear Strength (kPa)		50.7

Moisture Content

Tare ID	W101
Mass tare (g)	8.4
Mass wet + tare (g)	340.6
Mass dry + tare (g)	237.2
Moisture %	45.2%

Unit Weight

Bulk Weight (g)		1070.8
Length (mm)	**1**	149.28
	2	149.99
	3	149.55
	4	149.54
Average Length (m)		0.150
Diam. (mm)	**1**	72.99
	2	71.87
	3	72.99
	4	73.01
Average Diameter (m)		0.073
Volume (m^3)		6.21E-04
Bulk Unit Weight (kN/m^3)		16.9
Bulk Unit Weight (pcf)		107.6
Dry Unit Weight (kN/m^3)		11.6
Dry Unit Weight (pcf)		74.1

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Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Test Hole TH23-05
Sample # T44
Depth (m) 6.1 - 6.7
Sample Date 11-Oct-23
Test Date 09-Nov-23
Technician AD

Unconfined Strength

	kPa	ksf
Max q_u	72.2	1.5
Max S_u	36.1	0.8

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), trace rootlets, grey, moist, firm, high plasticity

Length	149.6	(mm)	**Moisture %**	45%	
Diameter	72.7	(mm)	**Bulk Unit Wt.**	16.9	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	11.6	(kN/m^3)
Initial Area	0.00415	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	1.10	54.0	1.13
	0.90	44.1	0.92
	1.10	54.0	1.13
Average	**1.03**	**50.7**	**1.06**

Failure Geometry

Sketch:

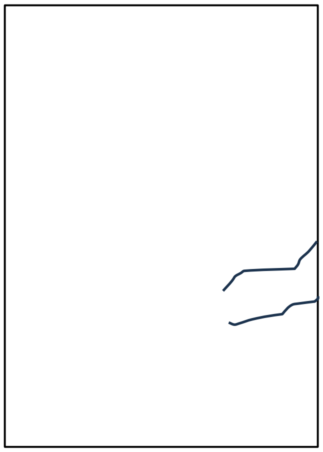

Photo:

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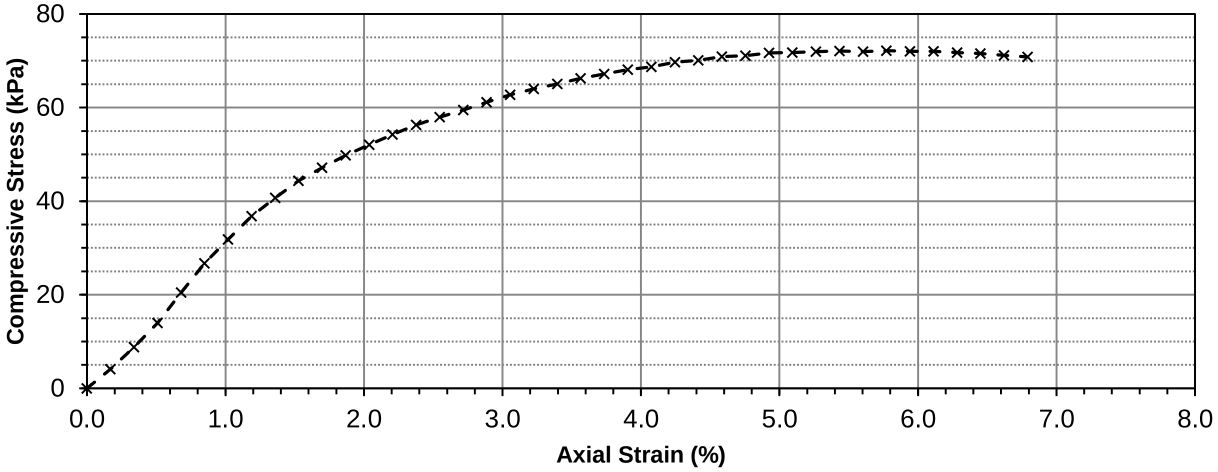
Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.81	0.0000	0.00	0.004153	0.0	0.00	0.00
10	1.15	0.2540	0.17	0.004160	17.1	4.12	2.06
20	1.54	0.5080	0.34	0.004167	36.8	8.83	4.42
30	1.97	0.7620	0.51	0.004174	58.5	14.01	7.00
40	2.51	1.0160	0.68	0.004181	85.7	20.49	10.25
50	3.03	1.2700	0.85	0.004188	111.9	26.72	13.36
60	3.46	1.5240	1.02	0.004196	133.6	31.84	15.92
70	3.88	1.7780	1.19	0.004203	154.7	36.82	18.41
80	4.21	2.0320	1.36	0.004210	171.4	40.71	20.35
90	4.52	2.2860	1.53	0.004217	187.0	44.34	22.17
100	4.76	2.5400	1.70	0.004225	199.1	47.13	23.56
110	4.99	2.7940	1.87	0.004232	210.7	49.79	24.89
120	5.19	3.0480	2.04	0.004239	220.8	52.08	26.04
130	5.38	3.3020	2.21	0.004247	230.3	54.24	27.12
140	5.56	3.5560	2.38	0.004254	239.4	56.28	28.14
150	5.71	3.8100	2.55	0.004261	247.0	57.96	28.98
160	5.85	4.0640	2.72	0.004269	254.0	59.51	29.75
170	6.00	4.3180	2.89	0.004276	261.6	61.17	30.59
180	6.14	4.5720	3.06	0.004284	268.6	62.71	31.36
190	6.26	4.8260	3.23	0.004291	274.7	64.01	32.01
200	6.36	5.0800	3.40	0.004299	279.7	65.07	32.54
210	6.47	5.3340	3.57	0.004306	285.3	66.25	33.12
220	6.56	5.5880	3.74	0.004314	289.8	67.18	33.59
230	6.65	5.8420	3.91	0.004322	294.4	68.11	34.06

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	6.71	6.0960	4.08	0.004329	297.4	68.69	34.35
250	6.81	6.3500	4.24	0.004337	302.4	69.73	34.87
260	6.85	6.6040	4.41	0.004345	304.4	70.07	35.04
270	6.93	6.8580	4.58	0.004352	308.5	70.87	35.44
280	6.96	7.1120	4.75	0.004360	310.0	71.09	35.55
290	7.02	7.3660	4.92	0.004368	313.0	71.66	35.83
300	7.04	7.6200	5.09	0.004376	314.0	71.76	35.88
310	7.07	7.8740	5.26	0.004384	315.5	71.98	35.99
320	7.09	8.1280	5.43	0.004391	316.5	72.08	36.04
330	7.09	8.3820	5.60	0.004399	316.5	71.95	35.98
340	7.12	8.6360	5.77	0.004407	318.0	72.16	36.08
350	7.12	8.8900	5.94	0.004415	318.0	72.03	36.02
360	7.13	9.1440	6.11	0.004423	318.5	72.02	36.01
370	7.12	9.3980	6.28	0.004431	318.0	71.77	35.89
380	7.11	9.6520	6.45	0.004439	317.5	71.53	35.77
390	7.09	9.9060	6.62	0.004447	316.5	71.17	35.59
400	7.07	10.1600	6.79	0.004455	315.5	70.82	35.41

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-05
Sample #	T47
Depth (m)	9.1 - 9.8
Sample Date	11-Oct-23
Test Date	09-Nov-23
Technician	AD

Tube Extraction

Recovery (mm) 270

Bottom 9.41 m	9.29 m	9.27 m	**Top** 9.14 m
Keep	Moisture Content PP/TV Visual	Toss	
120 mm	20 mm	130 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.30
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	29.4

Pocket Penetrometer

Reading	**1**	0.60
	2	0.70
	3	0.60
	Average	0.63
Undrained Shear Strength (kPa)		31.1

Moisture Content

Tare ID	A104
Mass tare (g)	8.4
Mass wet + tare (g)	228.6
Mass dry + tare (g)	160.2
Moisture %	45.1%

Unit Weight

Bulk Weight (g)		-
Length (mm)	**1**	-
	2	-
	3	-
	4	-
Average Length (m)		-
Diam. (mm)	**1**	-
	2	-
	3	-
	4	-
Average Diameter (m)		-
Volume (m^3)		-
Bulk Unit Weight (kN/m^3)		-
Bulk Unit Weight (pcf)		-
Dry Unit Weight (kN/m^3)		-
Dry Unit Weight (pcf)		-

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-06
Sample #	T57
Depth (m)	6.1 - 6.7
Sample Date	12-Oct-23
Test Date	09-Nov-23
Technician	AD

Tube Extraction

Recovery (mm) 620

Bottom				**Top**
6.72 m	6.60 m	6.43 m	6.26 m	6.1 m
Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss	
120 mm	170 mm	170 mm	160 mm	

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.55
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	53.9

Pocket Penetrometer

Reading	**1**	1.20
	2	1.30
	3	1.30
	Average	1.27
Undrained Shear Strength (kPa)		62.1

Moisture Content

Tare ID	E86
Mass tare (g)	6.8
Mass wet + tare (g)	360.2
Mass dry + tare (g)	252.6
Moisture %	43.8%

Unit Weight

Bulk Weight (g)		1093.6
Length (mm)	**1**	152.94
	2	152.98
	3	152.84
	4	152.94
Average Length (m)		0.153
Diam. (mm)	**1**	72.22
	2	72.65
	3	72.10
	4	72.59
Average Diameter (m)		0.072
Volume (m^3)		6.29E-04
Bulk Unit Weight (kN/m^3)		17.0
Bulk Unit Weight (pcf)		108.5
Dry Unit Weight (kN/m^3)		11.9
Dry Unit Weight (pcf)		75.4

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Unconfined Compressive Strength
ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-06
Sample #	T57
Depth (m)	6.1 - 6.7
Sample Date	12-Oct-23
Test Date	09-Nov-23
Technician	AD

Unconfined Strength

	kPa	ksf
Max q_u	56.0	1.2
Max S_u	28.0	0.6

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), grey, moist, firm, high plasticity

Length	152.9	(mm)
Diameter	72.4	(mm)
L/D Ratio	2.1	
Initial Area	0.00412	(m^2)
Load Rate	1.00	(%/min)

Moisture %	44%	
Bulk Unit Wt.	17.0	(kN/m^3)
Dry Unit Wt.	11.9	(kN/m^3)
Liquid Limit	-	
Plastic Limit	-	
Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	kPa	ksf
0.55	53.9	1.13
Vane Size		
m		

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	kPa	ksf
	1.20	58.9	1.23
	1.30	63.8	1.33
	1.30	63.8	1.33
Average	**1.27**	**62.1**	**1.30**

Failure Geometry

Sketch:

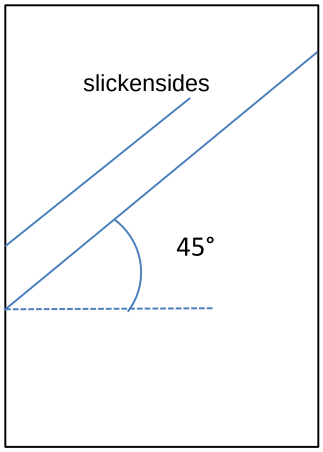

Photo:

Project 0022-186-00
Location COW TRANSIT GARAGE
Hole No. TH23-06 Sample No. T57
Depth 20'-22'
Technician TC Date OCT 12, 2023

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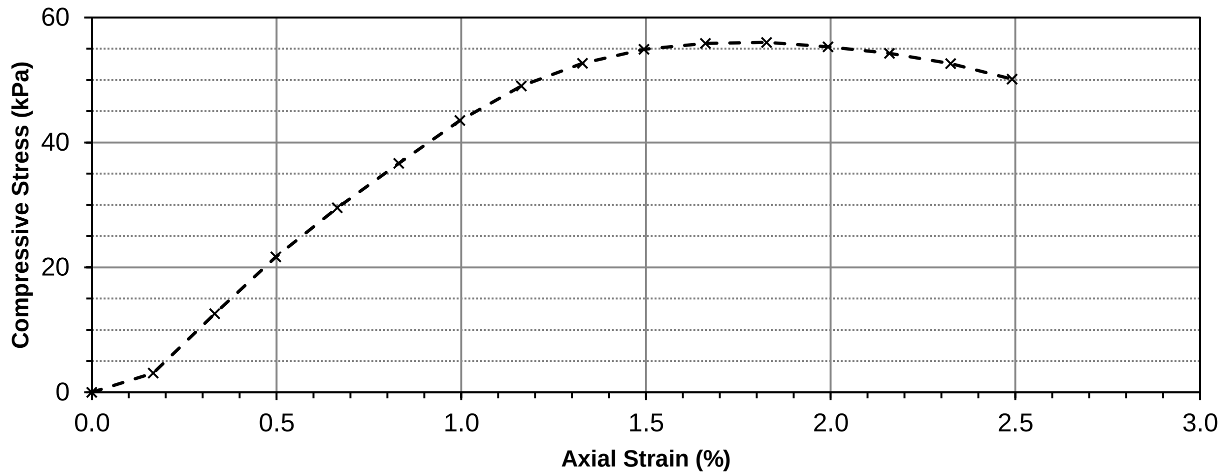
Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.71	0.0000	0.00	0.004116	0.0	0.00	0.00
10	0.96	0.2540	0.17	0.004123	12.6	3.06	1.53
20	1.74	0.5080	0.33	0.004129	51.9	12.57	6.29
30	2.49	0.7620	0.50	0.004136	89.7	21.69	10.85
40	3.14	1.0160	0.66	0.004143	122.5	29.56	14.78
50	3.73	1.2700	0.83	0.004150	152.2	36.68	18.34
60	4.30	1.5240	1.00	0.004157	180.9	43.53	21.76
70	4.76	1.7780	1.16	0.004164	204.1	49.02	24.51
80	5.07	2.0320	1.33	0.004171	219.8	52.68	26.34
90	5.26	2.2860	1.49	0.004178	229.3	54.89	27.44
100	5.35	2.5400	1.66	0.004185	233.9	55.88	27.94
110	5.37	2.7940	1.83	0.004192	234.9	56.03	28.01
120	5.32	3.0480	1.99	0.004199	232.4	55.33	27.67
130	5.24	3.3020	2.16	0.004207	228.3	54.28	27.14
140	5.11	3.5560	2.33	0.004214	221.8	52.63	26.32
150	4.91	3.8100	2.49	0.004221	211.7	50.15	25.08

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-06
Sample #	T59
Depth (m)	9.1 - 9.8
Sample Date	12-Oct-23
Test Date	09-Nov-23
Technician	AD

Tube Extraction

Recovery (mm) 660

Bottom **Top**

9.8 m 9.70 m 9.53 m 9.36 m 9.14 m

Moisture Content PP/TV Visual	Bulk Qu	Keep	Toss
100 mm	170 mm	170 mm	220 mm

Visual Classification

Material	CLAY
Composition	silty
trace sand	
trace gravel (<20 mm diam.)	
trace silt inclusions (<5 mm diam.)	
Color	grey
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	varved (clay and clay with silt inclusions, 15 mm thickness)
Gradation	

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	**1**	1.10
	2	1.00
	3	1.10
	Average	1.07
Undrained Shear Strength (kPa)		52.3

Moisture Content

Tare ID	AB69
Mass tare (g)	6.8
Mass wet + tare (g)	262.2
Mass dry + tare (g)	175.8
Moisture %	51.1%

Unit Weight

Bulk Weight (g)		1261.4
Length (mm)	**1**	151.61
	2	151.16
	3	151.54
	4	151.64
Average Length (m)		0.151
Diam. (mm)	**1**	72.47
	2	72.78
	3	72.13
	4	72.33
Average Diameter (m)		0.072
Volume (m^3)		6.24E-04
Bulk Unit Weight (kN/m^3)		19.8
Bulk Unit Weight (pcf)		126.2
Dry Unit Weight (kN/m^3)		13.1
Dry Unit Weight (pcf)		83.5

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Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-06
Sample #	T59
Depth (m)	9.1 - 9.8
Sample Date	12-Oct-23
Test Date	09-Nov-23
Technician	AD

Unconfined Strength

	kPa	ksf
Max q_u	84.9	1.8
Max S_u	42.5	0.9

Specimen Data

Description CLAY - silty, trace sand, trace gravel (<20 mm diam.), trace silt inclusions (<5 mm diam.), grey, moist, firm, high plasticity, varved (clay and clay with silt inclusions, 15 mm thickness)

Length	151.5	(mm)	**Moisture %**	51%	
Diameter	72.4	(mm)	**Bulk Unit Wt.**	19.8	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	13.1	(kN/m^3)
Initial Area	0.00412	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	1.10	54.0	1.13
	1.00	49.1	1.02
	1.10	54.0	1.13
Average	**1.07**	**52.3**	**1.09**

Failure Geometry

Sketch:

