

APPENDIX 'A'

GEOTECHNICAL REPORT



WSP of Canada Inc.

City of Winnipeg Industrial Streets Renewal

Prepared for:

Kelly Groff, P.Eng.

WSP of Canada Inc.

111-93 Lombard Avenue

Winnipeg, MB

R3B 3B1

Project Number: 1000-043-31

Date: January 30, 2026



January 30, 2026

Our File No. 1000-043-31

Kelly Groff, P.Eng.
WSP of Canada Inc.
1600 Buffalo Place
Winnipeg, MB
R3T 6B8

RE: City of Winnipeg Industrial Streets Renewal

TREK Engineering Inc. is pleased to submit our Final Report for the geotechnical investigation for City of Winnipeg Industrial Streets Renewals project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Engineering Inc.
Per:

A handwritten signature in blue ink, appearing to read "N. Ferreira", is written over the typed name.


Nelson John Ferreira, Ph.D., P.Eng., FEC
Senior Geotechnical Engineer

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	KF	January 30, 2026	Final Report

Authorization Signatures

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Kate Franklin M.Sc. (Geotechnical Engineering)
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Senior Geotechnical Engineer



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1.0 Introduction

This report summarizes the results of the road investigation completed for the City of Winnipeg Industrial Streets Renewals project. The project included drilling test holes and collecting pavement cores along several streets. The test hole information collected describes the pavement structure of the existing road as well as the soil stratigraphy beneath the pavement structure. The investigation was carried out following the City of Winnipeg RFP No. 751-2023 (Section E3 – Site Investigation Requirements).

2.0 Road Investigation

The investigation included coring of pavement at 24 locations on 9 different streets with drilling of test holes occurring at 10 locations along 4 streets. The investigation locations are shown on Figures 01 to 03 (attached) and the table below summarizes the investigation program per street.

Table 1: Road Investigation Program

City of Winnipeg Industrial Streets	# of Locations	Investigation
Austin St. – Higgins Ave to Henry Ave	3	3 Test Holes to 3.0m
Martha St. – Austin St. to Logan Ave	3	3 Test Holes to 3.0m
Bushnell St. – Logan Ave to Alexander Ave	2	2 Test Holes to 3.0m
McDermot/Adelaide Alley – Princess St. to Notre Dame Ave	2	2 Test Holes to 3.0m
Harriet St. – Bannatyne Ave to McDermot Ave	2	2 Cores
Harriet St. – McDermot Ave to Notre Dame Ave	3	3 Cores
Gunnell St – Henry Ave to Logan Ave	3	3 Cores
Henry Ave – Sherbrooke St. to Gunnell St.	3	3 Cores
Sherbrooke St. – Logan Ave to Henry Ave	3	3 Cores

The road investigation was conducted between December 11, 2025 to December 19, 2025. The pavement structure (asphalt/concrete) was cored by Tyler Green of TREK Engineering Inc. (TREK) using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bit. The test holes were drilled by Maple Leaf Drilling to a depth of approximately 3.0 m below road surface using a truck mounted drill rig equipped with 125 mm diameter solid stem augers. The sub-surface conditions were observed during drilling and visually classified by Kate Franklin of TREK. Other pertinent

information, such as groundwater and drilling conditions, was also recorded during the drilling investigation. Disturbed (auger cuttings) samples and bulk samples retrieved during the sub-surface investigation were transported to TREK’s material testing laboratory for further testing. Pavement core samples were also retrieved and logged at TREK’s material testing laboratory.

Core and test hole logs noted on the summary tables and test hole locations are based on UTM coordinates obtained using a hand-held GPS, and their location relative to the nearest address or intersection, measured distance from the edge of pavement, or other permanent features.

The laboratory testing program consisted of moisture content determination on all samples, as well as Atterberg Limits, and grain size analysis (mechanical sieve and hydrometer methods) on select samples between 0.6 and 0.9 m below pavement as well as Standard Proctor and CBR testing. Information gathered for each street package is included in separate appendices (Appendices A to D). The information provided in the Appendices includes test hole logs, laboratory testing summary tables and results, photos of the concrete cores, and summary of pavement core compressive strength.

Five CBR’s were completed on bulk samples of the soil units present below the pavement. Tests were performed on clay and silt layers encountered within the prescribed sample depth for CBR testing and the results are shown in the table below.

Table 2: CBR Testing Summary

Soil Unit	Street	Depth (m)	SPMDD (kg/m ³)	Opt. Moisture (%)	Percent Proctor (%)	Moisture Content (%)	CBR Value at 2.54 mm	CBR Value at 5.08 mm
Clay	Austin St: TH25-05, TH25-06 & TH25-07 Combined	0.8 - 2.0	1401	28.8	95.4	29.2	1.1%	1.0%
Clay	Martha St: TH25-08 & TH25-09 Combined	0.8 – 1.2 0.8 – 1.5	1459	28.5	95.1	28.2	2.3%	1.8%
Silt	Martha St: TH25-08 & TH25-09 Combined	1.2 – 2.0 1.5 – 2.0	1856	13.9	95.1	13.8	4.3%	4.5%
Clay	Bushnell St: TH25-03 & TH25-04 Combined	1.6 - 2.0 1.5 - 2.0	1392	29.9	95.4	29.3	1.5%	1.3%
Clay	McDermot/Adelaide Alley: TH25-02	1.5 - 2.0	1359	30.3	95.6	30.9	1.5%	1.1%

The test hole logs include a description of the soil units encountered during drilling and other pertinent information such as groundwater conditions and a summary of the laboratory testing results. The soils were classified in general accordance with the Unified Soil Classification System (USCS) and the AASHTO soil classification system (American Association of state highway and transportation

officials). The AASHTO system classifies soils based on laboratory testing results from Atterberg Limits and grain size testing methods (hydrometer and mechanical sieve method). Where laboratory testing was not conducted, the AASHTO classification of the soils were interpreted based on a visual assessment as indicated with a (I) on the test hole logs and attached tables. For cohesive soils, the AASHTO system uses a combination of testing results to determine the Group Index of the soils and thus, were only determined where sufficient laboratory test data was available.

Ten concrete cores were selected for concrete compressive strength breaks and the length to diameter ratio ranged between 1.19 to 1.52 for the cores collected.

The core compressive strength tests were tested in accordance with CSA A23.2-14C – wet dried condition. The measured compressive strengths were also corrected based on an adapted ACI 214.4R-03 Standard to estimate the in-place concrete strengths. The table below summarizes the compressive strength results while the compressive strength testing details and the correction factor methodology are included in Appendix E through I.

Table 3: Concrete Core Compressive Strength Results

Core ID (Location)	Uncorrected Compressive Strength (MPa)	Corrected Compressive Strength (MPa)
PC25-20 (Harriet St.)	56.34	61.15
PC25-21 (Harriet St.)	51.04	55.69
PC25-22 (Harriet St.)	62.21	66.79
PC25-23 (Harriet St.)	67.86	73.11
PC25-11 (Gunnell St.)	52.40	61.95
PC25-13 (Gunnell St.)	65.63	71.25
PC25-17 (Henry Ave)	50.26	54.24
PC25-15 (Sherbrooke Ave)	37.84	44.12
PC25-18 (Sherbrooke Ave)	51.59	57.14
PC25-19 (Sherbrooke Ave)	53.27	58.19

3.0 Closure

The 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, laboratory testing, geometries). Soil conditions are natural deposits that can be highly

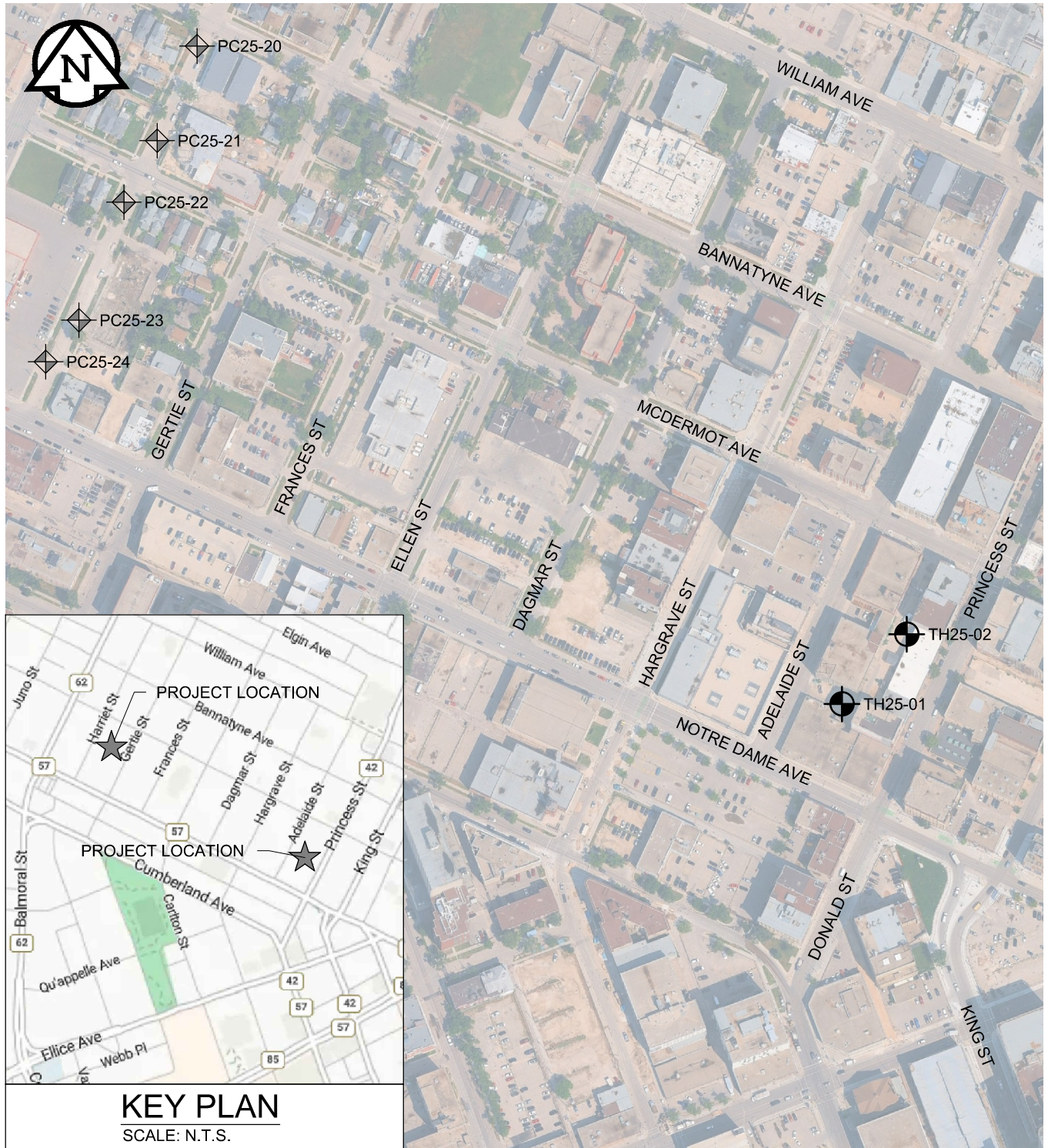
variable across a site. If sub-surface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

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 a mutually executed 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 Engineering Inc. (the Consultant) for the exclusive use of WSP of Canada Inc. (the Client) 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

Z:\Projects\1000 Soils Lab\1000-043 WSP\1000-043-31 City of Winnipeg Industrial Streets\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Figs 01 to 03 2026-01-26 COW Industrial Streets 0_A_1000-043-31.dwg, 2026-01-26 4:21:50 PM



LEGEND:

- TEST HOLE (TREK, 2025)
- PAVEMENT CORE (TREK, 2025)

NOTES:

1. AERIAL IMAGERY FROM GOOGLE EARTH (2024).
2. TEST HOLE AND PAVEMENT CORE LOCATIONS WERE RECORDED USING A HANDHELD GPS UNIT.

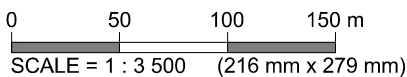


Figure 01
Test Hole and Pavement Core
Location Plan

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LEGEND:

- TEST HOLE (TREK, 2025)
- PAVEMENT CORE (TREK, 2025)

NOTES:

1. AERIAL IMAGERY FROM GOOGLE EARTH (2024).
2. TEST HOLE AND PAVEMENT CORE LOCATIONS WERE RECORDED USING A HANDHELD GPS UNIT.

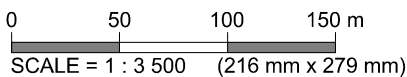
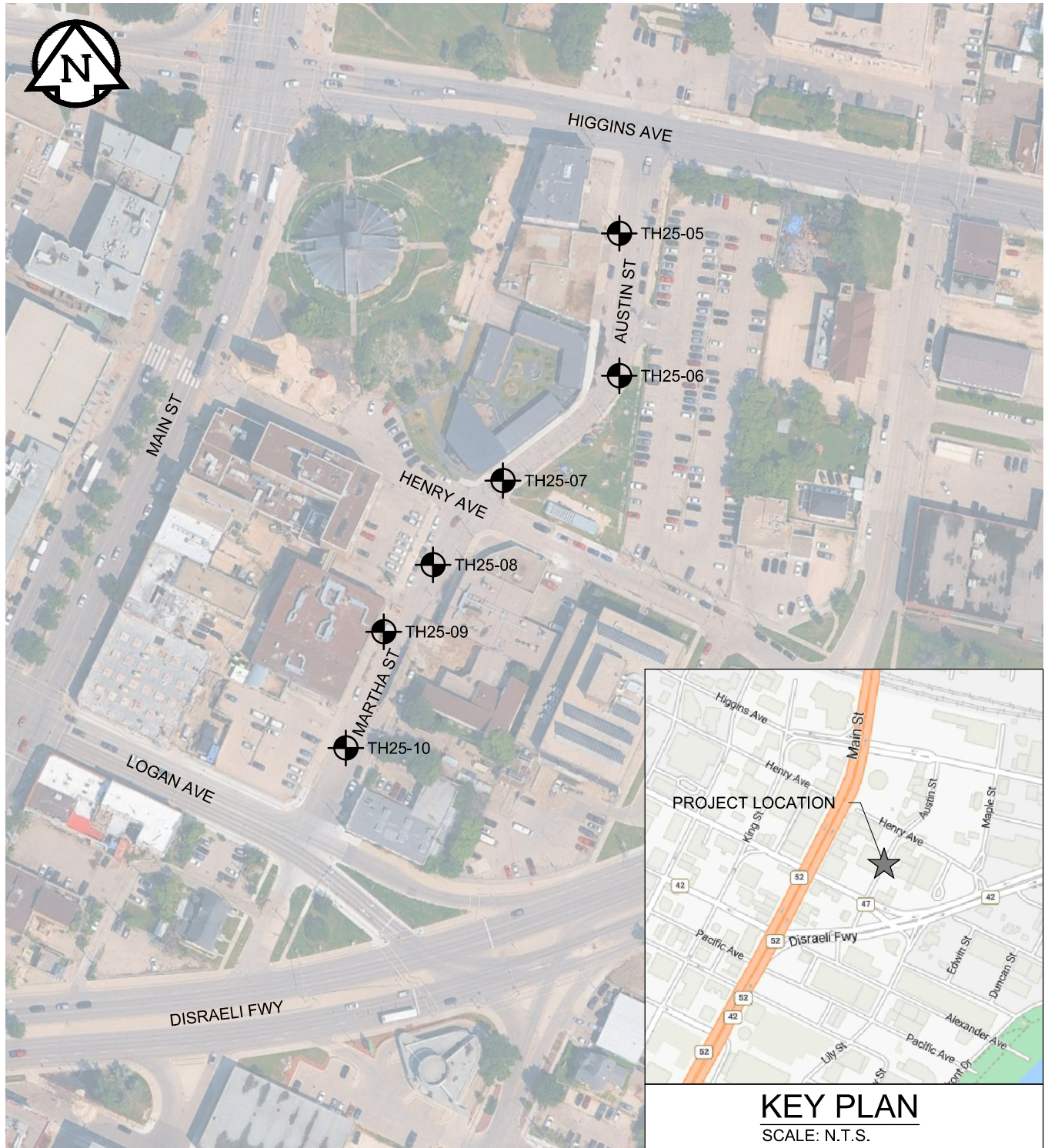


Figure 02
Test Hole and Pavement Core
Location Plan

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LEGEND:

TEST HOLE (TREK, 2025)

NOTES:

1. AERIAL IMAGERY FROM GOOGLE EARTH (2024).
2. TEST HOLE LOCATIONS WERE RECORDED USING A HANDHELD GPS UNIT.

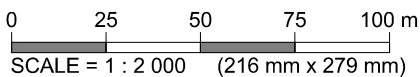


Figure 03
Test Hole Location Plan

Appendix A
Test Hole Logs, Summary Tables, Lab Testing Results and
Photographs of Pavement Core Samples
Austin St. – Higgins Ave to Henry Ave

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 634072 E 5529629 Austin St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)							
					16	17	18	19	20	21	0	50	100	150	200	250
0.0 - 0.1		ASPHALT (150mm thick)														
0.1 - 0.2		CONCRETE (140mm thick)														
0.2 - 0.7		CLAY - silty, trace sand - brown - frozen to 0.6m, moist, very stiff when thawed - high plasticity - AASHTO: A-7-6 (61)														
0.7 - 1.0			G35													
1.0 - 1.5			G36													
1.5 - 2.0			G37													
2.0 - 2.5			G38													
2.5 - 3.0		SILT - trace to some clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-6 (I)	G39													
3.0			G40													

END OF TEST HOLE AT 3.0m IN SILT.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B41 Clay) taken at 0.7m to 2.0m.

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 634072 E 5529580 Austin St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0 20 40 60 80 100						0 50 100 150 200250					
											△ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○					
		ASPHALT (30mm thick)														
		CONCRETE (210mm thick)														
0.5		SAND and GRAVEL (FILL) - <25mm diam. gravel, trace clay, trace silt - frozen, brown, moist, dense, when thawed - well graded, sub-rounded, "pit run" - AASHTO: A-1 (I)		G42												
1.0		CLAY - silty, trace sand - brown - frozen to 0.9m, moist, very stiff, when thawed - high plasticity - AASHTO: A-7-6 (60)		G43												
1.5		- stiff below 1.5m		G44												
2.0				G45												
2.5		- trace silt inclusions (<5mm diam.) below 2.0m		G46												
				G47												
				G48												

END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B49 Clay) taken at 0.7m to 2.0m.

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 634032 E 5529544 Austin St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 16, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.1		ASPHALT (30mm thick)														
0.1 - 0.2		CONCRETE (240mm thick)														
0.2 - 0.4		SAND and GRAVEL (FILL) - <25mm diam. gravel, trace clay, trace silt, frozen - brown, moist, dense when thawed, well graded, sub-rounded, "pit run", AASHTO: A-1 (I)														
0.4 - 1.5		CLAY - silty, trace sand - grey - frozen to 0.7m, moist, very stiff when thawed - high plasticity - AASHTO: A-7-6 (I)														
1.5 - 3.0		- greyish brown, stiff below 1.5m														
			G58													
			G59													
			G60													
			G61													
			G62													
			G63													

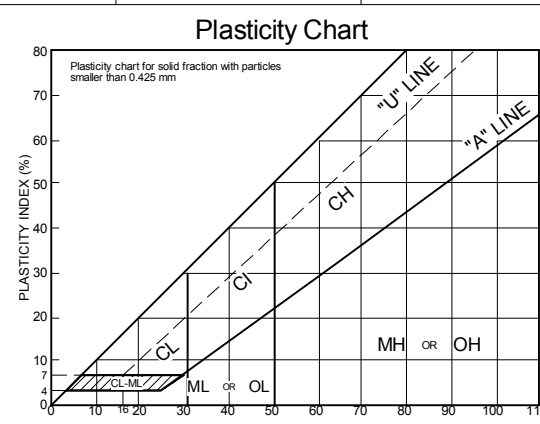
END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B64 Clay) taken at 0.7m to 2.0m.












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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size			
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)	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 cases 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	ASTM Sieve sizes #10 to #4 #40 to #10 #200 to #40 < #200			
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW				
		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 borderline 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	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075		
			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 borderline 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)		Sils 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		Particle Size ASTM Sieve Sizes mm > 300 75 to 300 19 to 75 4.75 to 19 3 in. to 12 in. 3/4 in. to 3 in. #4 to 3/4 in.
						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								
Sils and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts		Material Sand Coarse Medium Fine Silt or Clay					
	CH	Inorganic clays of high plasticity, fat clays							
	OH	Organic clays of medium to high plasticity, organic silts							
	Pt	Peat and other highly organic soils							
Highly Organic Soils				Von Post Classification Limit	Strong colour or odour, and often fibrous texture				

* 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

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	▽ Water Level at Time of Drilling
PL - Plastic Limit (%)	▼ Water Level at End of Drilling
PI - Plasticity Index (%)	▽ Water Level After Drilling as Indicated on Test Hole Logs
MC - Moisture Content (%)	
SPT - Standard Penetration Test	
RQD- Rock Quality Designation	
Qu - Unconfined Compression	
Su - Undrained Shear Strength	
VW - Vibrating Wire Piezometer	
SI - Slope Incliner	

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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



**City of Winnipeg Industrial Streets Renewal
Austin St. - Higgins Ave to Henry Ave
Sub-Surface Investigation**

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH25-05	Located at the North corner of #52 Austin St., Southbound median lane, 4.4 m East of West curb. UTM : 634072 m E 5529629 m N	Asphalt	150	Concrete	140	Clay, AASHTO: A-7-6 (61)	0.8	0.9	33	64	34	2	0	20	75	55
						Clay, AASHTO: A-7-6 (61)	1.1	1.2	34							
						Clay, AASHTO: A-7-6 (61)	1.4	1.5	32							
						Clay, AASHTO: A-7-6 (61)	1.8	1.9	37							
						Clay, AASHTO: A-7-6 (61)	2.1	2.3	34							
						Silt, AASHTO: A-6 (I)	2.6	2.7	23							
TH25-06	Located at #49 Austin St., Northbound curb lane, 1.7 m West of East curb UTM : 634072 m E 5529629 m N	Asphalt	30	Concrete	210	Sand and Gravel, AASHTO: A-1 (I)	0.5	0.6	9							
						Clay, AASHTO: A-7-6 (60)	0.8	0.9	26							
						Clay, AASHTO: A-7-6 (60)	1.1	1.2	30	67	30	3	0	20	75	55
						Clay, AASHTO: A-7-6 (60)	1.4	1.5	30							
						Clay, AASHTO: A-7-6 (60)	1.8	1.9	48							
						Clay, AASHTO: A-7-6 (60)	2.1	2.3	42							
TH25-07	Located 4.5 m North of Henry Ave, Northbound curb lane, 1.4 m West of East curb. UTM : 634032 m E 5529544 m N	Asphalt	30	Concrete	240	Clay, AASHTO: A-7-6 (I)	0.8	0.9	34							
						Clay, AASHTO: A-7-6 (I)	1.1	1.2	33							
						Clay, AASHTO: A-7-6 (I)	1.4	1.5	26							
						Clay, AASHTO: A-7-6 (I)	1.8	1.9	26							
						Clay, AASHTO: A-7-6 (I)	2.1	2.3	42							
						Clay, AASHTO: A-7-6 (I)	2.6	2.7	45							



Project No. 1000-043-01
Client WSP
Project City of Winnipeg Industrial Streets - Austin St

Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician K.Desikan

Test Hole	TH25-05	TH25-05	TH25-05	TH25-05	TH25-05	TH25-05
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G35	G36	G37	G38	G39	G40
Tare ID	E45	QT79	D218	E99	D249	B33
Mass of tare	6.8	8.2	6.8	7.0	6.8	6.9
Mass wet + tare	405.8	199.5	208.8	211.6	219.9	201.3
Mass dry + tare	307.2	150.8	160.4	156.6	166.2	164.6
Mass water	98.6	48.7	48.4	55.0	53.7	36.7
Mass dry soil	300.4	142.6	153.6	149.6	159.4	157.7
Moisture %	32.8%	34.2%	31.5%	36.8%	33.7%	23.3%

Test Hole	TH25-06	TH25-06	TH25-06	TH25-06	TH25-06	TH25-06
Depth (m)	0.5 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3
Sample #	G42	G43	G44	G45	G46	G47
Tare ID	QT7	E61	ZD17	W80	B10	QT41
Mass of tare	8.3	6.9	8.5	8.5	6.8	8.3
Mass wet + tare	210.5	206.2	405.5	197.2	212.4	209.1
Mass dry + tare	194.6	164.5	314.2	153.9	145.6	150.2
Mass water	15.9	41.7	91.3	43.3	66.8	58.9
Mass dry soil	186.3	157.6	305.7	145.4	138.8	141.9
Moisture %	8.5%	26.5%	29.9%	29.8%	48.1%	41.5%

Test Hole	TH25-06	TH25-07	TH25-07	TH25-07	TH25-07	TH25-07
Depth (m)	2.6 - 2.7	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3
Sample #	G48	G58	G59	G60	G61	G62
Tare ID	Z09	M70	Z02	QT22	AA10	E34
Mass of tare	8.6	7.0	7.0	8.3	6.8	6.9
Mass wet + tare	202.7	209.2	209.2	221.7	203.7	217.9
Mass dry + tare	136.9	161.8	164.9	172.3	146.9	152.3
Mass water	65.8	47.4	44.3	49.4	56.8	65.6
Mass dry soil	128.3	154.8	157.9	164.0	140.1	145.4
Moisture %	51.3%	30.6%	28.1%	30.1%	40.5%	45.1%



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Moisture Content Report ASTM D2216-98

Project No. 1000-043-01
Client WSP
Project City of Winnipeg Industrial Streets - Austin St

Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician K.Desikan

Test Hole	TH25-07					
Depth (m)	2.6 - 2.7					
Sample #	G63					
Tare ID	N16					
Mass of tare	8.7					
Mass wet + tare	210.3					
Mass dry + tare	141.4					
Mass water	68.9					
Mass dry soil	132.7					
Moisture %	51.9%					



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043.31
Client WSP
Project City of Winnipeg Industrial Streets

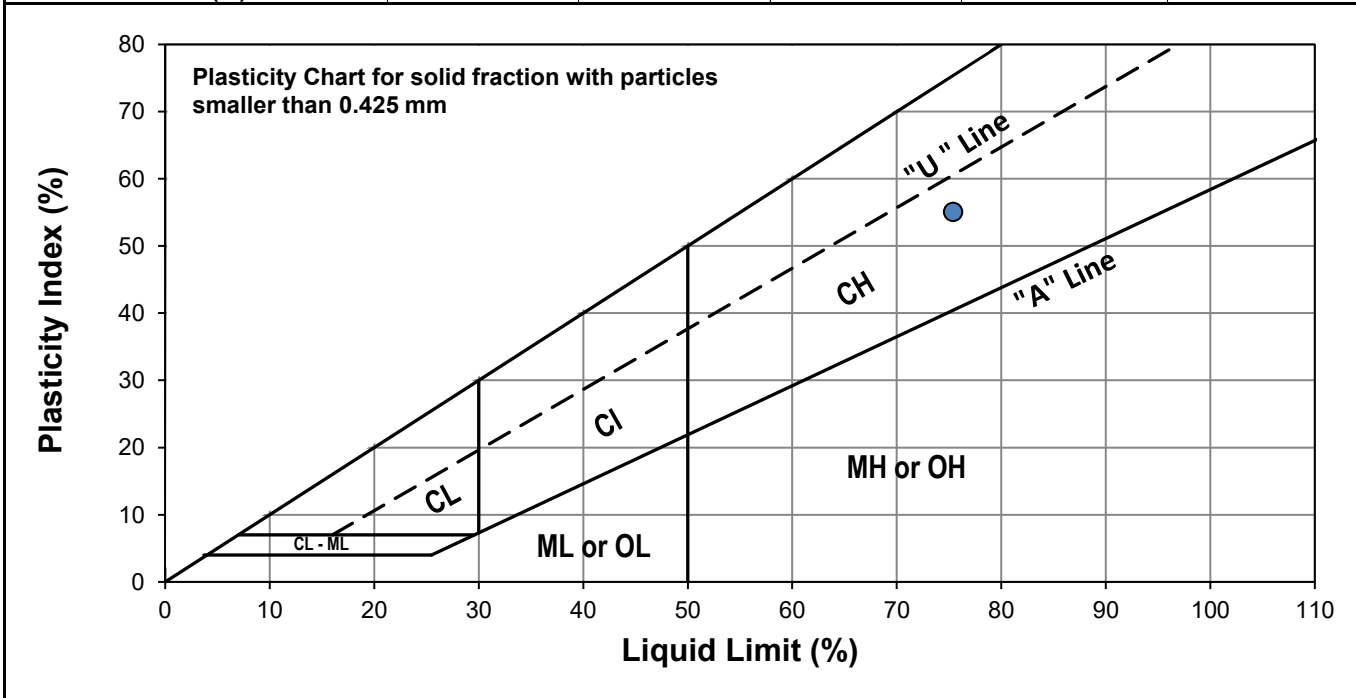


Test Hole TH25-05
Sample # G35
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 15-Jan-26
Technician A.Bhullar

Liquid Limit	75
Plastic Limit	20
Plasticity Index	55

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	16	23	35
Mass Tare (g)	14.202	13.529	14.060
Mass Wet Soil + Tare (g)	25.274	26.631	24.268
Mass Dry Soil + Tare (g)	20.353	20.960	20.000
Mass Water (g)	4.921	5.671	4.268
Mass Dry Soil (g)	6.151	7.431	5.940
Moisture Content (%)	80.003	76.315	71.852



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.217	14.024			
Mass Wet Soil + Tare (g)	21.631	21.687			
Mass Dry Soil + Tare (g)	20.404	20.369			
Mass Water (g)	1.227	1.318			
Mass Dry Soil (g)	6.187	6.345			
Moisture Content (%)	19.832	20.772			

Note: Additional information recorded/measured for this test is available upon request.