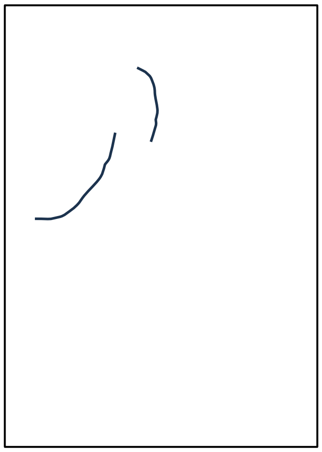
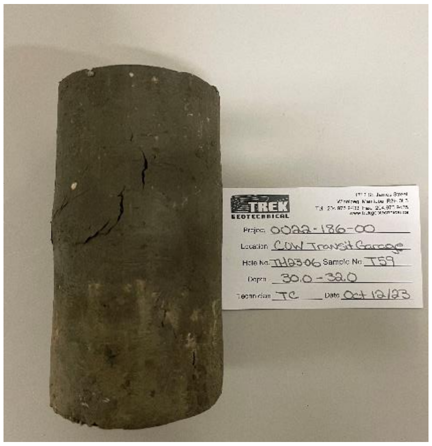


Photo:



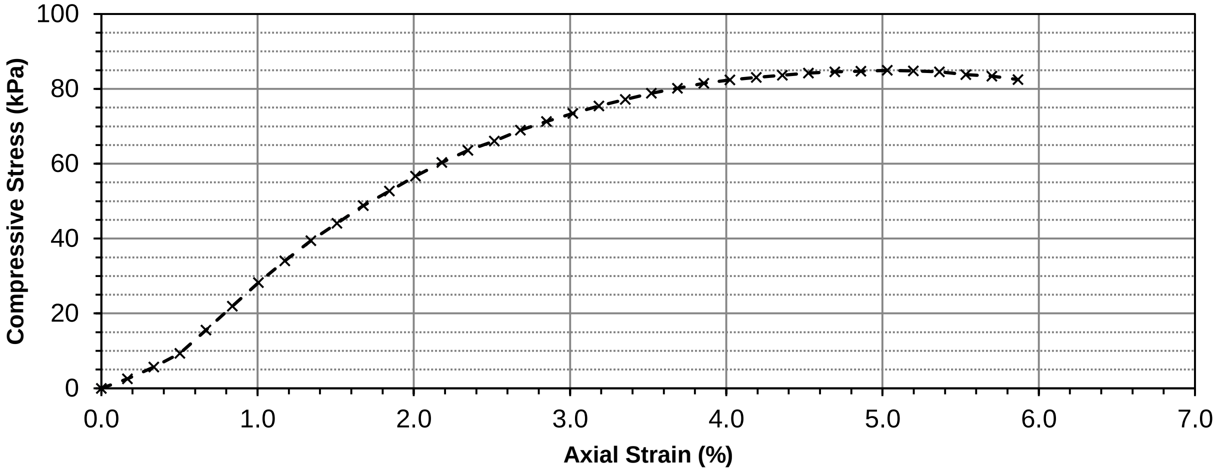
Project 0022-186-00
Location COW Transit Garage
Hole No. TH23-06 Sample No. T59
Depth 30.0 - 32.0
Technician TC Date Oct 12/23

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.72	0.0000	0.00	0.004120	0.0	0.00	0.00
10	0.93	0.2540	0.17	0.004127	10.6	2.56	1.28
20	1.19	0.5080	0.34	0.004134	23.7	5.73	2.87
30	1.49	0.7620	0.50	0.004141	38.8	9.37	4.69
40	2.00	1.0160	0.67	0.004148	64.5	15.55	7.78
50	2.53	1.2700	0.84	0.004155	91.2	21.96	10.98
60	3.05	1.5240	1.01	0.004162	117.4	28.22	14.11
70	3.54	1.7780	1.17	0.004169	142.1	34.09	17.05
80	3.99	2.0320	1.34	0.004176	164.8	39.47	19.73
90	4.38	2.2860	1.51	0.004183	184.5	44.10	22.05
100	4.78	2.5400	1.68	0.004190	204.6	48.84	24.42
110	5.11	2.7940	1.84	0.004197	221.3	52.72	26.36
120	5.45	3.0480	2.01	0.004205	238.4	56.70	28.35
130	5.76	3.3020	2.18	0.004212	254.0	60.31	30.16
140	6.04	3.5560	2.35	0.004219	268.1	63.56	31.78
150	6.26	3.8100	2.52	0.004226	279.2	66.07	33.04
160	6.51	4.0640	2.68	0.004234	291.8	68.93	34.47
170	6.72	4.3180	2.85	0.004241	302.4	71.31	35.66
180	6.91	4.5720	3.02	0.004248	312.0	73.44	36.72
190	7.09	4.8260	3.19	0.004256	321.1	75.45	37.72
200	7.25	5.0800	3.35	0.004263	329.1	77.21	38.60
210	7.40	5.3340	3.52	0.004270	336.7	78.84	39.42
220	7.52	5.5880	3.69	0.004278	342.7	80.12	40.06
230	7.65	5.8420	3.86	0.004285	349.3	81.51	40.76

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	7.74	6.0960	4.02	0.004293	353.8	82.42	41.21
250	7.81	6.3500	4.19	0.004300	357.4	83.10	41.55
260	7.87	6.6040	4.36	0.004308	360.4	83.66	41.83
270	7.93	6.8580	4.53	0.004315	363.4	84.21	42.11
280	7.97	7.1120	4.69	0.004323	365.4	84.53	42.27
290	8.00	7.3660	4.86	0.004331	366.9	84.73	42.37
300	8.03	7.6200	5.03	0.004338	368.4	84.93	42.47
310	8.03	7.8740	5.20	0.004346	368.4	84.78	42.39
320	8.02	8.1280	5.37	0.004354	367.9	84.51	42.26
330	7.97	8.3820	5.53	0.004361	365.4	83.79	41.89
340	7.95	8.6360	5.70	0.004369	364.4	83.41	41.70
350	7.88	8.8900	5.87	0.004377	360.9	82.45	41.23

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Atterberg Limits
ASTM D4318-10e1

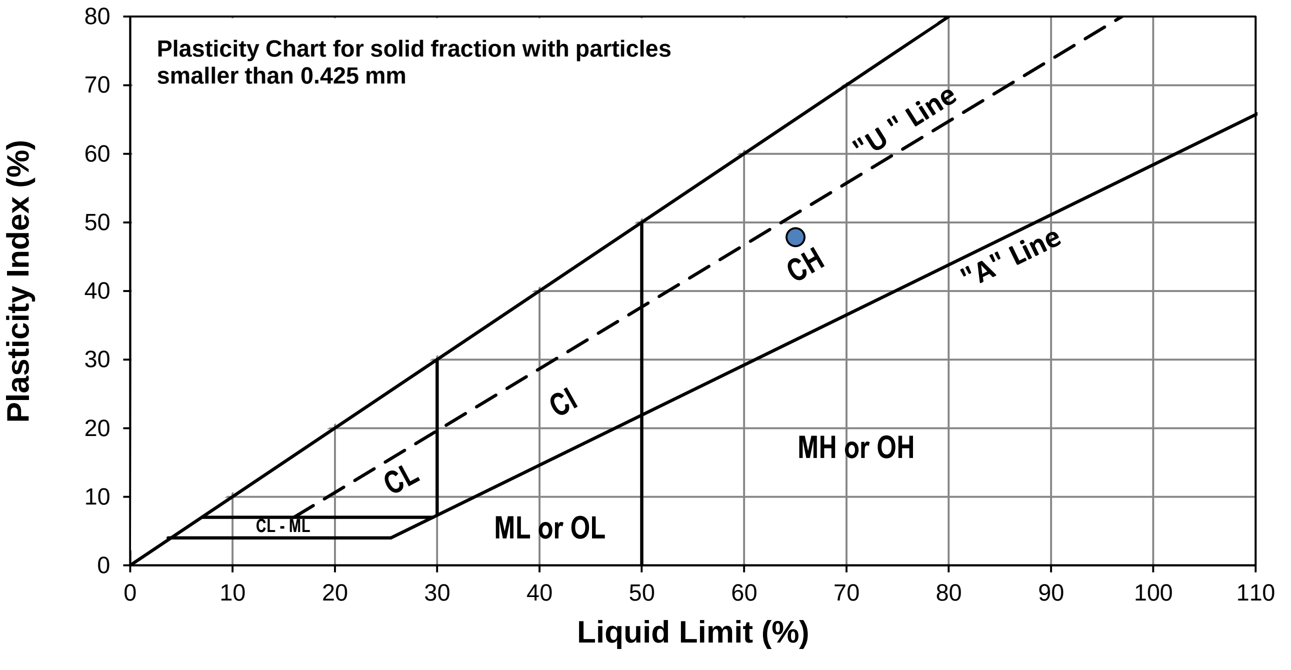
Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project City of Winnipeg Transit Garage

Test Hole TH23-09
Sample # T88
Depth (m) 4.6 - 5.2
Sample Date 11-Oct-23
Test Date 01-Nov-23
Technician AB

Liquid Limit	65
Plastic Limit	17
Plasticity Index	48

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	18	23	33		
Mass Tare (g)	14.262	13.942	14.170		
Mass Wet Soil + Tare (g)	28.756	27.293	30.355		
Mass Dry Soil + Tare (g)	22.891	21.998	24.122		
Mass Water (g)	5.865	5.295	6.233		
Mass Dry Soil (g)	8.629	8.056	9.952		
Moisture Content (%)	67.968	65.727	62.631		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.038	13.998			
Mass Wet Soil + Tare (g)	21.935	23.237			
Mass Dry Soil + Tare (g)	20.748	21.907			
Mass Water (g)	1.187	1.330			
Mass Dry Soil (g)	6.710	7.909			
Moisture Content (%)	17.690	16.816			

Note: Additional information recorded/measured for this test is available upon request.

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-09
Sample #	T88
Depth (m)	4.6 - 5.2
Sample Date	13-Oct-23
Test Date	02-Nov-23
Technician	PC

Tube Extraction

Recovery (mm) 620

Bottom **Top**

5.19 m 5.01 m 4.85 m 4.77 m 4.57 m

Toss	Keep	Bulk Qu	Moisture Content PP/TV Visual	Toss
20 mm	160 mm	160 mm	80 mm	200 mm

Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<15 mm diam.)	
trace precipitates (sulphates <15 mm diam.)	
trace rootlets	
Color	brown
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	stratified silt and clay (<10 mm thick)
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	**1**	0.90
	2	0.80
	3	0.90
	Average	0.87
Undrained Shear Strength (kPa)		42.5

Moisture Content

Tare ID	G1
Mass tare (g)	82.2
Mass wet + tare (g)	542.7
Mass dry + tare (g)	402.5
Moisture %	43.8%

Unit Weight

Bulk Weight (g)		1055.6
Length (mm)	**1**	150.03
	2	150.38
	3	149.76
	4	150.05
Average Length (m)		0.150
Diam. (mm)	**1**	72.55
	2	72.71
	3	72.54
	4	72.62
Average Diameter (m)		0.073
Volume (m^3)		6.21E-04
Bulk Unit Weight (kN/m^3)		16.7
Bulk Unit Weight (pcf)		106.1
Dry Unit Weight (kN/m^3)		11.6
Dry Unit Weight (pcf)		73.8

Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-09
Sample #	T88
Depth (m)	4.6 - 5.2
Sample Date	13-Oct-23
Test Date	02-Nov-23
Technician	PC

Unconfined Strength

	kPa	**ksf**
Max q_u	40.9	0.9
Max S_u	20.5	0.4

Specimen Data

Description CLAY - silty, trace silt inclusions (<15 mm diam.), trace precipitates (sulphates <15 mm diam.), trace rootlets, brown, moist, firm, high plasticity, stratified silt and clay (<10 mm thick)

Length	150.1	(mm)
Diameter	72.6	(mm)
L/D Ratio	2.1	
Initial Area	0.00414	(m^2)
Load Rate	1.00	(%/min)

Moisture %	44%	
Bulk Unit Wt.	16.7	(kN/m^3)
Dry Unit Wt.	11.6	(kN/m^3)
Liquid Limit	65	
Plastic Limit	14	
Plasticity Index	48	

Undrained Shear Strength Tests

Torvane

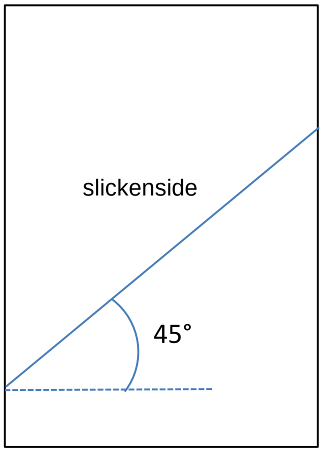
Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	0.90	44.1	0.92
	0.80	39.2	0.82
	0.90	44.1	0.92
Average	**0.87**	**42.5**	**0.89**

Failure Geometry

Sketch:



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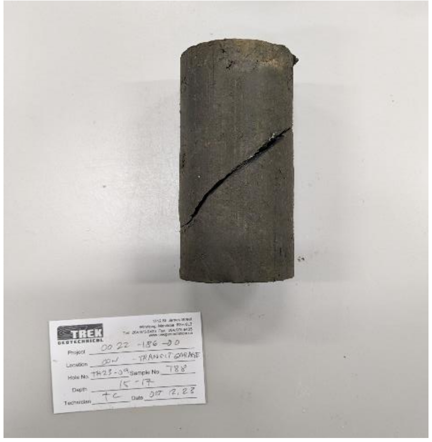
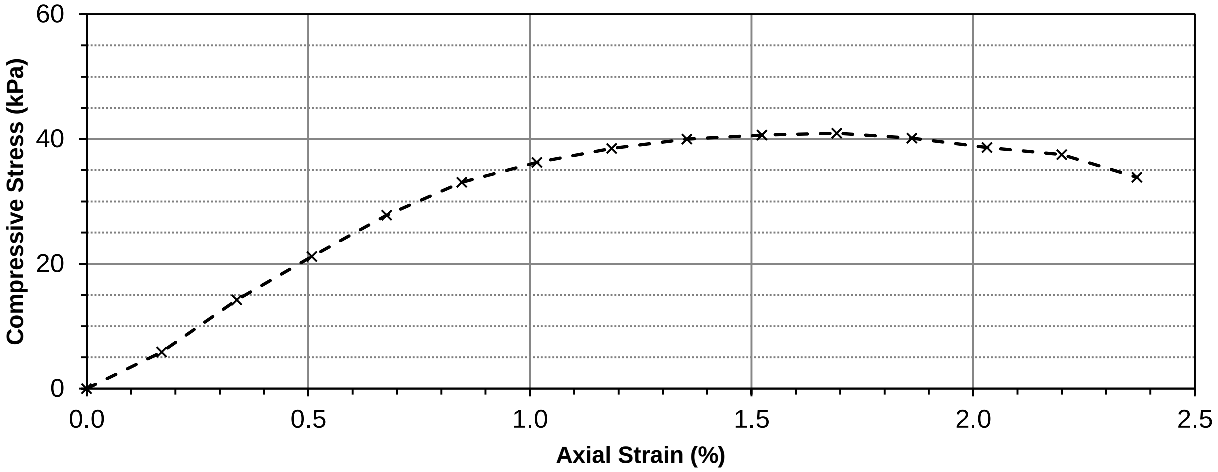


Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.78	0.0000	0.00	0.004140	0.0	0.00	0.00
10	1.26	0.2540	0.17	0.004147	24.2	5.83	2.92
20	1.95	0.5080	0.34	0.004154	59.0	14.20	7.10
30	2.53	0.7620	0.51	0.004161	88.2	21.20	10.60
40	3.08	1.0160	0.68	0.004168	115.9	27.81	13.91
50	3.52	1.2700	0.85	0.004176	138.1	33.07	16.54
60	3.79	1.5240	1.02	0.004183	151.7	36.27	18.14
70	3.98	1.7780	1.18	0.004190	161.3	38.50	19.25
80	4.11	2.0320	1.35	0.004197	167.8	39.99	20.00
90	4.17	2.2860	1.52	0.004204	170.9	40.64	20.32
100	4.20	2.5400	1.69	0.004212	172.4	40.93	20.47
110	4.14	2.7940	1.86	0.004219	169.4	40.14	20.07
120	4.02	3.0480	2.03	0.004226	163.3	38.64	19.32
130	3.93	3.3020	2.20	0.004233	158.8	37.50	18.75
140	3.63	3.5560	2.37	0.004241	143.6	33.87	16.94

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage
Test Hole	TH23-09
Sample #	T90
Depth (m)	7.6 - 8.2
Sample Date	13-Oct-23
Test Date	09-Nov-23
Technician	DS

Tube Extraction

Recovery (mm) 610

Bottom				**Top**
8.23 m	8.20 m	7.94 m	7.78 m	7.62 m

Toss	Moisture Content PP/TV Visual	Keep	Bulk Qu
30 mm	265 mm	160 mm	155 mm

Visual Classification

Material	CLAY
Composition	silty
some sand	
some gravel (<20 mm diam.)	
trace silt inclusions (<15 mm diam.)	
Color	brown
Moisture	moist
Consistency	firm
Plasticity	high plasticity
Structure	stratified silt and clay (<10 mm thick)
Gradation	-

Torvane

Reading	0.45
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	44.1

Pocket Penetrometer

Reading	**1**	0.80
	2	0.90
	3	0.90
	Average	0.87
Undrained Shear Strength (kPa)		42.5

Moisture Content

Tare ID	D42
Mass tare (g)	8.6
Mass wet + tare (g)	289.8
Mass dry + tare (g)	223.4
Moisture %	30.9%

Unit Weight

Bulk Weight (g)		1187.2
Length (mm)	**1**	145.30
	2	145.79
	3	145.05
	4	145.16
Average Length (m)		0.145
Diam. (mm)	**1**	71.98
	2	72.66
	3	72.90
	4	72.10
Average Diameter (m)		0.072
Volume (m^3)		5.98E-04
Bulk Unit Weight (kN/m^3)		19.5
Bulk Unit Weight (pcf)		123.8
Dry Unit Weight (kN/m^3)		14.9
Dry Unit Weight (pcf)		94.6

Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting Ltd.
Project	COW Transit Garage

Test Hole	TH23-09
Sample #	T90
Depth (m)	7.6 - 8.2
Sample Date	13-Oct-23
Test Date	09-Nov-23
Technician	DS

Unconfined Strength

	kPa	ksf
Max q_u	73.3	1.5
Max S_u	36.6	0.8

Specimen Data

Description CLAY - silty, some sand, some gravel (<20 mm diam.), trace silt inclusions (<15 mm diam.), brown, moist, firm, high plasticity, stratified silt and clay (<10 mm thick)

Length	145.3	(mm)	**Moisture %**	31%	
Diameter	72.4	(mm)	**Bulk Unit Wt.**	19.5	(kN/m^3)
L/D Ratio	2.0		**Dry Unit Wt.**	14.9	(kN/m^3)
Initial Area	0.00412	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

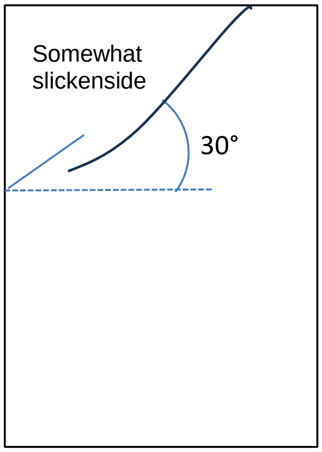
Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
0.45	44.1	0.92
Vane Size		
m		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	0.80	39.2	0.82
	0.90	44.1	0.92
	0.90	44.1	0.92
Average	**0.87**	**42.5**	**0.89**

Failure Geometry

Sketch:



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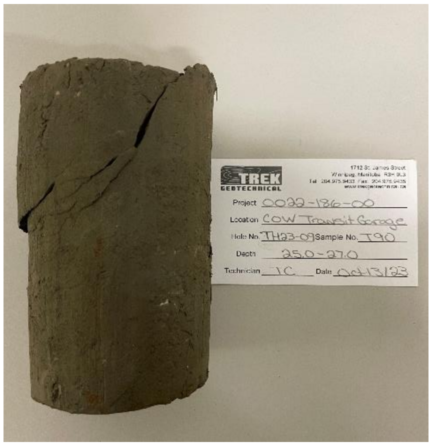
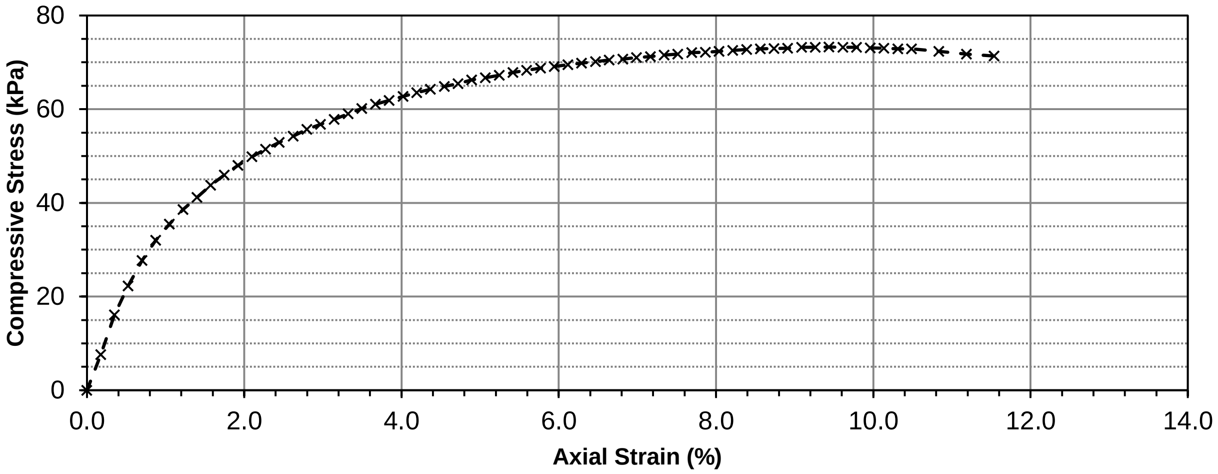


Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.74	0.0000	0.00	0.004118	0.0	0.00	0.00
10	1.36	0.2540	0.17	0.004125	31.2	7.58	3.79
20	2.06	0.5080	0.35	0.004132	66.5	16.10	8.05
30	2.57	0.7620	0.52	0.004140	92.2	22.28	11.14
40	3.02	1.0160	0.70	0.004147	114.9	27.71	13.86
50	3.38	1.2700	0.87	0.004154	133.1	32.03	16.02
60	3.67	1.5240	1.05	0.004162	147.7	35.49	17.74
70	3.93	1.7780	1.22	0.004169	160.8	38.57	19.28
80	4.15	2.0320	1.40	0.004176	171.9	41.15	20.58
90	4.37	2.2860	1.57	0.004184	183.0	43.73	21.87
100	4.56	2.5400	1.75	0.004191	192.5	45.94	22.97
110	4.74	2.7940	1.92	0.004199	201.6	48.02	24.01
120	4.90	3.0480	2.10	0.004206	209.7	49.85	24.92
130	5.04	3.3020	2.27	0.004214	216.7	51.43	25.72
140	5.17	3.5560	2.45	0.004221	223.3	52.89	26.45
150	5.29	3.8100	2.62	0.004229	229.3	54.23	27.12
160	5.42	4.0640	2.80	0.004236	235.9	55.68	27.84
170	5.52	4.3180	2.97	0.004244	240.9	56.77	28.38
180	5.62	4.5720	3.15	0.004252	246.0	57.85	28.93
190	5.73	4.8260	3.32	0.004259	251.5	59.05	29.52
200	5.83	5.0800	3.50	0.004267	256.6	60.12	30.06
210	5.92	5.3340	3.67	0.004275	261.1	61.07	30.54
220	6.00	5.5880	3.85	0.004283	265.1	61.91	30.95
230	6.08	5.8420	4.02	0.004290	269.2	62.73	31.37

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting Ltd.
Project COW Transit Garage

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	6.16	6.0960	4.19	0.004298	273.2	63.56	31.78
250	6.23	6.3500	4.37	0.004306	276.7	64.26	32.13
260	6.29	6.6040	4.54	0.004314	279.7	64.84	32.42
270	6.35	6.8580	4.72	0.004322	282.8	65.42	32.71
280	6.43	7.1120	4.89	0.004330	286.8	66.24	33.12
290	6.48	7.3660	5.07	0.004338	289.3	66.69	33.35
300	6.54	7.6200	5.24	0.004346	292.3	67.27	33.63
310	6.60	7.8740	5.42	0.004354	295.4	67.84	33.92
320	6.65	8.1280	5.59	0.004362	297.9	68.29	34.15
330	6.70	8.3820	5.77	0.004370	300.4	68.74	34.37
340	6.74	8.6360	5.94	0.004378	302.4	69.07	34.54
350	6.79	8.8900	6.12	0.004386	304.9	69.52	34.76
360	6.83	9.1440	6.29	0.004395	307.0	69.85	34.92
370	6.87	9.3980	6.47	0.004403	309.0	70.18	35.09
380	6.91	9.6520	6.64	0.004411	311.0	70.50	35.25
390	6.94	9.9060	6.82	0.004419	312.5	70.71	35.36
400	6.98	10.1600	6.99	0.004428	314.5	71.04	35.52
410	7.01	10.4140	7.17	0.004436	316.0	71.24	35.62
420	7.05	10.6680	7.34	0.004444	318.0	71.56	35.78
430	7.08	10.9220	7.52	0.004453	319.6	71.77	35.88
440	7.12	11.1760	7.69	0.004461	321.6	72.08	36.04
450	7.14	11.4300	7.87	0.004470	322.6	72.17	36.09
460	7.17	11.6840	8.04	0.004478	324.1	72.37	36.19
470	7.20	11.9380	8.21	0.004487	325.6	72.57	36.29
480	7.23	12.1920	8.39	0.004495	327.1	72.77	36.39
490	7.25	12.4460	8.56	0.004504	328.1	72.86	36.43
500	7.27	12.7000	8.74	0.004512	329.1	72.94	36.47
510	7.29	12.9540	8.91	0.004521	330.1	73.02	36.51
520	7.32	13.2080	9.09	0.004530	331.7	73.22	36.61
530	7.33	13.4620	9.26	0.004538	332.2	73.19	36.59
540	7.35	13.7160	9.44	0.004547	333.2	73.27	36.63
550	7.36	13.9700	9.61	0.004556	333.7	73.24	36.62
560	7.37	14.2240	9.79	0.004565	334.2	73.21	36.60
570	7.37	14.4780	9.96	0.004574	334.2	73.06	36.53
580	7.38	14.7320	10.14	0.004583	334.7	73.03	36.52
590	7.38	14.9860	10.31	0.004591	334.7	72.89	36.45
600	7.39	15.2400	10.49	0.004600	335.2	72.86	36.43
620	7.37	15.7480	10.84	0.004618	334.2	72.36	36.18
640	7.34	16.2560	11.19	0.004637	332.7	71.75	35.87
660	7.33	16.7640	11.54	0.004655	332.2	71.35	35.68

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Standard Proctor Compaction Test

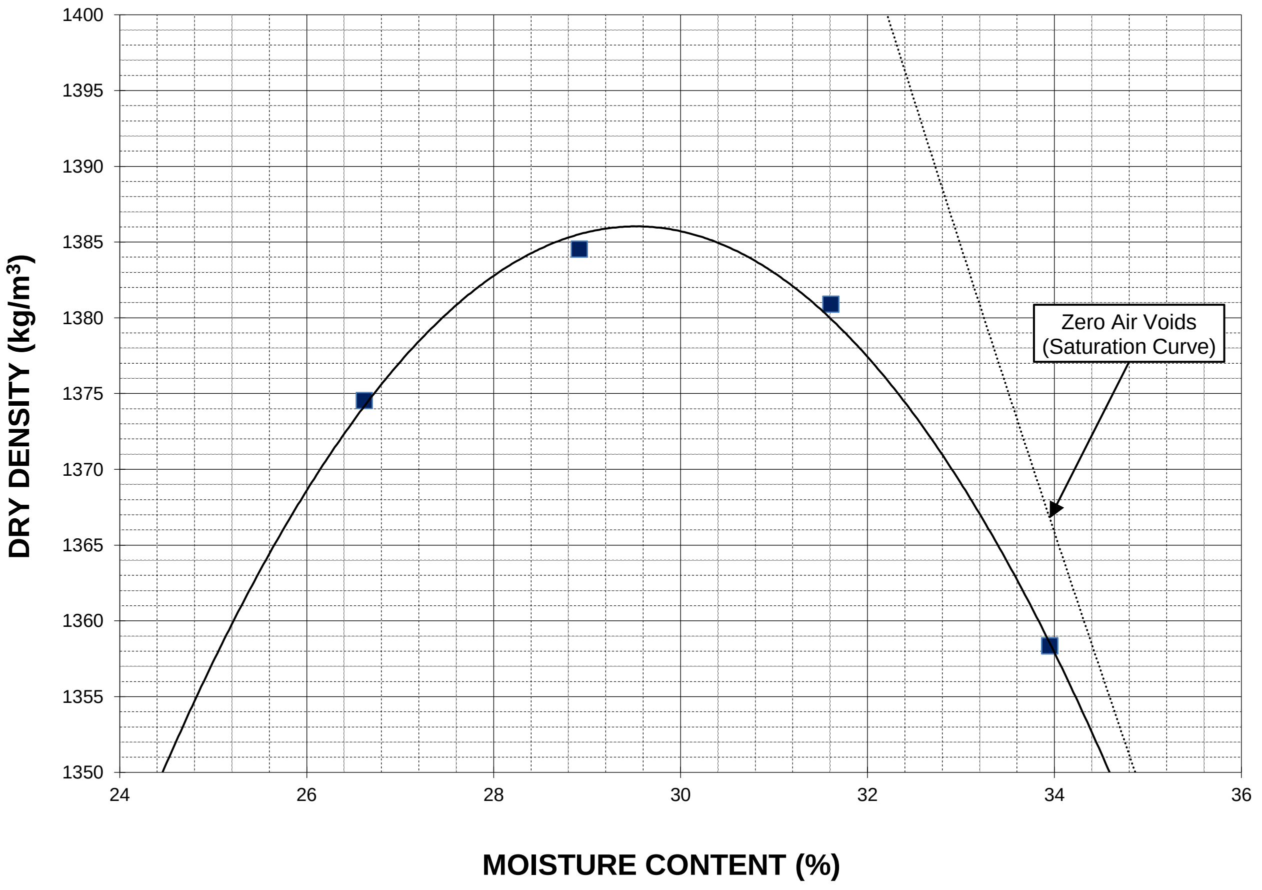
ASTM D698-12e2

Project No. 0022-186-00
Client Dillon Consulting Ltd
Project City of Winnipeg Transit Garage

Sample # R23-530
Source TH23-02 and TH23-01 (combined)
Material Clay
Sample Date 11-Oct-23
Test Date 26-Oct-23
Technician AD

Maximum Dry Density (kg/m3)	1386
Optimum Moisture (%)	29.5

Trial Number	1	2	3	4	
Wet Density (kg/m^3)	1740	1785	1817	1820	
Dry Density (kg/m^3)	1375	1385	1381	1358	
Moisture Content (%)	26.6	28.9	31.6	33.9	



Note: Additional information recorded/measured for this test is available upon request.

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California Bearing Ratio Test Data Sheet

ASTM D1883-16

Project No.	0022-186-00	**Source**	TH23-01 and TH23-02 (Combined)
Client	Dillon Consulting	**Material**	Clay
Project	City of Winnipeg Transit Garage	**Sample Date**	2023-10-11
Sample #	Bulk Sample	**Test Date**	2023-10-31
		Technician	AD

Proctor Results (ASTM D698)

Maximum Dry Density	1386	kg/m3
Optimum Moisture Content	29.5	%
Material Retained on 19 mm Sieve	0.0	%

CBR Sample Compaction

Dry Density	1322	kg/m3
Initial Moisture Content	30.7	%
Relative Density	95.4	% SPMDD

Soaking Results

Surcharge	4.54	kg
Swell	2.6	%
Moisture Content in top 25 mm	50.6	%
Immersion Period	96	h

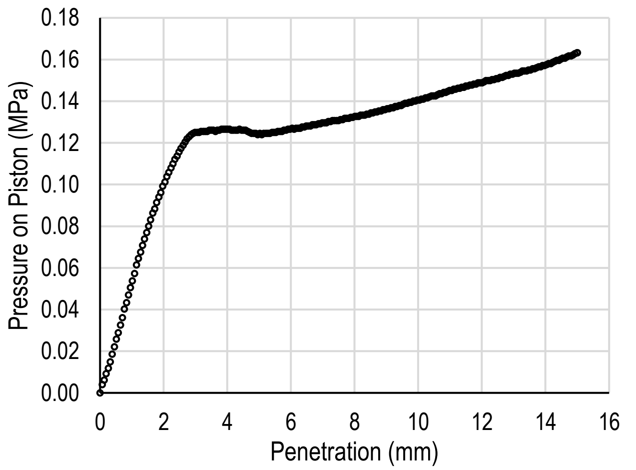
CBR Results

CBR at 2.54 mm	1.7	%
CBR at 5.08 mm	1.2	%
Zero Correction	0	mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.03	0.03
1.27	0.07	0.07
1.91	0.10	0.10
2.54	0.12	0.12
3.18	0.13	0.13
3.81	0.13	0.13
4.45	0.13	0.13
5.08	0.12	0.12
7.62	0.13	0.13
10.16	0.14	0.14
12.70	0.15	0.15

Load/Penetration Curve



Comments:

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	November 9, 2023
To	Michael Van Helden, TREK Geotechnical
From	Sepehr Chalajour, TREK Geotechnical
Project No.	0022-186-00
Project	City of Winnipeg Transit Garage
Subject	Laboratory Testing Results – Lab Req. R23-530
Distribution	Brent Hay

Attached are the Unconfined Compressive Strength (UCS) testing results for the above noted project. The testing included moisture content determinations, unit weight and unconfined compressive strength.

Regards,

Sepehr Chalajour M.Sc. EIT, PhD Candidate.

Attach.