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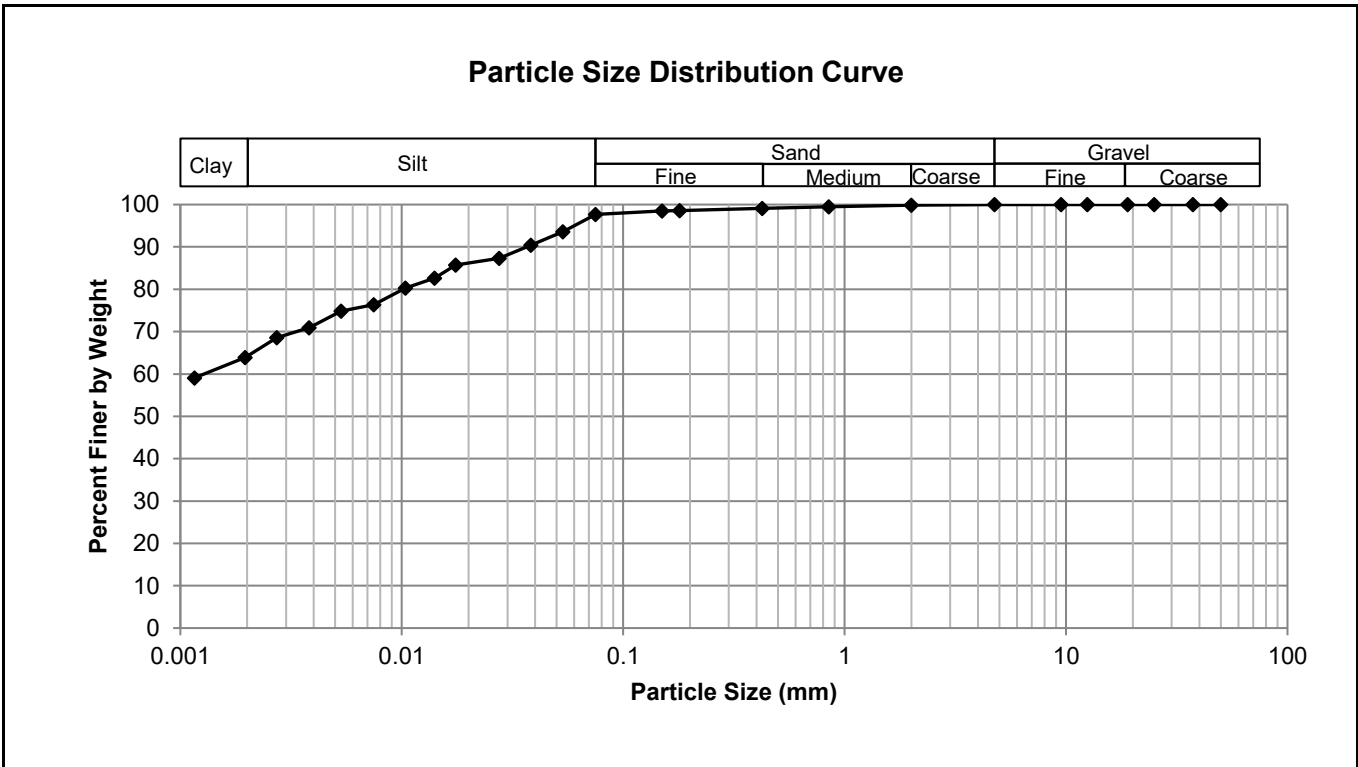
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-05
Sample # G35
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 07-Jan-26
Technician A.Dustmamatov

Gravel	0.0%
Sand	2.3%
Silt	33.6%
Clay	64.1%



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	97.67
37.5	100.00	2.00	99.90	0.0534	93.56
25.0	100.00	0.850	99.50	0.0383	90.44
19.0	100.00	0.425	99.10	0.0275	87.31
12.5	100.00	0.180	98.60	0.0175	85.75
9.50	100.00	0.150	98.48	0.0141	82.63
4.75	100.00	0.075	97.67	0.0104	80.29
				0.0075	76.38
				0.0053	74.82
				0.0038	70.92
				0.0027	68.61
				0.0020	63.89
				0.0012	59.09



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Street

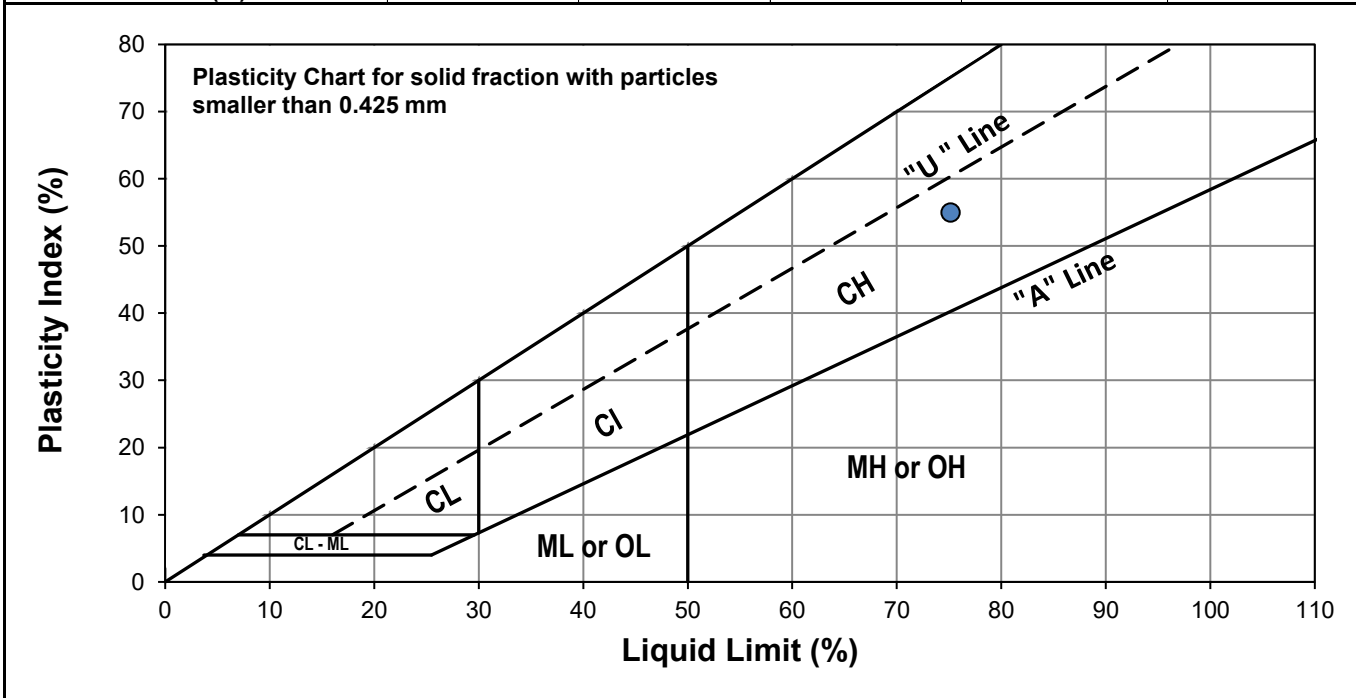


Test Hole TH25-06
Sample # G44
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 13-Jan-26
Technician K.Franklin

Liquid Limit	75
Plastic Limit	20
Plasticity Index	55

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	18	22	33
Mass Tare (g)	14.150	14.066	14.024
Mass Wet Soil + Tare (g)	25.446	25.314	25.038
Mass Dry Soil + Tare (g)	20.541	20.476	20.355
Mass Water (g)	4.905	4.838	4.683
Mass Dry Soil (g)	6.391	6.410	6.331
Moisture Content (%)	76.749	75.476	73.969



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.217	14.202			
Mass Wet Soil + Tare (g)	23.299	21.795			
Mass Dry Soil + Tare (g)	21.765	20.528			
Mass Water (g)	1.534	1.267			
Mass Dry Soil (g)	7.548	6.326			
Moisture Content (%)	20.323	20.028			

Note: Additional information recorded/measured for this test is available upon request.



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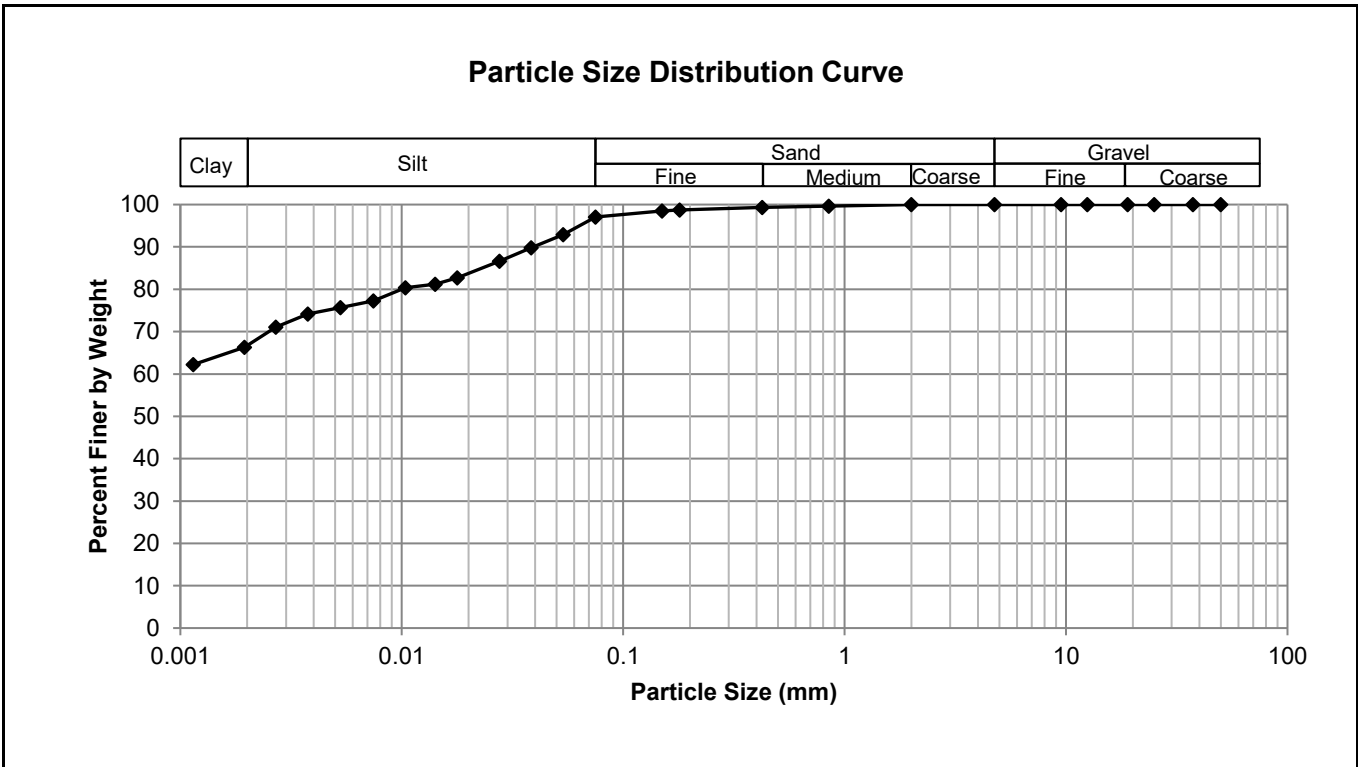
Grain Size Analysis (Hydrometer Method) AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-06
Sample # G44
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 07-Jan-26
Technician A.Dustmamatov

Gravel	0.0%
Sand	2.9%
Silt	30.4%
Clay	66.7%



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	97.06
37.5	100.00	2.00	100.00	0.0536	92.90
25.0	100.00	0.850	99.66	0.0385	89.78
19.0	100.00	0.425	99.30	0.0276	86.65
12.5	100.00	0.180	98.69	0.0178	82.74
9.50	100.00	0.150	98.52	0.0142	81.18
4.75	100.00	0.075	97.06	0.0104	80.40
				0.0074	77.27
				0.0053	75.71
				0.0038	74.14
				0.0027	71.08
				0.0019	66.33
				0.0011	62.23



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Standard Proctor Compaction Test ASTM D698-12e2

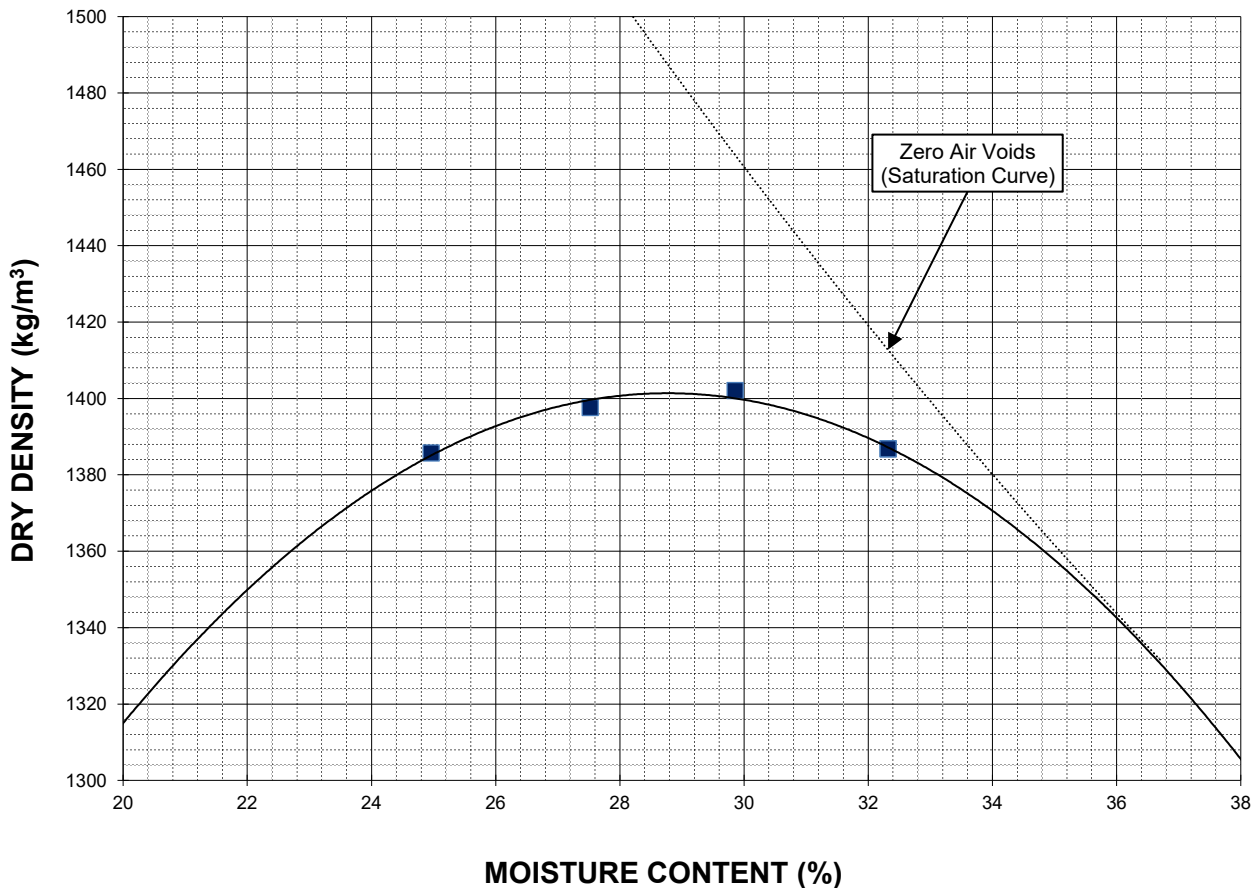
Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Sample # B41, B49 and B64 (combined)
Source TH25-05, 06 and TH25-07 (Austin St)
Material Clay
Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician A. Dustmamatov

Maximum Dry Density (kg/m³)	1401
Optimum Moisture (%)	28.8

Trial Number	1	2	3	4
Wet Density (kg/m³)	1732	1782	1821	1835
Dry Density (kg/m³)	1386	1398	1402	1387
Moisture Content (%)	25.0	27.5	29.9	32.3



Note: Additional information recorded/measured for this test is available upon request.



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California Bearing Ratio Test Data Sheet

ASTM D1883-21

Project No.	1000-043-31	Source	TH25-05, 06 and TH25-07 (Austin St)
Client	WSP	Material	Clay
Project	COW Industrial Streets	Sample Date	15-Dec-25
Sample #	B41, B49 and B64 (combined)	Test Date	12-Jan-26
		Technician	A. Dustmamatov

Proctor Results (ASTM D698)

Maximum Dry Density	1401 kg/m ³
Optimum Moisture Content	28.8 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1336 kg/m ³
Initial Moisture Content	29.2 %
Relative Density	95.4 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	8.1 %
Moisture Content in top 25 mm	51.0 %
Immersion Period	96 h

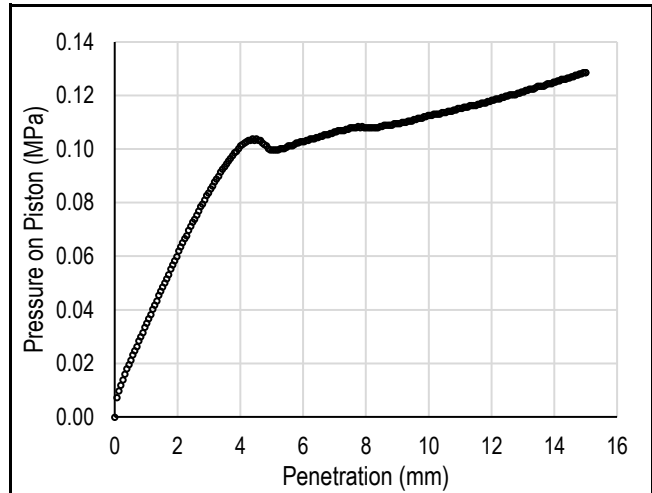
CBR Results

CBR at 2.54 mm	1.1 %
CBR at 5.08 mm	1.0 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.02	0.02
1.27	0.04	0.04
1.91	0.06	0.06
2.54	0.07	0.07
3.18	0.09	0.09
3.81	0.10	0.10
4.45	0.10	0.10
5.08	0.10	0.10
7.62	0.11	0.11
10.16	0.11	0.11
12.70	0.12	0.12

Load/Penetration Curve



Comments:



**City of Winnipeg Industrial Streets Renewal
Austin St. - Higgins Ave to Henry Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-05	UTM : 5529580 m N, 634072 m E; Located at #49 Austin St., Northbound curb lane, 1.7 m West of East curb.	Asphalt	30	Concrete	210	-
PC25-06	UTM : 5529629 m N, 634072 m E; Located at the North corner of #52 Austin St., Southbound median lane, 4.4 m East of West curb.	Asphalt	150	Concrete	140	-
PC25-09	UTM : 5529544 m N, 634032 m E; Located 4.5 m North of Henry Ave, Northbound curb lane, 1.4 m West of East curb.	Asphalt	30	Concrete	245	-



Photo 1: Pavement Core Sample at TH25-05



Photo 2: Pavement Core Sample at TH25-06



Photo 3: Pavement Core Sample at TH25-07

Appendix B
Test Hole Logs, Summary Table, Lab Testing Results and
Photographs of Pavement Core Samples
Martha St. – Austin St. to Logan Ave

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 634008 E 5529515 Martha St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.1		ASPHALT (120mm thick)														
0.1 - 0.2		CONCRETE (210mm thick)														
0.2 - 1.2		CLAY - silty, trace sand - grey - frozen to 0.6m, moist, very stiff when thawed - high plasticity - AASHTO: A-7-6 (63)		G50												
1.2 - 1.8		SILT - trace clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-6 (I)		G51												
1.8 - 2.0		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G52												
2.0 - 2.2				G53												
2.2 - 2.4				G54												
2.4 - 2.6				G55												
2.6 - 3.0																

END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B56 Silt and B57 Clay) taken at 1.2m to 1.8m, and 0.7 to 1.2 and 1.8m to 2.0m.

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 633991 E 5529492 Martha St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 19, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)	
					16	17	18	19	20	21		
					Particle Size (%)							
					0	20	40	60	80	100		
					PL MC LL 0 20 40 60 80 100							
					0 50 100 150 200 250							
0.0 - 0.1		ASPHALT (30mm thick)										
0.1 - 0.2		CONCRETE (245mm thick)										
0.2 - 1.5		CLAY - silty, trace sand - grey - frozen to 0.6m, moist, very stiff when thawed - high plasticity - AASHTO: A-7-6 (I)										
0.8			G73									
1.0			G74									
1.5			G75									
1.5 - 2.0		SILT - trace clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-6 (I)										
1.8			G76									
2.0 - 3.0		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)										
2.2			G77									
2.8			G78									

END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B80 Silt and B79 Clay) taken at 1.5m to 1.8m, and 0.7 to 1.5 and 1.8m to 2.0m.

Logged By: Tyler Green **Reviewed By:** _____ **Project Engineer:** Nelson Ferreira

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 633978 E 5529452 Martha St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 16, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)		Particle Size (%)		Undrained Shear Strength (kPa)	Test Type
					16	17	18	19		
0.0 - 0.05		ASPHALT (80mm thick)								
0.05 - 0.1		CONCRETE (170mm thick)								
0.1 - 0.7		CLAY - silty, trace sand - grey - frozen to 0.6m, moist, very stiff when thawed - high plasticity - AASHTO: A-7-6 (59)								
0.7 - 1.6		CLAY - with silt, trace sand - light brown - moist, soft - intermediate plasticity - AASHTO: A-6 (I)	G65							
1.6 - 2.0		CLAY - with silt, trace sand - light brown - moist, soft - intermediate plasticity - AASHTO: A-6 (I)	G66							
2.0 - 2.5		CLAY - with silt, trace sand - light brown - moist, soft - intermediate plasticity - AASHTO: A-6 (I)	G67							
2.5 - 3.0		CLAY - with silt, trace sand - light brown - moist, soft - intermediate plasticity - AASHTO: A-6 (I)	G68							
			G69							
			G70							

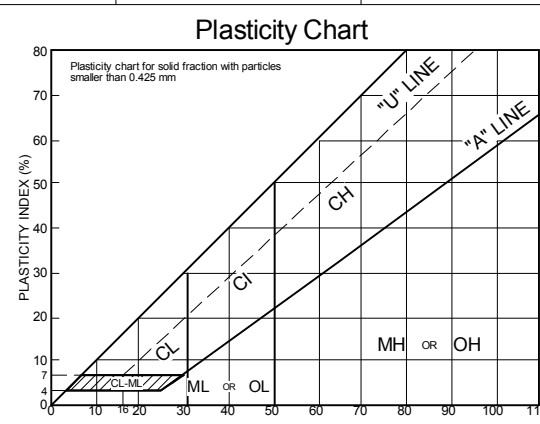
END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B71 Clay and B72 Silt) taken at 0.7m to 1.6m, and 1.6 to 2.0m.












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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size	Material				
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)	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 cases 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	ASTM Sieve sizes	Sand				
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW			#10 to #4			
		Sands (More than half of coarse fraction is smaller than 4.75 mm)	GM		Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	mm	Coarse Medium Fine		
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7				Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols	#40 to #10 #200 to #40
	Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Sands with fines (Appreciable amount of 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	mm	Silt or Clay		
			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 borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures					Atterberg limits above "A" line or P.I. greater than 7	
		Sils 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					Von Post Classification Limit	Strong colour or odour, and often fibrous texture
			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										
MH	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts										
Sils and Clays (Liquid limit greater than 50)	CH	Inorganic clays of high plasticity, fat clays	Boulders Cobbles Gravel Coarse Fine								
	OH	Organic clays of medium to high plasticity, organic silts									
Highly Organic Soils	Pt	Peat and other highly organic soils									

* 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

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 Incliner
- ▽ 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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



Project No. 1000-043-01
Client WSP
Project City of Winnipeg Industrial Streets - Martha St

Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician K.Desikan

Test Hole	TH25-08	TH25-08	TH25-08	TH25-08	TH25-08	TH25-08
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G50	G51	G52	G53	G54	G55
Tare ID	E05	E55	M20	D35	QW18	D29
Mass of tare	7.0	8.7	6.9	6.9	6.8	8.4
Mass wet + tare	202.4	405.1	214.1	203.7	200.0	218.3
Mass dry + tare	152.3	306.6	171.4	163.5	142.7	153.5
Mass water	50.1	98.5	42.7	40.2	57.3	64.8
Mass dry soil	145.3	297.9	164.5	156.6	135.9	145.1
Moisture %	34.5%	33.1%	26.0%	25.7%	42.2%	44.7%

Test Hole	TH25-09	TH25-09	TH25-09	TH25-09	TH25-09	TH25-09
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G73	G74	G75	G76	G77	G78
Tare ID	N48	D31	D211	AC25	D212	N112
Mass of tare	8.6	8.5	7.1	7.0	6.8	8.5
Mass wet + tare	204.4	201.6	221.4	207.5	212.4	213.2
Mass dry + tare	155.0	152.3	165.7	171.0	155.1	155.7
Mass water	49.4	49.3	55.7	36.5	57.3	57.5
Mass dry soil	146.4	143.8	158.6	164.0	148.3	147.2
Moisture %	33.7%	34.3%	35.1%	22.3%	38.6%	39.1%

Test Hole	TH25-10	TH25-10	TH25-10	TH25-10	TH25-10	TH25-10
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G65	G66	G67	G68	G69	G70
Tare ID	D232	D12	Z4	N23	W21	W01
Mass of tare	6.9	8.5	6.8	8.6	8.8	8.5
Mass wet + tare	411.9	207.1	206.0	208.2	216.1	202.5
Mass dry + tare	314.4	159.3	159.2	170.6	179.2	166.0
Mass water	97.5	47.8	46.8	37.6	36.9	36.5
Mass dry soil	307.5	150.8	152.4	162.0	170.4	157.5
Moisture %	31.7%	31.7%	30.7%	23.2%	21.7%	23.2%



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Street

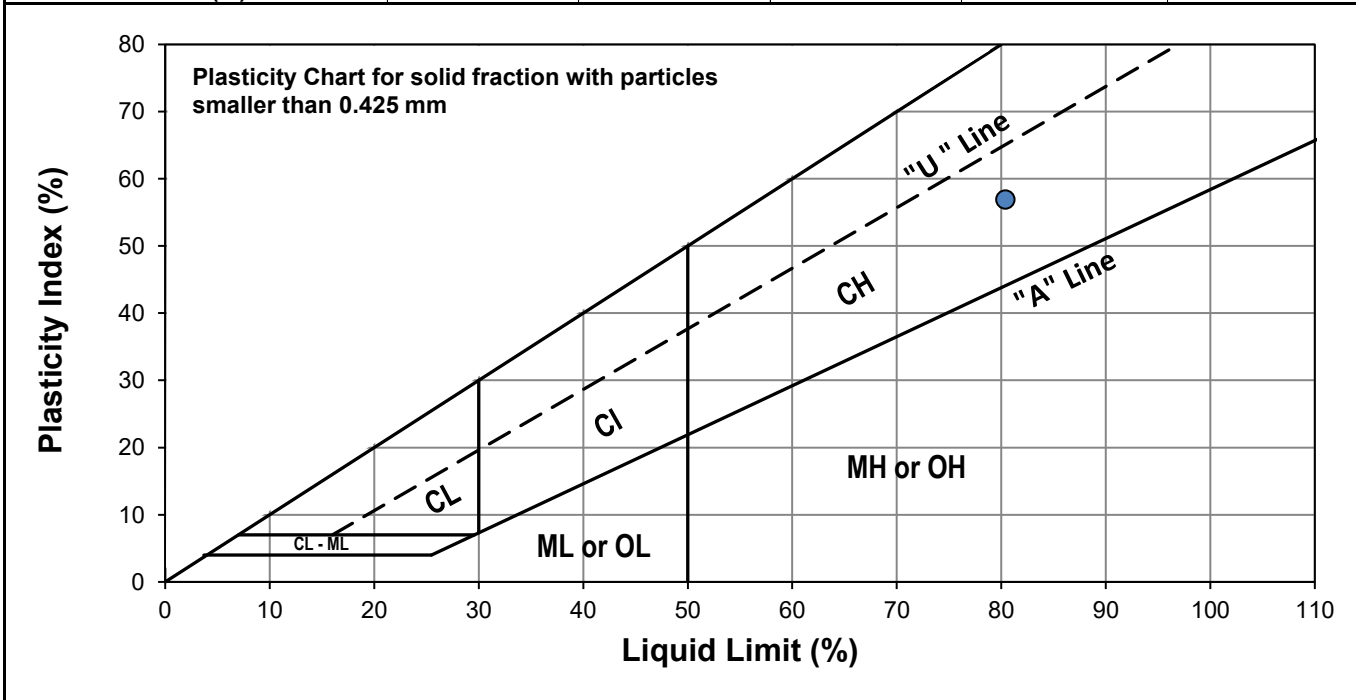


Test Hole TH25-08
Sample # G51
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 13-Jan-26
Technician K.Franklin

Liquid Limit	80
Plastic Limit	23
Plasticity Index	57

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	19	22	35
Mass Tare (g)	14.166	13.987	14.026
Mass Wet Soil + Tare (g)	25.066	24.469	24.341
Mass Dry Soil + Tare (g)	20.114	19.756	19.858
Mass Water (g)	4.952	4.713	4.483
Mass Dry Soil (g)	5.948	5.769	5.832
Moisture Content (%)	83.255	81.695	76.869



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.191	14.081			
Mass Wet Soil + Tare (g)	22.071	21.654			
Mass Dry Soil + Tare (g)	20.569	20.220			
Mass Water (g)	1.502	1.434			
Mass Dry Soil (g)	6.378	6.139			
Moisture Content (%)	23.550	23.359			

Note: Additional information recorded/measured for this test is available upon request.