Review Control:

Prepared By: SC	*Reviewed By:* AF	*Checked By:* NJF

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Shelby Tube Visual

Project No.	0022-186-00
Client	Dillom Consulting Ltd.
Project	City of Winnnipeg Transit Garage
Test Hole	TH23-09
Sample #	C98A
Depth (m)	16.0 - 16.2
Sample Date	Oct 13,2023
Test Date	Nov 8,2023
Technician	SC

Tube Extraction

Recovery (mm) 165

Bottom - 16.17 m **Top - 16 m**

Visual Classification

Material	SHALE
Composition	
Color	-
Moisture	-
Consistency	-
Plasticity	-
Structure	-
Gradation	-

Torvane

Reading	max
Vane Size (s,m,l)	s
Undrained Shear Strength (kPa)	-

Pocket Penetrometer

Reading	**1**	max
	2	max
	3	max
	Average	-
Undrained Shear Strength (kPa)		-

Moisture Content

Tare ID	D12
Mass tare (g)	8.4
Mass wet + tare (g)	180.8
Mass dry + tare (g)	164.6
Moisture %	10.4%

Unit Weight

Bulk Weight (g)		975.4
Length (mm)	**1**	128.97
	2	129.12
	3	129.04
	4	129.37
Average Length (m)		0.129
Diam. (mm)	**1**	62.83
	2	63.36
	3	62.91
	4	63.71
Average Diameter (m)		0.063
Volume (m^3)		4.05E-04
Bulk Unit Weight (kN/m^3)		23.6
Bulk Unit Weight (pcf)		150.3
Dry Unit Weight (kN/m^3)		21.4
Dry Unit Weight (pcf)		136.2

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Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillom Consulting Ltd.
Project City of Winnnipeg Transit Garage

Test Hole TH23-09
Sample # C98A
Depth (m) 16.0 - 16.2
Sample Date Oct 13,2023
Test Date Nov 8,2023
Technician SC

Unconfined Strength

	kPa	ksf
Max q_u	1220.6	25.5
Max S_u	610.3	12.7

Specimen Data

Description Shale

Length	129.1	(mm)	**Moisture %**	10%	
Diameter	63.2	(mm)	**Bulk Unit Wt.**	23.6	(kN/m^3)
L/D Ratio	2.0		**Dry Unit Wt.**	21.4	(kN/m^3)
Initial Area	0.00314	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
max	-	-
Vane Size		
s		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	max	-	-
	max	-	-
	max	-	-
Average	-	-	-

Failure Geometry

Sketch:

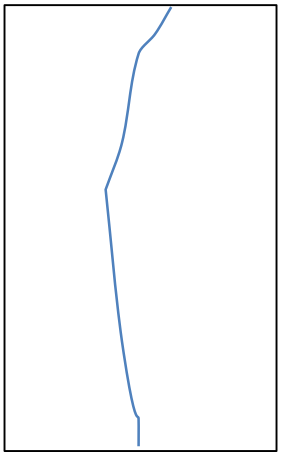


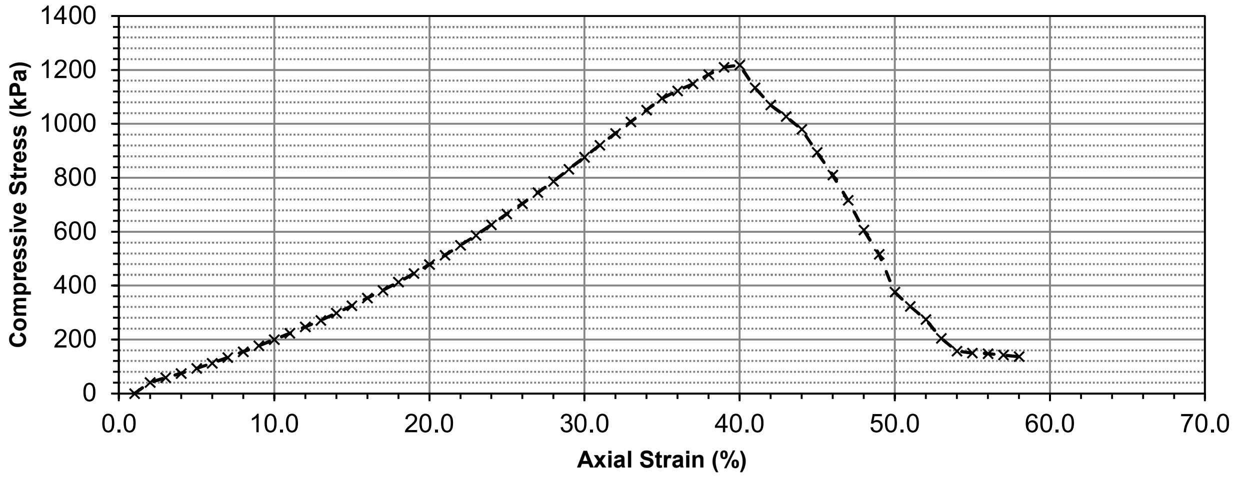
Photo:

Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillom Consulting Ltd.
Project	City of Winnnipeg Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0.00	-	0.00	0.00	0.00314	0	0.0	0.0
0.08	-	0.08	0.06	0.00314	127	40.5	20.2
0.17	-	0.17	0.13	0.00314	183	58.3	29.1
0.27	-	0.27	0.21	0.00314	235	74.7	37.4
0.37	-	0.37	0.28	0.00315	293	93.1	46.6
0.46	-	0.46	0.36	0.00315	354	112.4	56.2
0.56	-	0.56	0.43	0.00315	420	133.3	66.6
0.65	-	0.65	0.50	0.00315	488	154.8	77.4
0.75	-	0.75	0.58	0.00316	558	176.8	88.4
0.84	-	0.84	0.65	0.00316	630	199.5	99.8
0.93	-	0.93	0.72	0.00316	703	222.5	111.2
1.02	-	1.02	0.79	0.00316	780	246.7	123.3
1.11	-	1.11	0.86	0.00316	859	271.4	135.7
1.20	-	1.20	0.93	0.00317	943	297.8	148.9
1.29	-	1.29	1.00	0.00317	1030	325.0	162.5
1.38	-	1.38	1.07	0.00317	1121	353.5	176.8
1.47	-	1.47	1.14	0.00317	1214	382.5	191.3
1.56	-	1.56	1.21	0.00318	1312	413.1	206.6
1.65	-	1.65	1.28	0.00318	1414	444.9	222.5
1.74	-	1.74	1.35	0.00318	1522	478.6	239.3
1.83	-	1.83	1.42	0.00318	1633	513.1	256.6
1.92	-	1.92	1.49	0.00318	1749	549.2	274.6
2.01	-	2.01	1.56	0.00319	1870	586.8	293.4
2.10	-	2.10	1.63	0.00319	1995	625.5	312.8

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	October 23, 2023
To	Tyler Chapko, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0022-186-00
Project	City of Winnipeg Transit Garage
Subject	Laboratory Testing Results – Lab Req. R23-525
Distribution	Michael Van Helden

Attached are the laboratory testing results for the above noted project. The testing included unconfined compression test on a shale core sample.

Regards,

Angela Fidler-Kliewer, C.Tech.,

Attach.

Review Control:

Prepared By: AFK	*Reviewed By: AFK*	*Checked By: NJF*

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Core Barrel Visual

Project No.	0022-186-00
Client	Dillon Consulting
Project	City of Winnipeg Transit Garage

Test Hole	TH23-09
Sample #	CC99A
Depth (m)	17.5 - 17.7
Sample Date	13-Oct-23
Test Date	18-Oct-23
Technician	SC

Tube Extraction

Recovery (mm) 200

Bottom - 17.73 m **Top - 17.53 m**

Shale

200 mm

Visual Classification

Material	CLAY (SHALE)
Composition	Cemented
Color	Grey
Moisture	Dry
Consistency	Very Hard
Plasticity	-
Structure	-
Gradation	-

Torvane

Reading	max
Vane Size (s,m,l)	s
Undrained Shear Strength (kPa)	-

Pocket Penetrometer

Reading	**1**	max
	2	max
	3	max
	Average	-
Undrained Shear Strength (kPa)		-

Moisture Content

Tare ID	W13
Mass tare (g)	6.8
Mass wet + tare (g)	103.0
Mass dry + tare (g)	97.2
Moisture %	6.4%

Unit Weight

Bulk Weight (g)		1065.4
Length (mm)	**1**	135.42
	2	135.51
	3	135.29
	4	135.53
Average Length (m)		0.135
Diam. (mm)	**1**	63.44
	2	63.22
	3	63.81
	4	63.57
Average Diameter (m)		0.064
Volume (m^3)		4.29E-04
Bulk Unit Weight (kN/m^3)		24.4
Bulk Unit Weight (pcf)		155.0
Dry Unit Weight (kN/m^3)		22.9
Dry Unit Weight (pcf)		145.7

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Unconfined Compressive Strength

ASTM D2166

Project No.	0022-186-00
Client	Dillon Consulting
Project	City of Winnipeg Transit Garage
Test Hole	TH23-09
Sample #	CC99A
Depth (m)	17.5 - 17.7
Sample Date	13-Oct-23
Test Date	18-Oct-23
Technician	SC

Unconfined Strength

	kPa	ksf
Max q_u	5054.5	105.6
Max S_u	2527.2	52.8

Specimen Data

Description CLAY (SHALE) - Cemented, Grey, Dry, Very Hard

Length	135.4	(mm)	**Moisture %**	6.4%	
Diameter	63.5	(mm)	**Bulk Unit Wt.**	24.4	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	22.9	(kN/m^3)
Initial Area	0.00317	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	**Undrained Shear Strength**	
tsf	**kPa**	**ksf**
max	-	-
Vane Size		
s		

Pocket Penetrometer

	Reading	**Undrained Shear Strength**	
	tsf	**kPa**	**ksf**
	max	-	-
	max	-	-
	max	-	-
Average	**-**	**-**	**-**

Failure Geometry

Sketch:

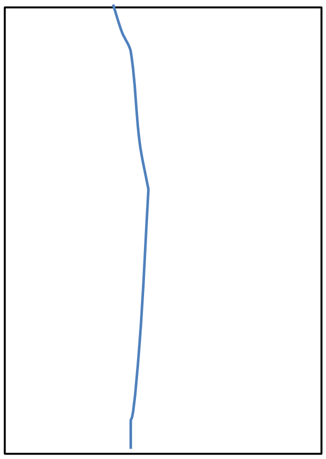


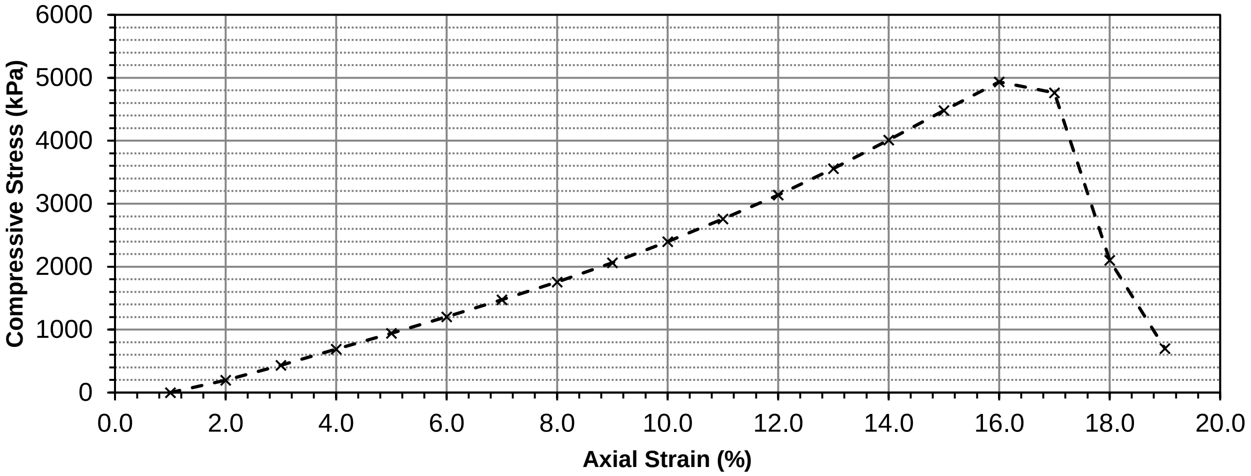
Photo:

Unconfined Compressive Strength

ASTM D2166

Project No. 0022-186-00
Client Dillon Consulting
Project City of Winnipeg Transit Garage

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0.00	-	0.00	0.00	0.00317	0	0.0	0.0
0.21	-	0.21	0.15	0.00317	619	195.1	97.6
0.38	-	0.38	0.28	0.00318	1383	435.3	217.7
0.56	-	0.56	0.41	0.00318	2189	688.1	344.1
0.74	-	0.74	0.54	0.00319	3004	943.1	471.6
0.91	-	0.91	0.67	0.00319	3845	1205.6	602.8
1.08	-	1.08	0.80	0.00319	4706	1473.6	736.8
1.26	-	1.26	0.93	0.00320	5622	1758.1	879.1
1.43	-	1.43	1.06	0.00320	6601	2061.6	1030.8
1.61	-	1.61	1.19	0.00321	7686	2397.4	1198.7
1.78	-	1.78	1.32	0.00321	8852	2757.5	1378.7
1.96	-	1.96	1.45	0.00321	10085	3137.4	1568.7
2.14	-	2.14	1.58	0.00322	11449	3557.1	1778.5
2.31	-	2.31	1.71	0.00322	12922	4009.4	2004.7
2.48	-	2.48	1.83	0.00323	14462	4481.4	2240.7
2.66	-	2.66	1.96	0.00323	15944	4934.1	2467.0
2.85	-	2.85	2.11	0.00324	15410	4761.9	2381.0
2.99	-	2.99	2.20	0.00324	6801	2099.5	1049.8
3.20	-	3.20	2.36	0.00324	2271	699.9	350.0

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	October 18, 2023
To	Tyler Chapko, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0022-186-00
Project	City of Winnipeg Transit Garage
Subject	Laboratory Testing Results – Lab Req. R23-525
Distribution	Michael Van Helden

Attached are the laboratory testing results for the above noted project. The testing included unconfined compression test on rock core.

Regards,

Angela Fidler-Kliewer, C.Tech.,

Attach.

Review Control:

Prepared By: IA	*Reviewed By: AFK*	*Checked By: NJF*

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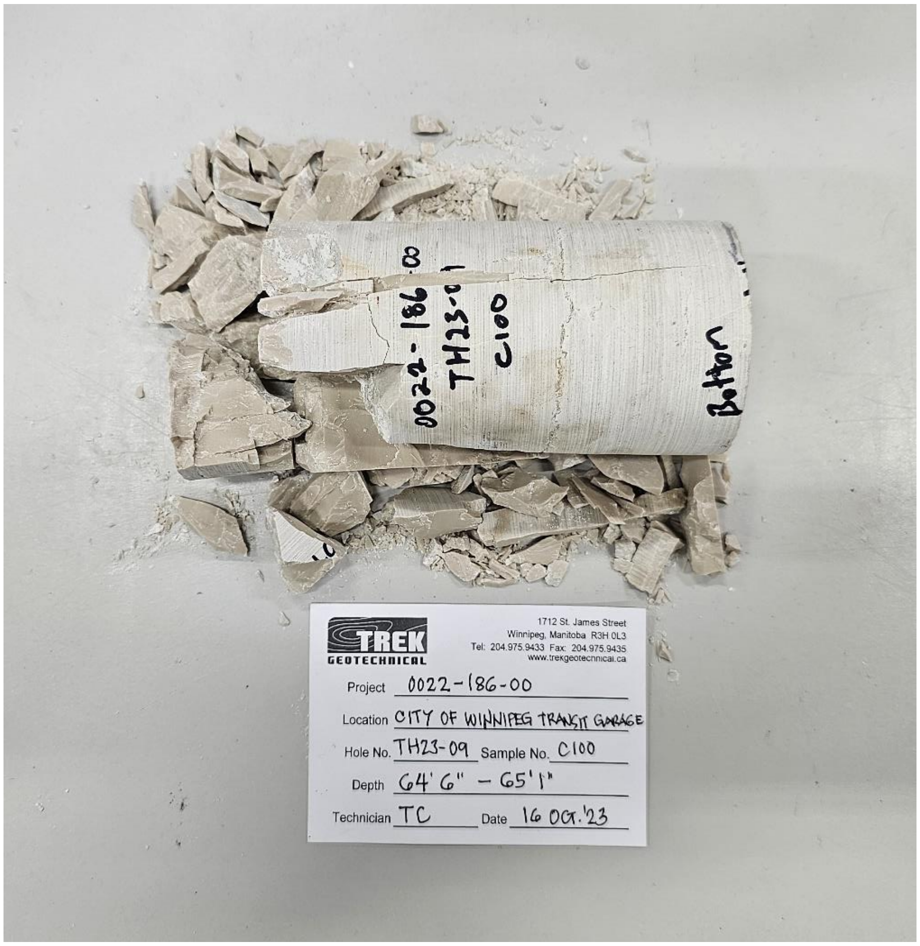
Rock Core Unconfined Compressive Strength Report

UNCONFINED COMPRESSIVE STRENGTH OF INTACT ROCK CORE SPECIMENS (ASTM D 7012)