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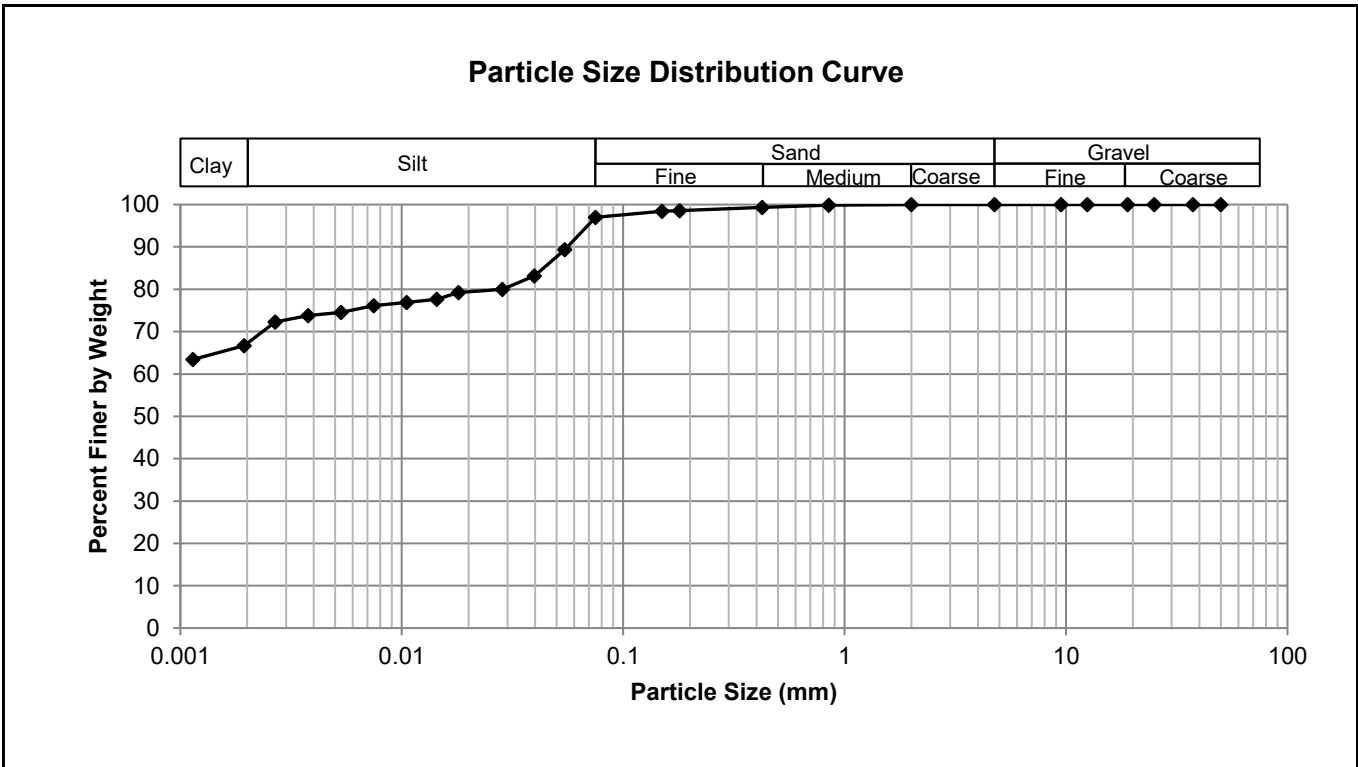
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-08
Sample # G51
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 07-Jan-26
Technician A.Dustmamatov

Gravel	0.0%
Sand	3.0%
Silt	29.8%
Clay	67.1%



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	96.97
37.5	100.00	2.00	100.00	0.0545	89.39
25.0	100.00	0.850	99.88	0.0397	83.14
19.0	100.00	0.425	99.37	0.0285	80.01
12.5	100.00	0.180	98.57	0.0181	79.23
9.50	100.00	0.150	98.42	0.0144	77.67
4.75	100.00	0.075	96.97	0.0105	76.89
				0.0075	76.10
				0.0053	74.54
				0.0038	73.76
				0.0027	72.25
				0.0019	66.72
				0.0011	63.43



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Atterberg Limits
ASTM D4318-17e1

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Client WSP
Project City of Winnipeg Industrial Streets

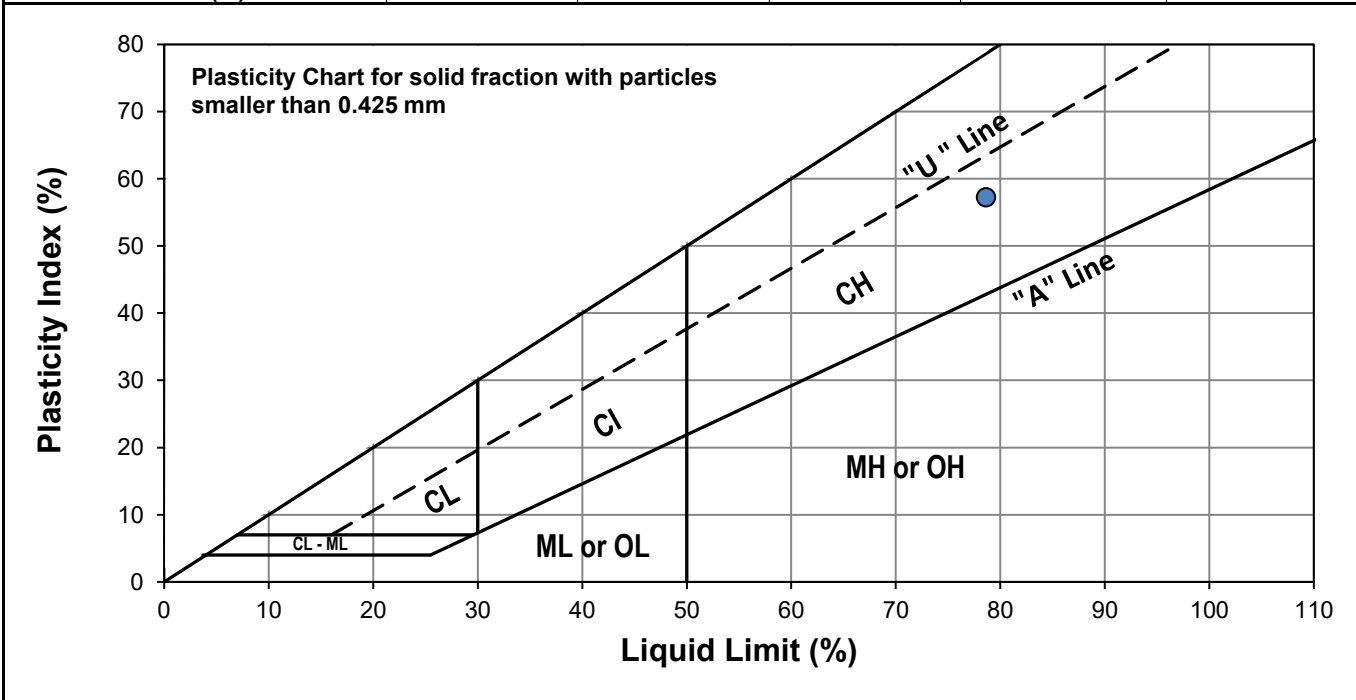


Test Hole TH25-10
Sample # G65
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 15-Jan-26
Technician A.Bhullar

Liquid Limit	79
Plastic Limit	21
Plasticity Index	57

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	15	22	34
Mass Tare (g)	14.166	14.196	14.173
Mass Wet Soil + Tare (g)	23.789	25.035	25.017
Mass Dry Soil + Tare (g)	19.428	20.223	20.335
Mass Water (g)	4.361	4.812	4.682
Mass Dry Soil (g)	5.262	6.027	6.162
Moisture Content (%)	82.877	79.841	75.982



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.107	14.043			
Mass Wet Soil + Tare (g)	21.667	21.989			
Mass Dry Soil + Tare (g)	20.327	20.596			
Mass Water (g)	1.340	1.393			
Mass Dry Soil (g)	6.220	6.553			
Moisture Content (%)	21.543	21.257			

Note: Additional information recorded/measured for this test is available upon request.



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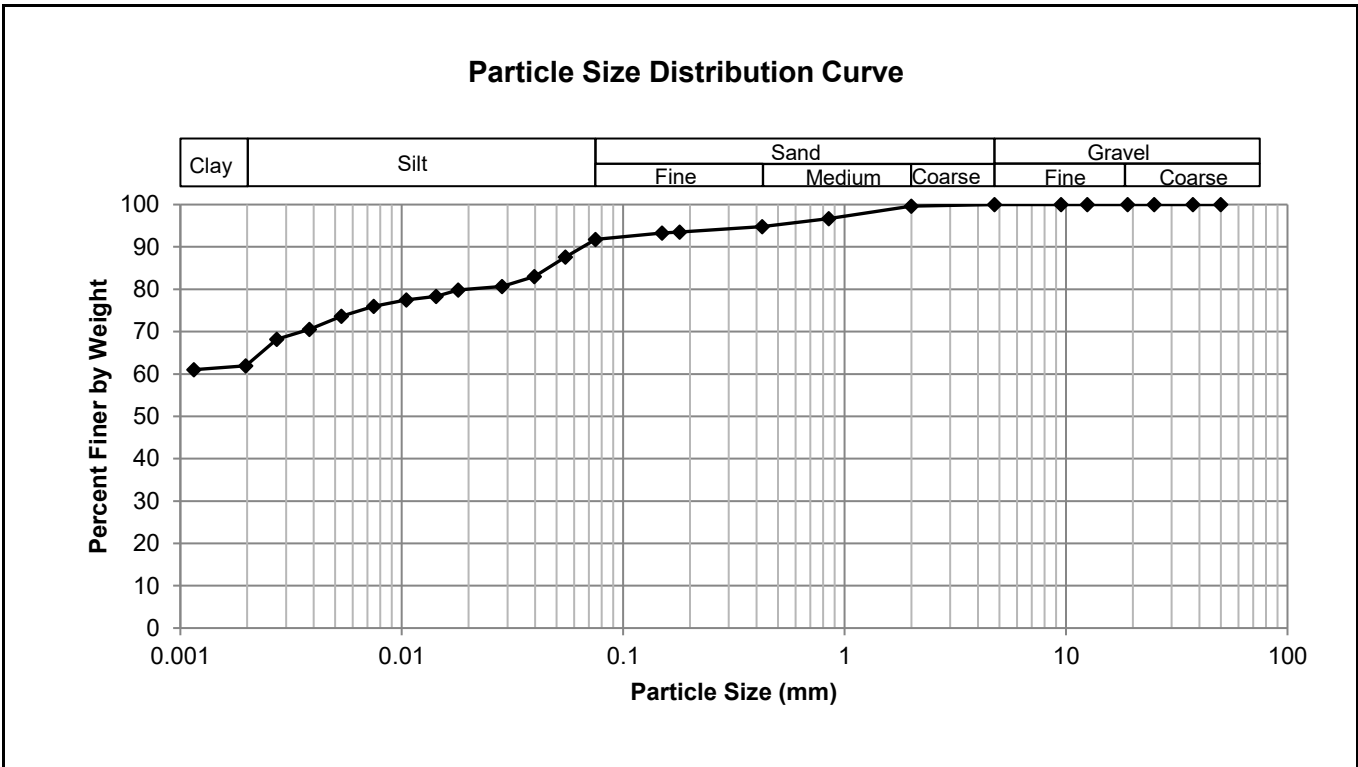
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-10
Sample # G65
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 07-Jan-26
Technician A.Dustmamatov

Gravel	0.0%
Sand	8.2%
Silt	29.6%
Clay	62.1%



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	91.75
37.5	100.00	2.00	99.61	0.0549	87.65
25.0	100.00	0.850	96.69	0.0397	82.98
19.0	100.00	0.425	94.82	0.0284	80.64
12.5	100.00	0.180	93.52	0.0180	79.86
9.50	100.00	0.150	93.31	0.0143	78.30
4.75	100.00	0.075	91.75	0.0105	77.53
				0.0075	75.97
				0.0053	73.63
				0.0038	70.52
				0.0027	68.24
				0.0020	61.95
				0.0012	61.01



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Standard Proctor Compaction Test ASTM D698-12e2

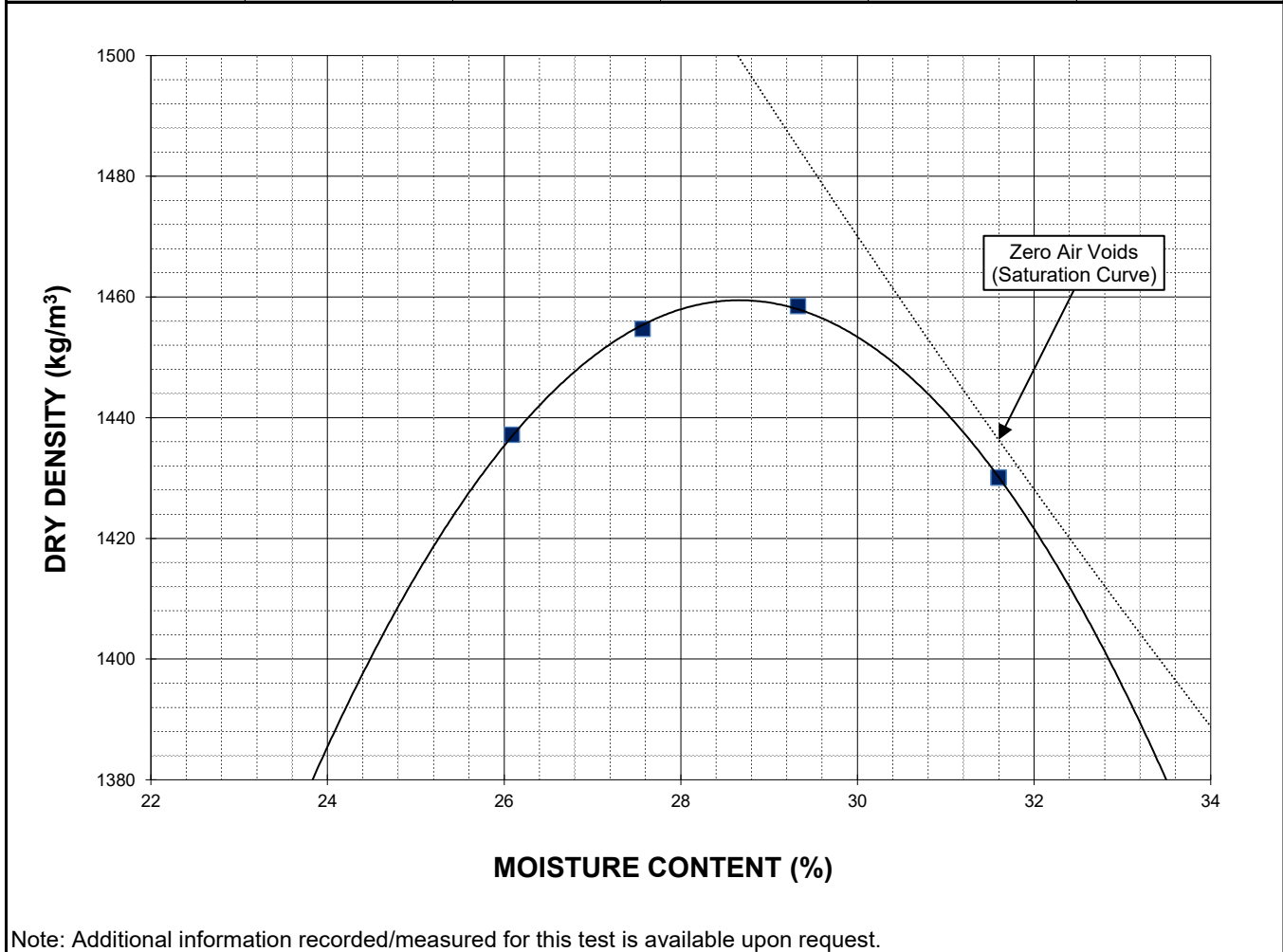
Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Sample # B57 and B79 (combined)
Source TH25-08 and TH25-09 (Martha St)
Material Clay
Sample Date 15-Dec-25
Test Date 24-Dec-25
Technician A. Dustmamatov

Maximum Dry Density (kg/m³)	1459
Optimum Moisture (%)	28.7

Trial Number	1	2	3	4	
Wet Density (kg/m³)	1812	1856	1886	1882	
Dry Density (kg/m³)	1437	1455	1458	1430	
Moisture Content (%)	26.1	27.6	29.3	31.6	



Note: Additional information recorded/measured for this test is available upon request.



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California Bearing Ratio Test Data Sheet

ASTM D1883-21

Project No.	1000-043-31	Source	TH25-08 and TH25-09 (Martha St)
Client	WSP	Material	Clay
Project	COW Industrial Streets	Sample Date	15-Dec-25
Sample #	B57 and B79 (combined)	Test Date	12-Jan-26
		Technician	A. Dustmamatov

Proctor Results (ASTM D698)

Maximum Dry Density	1459 kg/m ³
Optimum Moisture Content	28.5 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1388 kg/m ³
Initial Moisture Content	28.2 %
Relative Density	95.1 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	4.9 %
Moisture Content in top 25 mm	41.0 %
Immersion Period	96 h

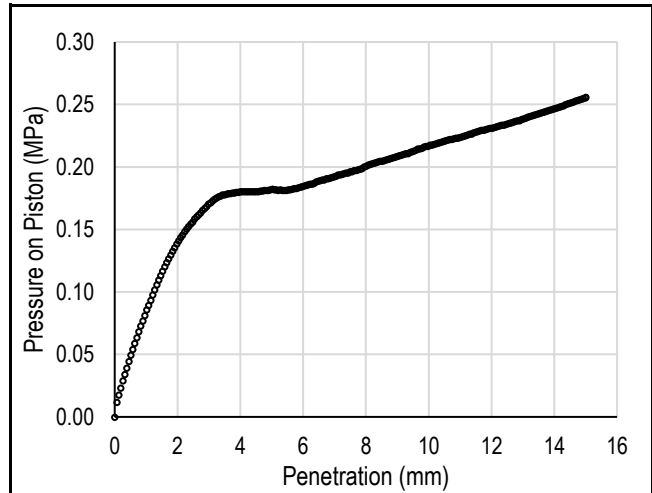
CBR Results

CBR at 2.54 mm	2.3 %
CBR at 5.08 mm	1.8 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.06	0.06
1.27	0.10	0.10
1.91	0.14	0.14
2.54	0.16	0.16
3.18	0.17	0.17
3.81	0.18	0.18
4.45	0.18	0.18
5.08	0.18	0.18
7.62	0.20	0.20
10.16	0.22	0.22
12.70	0.24	0.24

Load/Penetration Curve



Comments:



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Standard Proctor Compaction Test ASTM D698-12e2

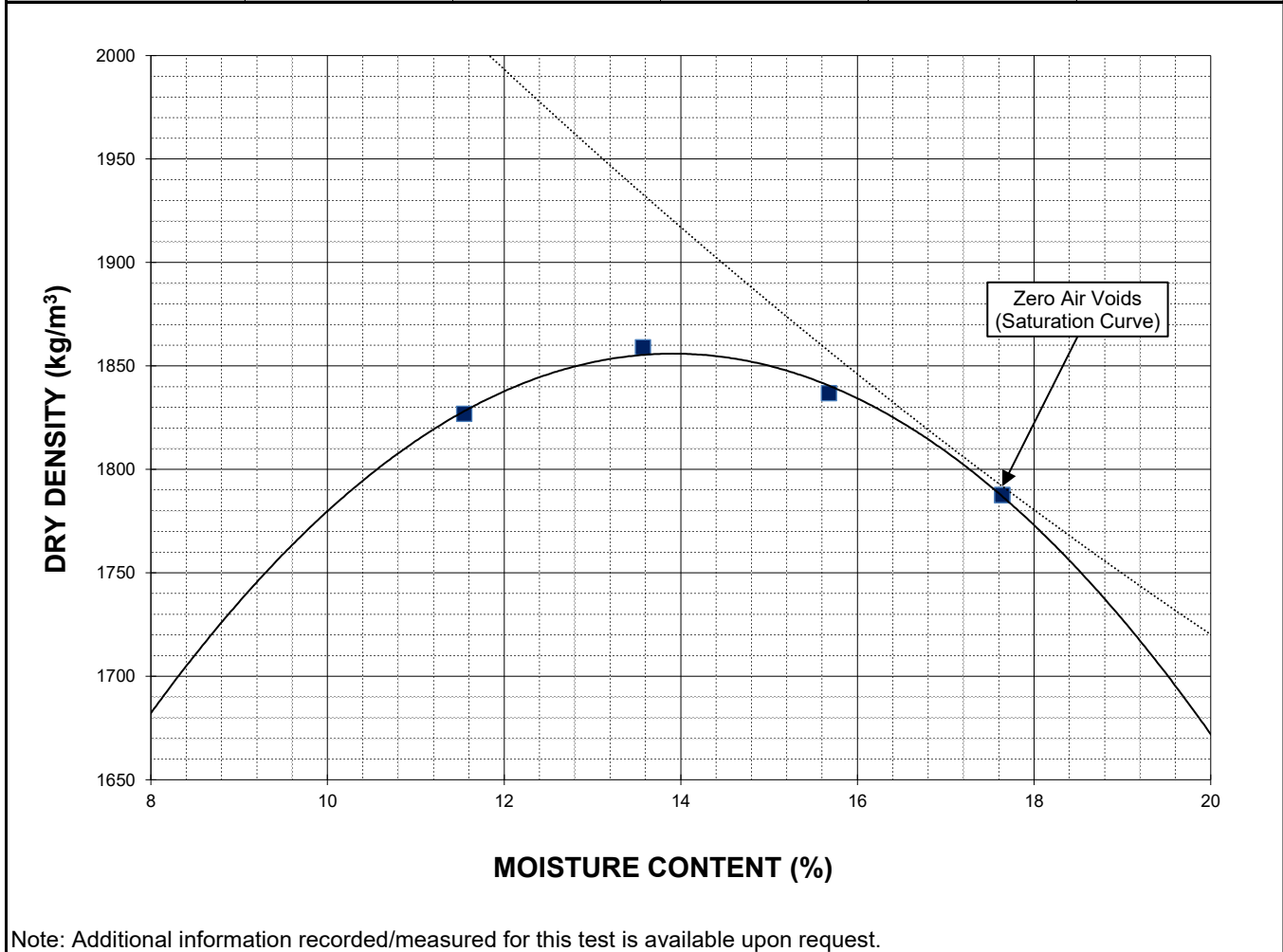
Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Sample # B56 and B80 (combined)
Source TH25-08 and TH25-09 (Martha St)
Material Silt
Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician A. Dustmamatov

Maximum Dry Density (kg/m³)	1856
Optimum Moisture (%)	13.9

Trial Number	1	2	3	4
Wet Density (kg/m³)	2038	2111	2125	2103
Dry Density (kg/m³)	1827	1859	1837	1788
Moisture Content (%)	11.5	13.6	15.7	17.6





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California Bearing Ratio Test Data Sheet

ASTM D1883-21

Project No.	1000-043-31	Source	TH25-08 and TH25-09 (Martha St)
Client	WSP	Material	Silt
Project	COW Industrial Streets	Sample Date	15-Dec-25
Sample #	B56 and B80 (combined)	Test Date	12-Jan-26
		Technician	A. Dustmamatov

Proctor Results (ASTM D698)

Maximum Dry Density	1856 kg/m ³
Optimum Moisture Content	13.9 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1764 kg/m ³
Initial Moisture Content	13.8 %
Relative Density	95.1 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	1.2 %
Moisture Content in top 25 mm	21.1 %
Immersion Period	96 h

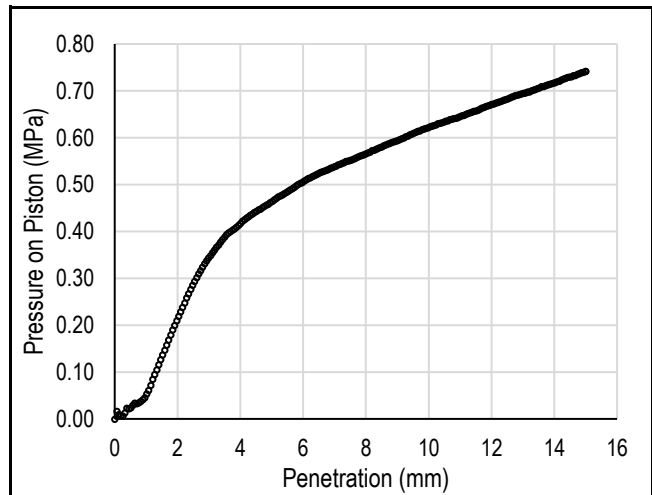
CBR Results

CBR at 2.54 mm	4.3 %
CBR at 5.08 mm	4.5 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.03	0.03
1.27	0.10	0.10
1.91	0.20	0.20
2.54	0.29	0.29
3.18	0.36	0.36
3.81	0.41	0.41
4.45	0.44	0.44
5.08	0.47	0.47
7.62	0.56	0.56
10.16	0.63	0.63
12.70	0.69	0.69

Load/Penetration Curve



Comments:



**City of Winnipeg Industrial Streets Renewal
Martha St. - Austin St. to Logan Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-07	UTM : 5529515 m N, 634008 m E; Located at #180 Martha St., Southbound median lane, 2.2 m West of centre line.	Asphalt	120	Concrete	210	-
PC25-08	UTM : 5529452 m N, 633978 m E; Located at #72 Martha St., Southbound median lane, 2.0 m West of centre line.	Asphalt	80	Concrete	170	-
PC25-10	UTM : 5529492 m N, 633991 m E; Located #71 Martha St., Northbound median lane, 4.5 East of West curb.	Asphalt	100	Concrete	180	-



Photo 1: Pavement Core Sample at TH25-07



Photo 2: Pavement Core Sample at TH25-08



Photo 3: Pavement Core Sample at TH25-10

Appendix C
Test Hole Logs, Summary Tables, Lab Testing Results and
Photographs of Pavement Core Samples
Bushnell St. – Logan Ave to Alexander Ave

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 632872 E 5529897 Bushnell St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.00 - 0.05		ASPHALT (50mm thick)														
0.05 - 0.10		CONCRETE (190mm thick)														
0.10 - 0.40		CLAY - silty, trace sand, trace organics - black - frozen to 0.6m, moist, stiff when thawed - high plasticity - AASHTO: A-7-6 (I)	<input checked="" type="checkbox"/>	G01												
0.40 - 0.80		CLAY - with silt, trace sand - light brown, moist, soft - intermediate plasticity - AASHTO: A-6 (I)	<input checked="" type="checkbox"/>	G02												
0.80 - 1.10		CLAY and SILT - trace sand - brown, moist, very stiff - high plasticity - AASHTO: A-7-6 (51)	<input checked="" type="checkbox"/>	G03												
1.10 - 1.50		CLAY - with silt, trace sand - light brown, moist, soft - intermediate plasticity - AASHTO: A-6 (I)	<input checked="" type="checkbox"/>	G04												
1.50 - 2.00		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	<input checked="" type="checkbox"/>	G05												
2.00 - 2.50		- trace silt inclusions (<50mm diam.) below 2.0m	<input checked="" type="checkbox"/>	G06												
2.50 - 3.00			<input checked="" type="checkbox"/>	G07												

END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B08 Silt and B09 Clay) taken at 0.7m to 1.5m and 1.5m to 2.0m.

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 632857 E 5529857 Bushnell St
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)				
					16	17	18	19	20	21	Test Type				
					Particle Size (%)										
					0	20	40	60	80	100					
					PL MC LL 0 20 40 60 80 100										
					0 20 40 60 80 100						0 50 100 150 200250				
		ASPHALT (75mm thick)													
		CONCRETE (30mm thick)													
0.0 - 0.5		CLAY - silty, trace sand, trace organics - black - moist, frozen to 0.6m, very stiff - high plasticity - AASHTO: A-7-6 (I)		G10											
0.5 - 1.0		CLAY - with silt, trace sand - light brown - moist, firm - intermediate plasticity - AASHTO: A-6 (26)		G11											
1.0 - 1.5				G12											
1.5 - 2.0				G13											
2.0 - 2.5		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G14											
2.5 - 3.0				G15											
				G16											

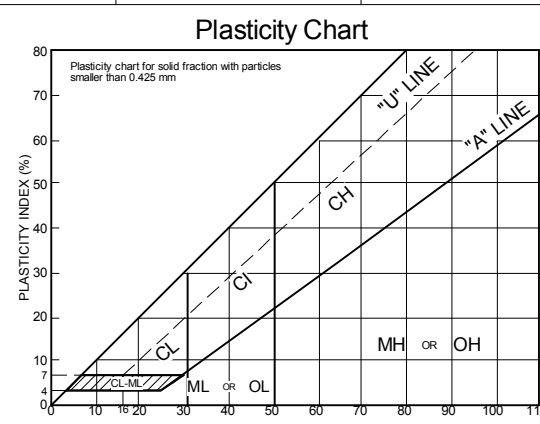
END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B17 Silt and B18 Clay) taken at 0.7m to 1.6m and 1.6m to 2.0m.












GENERAL NOTES

- 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.
- 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.
- 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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size			
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)	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 cases 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	ASTM Sieve sizes #10 to #4 #40 to #10 #200 to #40 < #200			
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW				
		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 borderline 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	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075		
			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 borderline 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)		Sils 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		Particle Size ASTM Sieve Sizes mm > 300 75 to 300 19 to 75 4.75 to 19
						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								
Sils 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							
	Material	Sand Coarse Medium Fine Silt or Clay							
Highly Organic Soils	Pt	Peat and other highly organic soils		Von Post Classification Limit	Strong colour or odour, and often fibrous texture	Material Boulders Cobbles Gravel Coarse Fine			

* 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

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 Incliner
- ▽ 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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



City of Winnipeg Industrial Streets Renewal
Bushnell St. - Logan Ave to Alexander Ave
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH25-03	Located at #256 Bushnell St, Southbound curb lane, 1.5 m East of West curb. UTM : 632857 m E 5529897 m N	Asphalt	50	Concrete	190	Clay, AASHTO: A-7-6 (I)	0.8	0.9	36							
						Clay with Silt, AASHTO: A-6 (I)	0.8	0.9	36							
						Clay, AASHTO: A-7-6 (51)	1.1	1.2	23	57	40	3	0	20	67	47
						Clay with Silt, AASHTO: A-6 (I)	1.4	1.5	23							
						Clay, AASHTO: A-7-6 (I)	1.8	1.9	23							
						Clay, AASHTO: A-7-6 (I)	2.1	2.3	44							
						Clay, AASHTO: A-7-6 (I)	2.6	2.7	36							
TH25-04	Located 5 m North of Alley, Southbound curb lane, 1.7 m East of West curb. UTM : 632872 m E 5529897 m N	Asphalt	75	Concrete	30	Clay, AASHTO: A-7-6 (I)	0.3	0.5	33							
						Clay with Silt, AASHTO: A-6 (26)	0.8	0.9	25	37	60	3	0	14	40	26
						Clay with Silt, AASHTO: A-6 (26)	1.1	1.2	41							
						Clay with Silt, AASHTO: A-6 (26)	1.4	1.5	45							
						Clay, AASHTO: A-7-6 (I)	1.8	1.9	49							
						Clay, AASHTO: A-7-6 (I)	2.1	2.3	36							
						Clay, AASHTO: A-7-6 (I)	2.6	2.7	26							



Project No. 1000-043-01
Client WSP
Project City of Winnipeg Industrial Streets - Bushnell St

Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician K.Desikan

Test Hole	TH25-03	TH25-03	TH25-03	TH25-03	TH25-03	TH25-03
Depth (m)	0.3 - 0.5	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	N92	AC34	AA06	QT50	H19	RR1
Mass of tare	7.0	6.7	6.9	8.3	8.4	6.8
Mass wet + tare	198.3	214.0	405.0	208.0	199.7	204.0
Mass dry + tare	147.8	171.7	310.5	170.3	141.6	140.0
Mass water	50.5	42.3	94.5	37.7	58.1	64.0
Mass dry soil	140.8	165.0	303.6	162.0	133.2	133.2
Moisture %	35.9%	25.6%	31.1%	23.3%	43.6%	48.0%

Test Hole	TH25-03	TH25-04	TH25-04	TH25-04	TH25-04	TH25-04
Depth (m)	2.6 - 2.7	0.3 - 0.5	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9
Sample #	G07	G10	G11	G12	G13	G14
Tare ID	F85	QT32	E30	MNG3	Z39	D234
Mass of tare	8.7	8.2	6.8	7.2	8.7	6.8
Mass wet + tare	210.9	198.4	399.4	208.3	211.3	203.6
Mass dry + tare	143.5	154.2	328.1	176.5	177.9	147.9
Mass water	67.4	44.2	71.3	31.8	33.4	55.7
Mass dry soil	134.8	146.0	321.3	169.3	169.2	141.1
Moisture %	50.0%	30.3%	22.2%	18.8%	19.7%	39.5%

Test Hole	TH25-04	TH25-04				
Depth (m)	2.1 - 2.3	2.6 - 2.7				
Sample #	G15	G16				
Tare ID	M25	D237				
Mass of tare	7.0	7.0				
Mass wet + tare	204.1	200.2				
Mass dry + tare	138.8	133.8				
Mass water	65.3	66.4				
Mass dry soil	131.8	126.8				
Moisture %	49.5%	52.4%				



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets

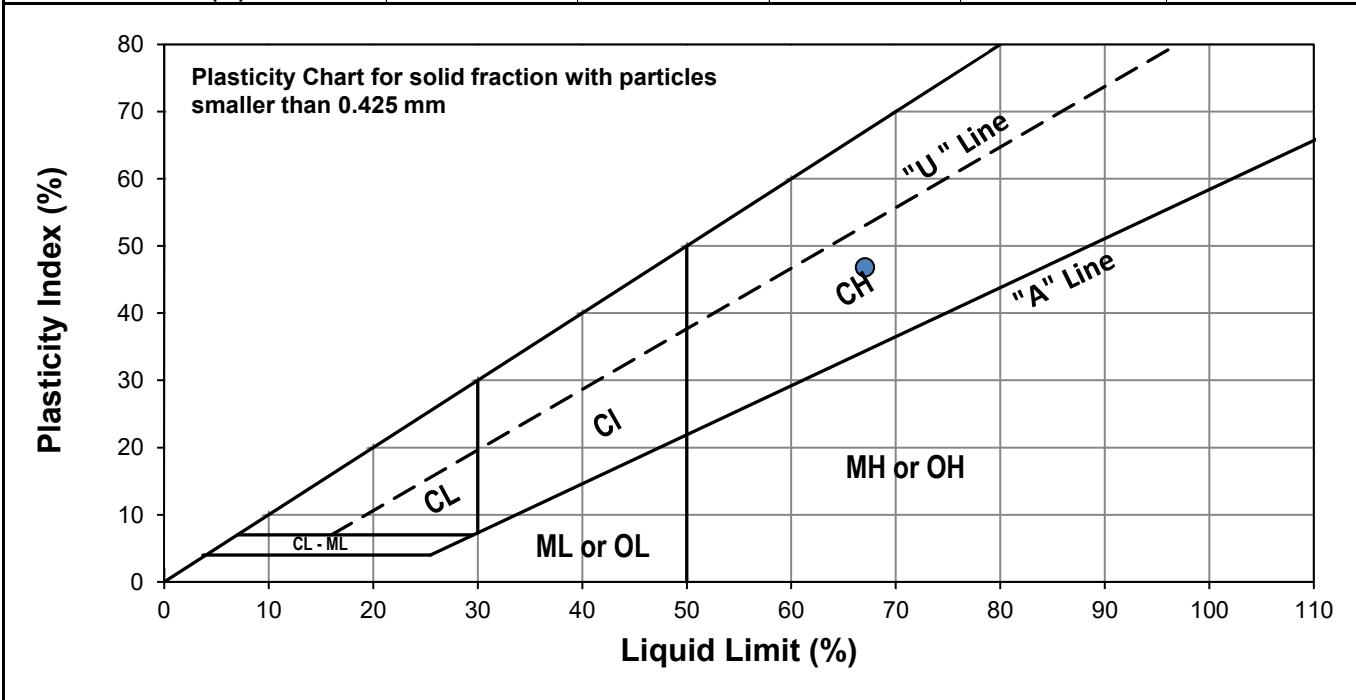


Test Hole TH25-03
Sample # G03
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 15-Jan-26
Technician Z.Dypianco

Liquid Limit	67
Plastic Limit	20
Plasticity Index	47

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	16	24	35
Mass Tare (g)	13.734	14.002	13.925
Mass Wet Soil + Tare (g)	26.316	26.135	25.614
Mass Dry Soil + Tare (g)	21.135	21.258	21.012
Mass Water (g)	5.181	4.877	4.602
Mass Dry Soil (g)	7.401	7.256	7.087
Moisture Content (%)	70.004	67.213	64.936



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.974	13.770			
Mass Wet Soil + Tare (g)	21.056	21.353			
Mass Dry Soil + Tare (g)	19.861	20.078			
Mass Water (g)	1.195	1.275			
Mass Dry Soil (g)	5.887	6.308			
Moisture Content (%)	20.299	20.212			

Note: Additional information recorded/measured for this test is available upon request.



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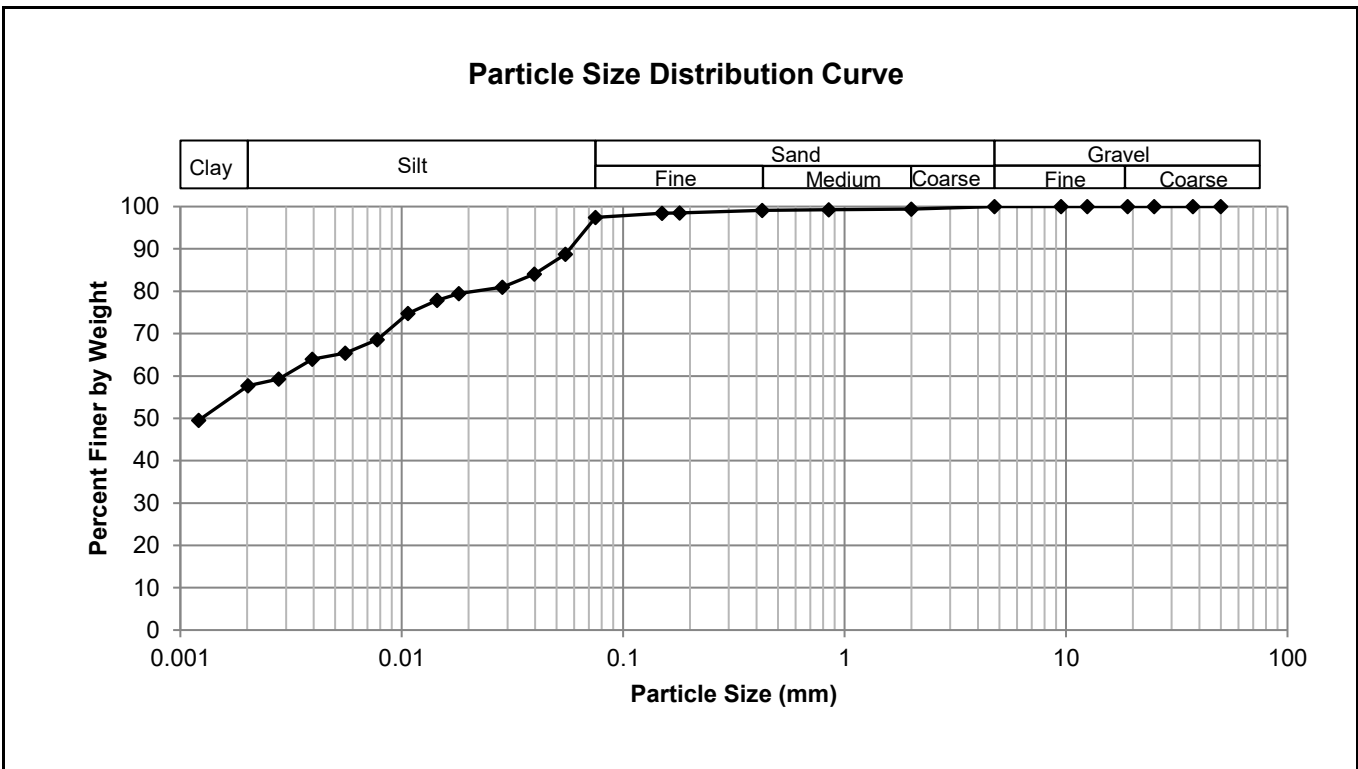
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-03
Sample # G03
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 14-Jan-26
Technician A. Fidler-Kliewer

Gravel	0.0%
Sand	2.6%
Silt	40.0%
Clay	57.4%



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	97.41
37.5	100.00	2.00	99.41	0.0549	88.74
25.0	100.00	0.850	99.29	0.0397	84.08
19.0	100.00	0.425	99.09	0.0285	80.97
12.5	100.00	0.180	98.53	0.0181	79.42
9.50	100.00	0.150	98.42	0.0144	77.87
4.75	100.00	0.075	97.41	0.0107	74.76
				0.0078	68.54
				0.0056	65.43
				0.0039	63.93
				0.0028	59.27
				0.0020	57.66
				0.0012	49.56



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets

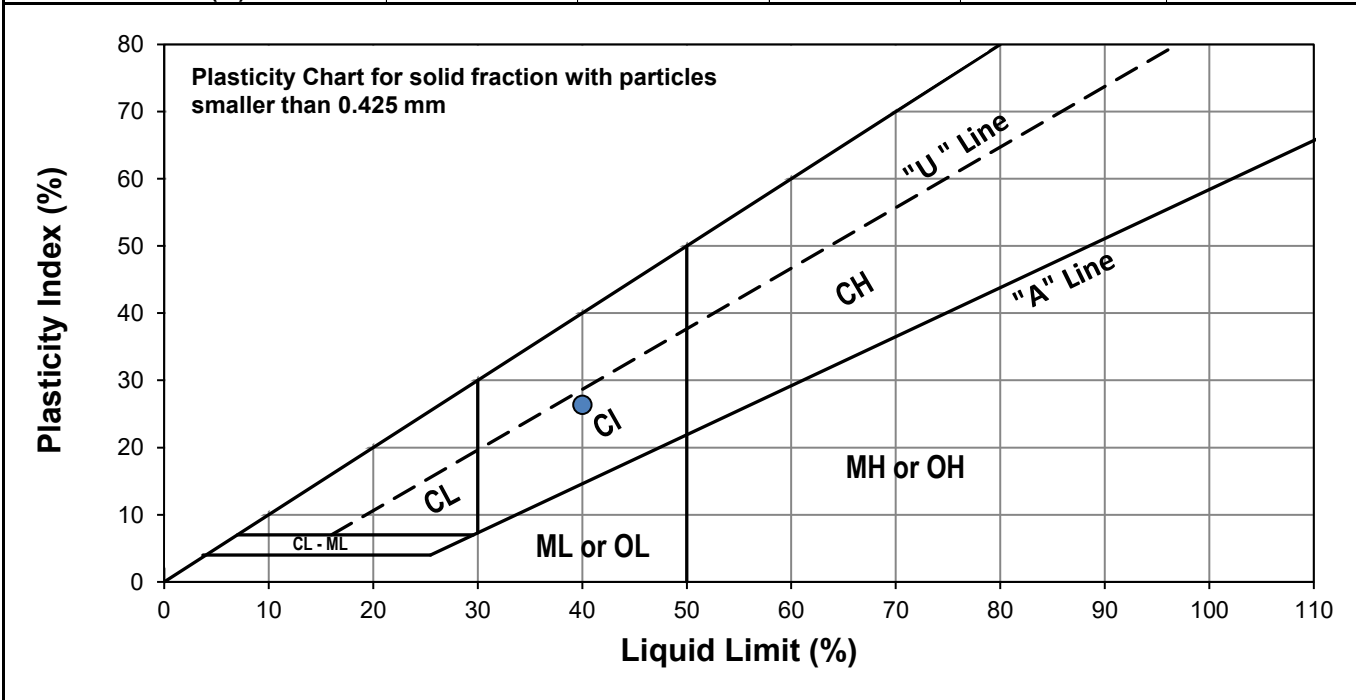


Test Hole TH25-04
Sample # G11
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 15-Jan-26
Technician Z.Dypianco

Liquid Limit	40
Plastic Limit	14
Plasticity Index	26

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	22	26	35
Mass Tare (g)	14.032	13.914	13.912
Mass Wet Soil + Tare (g)	27.935	20.506	28.580
Mass Dry Soil + Tare (g)	23.922	18.628	24.506
Mass Water (g)	4.013	1.878	4.074
Mass Dry Soil (g)	9.890	4.714	10.594
Moisture Content (%)	40.576	39.839	38.456



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.805	14.040			
Mass Wet Soil + Tare (g)	21.452	21.738			
Mass Dry Soil + Tare (g)	20.510	20.836			
Mass Water (g)	0.942	0.902			
Mass Dry Soil (g)	6.705	6.796			
Moisture Content (%)	14.049	13.273			

Note: Additional information recorded/measured for this test is available upon request.



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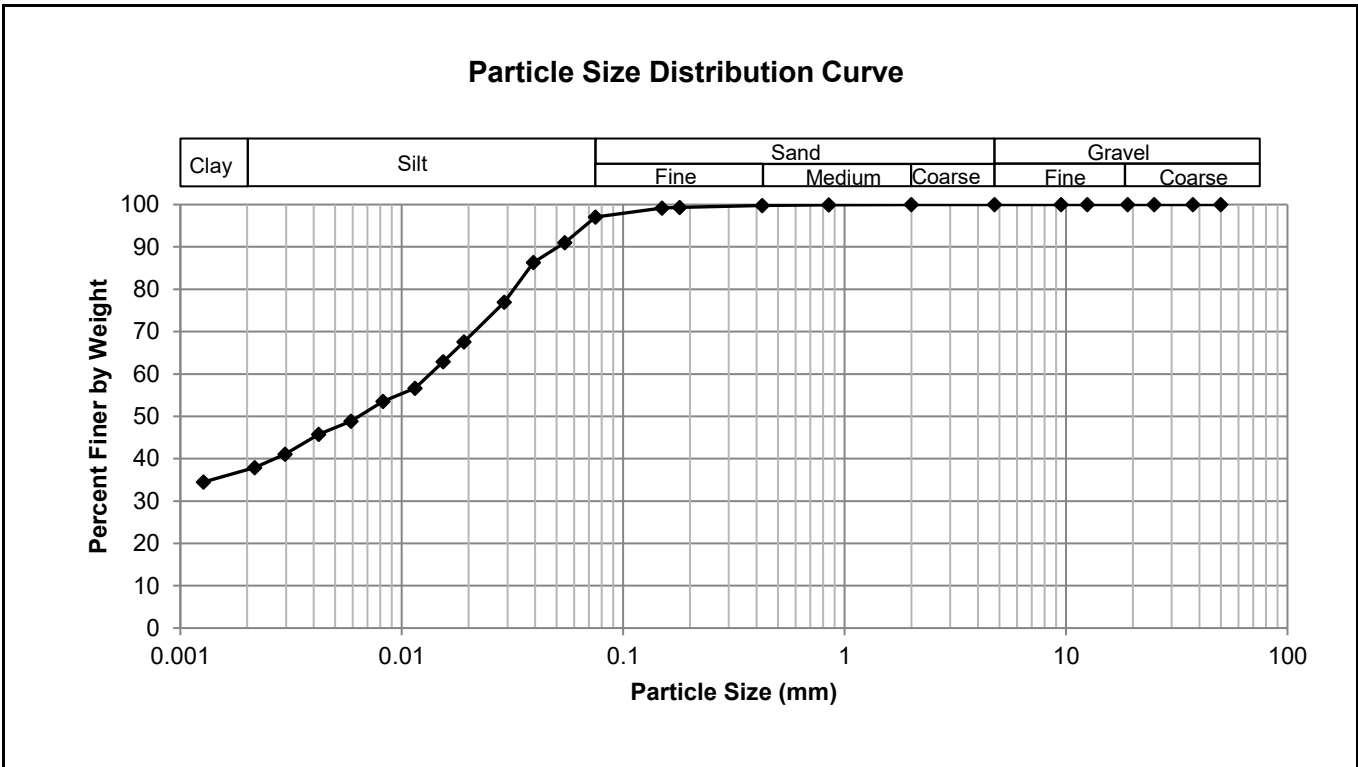
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-04
Sample # G11
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 14-Jan-26
Technician A. Fidler-Kliewer

Gravel	0.0%
Sand	2.9%
Silt	59.8%
Clay	37.3%



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	97.08
37.5	100.00	2.00	100.00	0.0544	91.05
25.0	100.00	0.850	99.92	0.0394	86.36
19.0	100.00	0.425	99.77	0.0290	76.98
12.5	100.00	0.180	99.34	0.0191	67.60
9.50	100.00	0.150	99.16	0.0154	62.91
4.75	100.00	0.075	97.08	0.0115	56.65
				0.0082	53.53
				0.0059	48.84
				0.0042	45.75
				0.0030	41.06
				0.0022	37.89
				0.0013	34.49



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Standard Proctor Compaction Test ASTM D698-12e2

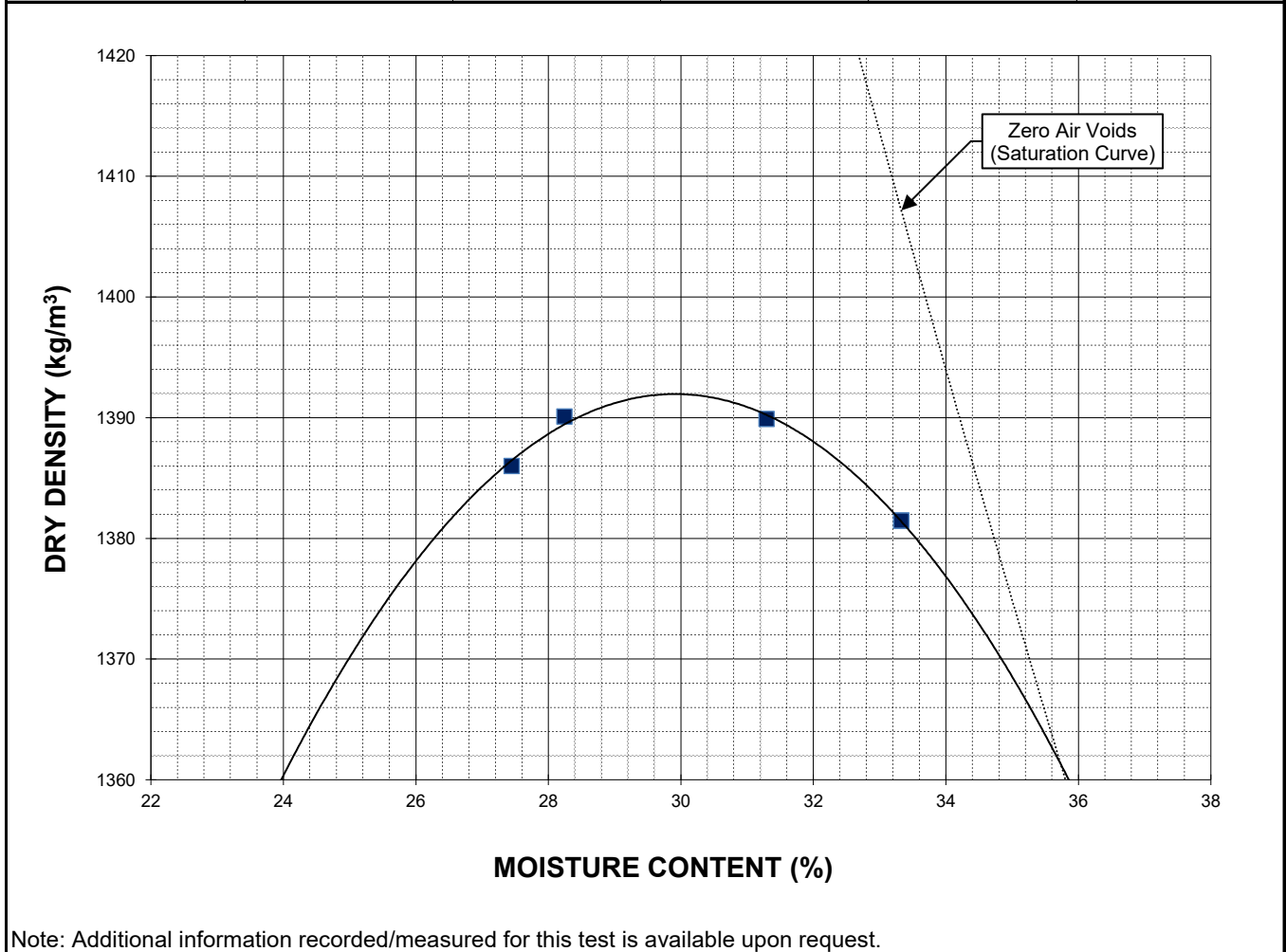
Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Sample # B9 and B18 (combined)
Source TH25-03 and TH25-04 (Bushnell St)
Material Clay
Sample Date 15-Dec-25
Test Date 24-Dec-25
Technician A. Dustmamatov

Maximum Dry Density (kg/m³)	1392
Optimum Moisture (%)	29.9

Trial Number	1	2	3	4
Wet Density (kg/m³)	1766	1783	1825	1842
Dry Density (kg/m³)	1386	1390	1390	1381
Moisture Content (%)	27.4	28.2	31.3	33.3



Note: Additional information recorded/measured for this test is available upon request.



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California Bearing Ratio Test Data Sheet

ASTM D1883-21

Project No.	1000-043-31	Source	TH25-03 and TH25-04 (Bushnell St)
Client	WSP	Material	Clay
Project	COW Industrial Streets	Sample Date	15-Dec-25
Sample #	B9 and B18 (combined)	Test Date	12-Jan-26
		Technician	A. Dustmamatov

Proctor Results (ASTM D698)

Maximum Dry Density	1392 kg/m ³
Optimum Moisture Content	29.9 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1328 kg/m ³
Initial Moisture Content	29.3 %
Relative Density	95.4 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	7.0 %
Moisture Content in top 25 mm	49.6 %
Immersion Period	96 h

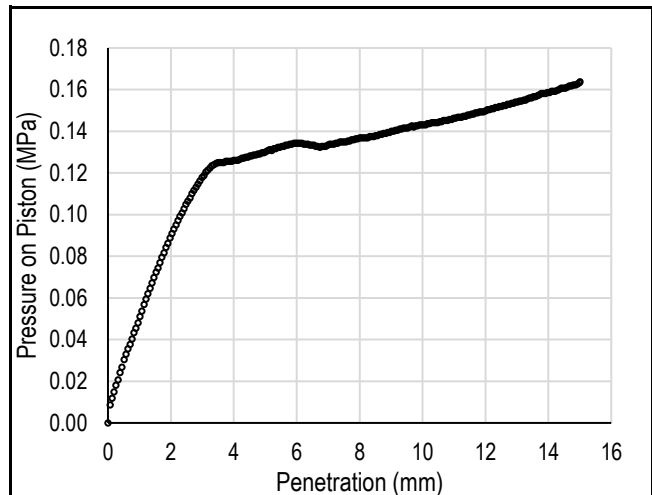
CBR Results

CBR at 2.54 mm	1.5 %
CBR at 5.08 mm	1.3 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.04	0.04
1.27	0.06	0.06
1.91	0.09	0.09
2.54	0.11	0.11
3.18	0.12	0.12
3.81	0.13	0.13
4.45	0.13	0.13
5.08	0.13	0.13
7.62	0.14	0.14
10.16	0.14	0.14
12.70	0.15	0.15

Load/Penetration Curve



Comments:



**City of Winnipeg Industrial Streets Renewal
Bushnell St. - Logan Ave to Alexander Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-03	UTM : 5529897 m N, 632872 m E; Located 5 m North of Alley, Southbound curb lane, 1.7 m East of West curb.	Asphalt	75	Concrete	-	-
PC25-04	UTM : 5529857 m N, 632857 m E; Located at #256 Bushnell St, Southbound curb lane, 1.5 m East of West curb.	Asphalt	50	Concrete	190	-

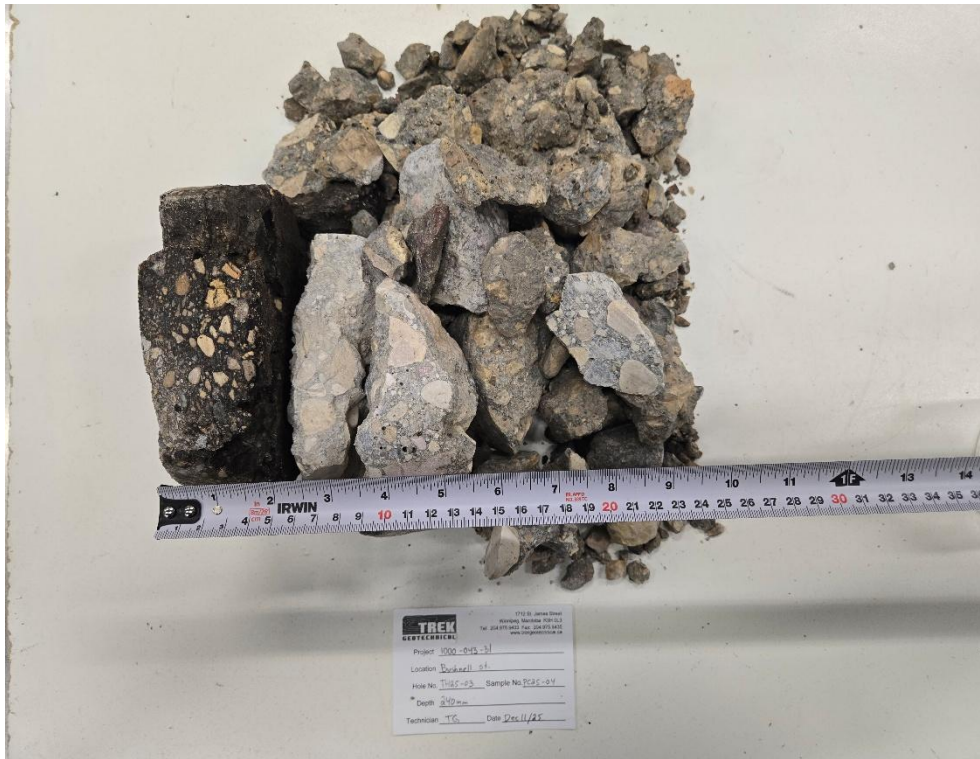


Photo 1: Pavement Core Sample at TH25-03



Photo 2: Pavement Core Sample at TH25-04

Appendix D

**Test Hole Logs, Summary Table, Lab Testing Results and
Photographs of Pavement Core Samples**

McDermot/Adelaide Alley – Princess St. to Notre Dame Ave

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 633294 E 5528842 McDermot/Adelaide Alley
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.00 - 0.05		ASPHALT (70mm thick)														
0.05 - 0.10		CONCRETE (140mm thick)														
0.10 - 0.90		CLAY - with silt, trace sand, trace organics - black - frozen to 0.6m, moist, very stiff when thawed - high plasticity - hydrocarbon like odour - AASHTO: A-7-6 (I)														
0.90 - 1.10		- grey below 0.9m		G27												
1.10 - 1.20				G28												
1.20 - 2.10		SILT - clayey, trace sand - light brown - moist, soft - low to intermediate plasticity - hydrocarbon like odour - AASHTO: A-6 (I)														
1.20 - 1.50		- black, strong hydrocarbon like odour below 1.5m		G29												
1.50 - 2.10				G30												
2.10 - 2.30		- brown, stiff below 2.1m		G31												
2.30 - 2.50				G32												
2.50 - 3.00		CLAY - silty - brown - moist, very stiff - high plasticity - hydrocarbon like odour - AASHTO: A-7-6 (I)														

END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B33 Silt and B34 Clay) taken at 1.2m to 2.0m and 0.8m to 1.2m.
- 5) Samples taken below 1.5m have strong hydrocarbon like odour and are not suitable for bulk testing.

Client: WSP **Project Number:** 1000-043-31
Project Name: City of Winnipeg Industrial Streets **Location:** UTM: 633333 E 5528884 McDermot/Adelaide Alley
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** December 15, 2025

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)	
					16	17	18	19	20	21		
0.0 - 0.1		CONCRETE (150mm thick)										
0.1 - 0.9		CLAY - with silt, trace sand, trace organics - black - frozen to 0.6m, moist, very stiff when thawed - intermediate to high plasticity - AASHTO: A-7-6 (37)										
0.9 - 1.5		- grey, AASHTO: A-7-6 (38) below 0.9m		G19								
1.5 - 2.0		SILT - clayey, trace sand - light brown, moist, soft - low to intermediate plasticity - AASHTO: A-6 (I)		G20								
2.0 - 3.0		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G21								
				G22								
				G23								
				G24								

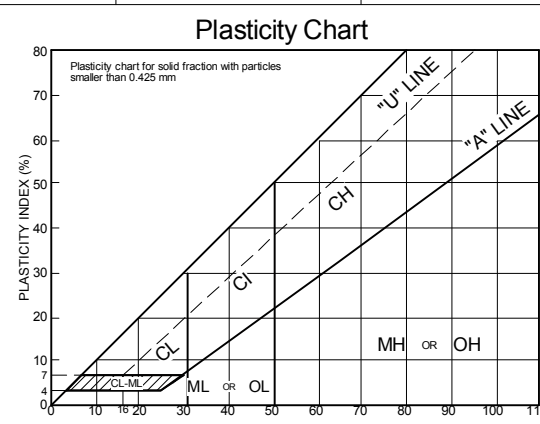
END OF TEST HOLE AT 3.0m IN CLAY.