Project No.	0022-186-00	**Date Received**	16-Oct-23	**Test Date**	18-Oct-23
Project	City of Winnipeg Transit Garage	**Sampled by**	TC	**Report No.**	R23-525
Client	Dillon Consulting Ltd.	**Requested by**	TC	**Technician**	I. Araquil

Core No.	Core Length as Received (mm)	Core Diameter (mm)	Core Length (mm)	Core Weight (g)	Density (g/mm³)	Area (sq.mm)	Core Load (kN)	Core Strength (Mpa)	Notes
TH23-09 (C100)	220	63.00	132.00	1101	$2.585\ X10^{-3}$	3117	109.76	35.2	



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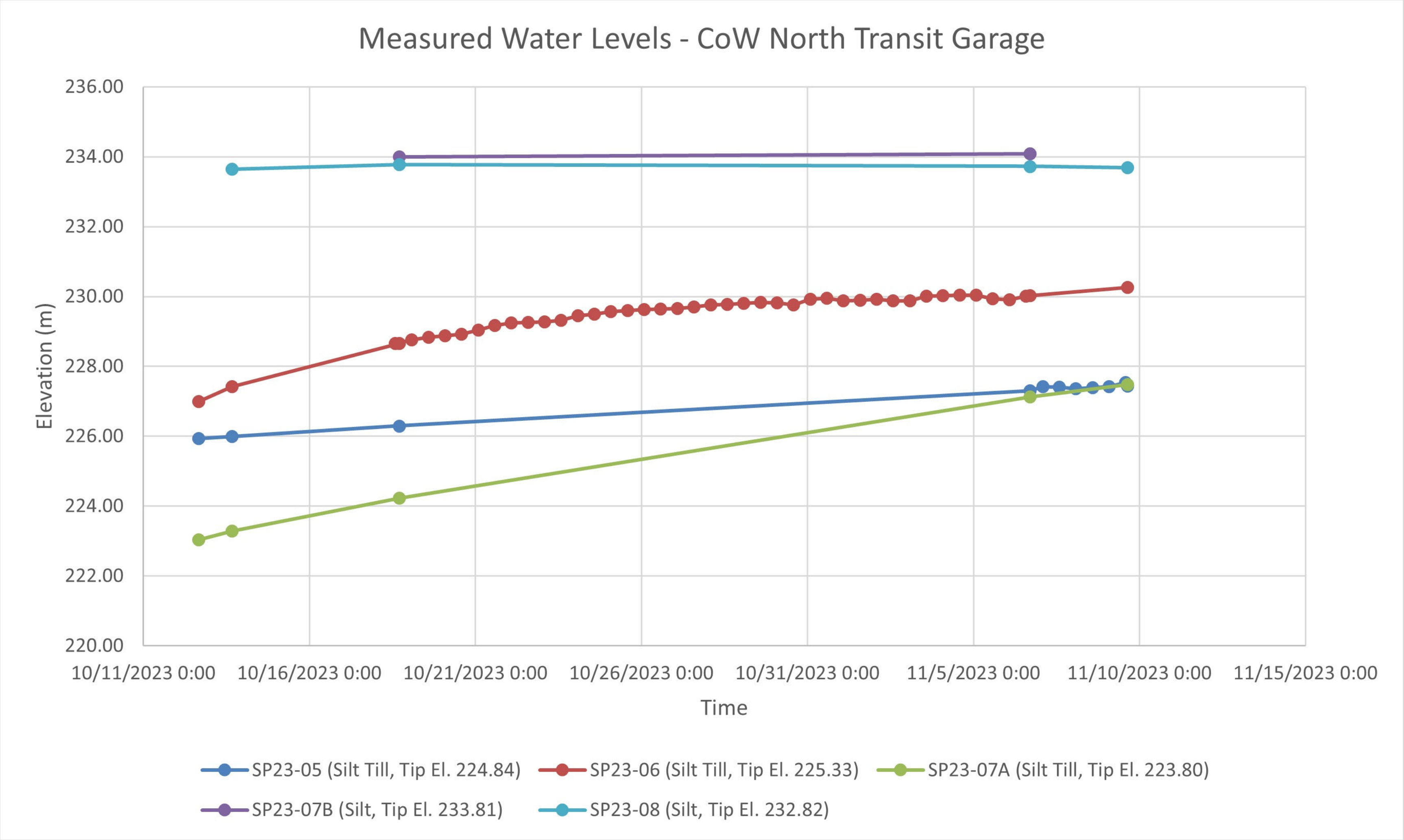
www.trekgeotechnical.ca

Project 0022-186-00
Location CITY OF WINNIPEG TRANSIT GARAGE
Hole No. TH23-09 Sample No. C100
Depth 64'6" – 65'1"
Technician TC Date 16 OCT.'23

Comments:

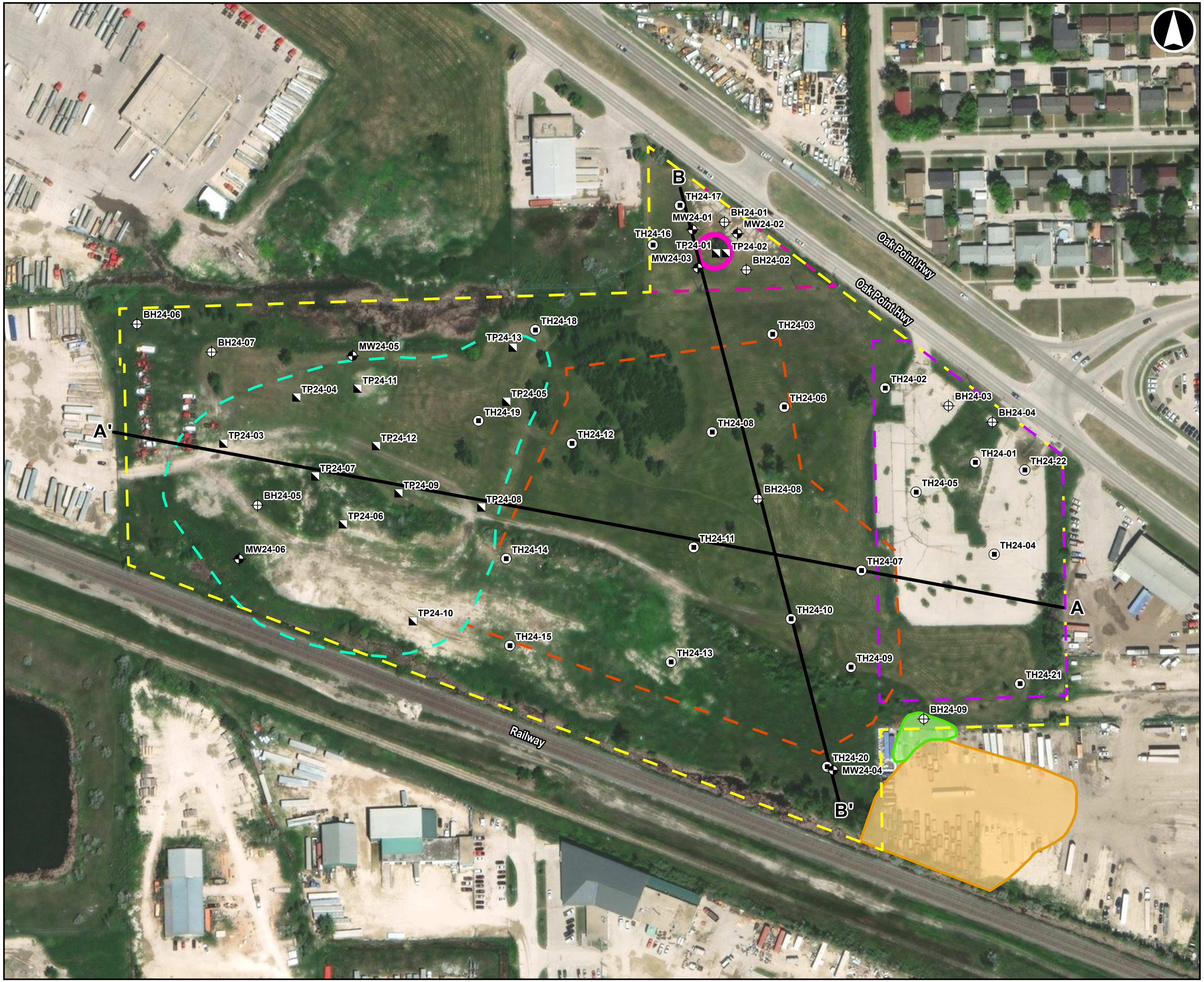
Appendix C

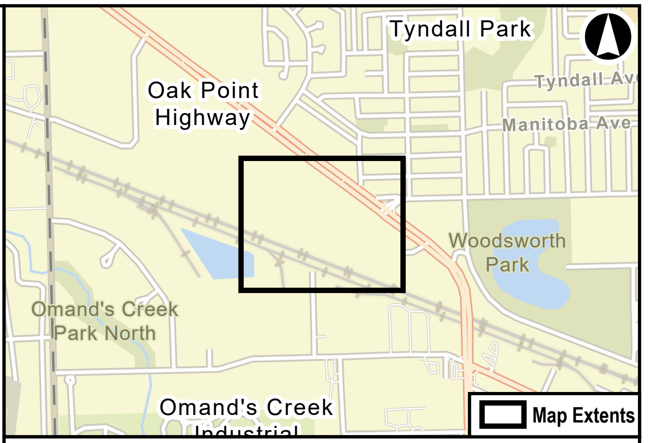
Water Level Monitoring Results


Measured Water Levels - CoW North Transit Garage
236.00
234.00
232.00
230.00
228.00
226.00
224.00
222.00
220.00
Elevation (m)
10/11/2023 0:00
10/16/2023 0:00
10/21/2023 0:00
10/26/2023 0:00
10/31/2023 0:00
11/5/2023 0:00
11/10/2023 0:00
11/15/2023 0:00
Time
SP23-05 (Silt Till, Tip El. 224.84)
SP23-06 (Silt Till, Tip El. 225.33)
SP23-07A (Silt Till, Tip El. 223.80)
SP23-07B (Silt, Tip El. 233.81)
SP23-08 (Silt, Tip El. 232.82)

Appendix G

Environmental Map and Logs





Legend

⊕ Borehole Location

Monitoring Well Location

Test Pit Location

⊙ Testhole Location (Geotech)

Cross Section Lines

Possible Buried Tank (Dillon Phase II, 2023 (Magnetic Survey Results))

Refuse (The City of Winnipeg (Brooklands Landfill Site Detail)

Cinders and Ash (The City of Winnipeg (Brooklands Landfill Site Detail)

APEC (Dillon Phase II, 2023 (Site Areas of Potential Environmental Concern (APEC))

APEC 1 - Former Brooklands Landfill

APEC 2 - Former Brooklands Speedway

APEC 3 - Historical and Current Imported Fill Materials

APEC 4 - Former Gas Station

APEC 5 - Former Imperial Oil Retail Fuel Outlet

WINNIPEG TRANSIT GARAGE
SUPPLEMENTAL ENVIRONMENTAL INVESTIGATION
CITY OF WINNIPEG

SITE PLAN

0 20 40 60 80 100
Metres

Datum: NAD 1983 UTM Zone 14N

Mar, 2024	PN#: 60721079	1:2,000 * when printed 11"x17"

Figure 2

AECOM

Data Sources:
Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, US Census Bureau, USDA, NRCan, Parks Canada, Maxar

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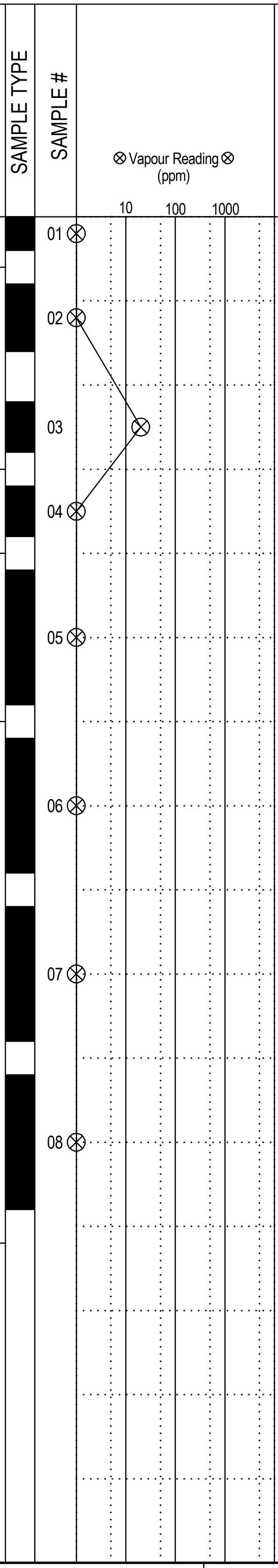
MAP LOCATION: L:\CALGARY-CACGY3\DCS\GIS\MANITOBA\60721079\DESIGN\01_REPORTS\SUPPLEMENTAL ENVIRONMENTAL INVESTIGATION\60721079_WINNIPEGTRANSITGARAGE_SUPPLEMENTALENVINVESTIGATION.APRX FIGURE: H002_60721079_WINNIPEGTRANSITGARAGE_SITEPLAN
DATE SAVED: 3/21/2024 USER NAME: PAIGE.CROSSMAN

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **BH24-01**
LOCATION: 628201.9, 553256.9		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 235.32

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▌ CORE

DEPTH (m)	SOIL DESCRIPTION
0	CONCRETE and ASPHALT
	SAND and GRAVEL - some silt, brown, moist, compact, fine to coarse sand, fine graned gravel.
	SILT - some clay, trace sand, light brown, moist, firm, medium plasticity, fine to coarse sand.
2	CLAY and SILT - brown, moist, firm, medium plasticity.
3	CLAY - trace of silt, brown, moist, firm, high plasticity.
6	END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Borehole backfilled with excavated material and bentonite upon completion.
3. DUP-07 is associated with sample BH24-01-03.



SAMPLE #	COMMENTS
01	
02	
03	Sample BH24-01-03 submitted for analysis of BTEX F1-F4, VOCs, PAHs
04	Sample BH24-01-04 submitted for analysis of BTEX F1-F4, VOCs, PAHs
05	
06	
07	Sample BH24-01-07 submitted for analysis of BTEX F1-F4, VOCs, PAHs
08	

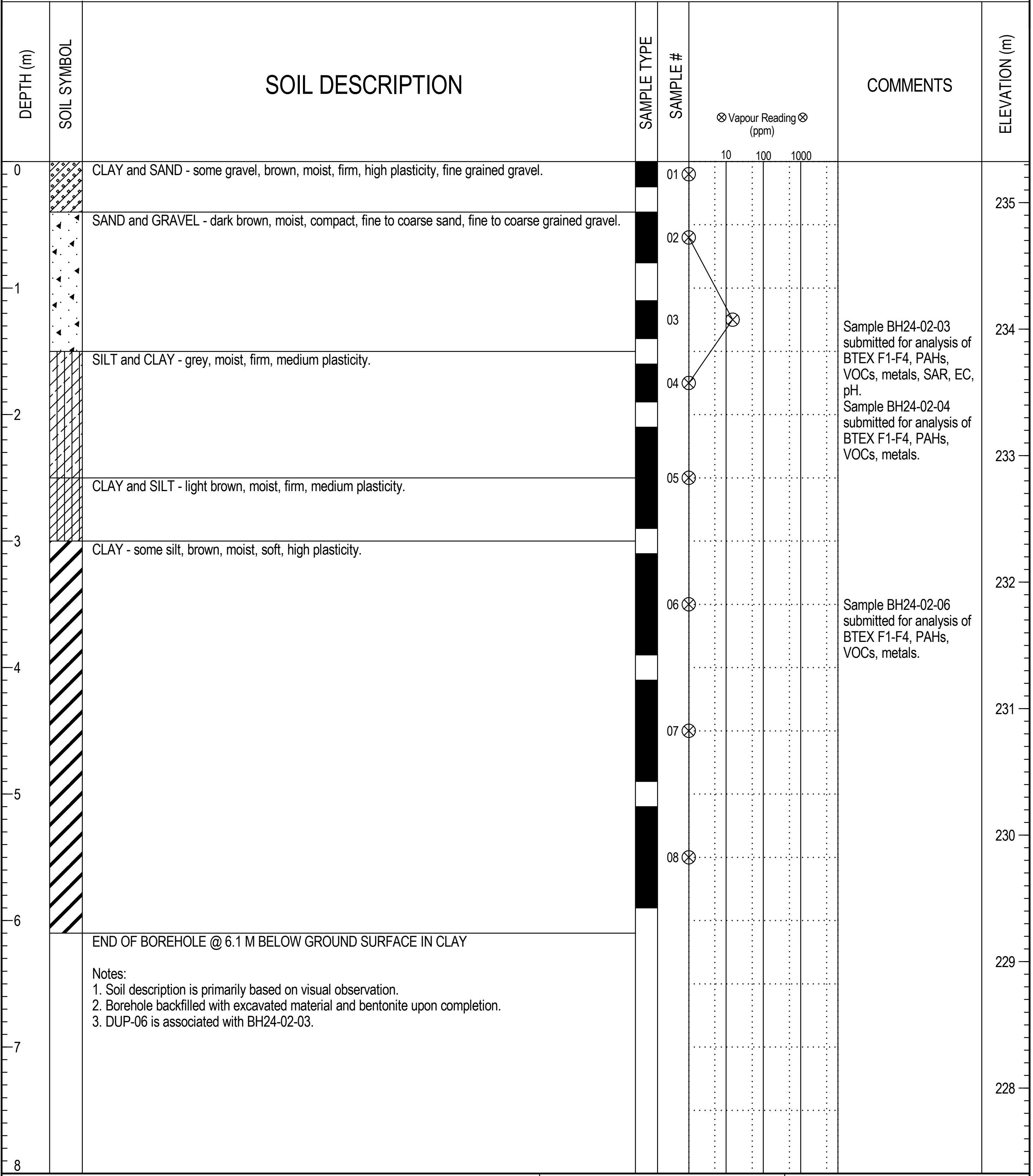
ELEVATION (m): 235, 234, 233, 232, 231, 230, 229, 228

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-13
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **BH24-02**
LOCATION: 628208.6, 5532537
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.
METHOD: Solid Stem Auger
ELEVATION (m): 235.32

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▐ CORE



CLAY and SAND - some gravel, brown, moist, firm, high plasticity, fine grained gravel.

SAND and GRAVEL - dark brown, moist, compact, fine to coarse sand, fine to coarse grained gravel.

SILT and CLAY - grey, moist, firm, medium plasticity.

CLAY and SILT - light brown, moist, firm, medium plasticity.

CLAY - some silt, brown, moist, soft, high plasticity.

END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Borehole backfilled with excavated material and bentonite upon completion.
3. DUP-06 is associated with BH24-02-03.

Comments:

Sample BH24-02-03 submitted for analysis of BTEX F1-F4, PAHs, VOCs, metals, SAR, EC, pH.
Sample BH24-02-04 submitted for analysis of BTEX F1-F4, PAHs, VOCs, metals.

Sample BH24-02-06 submitted for analysis of BTEX F1-F4, PAHs, VOCs, metals.

AECOM

LOGGED BY: Jonathan Ota
REVIEWED BY: Jen Murray
PROJECT ENGINEER: Kimber Osiowy
COMPLETION DEPTH: 6.10 m
COMPLETION DATE: 24-2-13

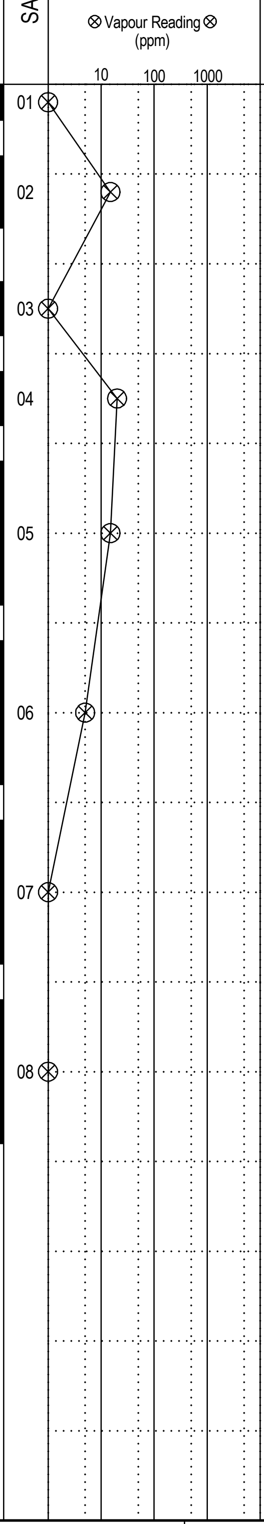
PROJECT: Winnipeg North Transit Garage | CLIENT: City of Winnipeg | TESTHOLE NO: **BH24-03**

LOCATION: 0628319, 5532464 | PROJECT NO.: 60721079

CONTRACTOR: Paddock Drilling Ltd. | METHOD: Solid Stem Auger | ELEVATION (m): 234.41

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION (m)
0	SAND and GRAVEL - light brown, moist, compact, fine to coarse sand, fine to coarse grained gravel (fill).	■	01		
	SILT and CLAY - trace of sand, brown, moist, firm, medium plasticity.	■	02	Sample BH24-03-02 submitted for analysis of BTEX F1-F4, PAHs.	234
1		■	03		233
	CLAY - some silt, brown, moist, firm, medium plasticity.	■	04	Sample BH24-03-04 submitted for analysis of BTEX F1-F4, PAHs.	
2		■	05		232
3	- soft, high plasticity below 3 m.	■	06	Sample BH24-03-06 submitted for analysis of BTEX F1-F4, PAHs.	231
4		■	07		230
5		■	08		229
6	END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material and bentonite upon completion. 3. DUP-05 is associated with BH24-03-04.				228
7					227
8					



LOGGED BY: Jonathan Ota | COMPLETION DEPTH: 6.10 m

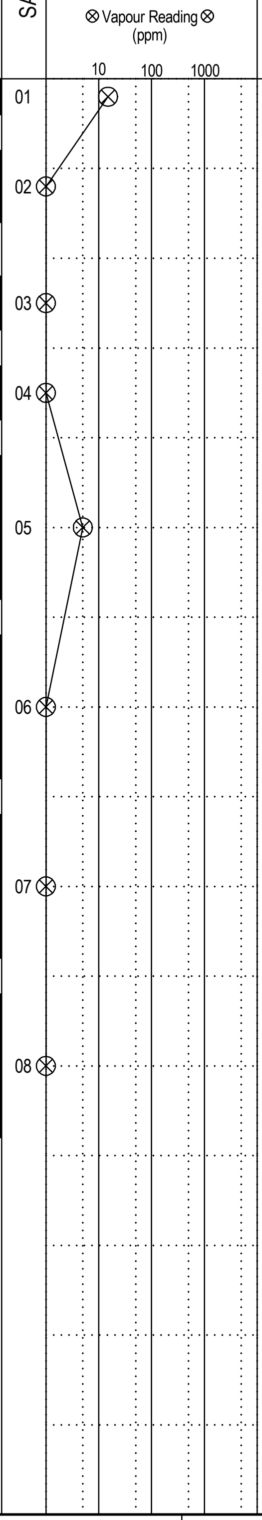
REVIEWED BY: Jen Murray | COMPLETION DATE: 24-2-13

PROJECT ENGINEER: Kimber Osiowy

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **BH24-04**
LOCATION: 628344.1, 5532456		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 234.51

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION (m)
0		SAND and GRAVEL, light brown, moist, loose, fine to coarse sand, fine to coarse grained gravel (fill).	■	01	Sample BH24-04-01 submitted for analysis of BTEX F1-F4, PAHs	
			■	02		234
1			■	03	Sample BH24-04-03 submitted for analysis of BTEX F1-F4, PAHs	233
		CLAY - brown, moist, stiff, medium plasticity.	■	04		
2			■	05	Sample BH24-04-05 submitted for analysis of BTEX F1-F4, PAHs	232
3			■	06		231
4			■	07		230
5			■	08		229
6		END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material and bentonite upon completion.				228
7						227
8						



LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **BH24-05**
LOCATION: 627947.2, 5532410
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.
METHOD: Solid Stem Auger
ELEVATION (m): 238.19

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	▨	CLAY and SILT - some sand, brown, moist, firm, medium plasticity, fine to coarse sand (fill).	■	01			238
			■	02		Sample BH24-05-02 submitted for analysis of metals.	
1			■	03			237
			■	04			
2		-black and soft below 2 m					236
			■	05		Sample BH24-05-05 submitted for analysis of dioxins and furans, and metals.	
3	▨	CLAY - brown, moist, firm, medium plasticity.					235
			■	06			
4		-some sand and soft, fine to coarse sand below 4 m					234
			■	07		Sample BH24-05-07 submitted for analysis of metals.	
5							233
			■	08			
6		END OF BOREHOLE @ 6.1 BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material and bentonite upon completion.					232
7							231
8							

LOGGED BY: Jonathan Ota
REVIEWED BY: Jen Murray
PROJECT ENGINEER: Kimber Osiowy
COMPLETION DEPTH: 6.10 m
COMPLETION DATE: 24-2-12

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **BH24-06**
LOCATION: 0627889, 5532507
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.
METHOD: Solid Stem Auger
ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	SILT and CLAY - some gravel, brown, moist, stiff, medium plasticity, fine grained gravel.	■	01			
	CLAY and SILT - trace gravels, dark brown, some orange, moist, firm, non-plastic, fine grained gravel, debris (metals).	■	02			
1		■	03		Sample BH24-06-03 submitted for analysis of dioxins and furans, metals, SAR, EC, pH.	1
	CLAY - trace of sand, brown, moist, stiff, high plasticity, fine to coarse sand.	■	04			
2		■	05		Sample BH24-06-05 submitted for analysis of metals.	2
3	CLAY and SAND - trace gravels, light brown, moist, soft, medium plasticity, fine to coarse sand, fine grained gravel.	■	06		Sample BH24-06-06 submitted for analysis of metals.	3
4		■	07			4
5		■	08			5
6	END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY and SAND. Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material and bentonite upon completion.					6
7						7
8						

AECOM

LOGGED BY: Jonathan Ota
REVIEWED BY: Jen Murray
PROJECT ENGINEER: Kimber Osiowy
COMPLETION DEPTH: 6.10 m
COMPLETION DATE: 24-2-12

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **BH24-07**
LOCATION: 627923.2, 5532491
PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.
METHOD: Solid Stem Auger
ELEVATION (m): 237.12

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		SILT and GRAVEL - light brown, moist, firm, medium plasticity, fine to coarse grained gravel (fill).	■	01			237
1		SAND and GRAVEL - some silt, some clay, brown, moist, compact, fine to coarse sand, fine to coarse grained gravel.	■ ■	02 03		Sample BH24-07-02 submitted for analysis of metals.	236
		CLAY and SILT - black, moist, firm, medium plasticity.	■	04		Sample BH24-07-04 submitted for analysis of dioxins and furans, and metals.	
2		SAND - some silt, light brown, moist, compact, fine.	■	05			235
3 4 5 6		CLAY - some silt, trace of sand, brown, moist, stiff, high plasticity. - some sand, fine to coarse below 4.5 m	■ ■ ■	06 07 08		Sample BH24-07-06 submitted for analysis of metals.	234 233 232
7 8		END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY					231 230

Notes:
1. Soil description is primarily based on visual observation.
2. Borehole backfilled with excavated material and bentonite upon completion.
3. DUP-03 is associated with BH24-07-04

AECOM

LOGGED BY: Jonathan Ota
COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray
COMPLETION DATE: 24-2-12
PROJECT ENGINEER: Kimber Osiowy

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **BH24-08**
LOCATION: 628217.1, 5532415		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 236.61

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		SILT and CLAY - some gravel, brown, moist, stiff, medium plasticity, fine grained gravel.	■	01			
		SAND and GRAVEL - some silt, moist, compact, brown, fine to coarse sand, fine to coarse grained gravel.	■	02			236
1			■	03		Sample BH24-08-03 submitted for analysis of dioxins and furans, and metals.	
		CLAY - trace of sand, trace gravels, brown, moist, firm, medium plasticity.	■	04			235
2		- some silt, light brown below 2 m.					
		- black, organic odour below 2.3 m.	■	05		Sample BH24-08-05 submitted for analysis of metals.	234
		- grey below 2.6 m.					
3		SILT - some sand, light brown, wet, soft, medium plasticity, fine to coarse sand.					
		CLAY - some silt, brown, moist, firm, high plasticity.	■	06		Sample BH24-08-06 submitted for analysis of metals.	233
4			■	07			232
5			■	08			231
6		END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavation materials and bentonite upon completion.					230
7							229
8							

ENVIRONMENTAL (VAPOUR ONLY) 60721079 BOREHOLE LOGS.GPJ UMA.GDT 24-3-15

AECOM

LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
PROJECT ENGINEER: Kimber Osiowy	

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **BH24-09**
LOCATION: 628305.5, 5532295		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 236.88

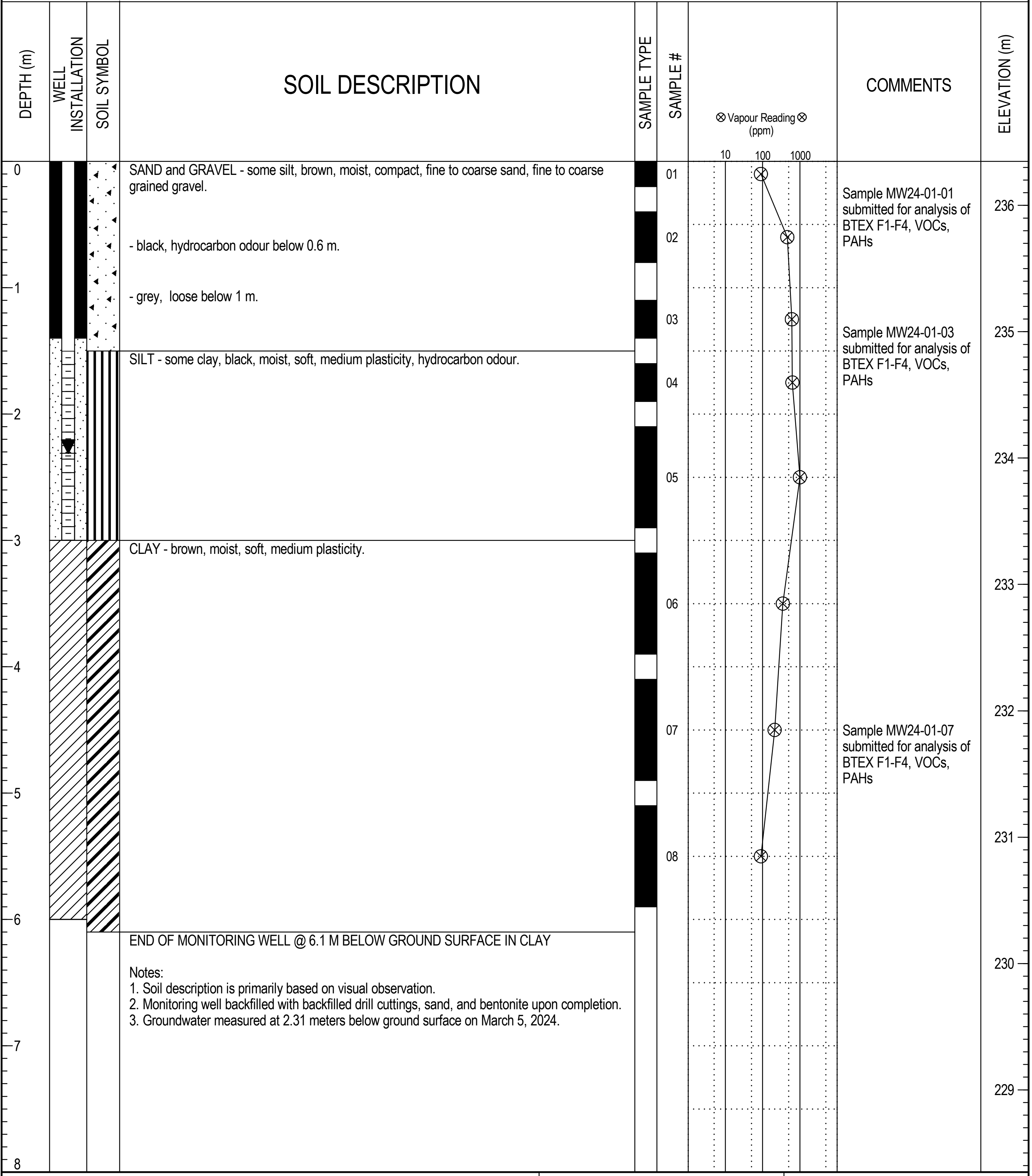
SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	▨	SILT and CLAY - some gravel, dark brown, moist, stiff, medium plasticity, coarse grained gravel.	■	01			
			■	02		Sample BH24-09-02 submitted for analysis of metals.	236
1			■	03			
	▥	SILT - some clay, trace gravels, dark brown, moist, stiff, medium plasticity.	■	04		Sample BH24-09-04 submitted for analysis of dioxins and furans, and metals.	235
2			■	05			
3	▨	CLAY - some silt, brown, moist, firm, medium plasticity.					234
			■	06		Sample BH24-09-06 submitted for analysis of metals.	233
4			■	07			
5							232
			■	08			231
6		END OF BOREHOLE @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material and bentonite upon completion. 3. DUP-04 is associated with BH24-09-04.					
7							230
8							229

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-01**
LOCATION: 0628180, 5532558		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 236.35

SAMPLE TYPE	■ GRAB	▥ SHELBY TUBE	☒ SPLIT SPOON	☰ BULK	▧ NO RECOVERY	▮ CORE
BACKFILL TYPE	■ BENTONITE	⁘ GRAVEL	▥ SLOUGH	⁘ GROUT	▨ CUTTINGS	⁘ SAND



SAND and GRAVEL - some silt, brown, moist, compact, fine to coarse sand, fine to coarse grained gravel.