Notes:

- 1) Seepage and sloughing not observed.
- 2) Test hole dry and open to 3.0m depth immediately after drilling.
- 3) Test hole backfilled with cuttings, bentonite and cold patch asphalt.
- 4) Bulk samples (B25 Silt and B26 Clay) taken at 0.7m to 1.5m and 1.5m to 2.0m.












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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size				
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)	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 cases 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	ASTM Sieve sizes #10 to #4 #40 to #10 #200 to #40 < #200				
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW					
		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 borderline 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	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075			
			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	Material Sand Coarse Medium Fine Silt or Clay			
			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)		Sils 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		Particle Size ASTM Sieve Sizes mm > 300 75 to 300 19 to 75 4.75 to 19 3 in. to 12 in. 3/4 in. to 3 in. #4 to 3/4 in.
						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									
Sils 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								
	Pt	Peat and other highly organic soils		Von Post Classification Limit	Strong colour or odour, and often fibrous texture					

* 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

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 Incliner
- ▽ 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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



**City of Winnipeg Industrial Streets Renewal
McDermot/Adelaide Alley - Princess St. to Notre Dame Ave
Sub-Surface Investigation**

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH25-01	Located behind #57 Adelaide St, Westbound lane, 0.3 m South of road edge. UTM : 633294 m E 5528842 m N	Asphalt	0	Concrete	140	Clay, AASHTO: A-7-6 (I)	0.8	0.9	22							
						Clay, AASHTO: A-7-6 (I)	1.1	1.2	19							
						Silt, AASHTO: A-6 (I)	1.4	1.5	20							
						Silt, AASHTO: A-6 (I)	1.8	1.9	39							
						Silt, AASHTO: A-6 (I)	2.1	2.3	50							
						Clay, AASHTO: A-7-6 (I)	2.6	2.7	52							
TH25-02	Located behind #62 Princess Ave, Southbound lane, 3.8 m East of building. UTM : 633333 m E 5528884 m N	Asphalt	0	Concrete	150	Clay, AASHTO: A-7-6 (37)	0.8	0.9	31	38	54	9	0	20	57	37
						Clay, AASHTO: A-7-6 (38)	1.1	1.2	23	50	46	4	0	20	56	36
						Silt, AASHTO: A-6 (I)	1.4	1.5	44							
						Clay, AASHTO: A-7-6 (I)	1.8	1.9	48							
						Clay, AASHTO: A-7-6 (I)	2.1	2.3	50							
						Clay, AASHTO: A-7-6 (I)	2.6	2.7	30							



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Moisture Content Report ASTM D2216-98

Project No. 1000-043-01
Client WSP
Project City of Winnipeg Industrial Streets - McDermot/Adelaide Alley

Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician K.Desikan

Test Hole	TH25-01	TH25-01	TH25-01	TH25-01	TH25-01	TH25-01
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G27	G28	G29	G30	G31	G32
Tare ID	E53	QT45	E51	B21	A104	D229
Mass of tare	7.0	8.5	6.9	7.3	8.7	6.7
Mass wet + tare	198.4	214.3	193.7	218.3	196.2	207.9
Mass dry + tare	147.0	159.3	158.3	179.0	161.5	146.9
Mass water	51.4	55.0	35.4	39.3	34.7	61.0
Mass dry soil	140.0	150.8	151.4	171.7	152.8	140.2
Moisture %	36.7%	36.5%	23.4%	22.9%	22.7%	43.5%

Test Hole	TH25-02	TH25-02	TH25-02	TH25-02	TH25-02	TH25-02
Depth (m)	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 1.9	2.1 - 2.3	2.6 - 2.7
Sample #	G19	G20	G21	G22	G23	G24
Tare ID	D239	Q75	W44	B9	QTT36	B18
Mass of tare	6.8	8.4	8.8	8.0	8.4	6.9
Mass wet + tare	407.3	342.6	202.6	222.9	222.1	204.3
Mass dry + tare	302.1	259.0	163.4	160.8	155.6	139.8
Mass water	105.2	83.6	39.2	62.1	66.5	64.5
Mass dry soil	295.3	250.6	154.6	152.8	147.2	132.9
Moisture %	35.6%	33.4%	25.4%	40.6%	45.2%	48.5%



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets

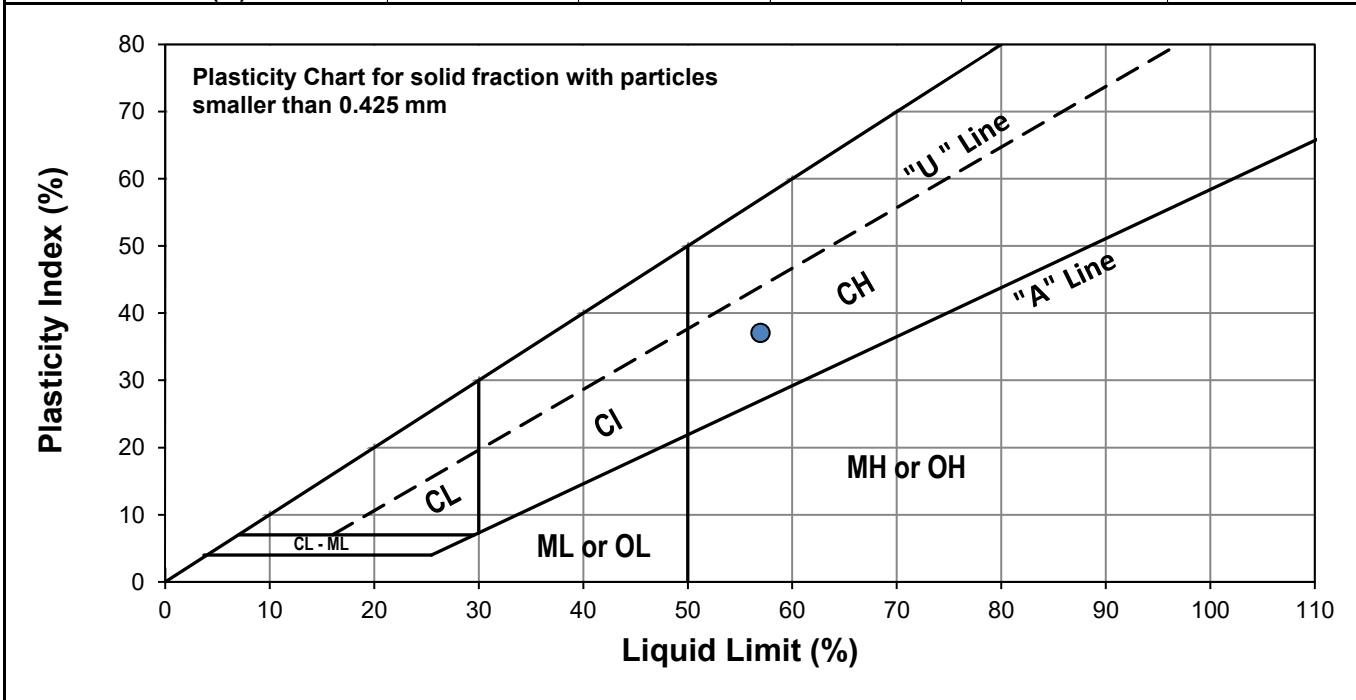


Test Hole TH25-02
Sample # G19
Depth (m) 0.8 - 0.9
Sample Date 15-Dec-25
Test Date 16-Jan-26
Technician A.Bhullar

Liquid Limit	57
Plastic Limit	20
Plasticity Index	37

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	19	22	32
Mass Tare (g)	14.032	13.992	14.144
Mass Wet Soil + Tare (g)	25.143	23.737	25.677
Mass Dry Soil + Tare (g)	21.068	20.182	21.534
Mass Water (g)	4.075	3.555	4.143
Mass Dry Soil (g)	7.036	6.190	7.390
Moisture Content (%)	57.916	57.431	56.062



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.750	13.800			
Mass Wet Soil + Tare (g)	21.452	21.340			
Mass Dry Soil + Tare (g)	20.175	20.088			
Mass Water (g)	1.277	1.252			
Mass Dry Soil (g)	6.425	6.288			
Moisture Content (%)	19.875	19.911			

Note: Additional information recorded/measured for this test is available upon request.



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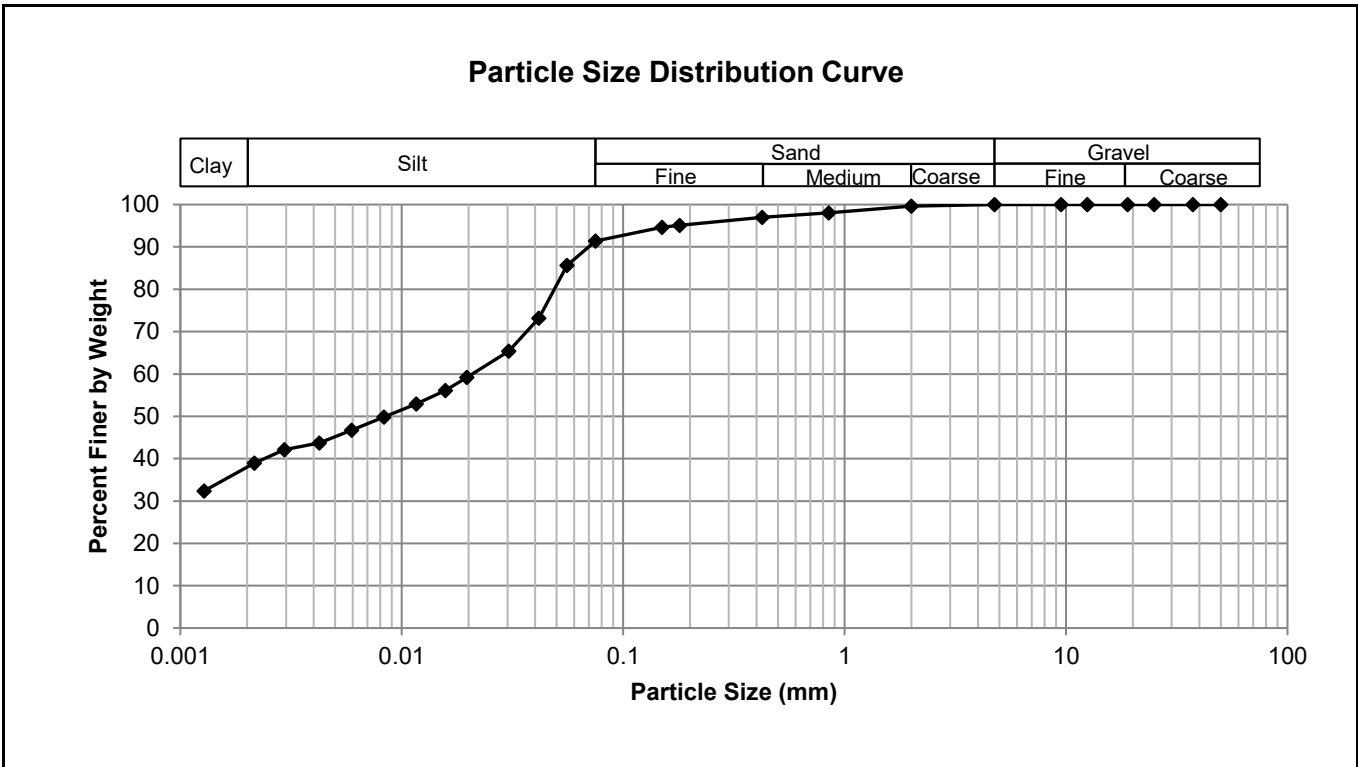
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-02
Sample # G19
Depth (m) 0.8 - 1.2
Sample Date 15-Dec-25
Test Date 14-Jan-26
Technician A. Fidler-Kliewer

Gravel	0.0%
Sand	8.6%
Silt	53.7%
Clay	37.8%



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	91.42
37.5	100.00	2.00	99.63	0.0558	85.68
25.0	100.00	0.850	98.07	0.0417	73.22
19.0	100.00	0.425	96.95	0.0304	65.43
12.5	100.00	0.180	95.09	0.0197	59.20
9.50	100.00	0.150	94.64	0.0158	56.09
4.75	100.00	0.075	91.42	0.0116	52.97
				0.0083	49.86
				0.0060	46.74
				0.0042	43.68
				0.0030	42.12
				0.0022	38.96
				0.0013	32.41



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Atterberg Limits
ASTM D4318-17e1

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets

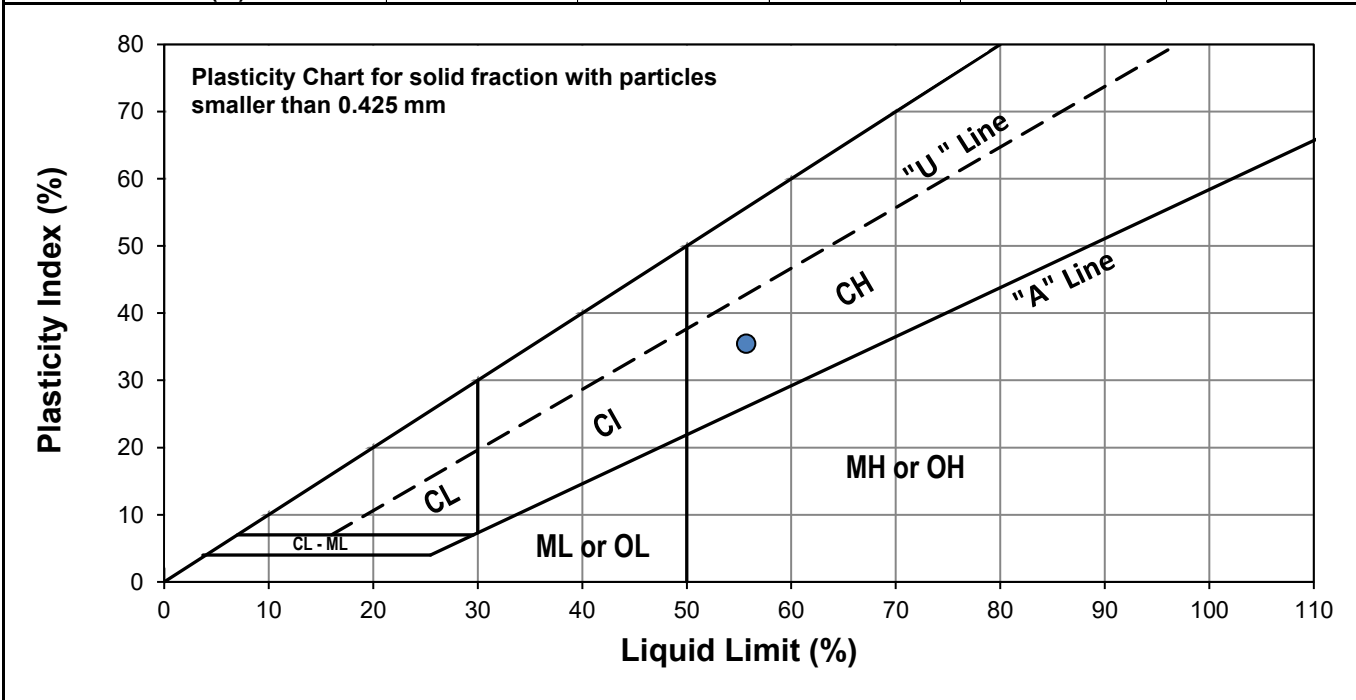


Test Hole TH25-02
Sample # G20
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 15-Jan-26
Technician A.Bhullar

Liquid Limit	56
Plastic Limit	20
Plasticity Index	35

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	16	22	34
Mass Tare (g)	14.045	14.104	13.806
Mass Wet Soil + Tare (g)	24.824	26.378	26.565
Mass Dry Soil + Tare (g)	20.835	21.947	22.112
Mass Water (g)	3.989	4.431	4.453
Mass Dry Soil (g)	6.790	7.843	8.306
Moisture Content (%)	58.748	56.496	53.612



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.866	14.032			
Mass Wet Soil + Tare (g)	23.192	21.809			
Mass Dry Soil + Tare (g)	21.642	20.486			
Mass Water (g)	1.550	1.323			
Mass Dry Soil (g)	7.776	6.454			
Moisture Content (%)	19.933	20.499			

Note: Additional information recorded/measured for this test is available upon request.



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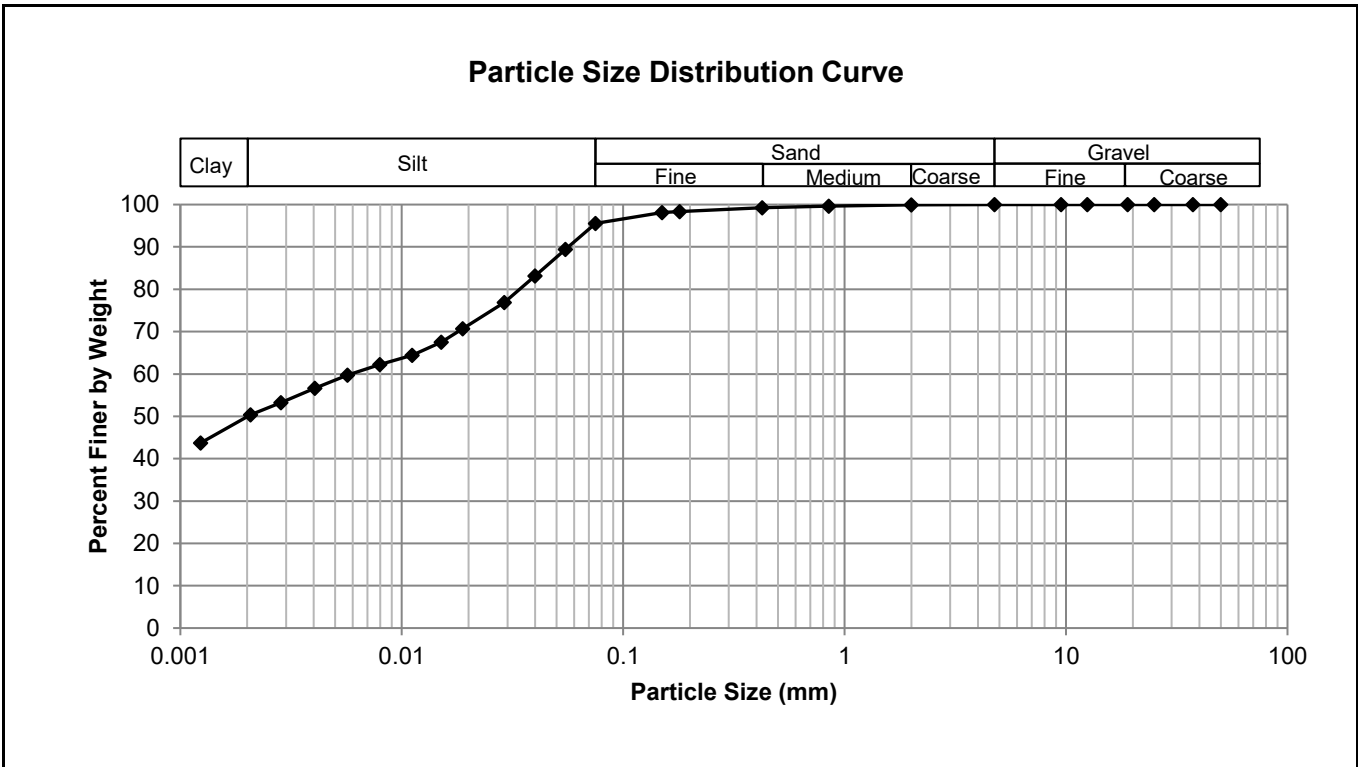
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Test Hole TH25-02
Sample # G20
Depth (m) 1.1 - 1.2
Sample Date 15-Dec-25
Test Date 14-Jan-26
Technician A. Fidler-Kliewer

Gravel	0.0%
Sand	4.4%
Silt	45.8%
Clay	49.7%



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	95.56
37.5	100.00	2.00	99.95	0.0548	89.42
25.0	100.00	0.850	99.61	0.0399	83.17
19.0	100.00	0.425	99.23	0.0290	76.92
12.5	100.00	0.180	98.35	0.0189	70.67
9.50	100.00	0.150	98.12	0.0151	67.54
4.75	100.00	0.075	95.56	0.0112	64.42
				0.0080	62.23
				0.0057	59.73
				0.0041	56.67
				0.0028	53.23
				0.0021	50.36
				0.0012	43.74



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Standard Proctor Compaction Test ASTM D698-12e2

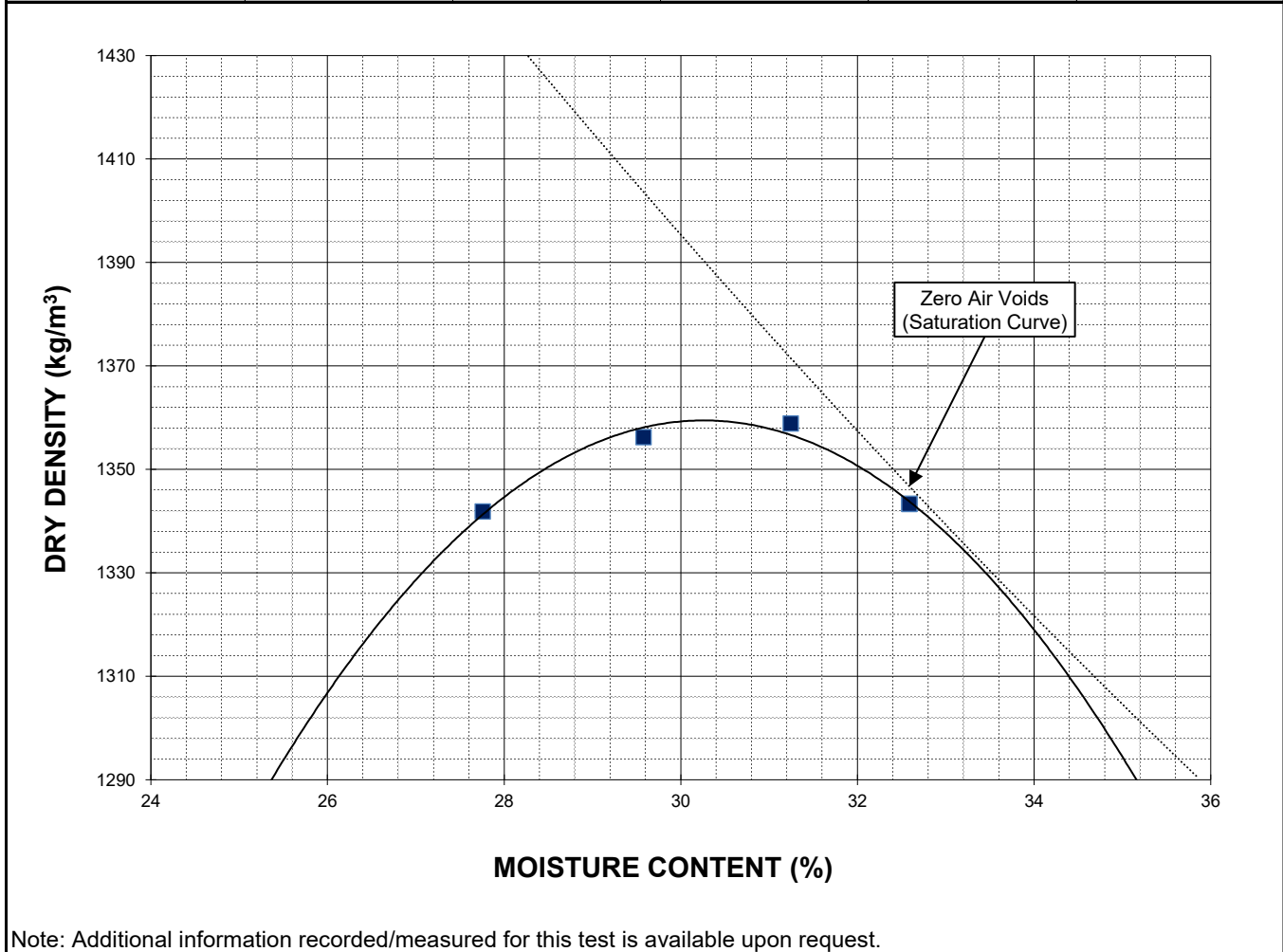
Project No. 1000-043-31
Client WSP
Project City of Winnipeg Industrial Streets



Sample # B26
Source TH25-02 (McDermot/Adelaide Alley)
Material Clay
Sample Date 15-Dec-25
Test Date 05-Jan-26
Technician A. Dustmamatov

Maximum Dry Density (kg/m³)	1359
Optimum Moisture (%)	30.3

Trial Number	1	2	3	4
Wet Density (kg/m³)	1714	1757	1783	1781
Dry Density (kg/m³)	1342	1356	1359	1343
Moisture Content (%)	27.8	29.6	31.2	32.6





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California Bearing Ratio Test Data Sheet

ASTM D1883-21

Project No.	1000-043-31	Source	TH25-02 (McDermot/Adelaide Alley)
Client	WSP	Material	Clay
Project	COW Industrial Streets	Sample Date	16-Dec-25
Sample #	B26	Test Date	12-Jan-26
		Technician	A. Dustmamatov

Proctor Results (ASTM D698)

Maximum Dry Density	1359 kg/m ³
Optimum Moisture Content	30.3 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1299 kg/m ³
Initial Moisture Content	30.9 %
Relative Density	95.6 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	6.1 %
Moisture Content in top 25 mm	49.9 %
Immersion Period	96 h

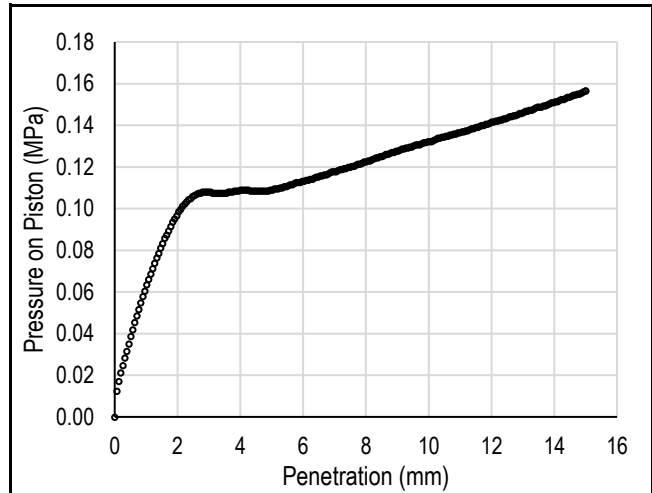
CBR Results

CBR at 2.54 mm	1.5 %
CBR at 5.08 mm	1.1 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.05	0.05
1.27	0.07	0.07
1.91	0.10	0.10
2.54	0.11	0.11
3.18	0.11	0.11
3.81	0.11	0.11
4.45	0.11	0.11
5.08	0.11	0.11
7.62	0.12	0.12
10.16	0.13	0.13
12.70	0.14	0.14

Load/Penetration Curve



Comments:



**City of Winnipeg Industrial Streets Renewal
McDermot/Adelaide Alley - Princess St. to Notre Dame Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-01	UTM : 5528884 m N, 6333333 m E; Located behind #62 Princess Ave, Southbound lane, 3.8 m East of building.	Asphalt	-	Concrete	150	-
PC25-02	UTM : 5528842 m N, 633294 m E; Located behind #57 Adelaide St, Westbound lane, 0.3 m South of road edge.	Asphalt	-	Concrete	140	-



Photo 1: Pavement Core Sample at TH25-01



Photo 2: Pavement Core Sample at TH25-02

Appendix E
Summary Table and Photographs of Pavement Core Samples

Harriet St. – Bannatyne Ave to McDermot Ave



**City of Winnipeg Industrial Streets Renewal
Harriet St. - Bannatyne Ave to McDermot Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-20	UTM : 5529238 m N, 632906 m E; Located 16 m South of Bannatyne Ave, Southbound curb lane, 2.1 m East of West curb.	Asphalt	-	Concrete	205	61.15
PC25-21	UTM : 5529181 m N, 632882 m E; Located 12 m North of McDermot Ave, Northbound curb lane, 3.9 m West of East curb.	Asphalt	-	Concrete	210	55.69



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Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-31

Date December 19, 2025

Project City of Winnipeg Industrial Streets Renewal

Technician T. Green

Client WSP Group Canada Inc.

Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Harriet St.	PC25-20	2025-12-16	2025-12-19	-	145	193	Soaked 48 h	56.34	61.15	1	0.9585	0.9802	1.0900	1.0600	1.0000
Harriet St.	PC25-21	2025-12-16	2025-12-19	-	145	200	Soaked 48 h	51.04	55.69	1	0.9634	0.9802	1.0900	1.0600	1.0000

Comments

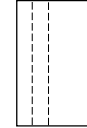
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc}F_{ld}F_{dia}F_{mc}F_DF_{reinf}$



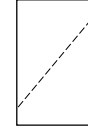
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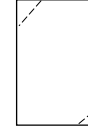
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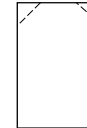
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Table 1 Factors involved in interpretation of core results by different codes.

List	Code/standard	Edition	Factors Considered					
			Aspect ratio	Diameter	Reinforcing	Moisture	Damage	Direction
1	Egyptian Code/Standard Specification	2008	✓		✓			✓
2	British Code/Standard Specification	2003	✓		✓			✓
3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

3.2. American Concrete Institute (ACI)

3.2.1. Former ACI Code (2002) & Current ASTM (2009)

The methodology of core interpretation given in the former ACI code was remained without changes for decades and up to Year (2003). The in-place strength of concrete cylinder at the location from which a core test specimen was extracted can be computed using the equation:

$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

3.2.2. Current ACI Code (2012) [15]

Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

Table 2 Mean values for factor $F_{l/d}$ according to ACI Code (1998) and ASTM.