- black, hydrocarbon odour below 0.6 m.

- grey, loose below 1 m.

SILT - some clay, black, moist, soft, medium plasticity, hydrocarbon odour.

CLAY - brown, moist, soft, medium plasticity.

END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. Groundwater measured at 2.31 meters below ground surface on March 5, 2024.

Sample MW24-01-01 submitted for analysis of BTEX F1-F4, VOCs, PAHs

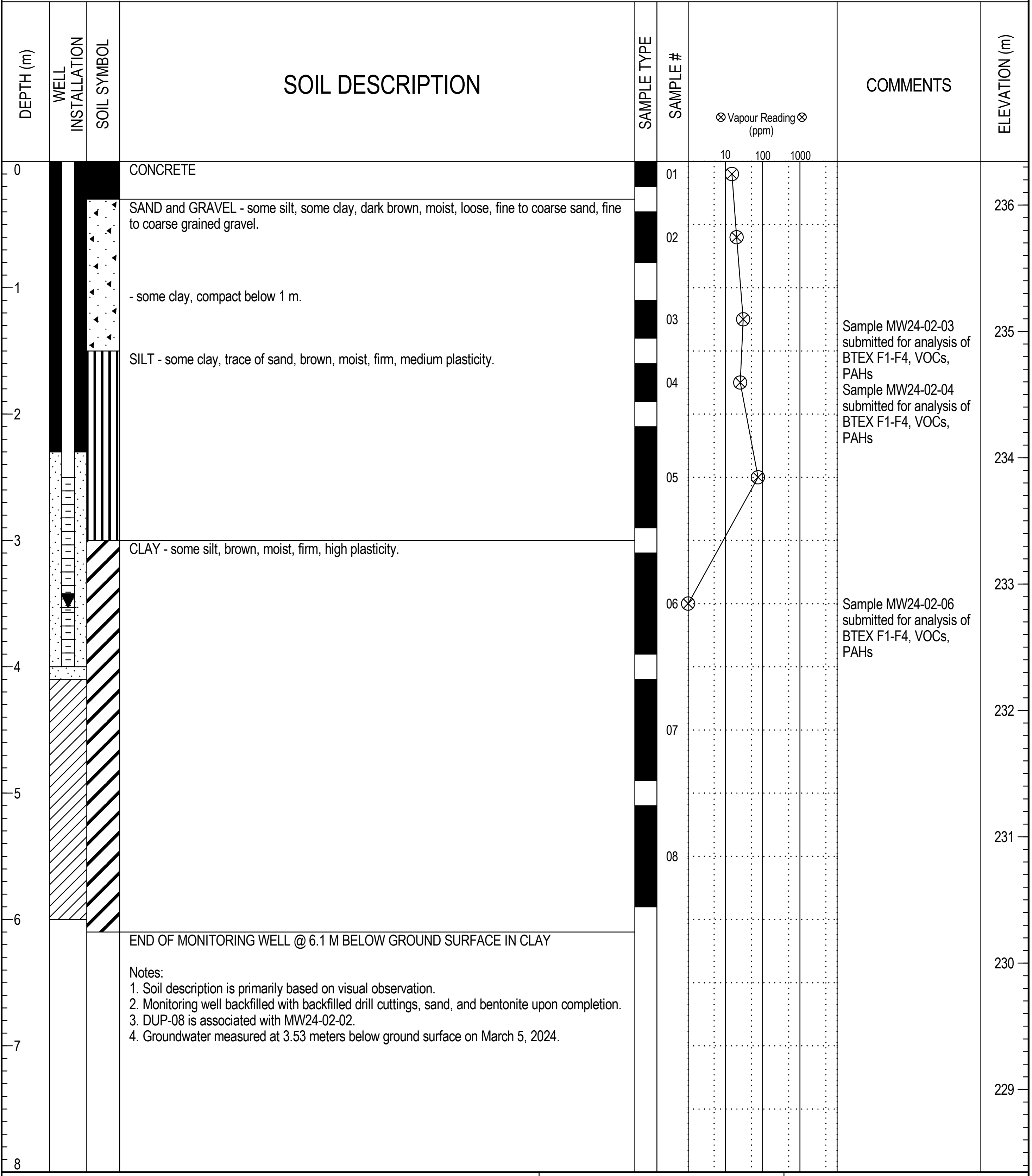
Sample MW24-01-03 submitted for analysis of BTEX F1-F4, VOCs, PAHs

Sample MW24-01-07 submitted for analysis of BTEX F1-F4, VOCs, PAHs

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-13
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-02**
LOCATION: 628206.9, 5532556		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 236.35

SAMPLE TYPE	■ GRAB	▥ SHELBY TUBE	☒ SPLIT SPOON	☰ BULK	▨ NO RECOVERY	▌ CORE
BACKFILL TYPE	■ BENTONITE	⁘ GRAVEL	▥ SLOUGH	⁘ GROUT	▨ CUTTINGS	⁘ SAND



CONCRETE

SAND and GRAVEL - some silt, some clay, dark brown, moist, loose, fine to coarse sand, fine to coarse grained gravel.

- some clay, compact below 1 m.

SILT - some clay, trace of sand, brown, moist, firm, medium plasticity.

CLAY - some silt, brown, moist, firm, high plasticity.

END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. DUP-08 is associated with MW24-02-02.
4. Groundwater measured at 3.53 meters below ground surface on March 5, 2024.

SAMPLE #	COMMENTS
03	Sample MW24-02-03 submitted for analysis of BTEX F1-F4, VOCs, PAHs
04	Sample MW24-02-04 submitted for analysis of BTEX F1-F4, VOCs, PAHs
06	Sample MW24-02-06 submitted for analysis of BTEX F1-F4, VOCs, PAHs

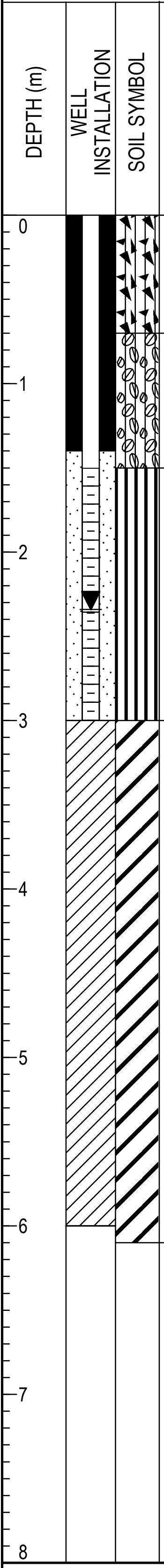
AECOM

LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-13
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

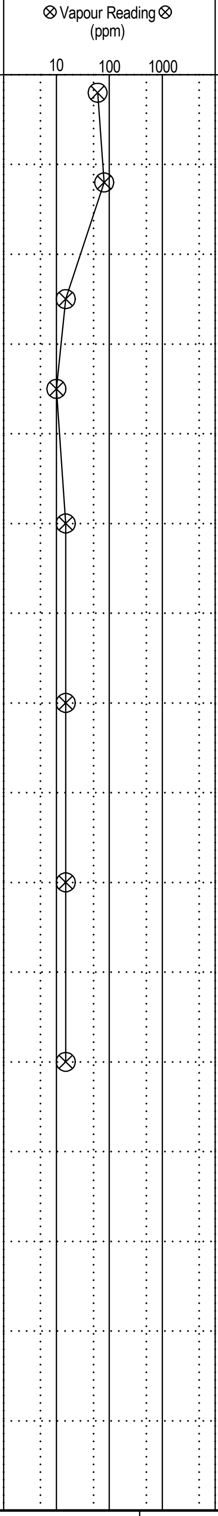
PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-03**
LOCATION: 628184.3, 5532538		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 236.35

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ▨ NO RECOVERY ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁘ GRAVEL ▥ SLOUGH ⁙ GROUT ▨ CUTTINGS ⁘ SAND



SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	ELEVATION (m)
SILT and GRAVEL - light brown, moist, soft, fine to coarse grained gravel (fill).	■	01		236
	■	02	Sample MW24-03-02 submitted for analysis of BTEX F1-F4, VOCs, PAHs, metals	
SAND and SILT - dark brown, moist, compact, fine to coarse sand.				
	■	03	Sample MW24-03-03 submitted for analysis of BTEX F1-F4, VOCs, PAHs, metals	235
SILT - some sand, light brown, wet, soft, medium plasticity, fine to coarse sand.	■	04	Sample MW24-03-04 submitted for analysis of BTEX F1-F4, VOCs, PAHs, metals	
	■	05		234
CLAY - brown, moist, high plasticity.				
	■	06		233
	■	07		232
	■	08		231
END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY				230
				229



Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. DUP-08 is associated with MW24-03-02.
4. Groundwater measured at 2.34 meters below ground surface on March 5, 2024.

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-13
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-04**
LOCATION: 628256.5, 5532266		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 237.82

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁚ GRAVEL ▥ SLOUGH ⁘ GROUT ▨ CUTTINGS ⁚ SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	SILT - some gravel, trace clay, brown, moist, firm, coarse grained gravel, debris (plastic, wood, cloth, glass).	01			
		02		Sample MW24-04-02 submitted for analysis of metals.	237
1		03			
	CLAY - some silt, trace gravel, brown, moist, firm, medium plasticity, debris (wood material).	04			236
2	SILT - some sand, black, moist, stiff, medium plasticity, fine to coarse grained sand, organic odour.	05		Sample MW24-04-05 submitted for analysis of dioxins and furans, and metals.	235
3	CLAY - trace of silt, brown, moist, firm, medium plasticity.	06		Sample MW24-04-06 submitted for analysis of metals.	234
4		07			233
5		08			232
6	END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY				231
7					230
8					

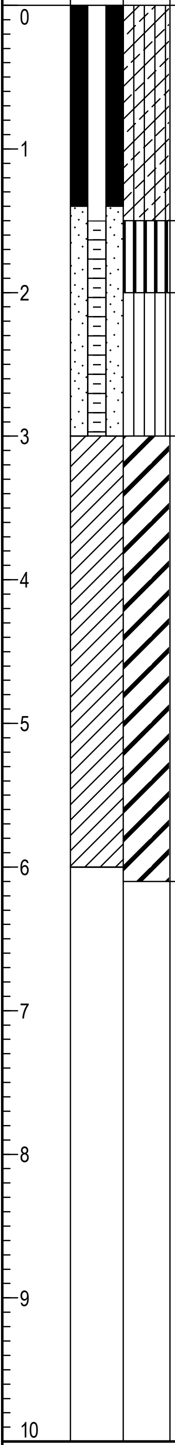
Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. Groundwater measured at 2.45 meters below ground surface on March 5, 2024.

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-05**
LOCATION: 627992.6, 5532503		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 238.78

SAMPLE TYPE	■ GRAB	▥ SHELBY TUBE	☒ SPLIT SPOON	☰ BULK	▨ NO RECOVERY	▮ CORE
BACKFILL TYPE	■ BENTONITE	⁚ GRAVEL	▥ SLOUGH	⁙ GROUT	▨ CUTTINGS	⁚ SAND

DEPTH (m) | WELL INSTALLATION | SOIL SYMBOL



SOIL DESCRIPTION

SILT and CLAY - some gravel, dark brown, moist, stiff, medium plasticity, fine to coarse grained gravel.

SILT - some clay, brown, moist, firm, medium plasticity.

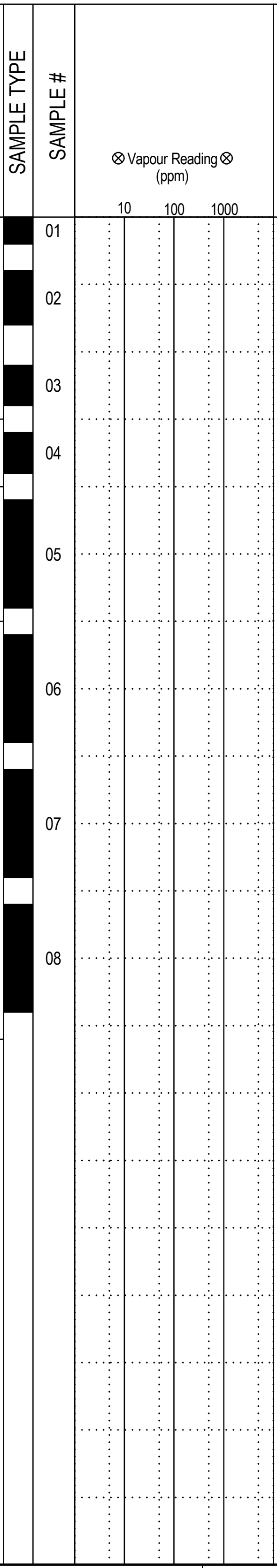
SILT and SAND - some gravel, brown and orange, moist, firm, fine to coarse sand, fine grained gravel, debris (glass).

CLAY - trace of silt, brown, moist, stiff, high plasticity.

END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. DUP-10 associated with MW24-05-05.
4. Groundwater measured on March 5, 2024 and well was dry.

SAMPLE TYPE | SAMPLE # | ⊗ Vapour Reading ⊗ (ppm)



SAMPLE #	COMMENTS
01	
02	
03	Sample MW24-05-03 submitted for analysis of metals.
04	
05	Sample MW24-05-05 submitted for analysis of metals.
06	
07	Sample MW24-05-06 submitted for analysis of metals, SAR, EC, pH.
08	

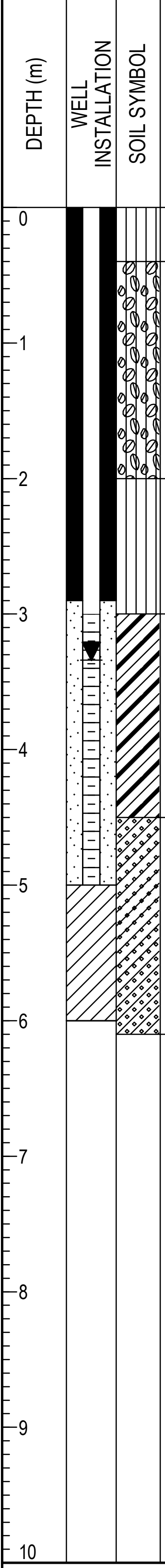
ELEVATION (m): 238, 237, 236, 235, 234, 233, 232, 231, 230, 229

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **MW24-06**
LOCATION: 627937.1, 5532383		PROJECT NO.: 60721079
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Solid Stem Auger	ELEVATION (m): 239.04

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◩ NO RECOVERY ▌ CORE

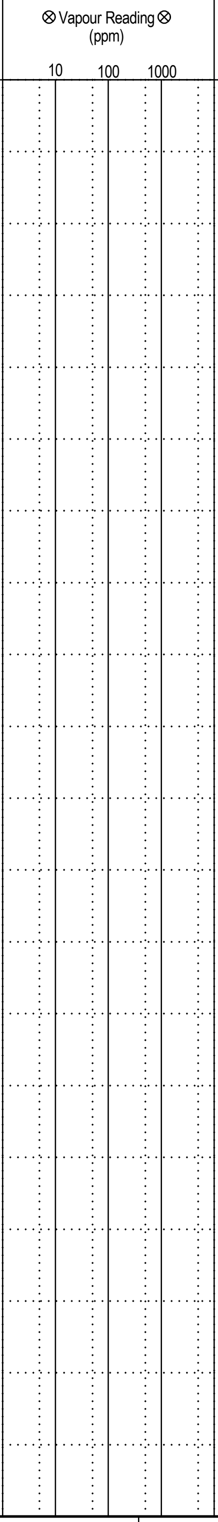
BACKFILL TYPE ■ BENTONITE ⁘ GRAVEL ▥ SLOUGH ▩ GROUT ▨ CUTTINGS ⁘ SAND

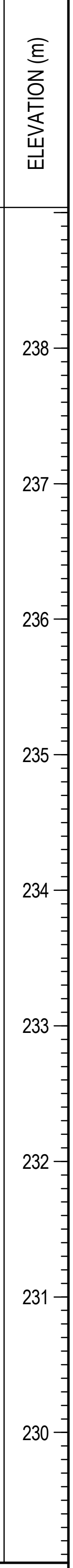


SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
SILT - some clay, some sand, trace gravels, light brown, moist, stiff, fine to coarse sand.	■	01	
SAND and SILT - light brown, moist, loose, fine sand.	■ ■ ■	02 03 04	Sample MW24-06-03 submitted for analysis of dioxins and furans, metals, SAR, EC, pH.
SILT - some clay, some sand, trace gravels, dark brown, moist, stiff, low plasticity, fine sand.	■	05	Sample MW24-06-05 submitted for analysis of metals.
CLAY - some silt, dark brown, moist, stiff, medium plasticity.	■	06	Sample MW24-06-06 submitted for analysis of metals.
CLAY and SAND - light brown, light brown, wet, firm, medium plasticity, fine to coarse grained sand.	■ ■	07 08	

END OF MONITORING WELL @ 6.1 M BELOW GROUND SURFACE IN CLAY

Notes:
1. Soil description is primarily based on visual observation.
2. Monitoring well backfilled with backfilled drill cuttings, sand, and bentonite upon completion.
3. Groundwater measured at 3.34 meters below ground surface on March 5, 2024.



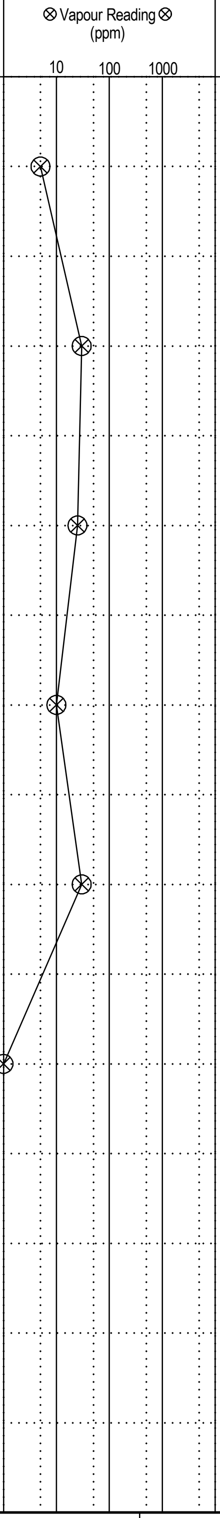


LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-12
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-01**
LOCATION: 628195.4907 5532545.493		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ◨ CORE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
0	SAND and GRAVEL (fill) - dark brown, moist, loose, fine sand, fine to coarse grained gravel.	■	01	
1	CLAY and SILT - grey, moist, soft, medium plasticity, debris (metal pipes), slight hydrocarbon odour.	■	02	Sample TP24-01-02 submitted for analysis of BTEX F1-F4, PAHs
2		■	03	Sample TP24-01-03 submitted for analysis of BTEX F1-F4, PAHs
3	CLAY - brown, moist, firm, medium plasticity.	■	04	
4		■	05	Sample TP24-01-05 submitted for analysis of BTEX F1-F4, PAHs
5		■	06	
6	END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY			
7				
8				



Notes:
1. Soil description is primarily based on visual observation.
2. Borehole backfilled with excavated material upon completion.
3. DUP-02 is associated with sample TP24-01-03.

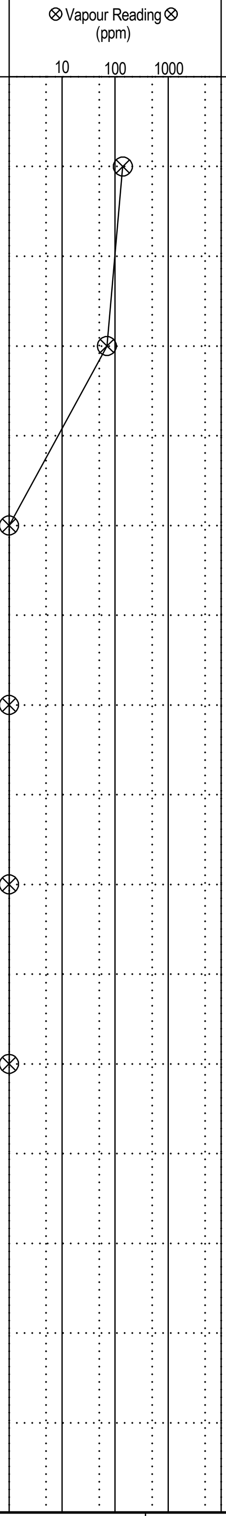
AECOM

LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-2-1
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **TP24-02**
LOCATION: 628200.6999 5532545.57
PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.
METHOD: Excavator
ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▌ CORE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
0	SAND and GRAVEL - some clay, brown/black, moist, loose, fine to coarse grained sand, fine to coarse grained gravel, hydrocarbon odour.	■	01	Sample TP24-02-01 submitted for analysis of BTEX F1-F4, PAHs
1	CLAY and SILT - grey, moist, soft, medium plasticity, debris (metal pipes), hydrocarbon odour.	■	03	Sample TP24-02-02 submitted for analysis of BTEX F1-F4, PAHs
2	CLAY - brown, moist, firm, medium plasticity.	■ ■ ■ ■	05 06 02 04	 Sample TP24-02-04 submitted for analysis of BTEX F1-F4, PAHs
6.1	END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY			



Notes:
1. Soil description is primarily based on visual observation.
2. Borehole backfilled with excavated material upon completion.

LOGGED BY: Jonathan Ota
REVIEWED BY: Jen Murray
PROJECT ENGINEER: Kimber Osiowy
COMPLETION DEPTH: 6.10 m
COMPLETION DATE: 24-2-1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-03**
LOCATION: 627931.0651 5532443.414		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▥	CLAY and SILT - some sand and gravel, light brown, moist, soft, medium plasticity, fine to coarse sand, fine to coarse grained gravel.	■	01			
	▨	CLAY - some silt, trace gravels, brown, moist, stiff, medium plasticity, fine grained gravels.	■	02			
1	▨						1
	▨	- black, low plasticity below 1.3 m	■	03		Sample TP24-03-03 submitted for analysis of metals	
2	▨						2
	▨	- brown below 2.5 m	■	04			
3	▨						3
	▨	- light brown, stiff, medium plasticity below 3.5 m	■	05			
4	▨						4
	▨	- trace cobbles, high plasticity below 4.5 m.	■	06			
5	▨						5
	▨		■	07		Sample TP24-03-07 submitted for analysis of metals	
		END OF TESTPIT @ 5.5 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material upon completion.					
6							6
7							7
8							

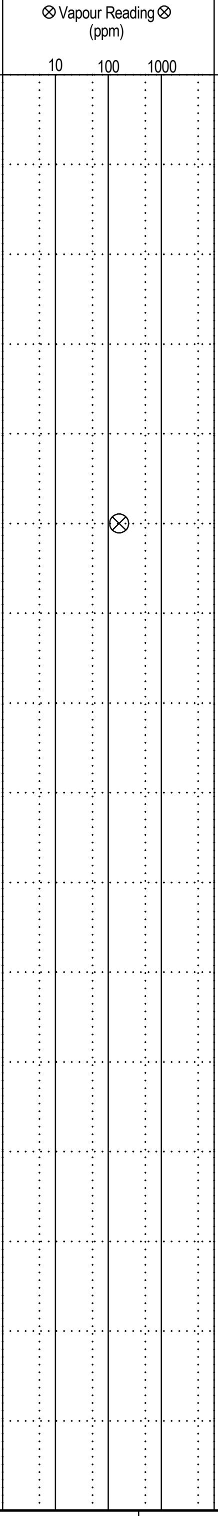
AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-30
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

ENVIRONMENTAL (VAPOUR ONLY) 60721079 TESTPIT LOGS.GPJ UMA.GDT 24-3-26

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-04**
LOCATION: 627970.2185 5532468.144		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS
0	CLAY and SILT - some sand and gravel, light brown, moist, firm, medium plasticity, fine to coarse sand, fine to coarse grained gravel.	■	01	
	CLAY - trace gravels, light brown, moist,stiff, medium plasticity, fine grained gravels, debris (wood and metal).	■	02	
1	- black, low plasticity below 1.5 m	■	03	
2	- grey, debris (glass bottles, ceramics, cobble, wood), slight hydrocarbon odour below 2.5 m	■	04	Sample TP24-04-04 submitted for analysis of BTEX F1-F4, PAHs and metals
3		■	05	
4		■	06	
5	CLAY - light brown, wet, stiff, high plasticity	■	07	Sample TP24-04-07 submitted for analysis of metals
6	END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material upon completion.			
7				
8				



AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-30
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-05**
LOCATION: 628082.8757 5532465.868		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ◨ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▥	CLAY - some silt, some gravel, light brown, moist, soft, non-plastic, fine grained gravel.	■	01			
			■	02			
1	▨	CLAY - trace gravel, brown, moist, stiff, medium plasticity, fine grained gravels, debris (wood, roots), organics.	■	03			1
2		- dark brown, wet, soft, debris (metal, wood, concrete) below 2 m.	■	04			2
3		ORGANICS - some clay, black, wet, soft, debris (glass, plastic, tires, metal, bricks).	■	05		Sample TP24-05-05 submitted for analysis of metals	3
4		END OF TESTPIT @ 4.1 M BELOW GROUND SURFACE IN ORGANICS Notes: 1. Soil description is primarily based on visual observation. 2. Groundwater encountered at 2.5 m bgs. 3. Borehole backfilled with excavated material upon completion.					4
5							5
6							6
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 5.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-06**
LOCATION: 627995.2033 5532400.078		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◪ NO RECOVERY ▮ CORE

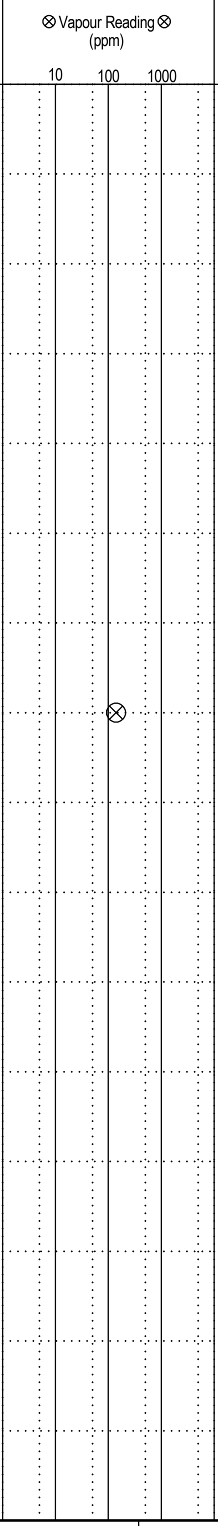
DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, brown, moist, stiff, medium plasticity.	■	01			
	▨	- some fine gravel, light brown, below 0.6 m.	■	02			
1	▨	- brown/black, debris (bricks, glass, wood, ceramics, metal) below 1 m.					1
	▨		■	03			
2	▨						2
	▨		■	04			
3	▨	CLAY - light brown, moist, stiff, high plasticity.					3
	▨		■	05			
4	▨						4
	▨		■	06		Sample TP24-06-06 submitted for analysis of SAR, EC, pH, and metals	
5	▨	- brown, wet, soft below 5 m.					5
	▨		■	07			
6	▨						6
		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY. Notes: 1. Soil description is primarily based on visual observation. 2. Groundwater encountered at 5.0 m bgs. 3. Borehole backfilled with excavated material upon completion.					
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-30
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-07**
LOCATION: 627980.2203 5532425.771		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◺ NO RECOVERY ▌ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, some gravel, brown, moist, stiff, medium plasticity, fine grained gravel.	■	01		
	▨		■	02		
1	▨	- dark brown, debris (wood, glass) below 1 m.				1
	▨		■	03		
2	▨					2
	▨		■	04		
3	▨	- black/grey, wet, low plasticity, debris (metal, plastic, glass, cables, wood), slight hydrocarbon smell below 3 m.				3
	▨		■	05		
4	▨					4
	▨		■	06		
5	▨	CLAY - grey, moist, stiff, high plasticity.				5
	▨		■	07	Sample TP24-07-05 submitted for analysis of metals	
6	▨					6
		END OF TESTPIT @ 6.1 M IN BELOW GROUND SURFACE CLAY. Notes: 1. Soil description is primarily based on visual observation. 2. Groundwater encountered at 3.5 m bgs. 3. Borehole backfilled with bentonite upon completion.				
7						7
8						



LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

AECOM

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-08**
LOCATION: 628069.4647 5532409.132		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS
0	▨	CLAY and GRAVEL - some silt, light brown, moist, soft, low plasticity, fine to coarse grained gravel.	■	01		
			■	02		
			■	03		Sample TP24-08-03 submitted for analysis of Dioxins/Furans and metals
2	▨	CLAY - trace gravel, dark brown, moist, stiff, medium plasticity, fine grained gravel.	■	04		
3		- wet, stiff, debris (tree material, wood, metal, tires, plastic, rebar) below 3 m.	■	05		
			■	06		Sample TP24-08-06 submitted for analysis of metals
5.5		END OF TESTPIT @ 5.5 M BELOW GROUND SURFACE IN CLAY.	■	07		

Notes:
1. Soil description is primarily based on visual observation.
2. Groundwater encountered at 5.5 m bgs.
3. Sloughing noted at 5.5 m bgs.
4. Borehole backfilled with excavation materials upon completion.

LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-09**
LOCATION: 628025.0115 5532416.703		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◩ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, some sand, some gravel, light brown, moist, soft, non-plastic, fine grained gravel.	■	01			
	▨		■	02			
1	▨	- some fine gravel, dark brown/orange, moist, soft, low plasticity, debris (glass, roots, ceramics) below 1m.					1
	▨		■	03			
2	▨	- brown, stiff, medium plasticity, debris (wood, cobble, glass) below 2 m.					2
	▨		■	04			
3	▨						3
	▨		■	05			
4	▨						4
	▨		■	06			
5	▨	CLAY - light brown and grey, moist, firm, medium plasticity.					5
	▨		■	07		Sample TP24-09-07 submitted for analysis of metals	
6		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material upon completion.					6
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-10**
LOCATION: 628032.7363 5532348.058		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◿ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▥	SILT and CLAY - brown, moist, stiff, medium plasticity.	■	01			
	▨	CLAY - trace gravel, dark brown, moist, stiff, medium plasticity, fine gravel, debris (tree roots and wood).	■	02			
1		- black, low plasticity, below 1 m.	■	03			1
2			■	04			2
3		- brown and no gravel below 3 m.	■	05			3
4			■	06			4
5	▨	CLAY - grey, moist, stiff, high plasticity.	■	07		Sample TP24-10-07 submitted for analysis of metals	5
6		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material upon completion.					6
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-11**
LOCATION: 628003.0269 5532472.907		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ⧄ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, light brown, moist, stiff, medium plasticity.	■	01			
	▨	- dark brown, debris (tires, concrete, metal, glass, wood) below 0.5 m.	■	02			
1	▨						1
	▨		■	03			
2	▨						2
	▨		■	04			
3	▨						3
	▨		■	05			
4	▨						4
	▨		■	06			
5	▨	CLAY - brown, moist, stiff, high plasticity.					5
	▨		■	07		Sample TP24-11-07 submitted for analysis of metals.	
6		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY. Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated material upon completion.					6
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-30
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage	CLIENT: City of Winnipeg	TESTHOLE NO: **TP24-12**
LOCATION: 628012.9499 5532442.059		PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.	METHOD: Excavator	ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ◸ NO RECOVERY ▮ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, some gravel, light brown, moist, stiff, medium plasticity, fine to coarse gravel.	■	01			
	▨	- trace fine to coarse gravels, brown below 0.5 m	■	02			
1	▨						1
	▨		■	03			
2	▨	- some fine to coarse gravel, dark brown/orange, soft, low plasticityl, debris (metal, wood, glass, ceramic, bricks) below 2 m.					2
	▨		■	04		Sample TP24-12-04 submitted for analysis of metals	
3	▨	- trace fine gravels, light brown, stiff, debris (wood, metal, glass) below 3 m.					3
	▨		■	05			
4	▨						4
	▨		■	06			
5	▨	CLAY - light brown, moist, firm, high plasticity.					5
	▨		■	07		Sample TP-24-12-07 submitted for analysis of SAR, EC, pH, and metals	
6	▨						6
		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY. Notes: 1. Soil description is primarily based on visual observation. 2. Borehole backfilled with excavated materials upon completion. 3. DUP-01 is associated with TP24-12-07.					
7							7
8							

AECOM	LOGGED BY: Jonathan Ota	COMPLETION DEPTH: 6.10 m
	REVIEWED BY: Jen Murray	COMPLETION DATE: 24-1-31
	PROJECT ENGINEER: Kimber Osiowy	Page 1 of 1

PROJECT: Winnipeg North Transit Garage
CLIENT: City of Winnipeg
TESTHOLE NO: **TP24-13**
LOCATION: 628086.3485 5532494.89
PROJECT NO.: 60721079
CONTRACTOR: KBL Projects Ltd.
METHOD: Excavator
ELEVATION (m):

SAMPLE TYPE ■ GRAB ▥ SHELBY TUBE ☒ SPLIT SPOON ☰ BULK ⧄ NO RECOVERY ◨ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0	▨	CLAY - some silt, some sand and gravel, light brown, moist, soft, non-plastic, fine to coarse sand, fine to coarse grained gravel.	■	01			
	▨		■	02			
1	▨		■	03			1
2	▨	- brown (some orange colouration) , moist, stiff, medium plasticity below 2 m.	■	04			2
3	▨		■	05			3
4	▨	- black, wet, debris (wood, metal, springs, plastic, glass) below 4 m.	■	06			4
5	▨		■	07		Sample TP24-13-07 submitted for analysis of metals	5
6		END OF TESTPIT @ 6.1 M BELOW GROUND SURFACE IN CLAY Notes: 1. Soil description is primarily based on visual observation. 2. Groundwater encountered at 3.0 m bgs. 3. Borehole backfilled with excavated material upon completion.					6
7							7
8							

AECOM

LOGGED BY: Jonathan Ota
REVIEWED BY: Jen Murray
PROJECT ENGINEER: Kimber Osiowy
COMPLETION DEPTH: 6.10 m
COMPLETION DATE: 24-1-31

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