	Specimen length-to-diameter ratio, l/d			
	1.00	1.25	1.50	1.75
$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r \times d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r \times r$) by ($\sum \Phi_r \times r$) as follows:

multiple bars

$$F_{reinf} = \left[1 + 1.5 \frac{\sum [\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (13)$$

where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

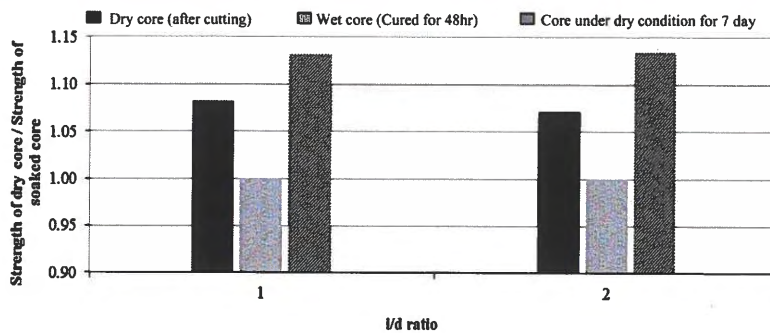


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).



Photo 1: Pavement Core Sample at PC25-20



Photo 2: Pavement Core Sample at PC25-21

Appendix F
Summary Table and Photographs of Pavement Core Samples
Harriet St. – McDermot Ave to Notre Dame Ave



**City of Winnipeg Industrial Streets Renewal
Harriet St. - McDermot Ave to Notre Dame Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-22	UTM : 5529144 m N, 632862 m E; Located 20 m South of McDermot Ave, Southbound curb lane, 3.5 m East of West curb.	Asphalt	-	Concrete	200	66.79
PC25-23	UTM : 5529073 m N, 632835 m E; Located at #55 Harriet St, Northbound curb lane, 3.2 m West of East curb.	Asphalt	-	Concrete	190	73.11
PC25-24	UTM : 5529048 m N, 632815 m E; Located 36 m North of Notre Dame Ave, Southbound curb lane, 1.7 m East of West curb.	Asphalt	-	Concrete	190	-



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Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-31

Date December 19, 2025

Project City of Winnipeg Industrial Streets Renewal

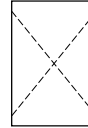
Technician T. Green

Client WSP Group Canada Inc.

Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Harriet St.	PC25-22	2025-12-16	2025-12-19	-	145	180	Soaked 48 h	62.21	66.79	1	0.9481	0.9802	1.0900	1.0600	1.0000
Harriet St.	PC25-23	2025-12-16	2025-12-19	-	145	182	Soaked 48 h	67.86	73.11	1	0.9513	0.9802	1.0900	1.0600	1.0000

Comments

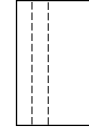
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc}F_{ld}F_{dia}F_{mc}F_DF_{reinf}$



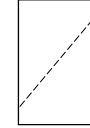
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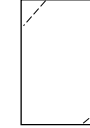
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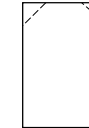
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3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

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$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

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Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

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	Specimen length-to-diameter ratio, l/d			
	1.00	1.25	1.50	1.75
$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
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	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r * d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r * r$) by ($\sum \Phi_r * r$) as follows:

multiple bars

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where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

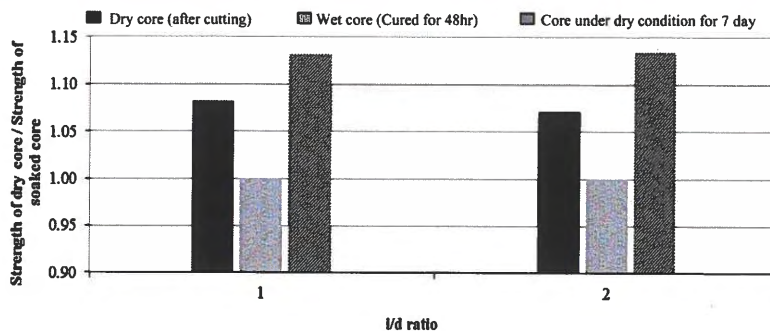


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).



Photo 1: Pavement Core Sample at PC25-22



Photo 2: Pavement Core Sample at PC25-23



Photo 3: Pavement Core Sample at PC25-24

Appendix G
Summary Table and Photographs of Pavement Core Samples

Gunnell St. – Henry Ave to Logan Ave



**City of Winnipeg Industrial Streets Renewal
Gunnell St. - Henry Ave to Logan Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-11	UTM : 5530027 m N, 632840 m E; Located 70 m North of Logan Ave, Southbound curb lane, 1.5 m East of West curb.	Asphalt	-	Concrete	220	61.95
PC25-12	UTM : 5529990 m N, 632829 m E; Located 33 m North of Logan Ave, Northbound curb lane, 1.5 m West of East curb.	Asphalt	-	Concrete	190	-
PC25-13	UTM : 5530048 m N, 632861 m E; Located 20 m South of Henry Ave, Northbound curb lane, 2.1 m West of East curb.	Asphalt	-	Concrete	200	71.25



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Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-31

Date December 19, 2025

Project City of Winnipeg Industrial Streets Renewal

Technician T. Green

Client WSP Group Canada Inc.

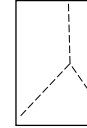
Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Gunnell St	PC25-11	2025-12-15	2025-12-19	-	145	196	Soaked 48 h	52.40	61.95	1	0.9603	0.9802	1.0900	1.0600	1.0870
Gunnell St	PC25-13	2025-12-15	2025-12-19	-	145	191	Soaked 48 h	65.63	71.25	1	0.9586	0.9802	1.0900	1.0600	1.0000

Comments

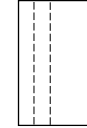
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc}F_{ld}F_{dia}F_{mc}F_DF_{reinf}$



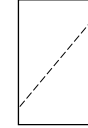
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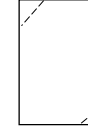
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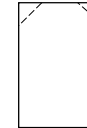
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		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

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The methodology of core interpretation given in the former ACI code was remained without changes for decades and up to Year (2003). The in-place strength of concrete cylinder at the location from which a core test specimen was extracted can be computed using the equation:

$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

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Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

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	Specimen length-to-diameter ratio, l/d			
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$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●		■	▲					
A7								■	▲	●			■	▲				
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r \times d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r \times r$) by ($\sum \Phi_r \times r$) as follows:

multiple bars

$$F_{reinf} = \left[1 + 1.5 \frac{\sum [\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (13)$$

where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

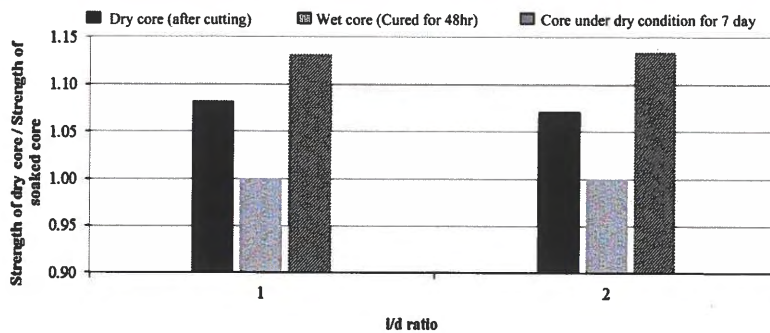


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).



Photo 1: Pavement Core Sample at PC25-11



Photo 2: Pavement Core Sample at PC25-12



Photo 3: Pavement Core Sample at PC25-13

Appendix H
Summary Table and Photographs of Pavement Core Samples

Henry Ave – Sherbrooke St. to Gunnell St.



**City of Winnipeg Industrial Streets Renewal
Henry Ave - Sherbrooke St. to Gunnell St.**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-14	UTM : 5530104 m N, 632796 m E; Located 23 m East of Gwendoline St., Westbound curb lane, 1.6 m South of North curb.	Asphalt	-	Concrete	185	-
PC25-16	UTM : 5530128 m N, 632742 m E; Located at #626 Henry Ave, Eastbound curb lane, 1.6 m North of South curb.	Asphalt	-	Concrete	220	-
PC25-17	UTM : 5530076 m N, 632857 m E; Located 6 m West of Gunnell St., Eastbound curb lane, 1.1 m North of South curb.	Asphalt	-	Concrete	200	54.24



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Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-31

Date December 19, 2025

Project City of Winnipeg Industrial Streets Renewal

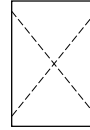
Technician T. Green

Client WSP Group Canada Inc.

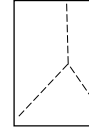
Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Henry Ave	PC25-17	2025-12-15	2025-12-19	-	145	188	Soaked 48 h	50.26	54.24	1	0.9528	0.9802	1.0900	1.0600	1.0000

Comments

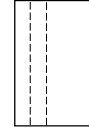
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc}F_{ld}F_{dia}F_{mc}F_DF_{reinf}$



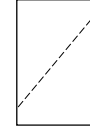
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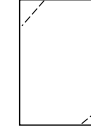
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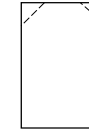
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List	Code/standard	Edition	Factors Considered					
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2	British Code/Standard Specification	2003	✓		✓			✓
3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

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	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
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A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
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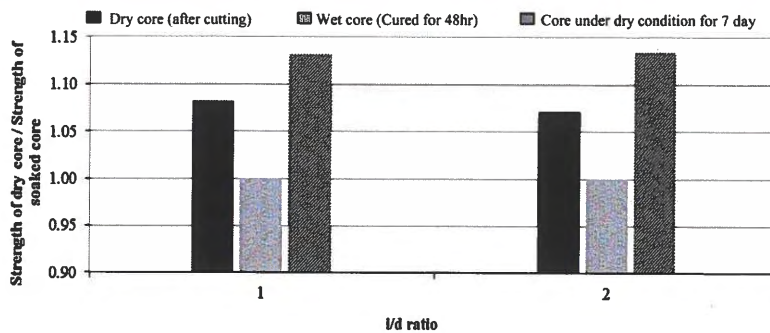


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).



Photo 1: Pavement Core Sample at PC25-14



Photo 2: Pavement Core Sample at PC25-16



Photo 3: Pavement Core Sample at PC25-17

Appendix I
Summary Table and Photographs of Pavement Core Samples

Sherbrooke St. – Logan Ave to Henry Ave



**City of Winnipeg Industrial Streets Renewal
Sherbrooke St. - Logan Ave to Henry Ave**

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		Corrected Compressive Strength (Mpa)
		Type	Thickness (mm)	Type	Thickness (mm)	
PC25-15	UTM : 5530151 m N, 632695 m E; Located at intersection of Henry Ave and Sherbrooke St., Eastbound curb lane, 1.1 m North of South curb.	Asphalt	-	Concrete	220	44.12
PC25-18	UTM : 5530128 m N, 632742 m E; Located at #626 Henry Ave, Eastbound curb lane, 1.6 m North of South curb.	Asphalt	-	Concrete	240	57.14
PC25-19	UTM : 5530076 m N, 632857 m E; Located 6 m West of Gunnell St., Eastbound curb lane, 1.1 m North of South curb.	Asphalt	-	Concrete	210	58.19



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Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-31

Date December 19, 2025

Project City of Winnipeg Industrial Streets Renewal

Technician T. Green

Client WSP Group Canada Inc.

Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Sherbrooke Ave	PC25-15	2025-12-16	2025-12-19	-	145	173	Soaked 48 h	37.84	44.12	1	0.9344	0.9802	1.0900	1.0600	1.1020
Sherbrooke Ave	PC25-18	2025-12-16	2025-12-19	-	145	220	Soaked 48 h	51.59	57.14	1	0.9779	0.9802	1.0900	1.0600	1.0000
Sherbrooke Ave	PC25-19	2025-12-16	2025-12-19	-	145	201	Soaked 48 h	53.27	58.19	1	0.9646	0.9802	1.0900	1.0600	1.0000

Comments

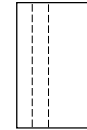
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc} F_{ld} F_{dia} F_{mc} F_D F_{reinf}$



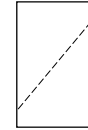
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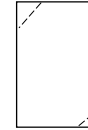
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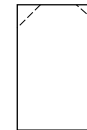
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4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

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	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r * d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r * r$) by ($\sum \Phi_r * r$) as follows:

multiple bars

$$F_{reinf} = \left[1 + 1.5 \frac{\sum [\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (13)$$

where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

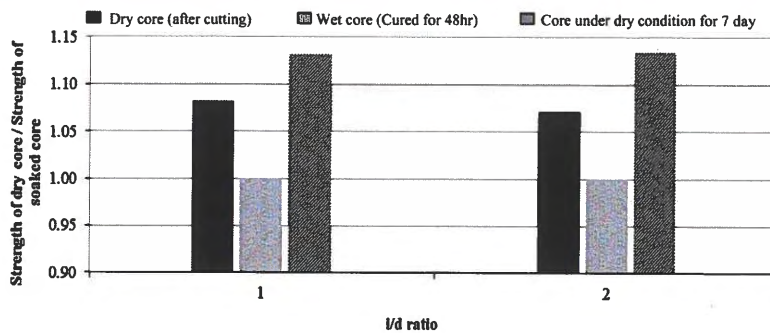


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).



Photo 1: Pavement Core Sample at PC25-15



Photo 2: Pavement Core Sample at PC25-18



Photo 3: Pavement Core Sample at PC25-19



Quality Engineering | Valued Relationships

WSP Canada Group Ltd.

2023 Local and Industrial Streets Renewal Package (23-RI-02)

Prepared for:

Mark Vogt, M.Sc., P.Eng.
WSP Canada Group Ltd.
111-93 Lombard Avenue
Winnipeg, MB
R3B 3B1

Project Number: 1000-043-22

Date: December 16, 2022



Quality Engineering | Valued Relationships

December 16, 2022

Our File No. 1000-043-22

Mark Vogt, M.Sc., P.Eng.
WSP Canada Group Ltd.
111-93 Lombard Avenue
Winnipeg, MB
R3B 3B1

RE: 2023 Local and Industrial Streets Renewal Package (23-RI-02)

TREK Geotechnical Inc. is pleased to submit our Final Report for the geotechnical investigation for 2023 Local and Industrial Streets Renewal Package (23-RI-02) project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

A handwritten signature in blue ink, appearing to read "Nelson John Ferreira", with a stylized flourish at the end.

Nelson John Ferreira, Ph.D., P.Eng.
Senior Geotechnical Engineer

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	AFK	December 16, 2022	Final Report

Authorization Signatures

Prepared By:



Angela Fidler-Kliewer, C.Tech.
Manager of Laboratory and Field Services



Reviewed By:

Nelson John Ferreira, Ph.D., P.Eng.
Senior Geotechnical Engineer



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Appendix B	Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos – Panet Rd (between Dugald Rd and 45 Panet Rd)

- Appendix C Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos–
Springfield Rd
- Appendix D Summary Table and Pavement Core Photos – Dugald Rd
- Appendix E Summary Table and Pavement Core Photos – Mazonod Rd
- Appendix F Summary Table and Pavement Core Photos – Beghin Ave

1.0 Introduction

This report summarizes the results of the road investigation completed for the Local and Industrial Streets Renewal 23-RI-02 project. The project included drilling test holes and collecting pavement cores along several streets. The test hole information collected describes the pavement structure of the existing road as well as the soil stratigraphy beneath the pavement structure. The investigation was carried out following the City of Winnipeg RFP No. 44-2022 (Appendix B – Site Investigation requirement for public works street projects).

2.0 Road Investigation

The investigation included coring of pavement at 19 locations on 7 different local and Industrial streets with drilling of test holes occurring at 9 of the cored locations along two streets. The investigation locations are shown on Figures 01 to 06 (attached) and the table below summarizes the investigation program per street.

Table I – Road Investigation Program

23-RI-02 Pavement and Geotechnical Investigation	# of Locations	Investigation
Panet Rd – Narin Av / CPR Tracks	3	3 test holes to a depths of 2.5 m
Panet Rd – Narin Av / CPR Tracks	2	2 Cores
Panet Rd – Dugald Rd / 45 Panet Rd	3	3 test holes to a depths of 2.5 m
Dugald Rd – Panet Rd / Dawson Rd N	4	4 Cores
Mazenod Rd SB and NB – Dugald Rd / De Baets St	2	4 Cores
Beghin Ave – De Baets St / Paquin Rd	2	4 Cores
Springfield Rd – Lagimodiere Blvd and Cox Blvd	3	3 test holes to a depths of 2.5 m

The road investigation was conducted between November 8, 2022 and November 25, 2022. The pavement structure (asphalt/concrete) was cored by Jashandeep Bhullar of TREK Geotechnical Inc. (TREK) using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bits. The test holes were drilled by Maple Leaf Drilling Ltd to a depth of approximately 3.0 m below road surface using a truck mounted drill rig equipped with 125 mm diameter solid stem augers. The sub-surface conditions were observed during drilling and visually classified by Jashandeep Singh Bhullar of TREK. Other pertinent information such as groundwater and drilling conditions were also recorded during the drilling investigation. Disturbed (auger cuttings) samples and bulk samples retrieved during

the sub-surface investigation were transported to TREK’s material testing laboratory for further testing. Pavement core samples were also retrieved and logged at TREK’s material testing laboratory

Core and test hole logs noted on the summary tables and test hole locations are based on UTM coordinates obtained using a hand-held GPS, and their location relative to the nearest address or intersection, measured distance from the edge of pavement, or other permanent features.

The laboratory testing program consisted of moisture content determination on all samples, as well as Atterberg Limits, and grain size analysis (mechanical sieve and hydrometer methods) on select samples between 0.6 and 0.9 m below pavement as well as Standard Proctor and CBR testing. Information gathered for each street package is included in separate appendices (Appendices A to F?). The information provided in the Appendices includes test hole logs, laboratory testing summary tables and results, photos of the concrete cores, and summary of pavement compressive strength.

Three CBR’s were completed on bulk samples of the soil units present below the pavement. Tests were performed on clay layers encountered within the prescribed sample depth for CBR testing and the results are shown in the table below.

Table 1: CBR Testing Summary

Soil Unit	Street	Depth (m)	SPMDD (kg/m ³)	Opt. Moisture (%)	Percent Proctor (%)	Moisture Content (%)	CBR Value at 2.54 mm	CBR Value at 5.08 mm
Clay	Panet Road (TH22-01 & 02 combined)	0.5 – 1.7	1489	26.2	94.6	25.6	1.9%	1.6%
Clay	Panet Road (TH22-07 & 08 combined)	0.3-2.4	1598	23.2	95.8	22.1	1.3%	1.3%
Clay	Springfield Road (TH22-18 & 19 combined)	0.8-3.0	1465	26.5	95.0	28.0	1.6%	1.4%

The test hole logs include a description of the soil units encountered during drilling and other pertinent information such as groundwater conditions and a summary of the laboratory testing results. The soils were classified in general accordance with the Unified Soil Classification System (USCS) and the AASHTO soil classification system (American Association of state highway and transportation officials). The AASHTO system classifies soils based on laboratory testing results from Atterberg Limits and grain size testing methods (hydrometer and mechanical sieve method). Where laboratory testing was not conducted, the AASHTO classification of the soils were interpreted based on a visual assessment as indicated with a (I) on the test hole logs and attached tables. For cohesive soils, the AASHTO system uses a combination of testing results to determine the Group Index of the soils and thus, were only determined where sufficient laboratory test data was available.

Six concrete cores were selected for concrete compressive strength breaks and the length to diameter ratio ranged between 1.28 to 1.43 for the cores collected. The core compressive strength tests were

tested in accordance with CSA A23.2-14C – wet dried condition. The measured compressive strengths were also corrected based on an adapted ACI 214.4R-03 Standard to estimate the in-place concrete strengths. The table below summarizes the compressive strength results while the compressive strength testing details and the correction factor methodology are included in Appendix A and D through F.

Table 2: Concrete Core Compressive Strength Results

Core ID (Location)	Uncorrected Compressive Strength (MPa)	Corrected Compressive Strength (MPa)
PC-04 (Panet Rd)	48.88	60.69
PC-05 (Panet Rd)	45.93	54.77
PC-10 (Dugald Road)	53.3	62.49
PC-14 (Mazenod Road)	46.73	55.22
PC-15 (Beghin Avenue)	59.36	63.29
PC-16 (Beghin Avenue)	51.80	55.91

3.0 Closure

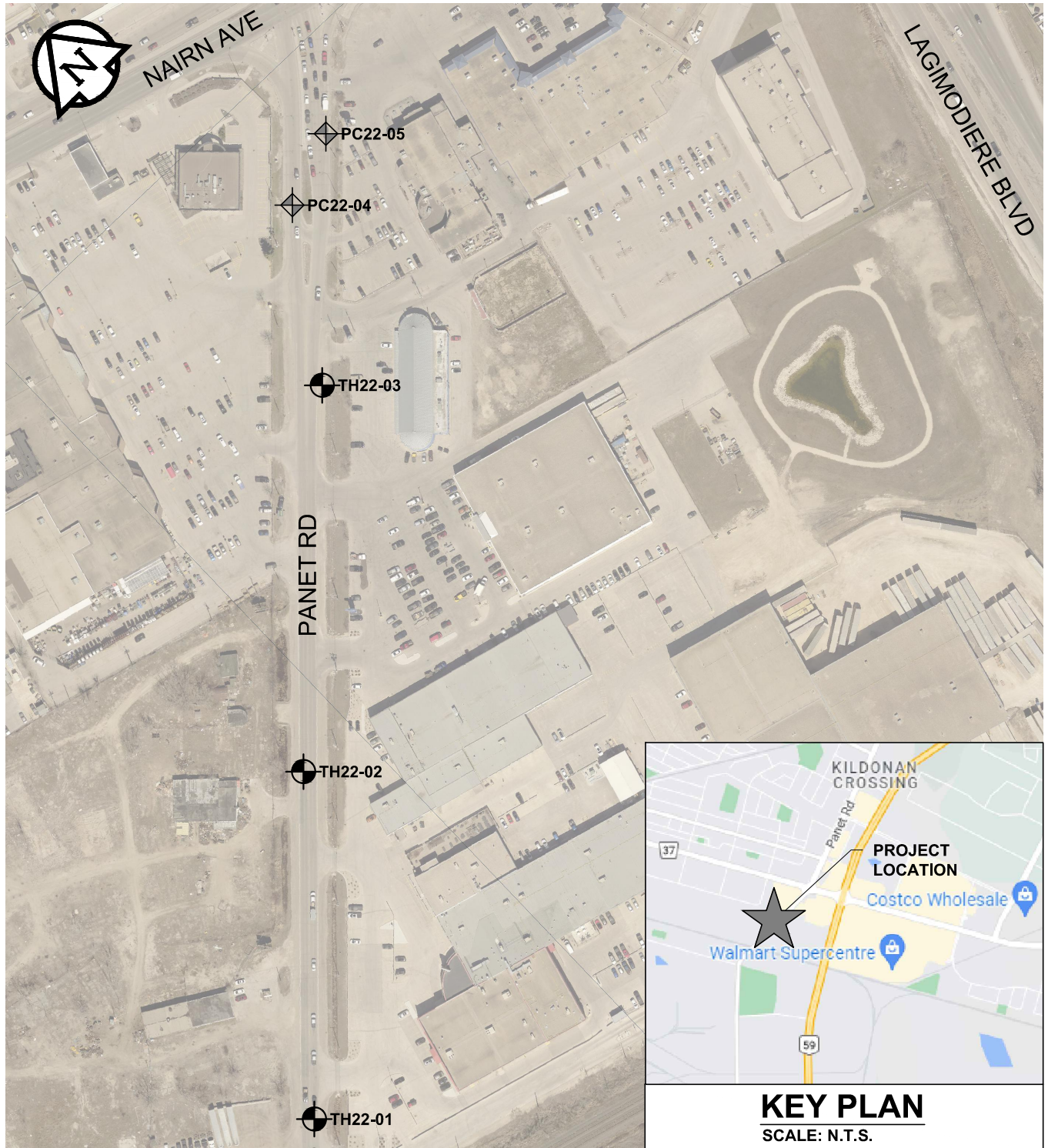
The information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation, laboratory testing, geometries). Soil conditions are natural deposits that can be highly variable across a site. If sub-surface 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 a mutually executed 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 WSP Canada Group Ltd. (the Client) 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

Z:\Projects\1000 Soils Lab\Projects\1000-043 WSP\1000-043-22 2023 Local Streets Package (23-RI-02)\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 01 to 06 2022-12-09 LSP23-RI-02_0_B 1000-043-22.dwg, 2022-12-09 2:19:44 PM

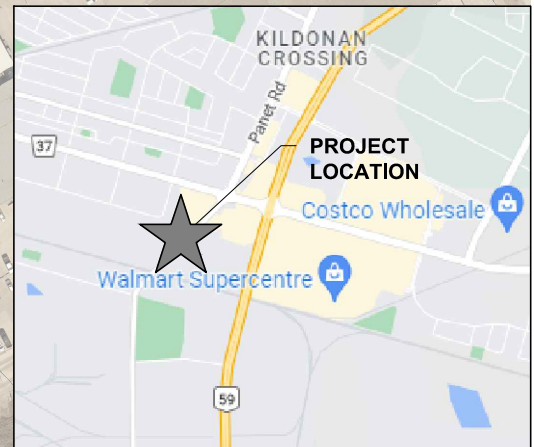
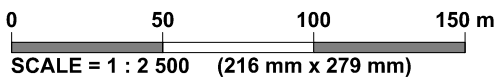


LEGEND:

- TEST HOLE (TREK, 2022)
- PAVEMENT CORE (TREK, 2022)

NOTES:

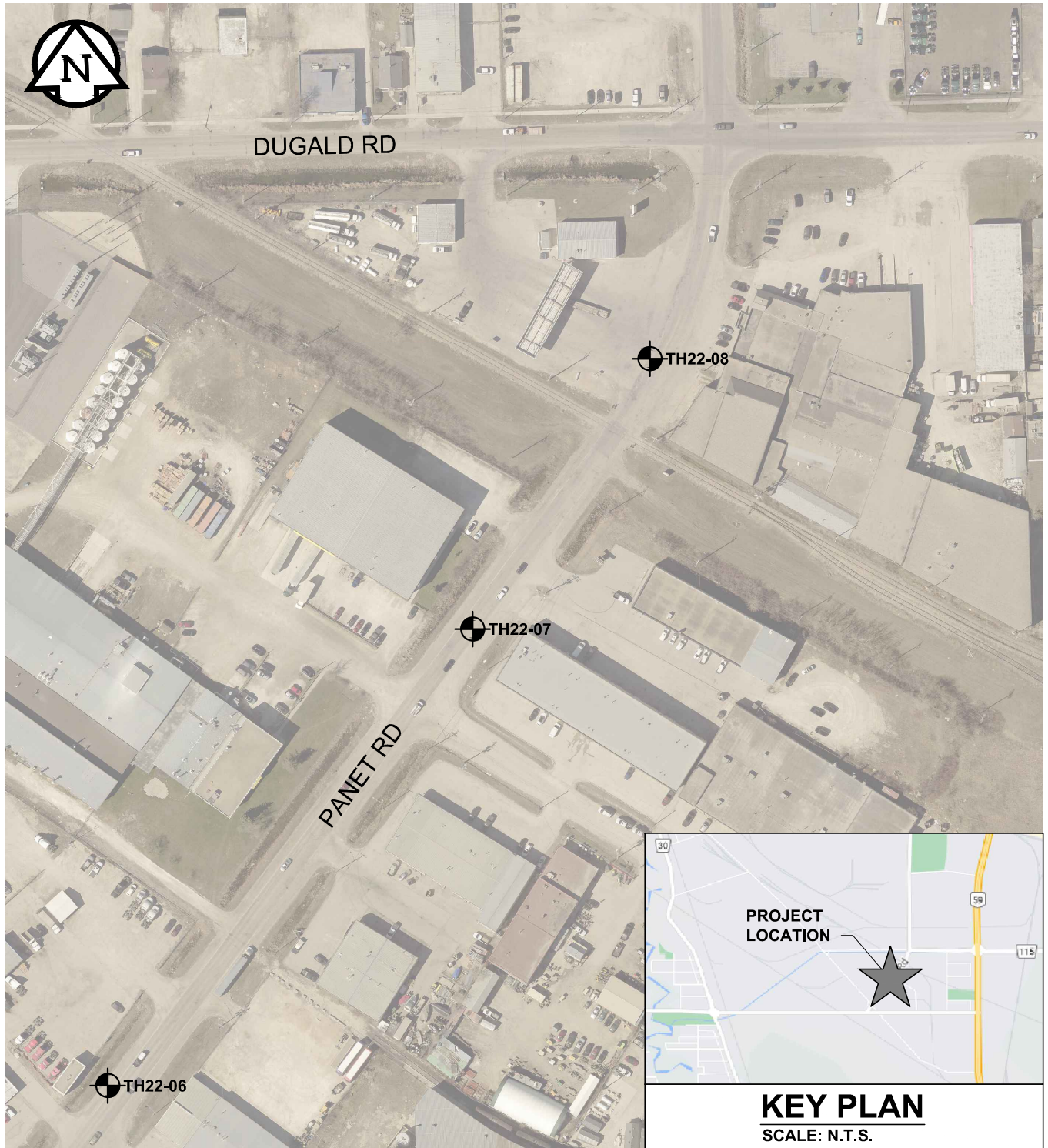
1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2021).



KEY PLAN
SCALE: N.T.S.

Figure 01
Test Hole and
Pavement Core Location Plan

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LEGEND:

TEST HOLE (TREK, 2022)

NOTES:

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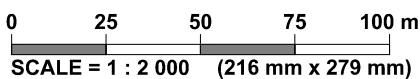


Figure 02
Test Hole Location Plan

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LEGEND:

TEST HOLE (TREK, 2022)

NOTES:

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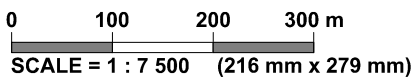
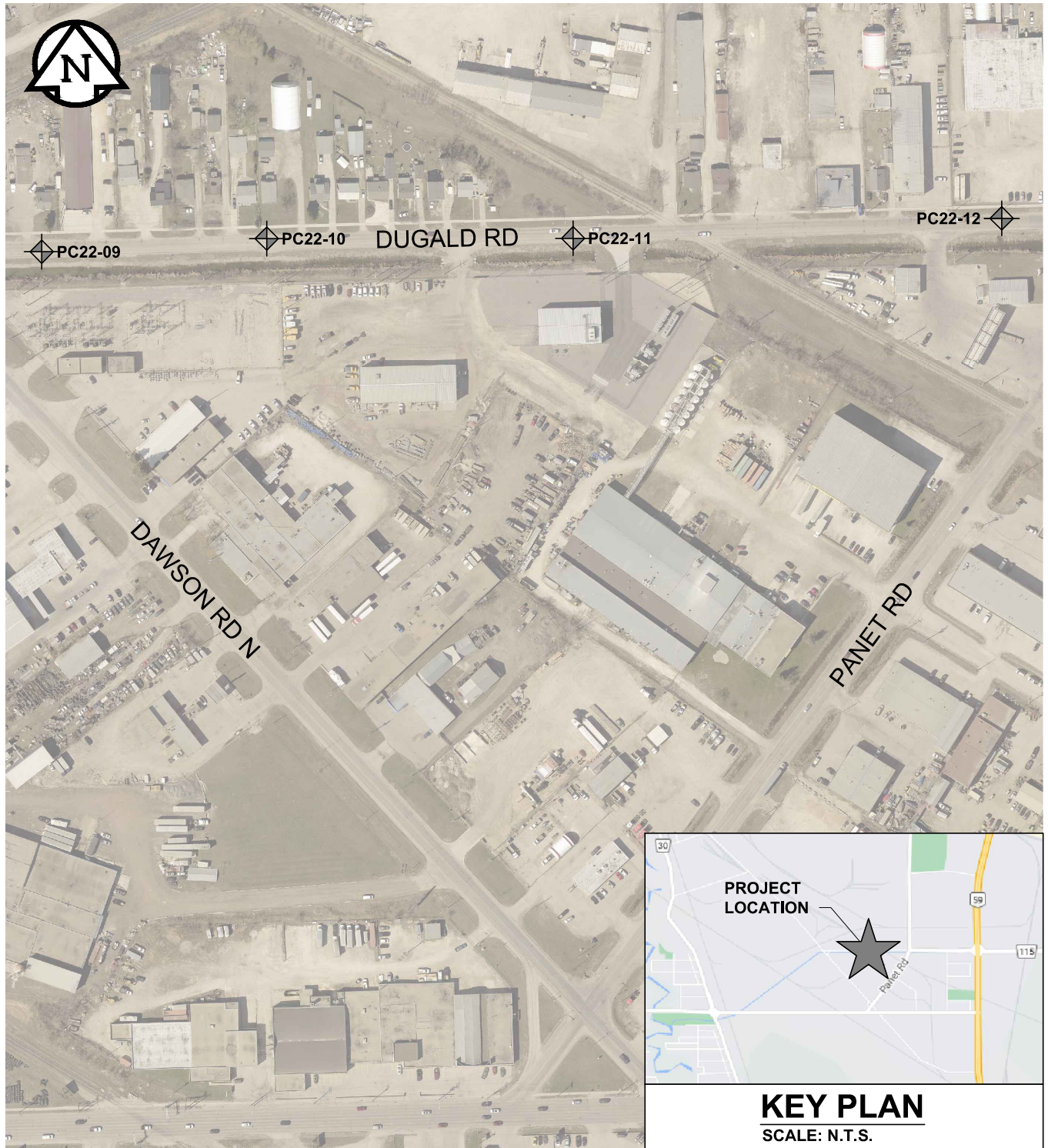


Figure 03
Test Hole Location Plan

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LEGEND:

◆ PAVEMENT CORE (TREK, 2022)

NOTES:

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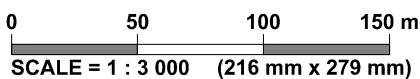
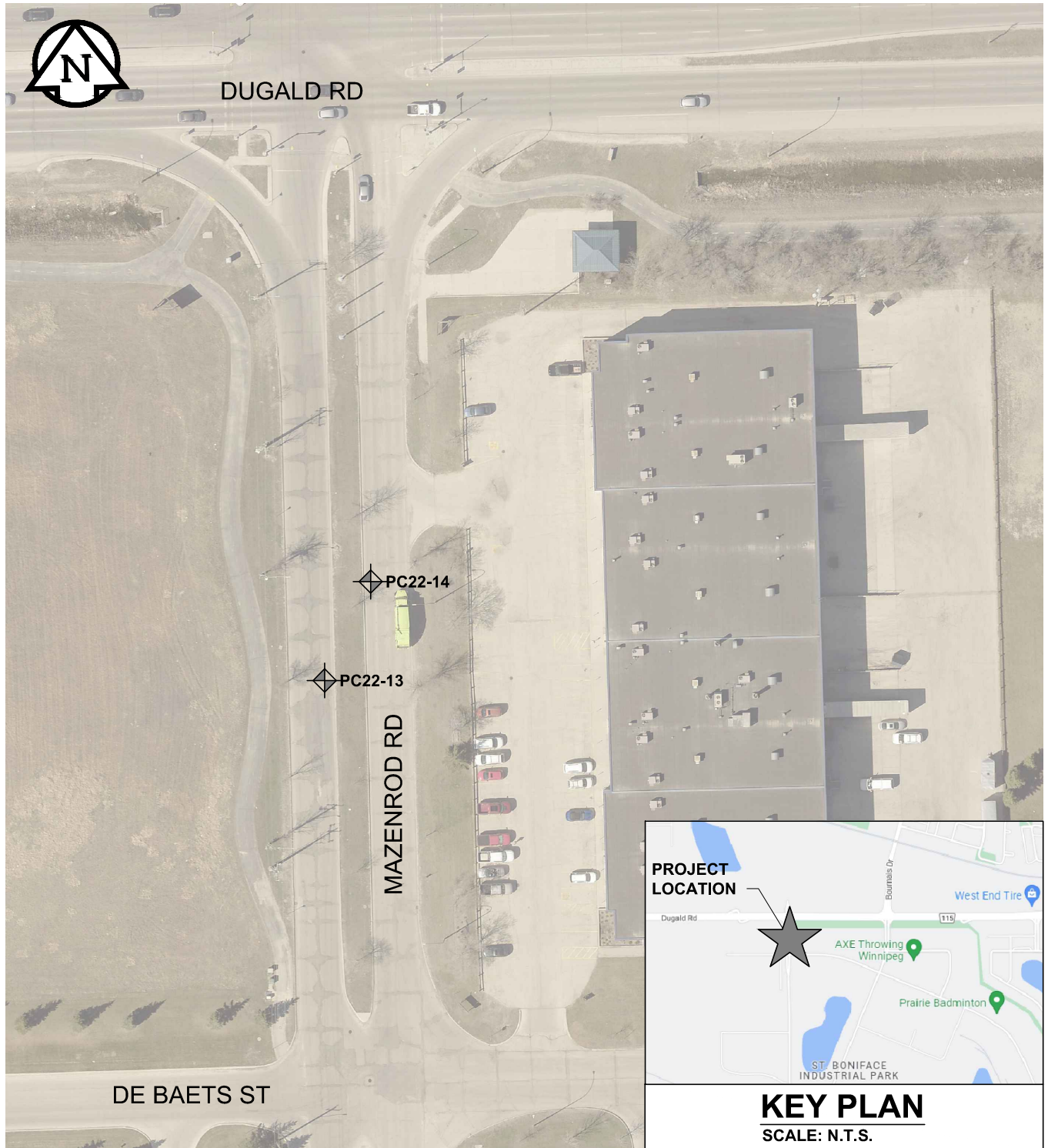


Figure 04
Pavement Core Location Plan

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LEGEND:

PAVEMENT CORE (TREK, 2022)

NOTES:

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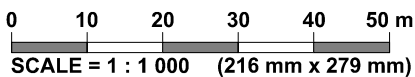


Figure 05
Pavement Core Location Plan



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LEGEND:

◆ PAVEMENT CORE (TREK, 2022)

NOTES:

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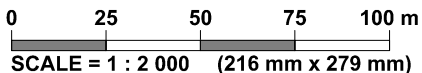


Figure 06
Pavement Core Location Plan

Appendix A

Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos – Panet Rd (between Nairn Ave and CPR tracks)

GENERAL NOTES

- 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.
- 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.
- 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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size	Material			
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)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting all gradation requirements for GW	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075	Sand Coarse Medium Fine			
		GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines						
		GM		Silty gravels, gravel-sand-silt mixtures						
		GC		Clayey gravels, gravel-sand-silt mixtures						
	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 Not meeting all gradation requirements for SW	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075	Sand Coarse Medium Fine		
			SP		Poorly-graded sands, gravelly sands, little or no fines					
		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 borderline cases requiring use of dual symbols	
			SC		Clayey sands, sand-clay mixtures					Atterberg limits above "A" line or P.I. greater than 7 Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
					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 cases requiring dual symbols*					
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 	mm > 300 75 to 300 19 to 75 4.75 to 19	Boulders Cobbles Gravel Coarse Fine			
		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	

* 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

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	▽ Water Level at Time of Drilling
PL - Plastic Limit (%)	▼ Water Level at End of Drilling
PI - Plasticity Index (%)	▽ Water Level After Drilling as Indicated on Test Hole Logs
MC - Moisture Content (%)	
SPT - Standard Penetration Test	
RQD- Rock Quality Designation	
Qu - Unconfined Compression	
Su - Undrained Shear Strength	
VW - Vibrating Wire Piezometer	
SI - Slope Incliner	

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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



Sub-Surface Log

Test Hole TH22-01 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. Project Number: 1000-043-22
 Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) Location: UTM N-5528813, E-638120
 Contractor: Maple Leaf Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount Date Drilled: November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)	
					16	17	18	19	20	21		
					Particle Size (%)							
					0	20	40	60	80	100		
					PL MC LL 0 20 40 60 80 100 0 50 100 150 200 250							
					Test Type △ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○							
0.0		ASPHALT - 120 mm thick		PC22-01								
0.0		CONCRETE - 110 mm thick										
0.0		SAND AND GRAVEL (FILL) - trace silt, trace gravel (< 50 mm diam.) - brown, moist, compact, sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)		G33	●							
0.5		CLAY - silty, trace sand, trace silt inclusions (< 10 mm diam.), trace organics - blackish grey - moist, stiff - high plasticity - AASHTO: A-7-6 (57)		G34	●						△ ⊕	
0.5				G35	●						△ ⊕	
1.0				G36							△ ⊕	
1.5				G37	●						△ ⊕	
1.5		- no organics, dark brown below 1.5 m		G38	●						△ ⊕	
2.0				G39	●						△ ⊕	
2.5		SILT - clayey, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-4 (I)		G40	●						⊕	
2.5				G41	●						⊕	
3.0				G42	●						⊕	

END OF TEST HOLE AT 3.0 m IN SILT.
 1) Sloughing not observed.
 2) Seepage observed below 2.1 m depth.
 3) Test hole open to 3.0 m depth and ground water level at 2.9 m depth immediately after drilling.
 4) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 5) Test hole located in front of #475 Panet Rd, 1.5 m West of East edge of road.
 6) The bulk sample was collected between 0.5 and 2.1 m depth.

Logged By: Jashandeep Singh Bhullar Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 23-R-02 0. B. USB 1000 043 22 GPU TREK GDT 12/15/22



Sub-Surface Log

Test Hole TH22-02 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. **Project Number:** 1000-043-22
Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) **Location:** UTM N-5528925, E-638219
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
		ASPHALT - 85 mm thick														
		CONCRETE - 115 mm thick		PC22-02												
		SAND AND GRAVEL (FILL) - trace silt, trace gravel (< 50 mm diam.) - brown, moist, compact, sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)		G16	●											
0.5		CLAY - silty, trace gravel (< 75 mm diam.) - greyish black - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G17		●										
1.0		- no gravel, brownish grey below 1.1 m		G18		●							△			+
1.5		- stiff below 1.4 m		G19		●							△			+
2.0		SILT - clayey - brown - moist, soft - low plasticity - AASHTO: A-4 (I)		G20		●							△			+
2.5				G21		●							△			+
3.0		CLAY - silty - brown, moist, stiff, high plasticity, AASHTO: A-7-6 (I)		G22		●										+
3.0				G23		●										+

END OF TEST HOLE AT 3.0 m IN CLAY.
 1) Seepage observed below 1.7 m depth.
 2) Sloughing not observed.
 3) Test hole open to 3.0 m depth and ground water level at 2.6 m depth immediately after drilling.
 4) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 5) Test hole located in front of #481 Panet Rd, 2.1 m East of West edge of road.
 6) The bulk sample was collected between 0.5 and 1.7 m depth.

Logged By: Jashandeep Singh Bhullar **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 23-R-02 0. B. USB 1000 043 22 GPL TREK GDT 12/15/22



Sub-Surface Log

Test Hole TH22-03 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. Project Number: 1000-043-22
 Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) Location: UTM N-5529041, E-638338
 Contractor: Maple Leaf Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount Date Drilled: November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.1		ASPHALT - 120 mm thick		PC22-03												
0.1 - 0.5		SAND AND GRAVEL (FILL) - trace clay, trace silt, trace gravel (< 50 mm diam.) - brown, moist - compact to dense, no to low plasticity - sub-rounded to angular crushed "pitrun", AASHTO: A-1-b (I)		G24												
0.5 - 1.0		CLAY - silty, trace sand - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (60) - brownish grey, stiff below 1.0 m		G25												
1.0 - 1.6				G26												
1.6 - 2.0		SILT - clayey, brown, moist, soft, low plasticity, AASHTO: A-4 (I)		G27												
2.0 - 2.4		CLAY - silty, trace silt inclusions (< 20 mm diam.) - brown - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G28												
2.4 - 2.5				G29												
2.5 - 2.6				G30												
2.6 - 2.8				G31												
2.8 - 3.0		- light brown below 2.4 m		G32												

END OF TEST HOLE AT 3.0 m IN CLAY.

- 1) Seepage or sloughing not observed.
- 2) Test hole open dry and open to 3.0 m depth immediately after drilling.
- 3) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
- 4) Test hole located in front of #435 Unit 2 Panet Rd, 0.4 m West of East edge of road.
- 5) The bulk sample was collected between 0.5 to 1.6 m and 1.6 to 3.0 m depth.

Logged By: Jashandeep Singh Bhullar Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 23-R-02 0. B. USB 1000 043 22 GPJ TREK GDT 12/15/22



2023 Local and Industrial Streets Renewal Project - 23-RI-02
Sub-Surface Investigation
Panet Rd - Narin Av / CPR Tracks

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits				
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index		
TH22-01	UTM: 14U 5528813 N, 638120 E Located in front of #475 Panet Rd, 1.5 m West of East edge of road.	Asphalt	120	Concrete	110	Sand and Gravel (Fill); AASHTO: A-7-6 (I)	0.2	0.4	9									
						Clay; AASHTO: A-7-6 (57)	0.4	0.6	30									
						Clay; AASHTO: A-7-6 (57)	0.8	0.9	32									
						Clay; AASHTO: A-7-6 (57)	1.1	1.2	32	66	31	3	0	23	74	52		
						Clay; AASHTO: A-7-6 (57)	1.4	1.5	32									
						Clay; AASHTO: A-7-6 (57)	1.5	1.7	32									
						Clay; AASHTO: A-7-6 (57)	1.8	2.0	30									
						Silt; AASHTO: A-4 (I)	2.1	2.3	23									
						Silt; AASHTO: A-4 (I)	2.6	2.7	28									
				Silt; AASHTO: A-4 (I)	2.9	3.0	24											
TH22-02	UTM: 14U 5528925 N, 638219 E Located in front of #481 Panet Rd, 2.1 m East of West edge of road.	Asphalt	85	Concrete	115	Sand and Gravel (Fill); AASHTO: A-1-b (I)	0.2	0.4	5									
						Clay; AASHTO: A-7-6 (I)	0.8	0.9	34									
						Clay; AASHTO: A-7-6 (I)	1.1	1.2	34									
						Clay; AASHTO: A-7-6 (I)	1.3	1.5	32									
						Silt; AASHTO: A-4 (I)	1.7	2.0	30									
						Silt; AASHTO: A-4 (I)	2.1	2.3	23									
						Silt; AASHTO: A-4 (I)	2.6	2.9	25									
						Clay; AASHTO: A-7-6 (I)	2.9	3.0	25									
TH22-03	UTM: 14U 5529041 N, 638338 E Located in front of #435 Unit 2 Panet Rd, 0.4 m West of East edge of road.	Asphalt	120	Concrete	-	Sand and Gravel (Fill); AASHTO: A-1-b (I)	0.1	0.5	10									
						Clay; AASHTO: A-7-6 (60)	0.8	1.0	29									
						Clay; AASHTO: A-7-6 (60)	1.0	1.2	31	64	31	5	0	22	78	56		
						Clay; AASHTO: A-7-6 (60)	1.4	1.5	32									
						Silt; AASHTO: A-4 (I)	1.6	1.7	27									
						Clay; AASHTO: A-7-6 (I)	1.7	1.9	35									
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	35									
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	42									
						Clay; AASHTO: A-7-6 (I)	2.9	3.0	50									

(I) - AASHTO classification was interpreted based on visual classification.



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Moisture Content Report ASTM D2216-10

Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Panet Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	0.2 - 0.4	0.4 - 0.6	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.5 - 1.7
Sample #	G33	G34	G35	G36	G37	G38
Tare ID	N64	H22	W13	AB96	E33	P36
Mass of tare	8.8	9.1	8.5	6.9	8.5	8.7
Mass wet + tare	372.2	234.6	323.5	416.8	254.7	289.6
Mass dry + tare	341.3	182.3	246.6	317.4	195.1	221.2
Mass water	30.9	52.3	76.9	99.4	59.6	68.4
Mass dry soil	332.5	173.2	238.1	310.5	186.6	212.5
Moisture %	9.3%	30.2%	32.3%	32.0%	31.9%	32.2%

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-02	TH22-02
Depth (m)	1.8 - 2.0	2.1 - 2.3	2.6 - 2.7	2.9 - 3.0	0.2 - 0.5	0.8 - 0.9
Sample #	G39	G40	G41	G42	G16	G17
Tare ID	F104	Z07	W10	AB69	AC26	H2
Mass of tare	8.5	8.8	8.5	6.8	6.8	8.6
Mass wet + tare	296.8	319.5	319.2	388.5	488.6	284.7
Mass dry + tare	230.2	261.7	250.9	313.8	466.7	214.8
Mass water	66.6	57.8	68.3	74.7	21.9	69.9
Mass dry soil	221.7	252.9	242.4	307.0	459.9	206.2
Moisture %	30.0%	22.9%	28.2%	24.3%	4.8%	33.9%

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	1.1 - 1.2	1.3 - 1.5	1.7 - 2.0	2.1 - 2.3	2.6 - 2.9	2.9 - 3.0
Sample #	G18	G19	G20	G21	G22	G23
Tare ID	P40	D37	Z59	N28	K19	W46
Mass of tare	8.8	8.6	8.0	8.4	8.5	8.7
Mass wet + tare	304.1	289.2	265.2	323.2	300.2	284.4
Mass dry + tare	228.5	220.6	205.7	265.4	242.1	228.9
Mass water	75.6	68.6	59.5	57.8	58.1	55.5
Mass dry soil	219.7	212.0	197.7	257.0	233.6	220.2
Moisture %	34.4%	32.4%	30.1%	22.5%	24.9%	25.2%



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Moisture Content Report ASTM D2216-10

Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Panet Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	0.1 - 0.5	0.8 - 1.0	1.0 - 1.2	1.4 - 1.5	1.6 - 1.7	1.7 - 1.9
Sample #	G24	G25	G26	G27	G28	G29
Tare ID	D38	AB64	K37	D32	A101	H21
Mass of tare	8.4	6.7	8.5	8.6	8.7	9.2
Mass wet + tare	418.1	343.4	400.0	268.5	361.6	312.5
Mass dry + tare	380.2	268.1	306.6	205.3	286.6	234.6
Mass water	37.9	75.3	93.4	63.2	75.0	77.9
Mass dry soil	371.8	261.4	298.1	196.7	277.9	225.4
Moisture %	10.2%	28.8%	31.3%	32.1%	27.0%	34.6%

Test Hole	TH22-03	TH22-03	TH22-03			
Depth (m)	2.1 - 2.3	2.4 - 2.7	2.9 - 3.0			
Sample #	G30	G31	G32			
Tare ID	N02	P51	N99			
Mass of tare	8.6	8.6	8.5			
Mass wet + tare	287.4	275.6	224.1			
Mass dry + tare	215.7	197.0	152.4			
Mass water	71.7	78.6	71.7			
Mass dry soil	207.1	188.4	143.9			
Moisture %	34.6%	41.7%	49.8%			



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Atterberg Limits
ASTM D4318-10e1

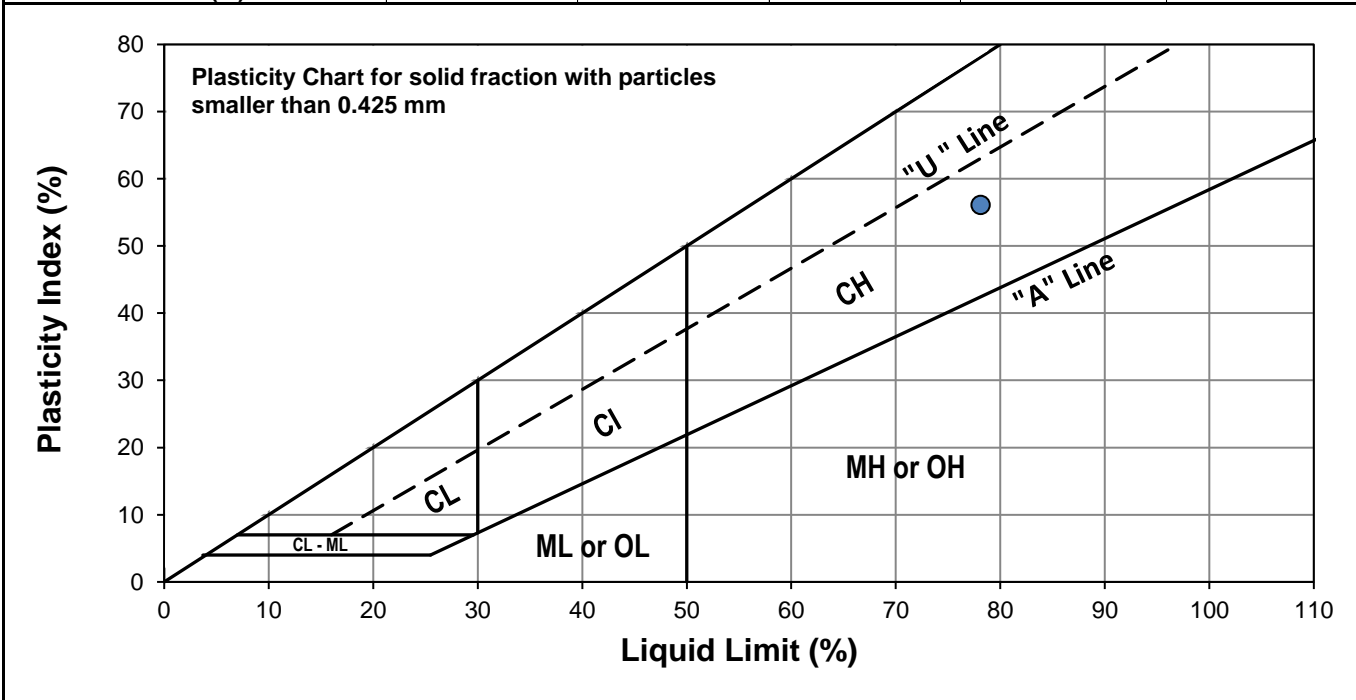
Project No. 1000-043-21
Client WSP Canada Group Ltd.
Project 2023 Local and Industrial Streets Package (23-R1-01)-Panet Rd
Test Hole TH22-03
Sample # G26
Depth (m) 1.0 - 1.3
Sample Date 15-Nov-22
Test Date 29-Nov-22
Technician MT



Liquid Limit	78
Plastic Limit	22
Plasticity Index	56

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	18	21	34
Mass Tare (g)	14.165	14.083	13.838
Mass Wet Soil + Tare (g)	24.150	23.181	28.223
Mass Dry Soil + Tare (g)	19.717	19.173	21.979
Mass Water (g)	4.433	4.008	6.244
Mass Dry Soil (g)	5.552	5.090	8.141
Moisture Content (%)	79.845	78.743	76.698



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.090	14.054			
Mass Wet Soil + Tare (g)	23.018	25.919			
Mass Dry Soil + Tare (g)	21.406	23.776			
Mass Water (g)	1.612	2.143			
Mass Dry Soil (g)	7.316	9.722			
Moisture Content (%)	22.034	22.043			

Note: Additional information recorded/measured for this test is available upon request.



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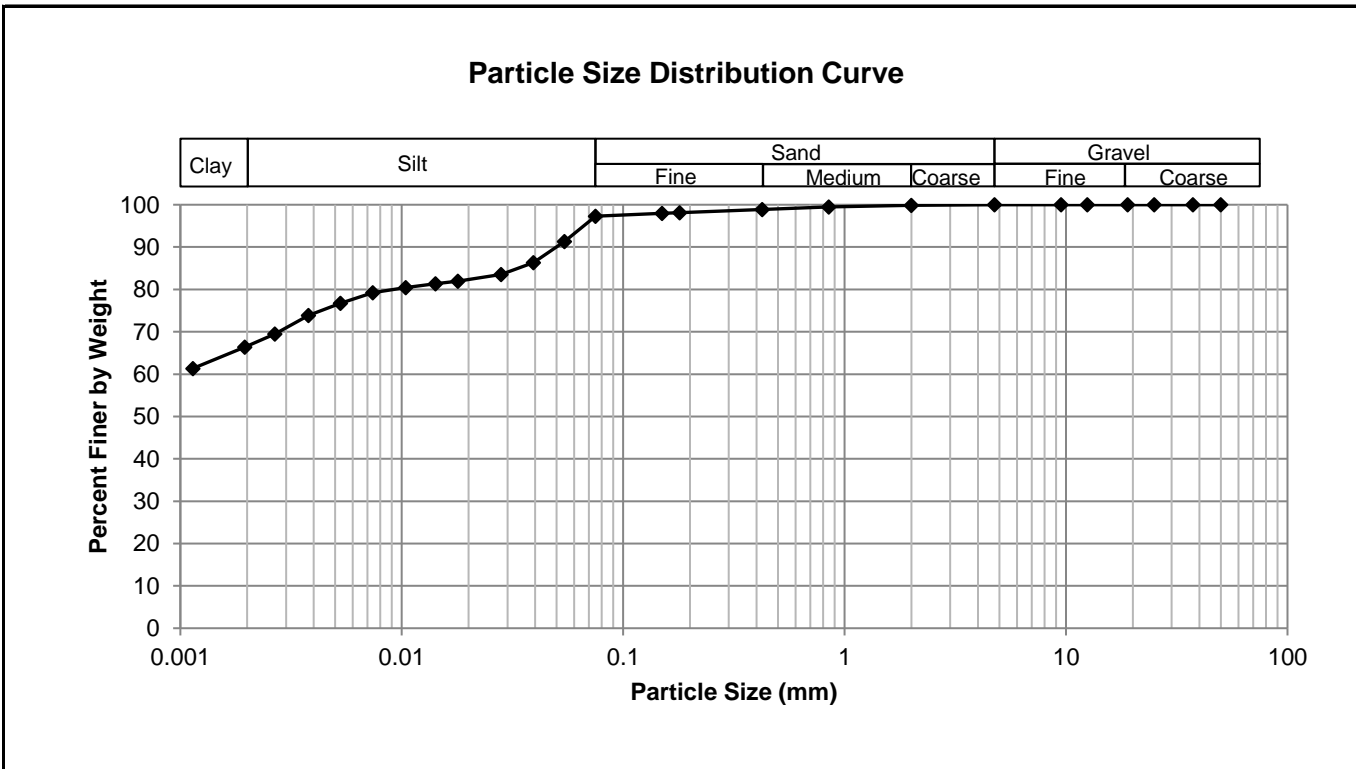
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local Street and Industrial Package (23-RI-02) Panet Rd



Test Hole TH22-01
Sample # G36
Depth (m) 1.1 - 1.2
Sample Date 14-Nov-22
Test Date 29-Nov-22
Technician DS

Gravel	0.0%
Sand	2.7%
Silt	30.7%
Clay	66.5%



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	97.26
37.5	100.00	2.00	99.89	0.0543	91.34
25.0	100.00	0.850	99.51	0.0393	86.34
19.0	100.00	0.425	98.90	0.0282	83.53
12.5	100.00	0.180	98.15	0.0180	81.92
9.50	100.00	0.150	98.01	0.0142	81.34
4.75	100.00	0.075	97.26	0.0104	80.41
				0.0074	79.20
				0.0053	76.70
				0.0038	73.89
				0.0027	69.47
				0.0020	66.35
				0.0011	61.36



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ASTM D4318-10e1

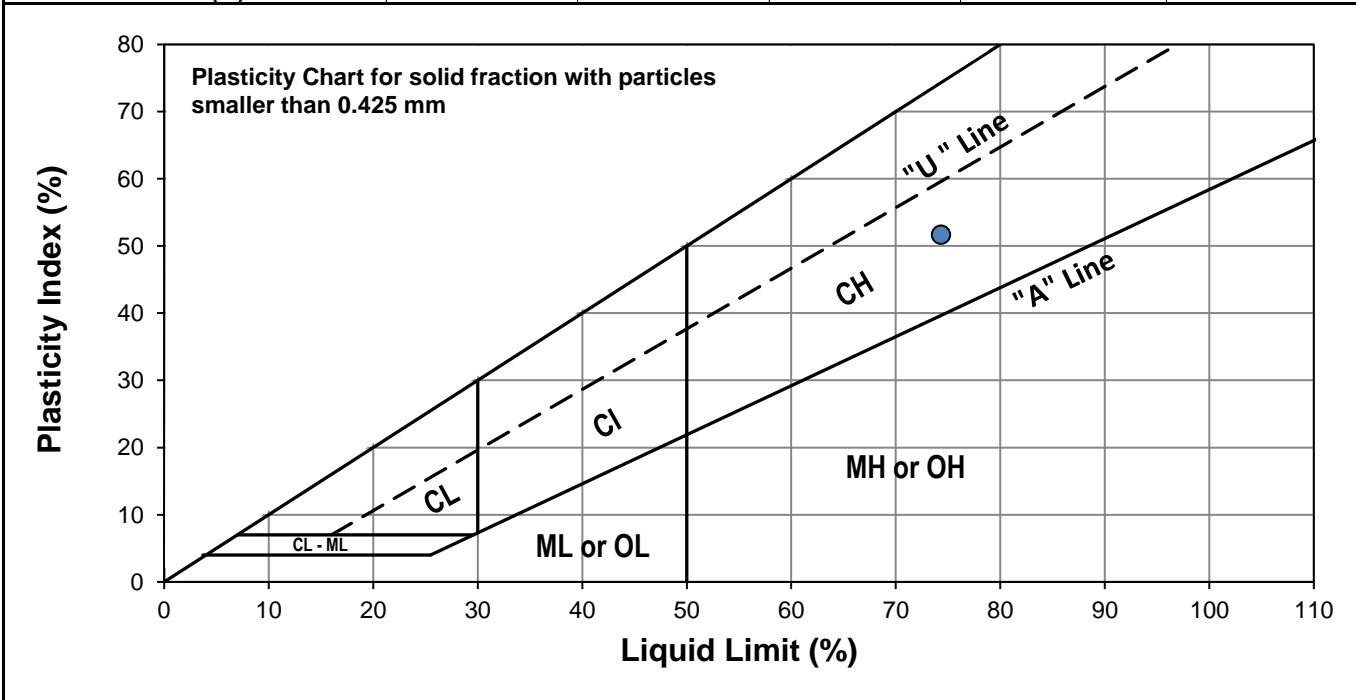
Project No. 1000-043-21
Client WSP Canada Group Ltd.
Project 2023 Local and Industrial Streets Package (23-R1-01) -Panet Rd
Test Hole TH22-01
Sample # G36
Depth (m) 1.1 - 1.2
Sample Date 15-Nov-22
Test Date 29-Nov-22
Technician MT



Liquid Limit	74
Plastic Limit	23
Plasticity Index	52

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	16	24	29
Mass Tare (g)	14.202	14.010	13.444
Mass Wet Soil + Tare (g)	26.668	25.514	22.432
Mass Dry Soil + Tare (g)	21.100	20.560	18.680
Mass Water (g)	5.568	4.954	3.752
Mass Dry Soil (g)	6.898	6.550	5.236
Moisture Content (%)	80.719	75.634	71.658



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.947	14.111			
Mass Wet Soil + Tare (g)	24.795	26.451			
Mass Dry Soil + Tare (g)	22.788	24.170			
Mass Water (g)	2.007	2.281			
Mass Dry Soil (g)	8.841	10.059			
Moisture Content (%)	22.701	22.676			

Note: Additional information recorded/measured for this test is available upon request.



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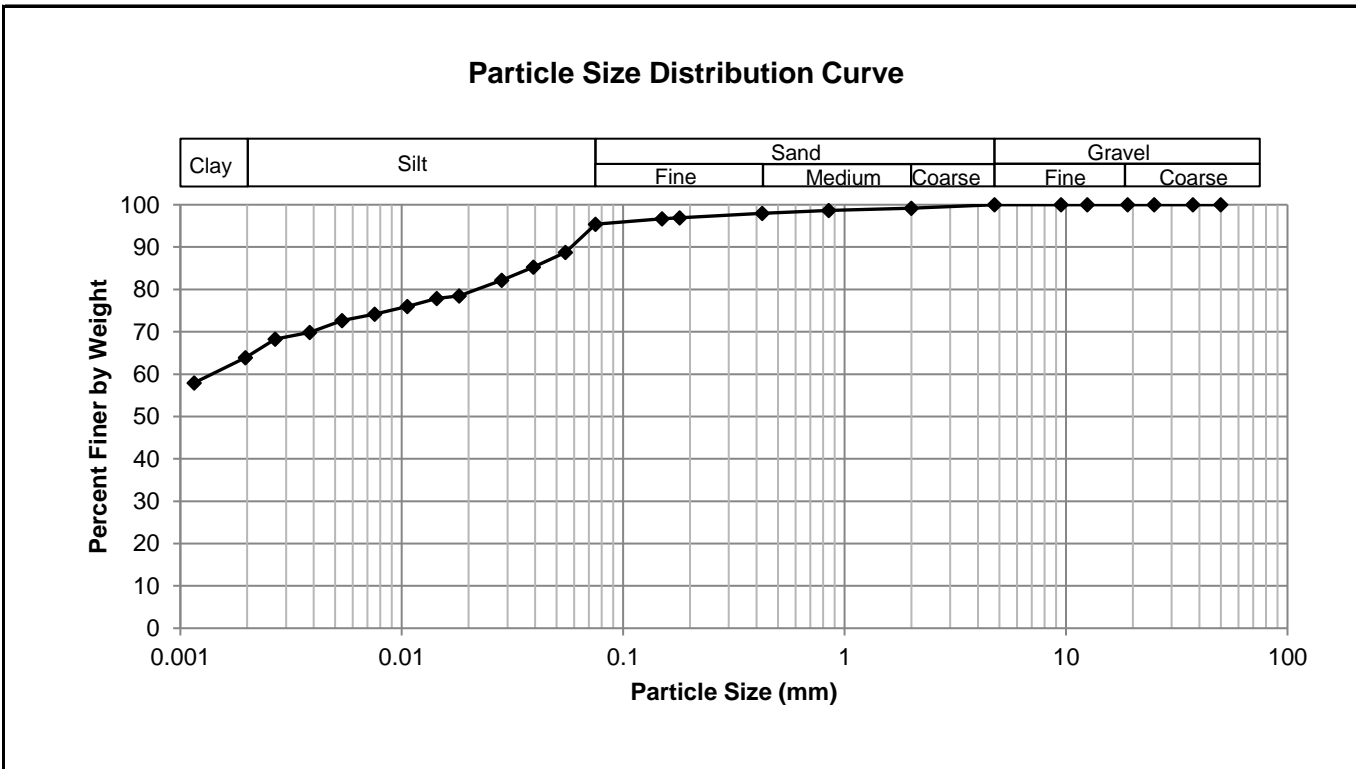
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local Street and Industrial Package (23-RI-02) Panet Rd



Test Hole TH22-03
Sample # G26
Depth (m) 1.0 - 1.2
Sample Date 14-Nov-22
Test Date 29-Nov-22
Technician DS

Gravel	0.0%
Sand	4.6%
Silt	31.3%
Clay	64.1%



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	95.38
37.5	100.00	2.00	99.21	0.0548	88.72
25.0	100.00	0.850	98.63	0.0394	85.31
19.0	100.00	0.425	97.98	0.0283	82.21
12.5	100.00	0.180	96.94	0.0182	78.45
9.50	100.00	0.150	96.67	0.0144	77.87
4.75	100.00	0.075	95.38	0.0106	76.01
				0.0076	74.18
				0.0054	72.63
				0.0038	69.83
				0.0027	68.25
				0.0020	63.91
				0.0012	57.94



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Standard Proctor Compaction Test
ASTM D698-12 (2021)

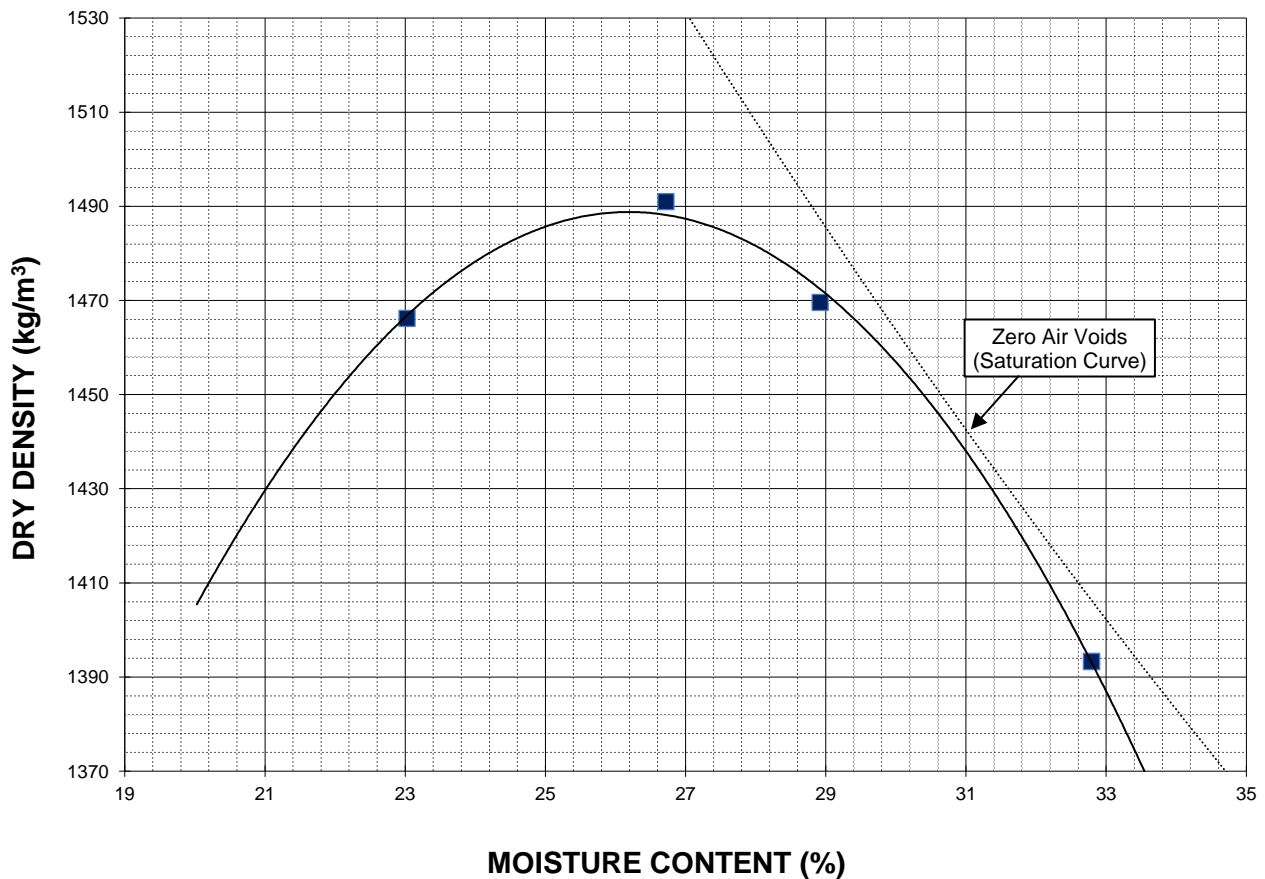


Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local and Industrial Streets Package (23-RI-02)

Sample # TH22-01 & TH22-02 (combined)
Source Panet Rd.
Material Clay
Sample Date 15-Nov-22
Test Date 23-Nov-22
Technician DS

Maximum Dry Density (kg/m³)	1489
Optimum Moisture (%)	26.2

Trial Number	1	2	3	4	
Wet Density (kg/m³)	1804	1890	1895	1850	
Dry Density (kg/m³)	1466	1491	1470	1393	
Moisture Content (%)	23.0	26.7	28.9	32.8	



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.	1000-043-22	Source	Panet Rd.
Client	WSP Canada Group Ltd.	Material	Clay
Project	2023 Local Streets (23-RI-02)	Sample Date	2022-11-15
Sample #	TH22-01 & TH22-02 (combined)	Test Date	2022-11-25
		Technician	DS

Proctor Results (ASTM D698)

Maximum Dry Density	1489 kg/m ³
Optimum Moisture Content	26.2 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1409 kg/m ³
Initial Moisture Content	25.6 %
Relative Density	94.6 % SPMD

Soaking Results

Surcharge	4.54 kg
Swell	2.3 %
Moisture Content in top 25 mm	39.3 %
Immersion Period	96 h

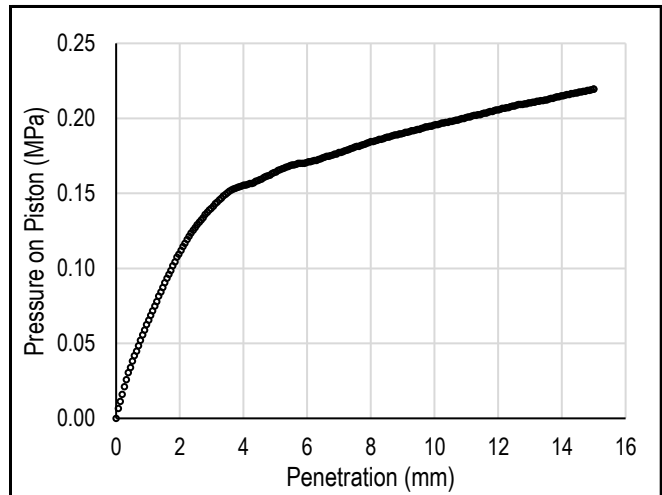
CBR Results

CBR at 2.54 mm	1.9 %
CBR at 5.08 mm	1.6 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.05	0.05
1.27	0.08	0.08
1.91	0.11	0.11
2.54	0.13	0.13
3.18	0.14	0.14
3.81	0.15	0.15
4.45	0.16	0.16
5.08	0.17	0.17
7.62	0.18	0.18
10.16	0.20	0.20
12.70	0.21	0.21

Load/Penetration Curve



Comments:

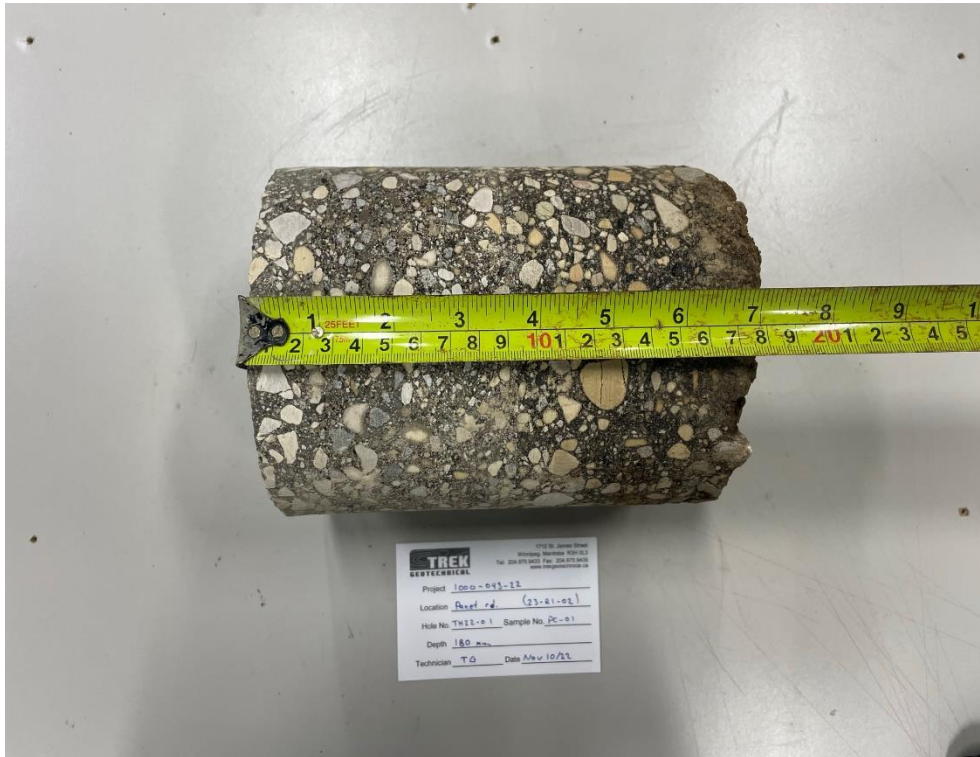


Photo 1: Pavement Core Sample at TH22-01



Photo 2: Pavement Core Sample at TH22-02



Photo 3: Pavement Core Sample at TH22-03



2023 Local and Industrial Streets Renewal Package - 23-RI-02

Panet Rd - Narin Av / CPR Tracks

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		
		Type	Thickness (mm)	Type	Thickness (mm)	Corrected Compressive Strength (Mpa)
PC22-01	UTM: 14U 5528813 N, 638120 E; Located in front of #475 Panet Rd, 1.5 m West of East edge of road.	Asphalt	120	Concrete	110	-
PC22-02	UTM: 14U 5528925 N, 638219 E; Located in front of #481 Panet Rd, 2.1 m East of West edge of road.	Asphalt	85	Concrete	115	-
PC22-03	UTM: 14U 5529041N, 638338 E; Located in front of #435 Unit 2 Panet Rd, 0.4 m West of East edge of road.	Asphalt	120	Concrete	-	-
PC22-04	UTM: 14U 5529106 N, 638382 E; 1.6 m East of West edge of road.	Asphalt	-	Concrete	190	61
PC22-05	UTM: 14U 5529117 N, 638415 E; 1.8 m West of East edge of road.	Asphalt	-	Concrete	215	54.77



Photo 1: Pavement Core Sample PC-04



Photo 2: Pavement Core Sample PC-05

Concrete Core Compressive Strength Report

CSA A23.2-14C

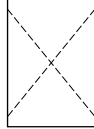
Project No. 1000-043-22
Project 2023 Local Streets Package - 23-R1-02
Client WSP Group Canada Inc.

Date December 14, 2022
Technician KM

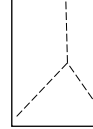
Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
*Panet Road	PC-04	2022-11-10	2022-12-14	-	145	186	Soaked 48 h	48.88	60.69	1	0.9506	0.9802	1.0900	1.0600	1.1531
Panet Road	PC-05	2022-11-10	2022-12-14	-	145	208	Soaked 48 h	45.93	54.77	1	0.9689	0.9802	1.0900	1.0600	1.0867

Comments

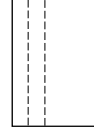
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc} F_{ld} F_{dia} F_{mc} F_D F_{reinf}$
 *PC-04 contained tie off rebar in specimen along with reinforcing rebar.



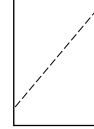
Type 1



Type 2



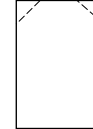
Type 3



Type 4



Type 5



Type 6

Reviewed by (print): Angela Fidler-Kliwer, C.Tech.

Signature: Angela Fidler-Kliwer

Table 1 Factors involved in interpretation of core results by different codes.

List	Code/standard	Edition	Factors Considered					
			Aspect ratio	Diameter	Reinforcing	Moisture	Damage	Direction
1	Egyptian Code/Standard Specification	2008	✓		✓			✓
2	British Code/Standard Specification	2003	✓		✓			✓
3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

3.2. American Concrete Institute (ACI)

3.2.1. Former ACI Code (2002) & Current ASTM (2009)

The methodology of core interpretation given in the former ACI code was remained without changes for decades and up to Year (2003). The in-place strength of concrete cylinder at the location from which a core test specimen was extracted can be computed using the equation:

$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

3.2.2. Current ACI Code (2012) [15]

Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

Table 2 Mean values for factor $F_{l/d}$ according to ACI Code (1998) and ASTM.

	Specimen length-to-diameter ratio, l/d			
	1.00	1.25	1.50	1.75
$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r * d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r * r$) by ($\sum \Phi_r * r$) as follows:

multiple bars

$$F_{reinf} = \left[1 + 1.5 \frac{\sum [\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (13)$$

where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

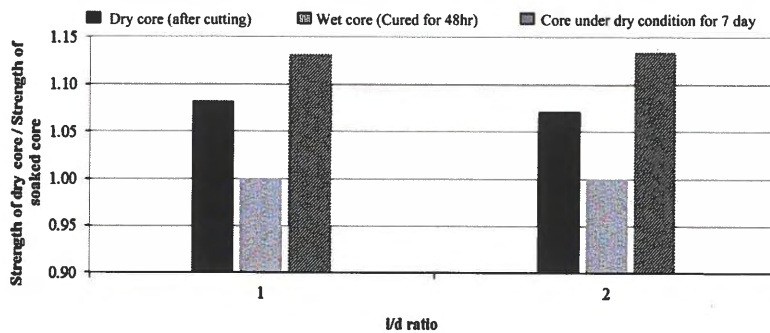


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).

Appendix B

Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos - Panet Rd (between Dugald Rd and 45 Panet Rd)

GENERAL NOTES

- 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.
- 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.
- 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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size	Material						
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)	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 cases 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	mm	Sand						
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW			ASTM Sieve Sizes					
		Sands (More than half of coarse fraction is smaller than 4.75 mm)	GM		Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	mm	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	Coarse Medium Fine				
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7				Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols			
	Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Sands with fines (Appreciable amount of 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		mm	Silt or Clay				
			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				mm	> 300 75 to 300 19 to 75 4.75 to 19	Boulders Cobbles Gravel Coarse Fine	
			SC		Clayey sands, sand-clay mixtures	Atterberg limits above "A" line or P.I. greater than 7							Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
		Silts and Clays (Liquid limit less than 50)	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				Von Post Classification Limit	Strong colour or odour, and often fibrous texture	mm	> 12 in. 3 in. to 12 in. 3/4 in. to 3 in. #4 to 3/4 in.
					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											
Highly Organic Soils	Silts and Clays (Liquid limit greater than 50)	OH	Organic clays of medium to high plasticity, organic silts										
		Pt	Peat and other highly organic soils										

* 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

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	▽ Water Level at Time of Drilling
PL - Plastic Limit (%)	▼ Water Level at End of Drilling
PI - Plasticity Index (%)	▽ Water Level After Drilling as Indicated on Test Hole Logs
MC - Moisture Content (%)	
SPT - Standard Penetration Test	
RQD- Rock Quality Designation	
Qu - Unconfined Compression	
Su - Undrained Shear Strength	
VW - Vibrating Wire Piezometer	
SI - Slope Incliner	

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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



Sub-Surface Log

Test Hole TH22-06 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. Project Number: 1000-043-22
 Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) Location: UTM N-5527395, E-637776
 Contractor: Maple Leaf Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount Date Drilled: November 25, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)									
					16	17	18	19	20	21	Test Type									
					Particle Size (%)															
					0	20	40	60	80	100										
					PL MC LL 0 20 40 60 80 100															
					0 20 40 60 80 100						0 50 100 150 200250									
											△ Torvane △ ⊕ Pocket Pen. ⊕ ⊠ Qu ⊠ ○ Field Vane ○									
0.0 - 0.2		ASPHALT - 250 mm thick		PC22-06																
0.2 - 0.5		SAND AND GRAVEL (FILL) - trace clay, trace silt, trace gravel (< 50 mm diam.) - brown - moist, compact - no to low plasticity, sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)		G89																
0.5 - 1.0		CLAY - silty, trace sand, trace gravel (< 10 mm diam.) - black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)		G90																
1.0 - 1.5		- stiff below 1.0 m		G91																
1.5 - 2.0				G92																
2.0 - 2.5		- trace silt inclusions (< 50 mm diam.), brown below 1.8 m		G93																
2.5 - 3.0				G94																
3.0 - 3.0		- some silt below 1.7 m		G95																

END OF TEST HOLE AT 3.0 m IN CLAY.
 1) Seepage or sloughing not observed.
 2) Test hole dry and open to 3.0 m depth immediately after drilling.
 3) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 4) Test hole located in front of #35 Panet Rd, 0.5 m East of West edge of road.
 5) The bulk sample was collected between 0.8 and 3.0 m depth.

Logged By: Jashandeep Singh Bhullar Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 2 23-R-02 0. B. USB 1000 043 22.GPJ TREK.GDT 12/15/22



Sub-Surface Log

Test Hole TH22-07 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. **Project Number:** 1000-043-22
Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) **Location:** UTM N-5527552, E-637904
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** November 25, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.2		ASPHALT - 120 mm thick		PC22-07												
0.2 - 1.0		CLAY (FILL) - silty, sandy, trace gravel (< 50 mm diam.) sub-rounded to angular - black - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G82												
1.0 - 1.7		CLAY - silty, trace silt inclusions (< 30 mm diam.) - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (49)		G83												
1.7 - 2.0		- brown below 1.7 m		G84												
2.0 - 2.2				G85												
2.2 - 2.4				G86												
2.4 - 2.7				G87												
2.7 - 3.0		SILT - clayey - brown - moist, soft - low plasticity, AASHTO: A-4 (I)		G88												

END OF TEST HOLE AT 3.0 m IN SILT.
 1) Seepage or sloughing not observed.
 2) Test hole dry and open to 3.0 m depth immediately after drilling.
 3) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 4) Test hole located in front of #405 Panet Rd, 2.2 m West of East edge of road.
 5) The bulk sample was collected between 0.2 and 2.7 m depth.

Logged By: Jashandeep Singh Bhullar **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 2 23-R-02 0. B. JSB 1000 043 22.GPJ TREK.GDT 12/15/22



Sub-Surface Log

Test Hole TH22-08 (Panet Rd)

1 of 1

Client: WSP Canada Group Ltd. Project Number: 1000-043-22
 Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) Location: UTM N-5527645, E-637965
 Contractor: Maple Leaf Drilling Ltd. Ground Elevation: Top of Pavement
 Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount Date Drilled: November 25, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.1		ASPHALT - 170 mm thick		PC22-08												
0.1 - 0.3		SAND AND GRAVEL (FILL) - clayey, trace silt, trace gravel (< 50 mm diam.) - black, moist, compact to dense, no to low plasticity - sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)		G76	●											
0.3 - 0.5		CLAY (FILL) - silty, sandy, trace gravel (< 50 mm diam.) - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G77	●								△	+		
0.5 - 1.0		CLAY - silty - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G78A	●									+		
1.0 - 1.5		CLAY - silty - black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)		G79A	●										+	
1.5 - 2.0		- brown below 1.7 m		G78B	●								△	+		
2.0 - 2.5		CLAY - silty - brown below 1.7 m		G79B	●								△	+		
2.5 - 2.7		SILT AND CLAY - brown, moist, firm, high plasticity, AASHTO: A-6 (I)		G80	●									+		
2.7 - 3.0		CLAY - silty, trace silt inclusions (< 20 mm diam.) - brown - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G81	●								△	+		

END OF TEST HOLE AT 3.0 m IN CLAY.
 1) Seepage or sloughing not observed.
 2) Test hole open dry and open to 3.0 m depth immediately after drilling.
 3) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 4) Test hole located in front of #110 Panet Rd, 1.2 m East of West edge of road.
 5) The bulk sample was collected between 0.3 to 2.4 m and 2.7 to 3.0 m depth.

Logged By: Jashandeep Singh Bhullar Reviewed By: Angela Fidler-Kliewer Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 PANET RD 2 23-R-02 0. B. JSB 1000 043 22.GPJ TREK.GDT 12/15/22



2023 Local and Industrial Streets Renewal Project - 23-RI-02
Sub-Surface Investigation
Panet Rd - Dugald Rd / 45 Panet Rd

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH22-06	UTM: 14U 5527395 N, 637776 E Located in front of #35 Panet Rd, 0.5 m East of West edge of road.	Asphalt	250	Concrete	-	Sand and Gravel (Fill); AASHTO: A-1-b (I)	0.3	0.6	13							
						Clay; AASHTO: A-7-6 (I)	0.8	0.9	33							
						Clay; AASHTO: A-7-6 (I)	1.1	1.2	38							
						Clay; AASHTO: A-7-6 (I)	1.4	1.5	34							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	33							
						Clay; AASHTO: A-7-6 (I)	2.3	2.4	35							
						Clay; AASHTO: A-7-6 (I)	2.7	3.0	27							
TH22-07	UTM: 14U 5527552 N, 637904 E Located in front of #405 Panet Rd, 2.2 m West of East edge of road.	Asphalt	120	Concrete	-	Clay (Fill); AASHTO: A-7-6 (I)	0.8	1.1	14							
						Clay; AASHTO: A-7-6 (49)	1.1	1.2	32	61	27	9	3	25	75	50
						Clay; AASHTO: A-7-6 (49)	1.4	1.5	34							
						Clay; AASHTO: A-7-6 (49)	1.7	1.8	29							
						Clay; AASHTO: A-7-6 (49)	2.0	2.1	34							
						Clay; AASHTO: A-7-6 (49)	2.3	2.6	31							
						Silt; AASHTO: A-4 (I)	2.7	3.0	24							
TH22-08	UTM: 14U 5527645 N, 637965 E Located in front of #110 Panet Rd, 1.2 m East of West edge of road.	Asphalt	170	Concrete	-	Sand and Gravel (Fill); AASHTO: A-1-b (I)	0.2	0.3	12							
						Clay (Fill); AASHTO: A-7-6 (I)	0.3	0.5	12							
						Clay (Fill); AASHTO: A-7-6 (I)	0.8	1.1	13							
						Clay; AASHTO: A-7-6 (I)	1.4	1.5	28							
						Clay; AASHTO: A-7-6 (I)	1.7	1.8	32							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	31							
						Silt and Clay; AASHTO: A-6 (I)	2.4	2.6	26							
						Clay; AASHTO: A-7-6 (I)	2.6	2.9	35							

(I) - AASHTO classification was interpreted based on visual classification.



Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Panet Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06
Depth (m)	0.2 - 0.5	0.8 - 0.9	1.1 - 1.2	1.4 - 1.5	1.8 - 2.0	2.3 - 2.4
Sample #	G89	G90	G91	G92	G93	G94
Tare ID	W69	Z68	K34	W27	C13	Z21
Mass of tare	8.5	8.5	8.6	8.3	8.4	8.5
Mass wet + tare	279.7	222.1	234.7	256.2	226.5	247.5
Mass dry + tare	248.2	169.0	173.0	193.4	172.8	185.0
Mass water	31.5	53.1	61.7	62.8	53.7	62.5
Mass dry soil	239.7	160.5	164.4	185.1	164.4	176.5
Moisture %	13.1%	33.1%	37.5%	33.9%	32.7%	35.4%

Test Hole	TH22-06	TH22-07	TH22-07	TH22-07	TH22-07	TH22-07
Depth (m)	2.7 - 3.0	0.8 - 1.1	1.1 - 1.2	1.4 - 1.5	1.7 - 1.8	2.0 - 2.1
Sample #	G95	G82	G83	G84	G85	G86
Tare ID	AA15	H29	W14	Z99	N84	F105
Mass of tare	6.9	7.4	8.6	8.4	8.6	8.5
Mass wet + tare	208.4	218.9	217.8	221.2	224.2	250.9
Mass dry + tare	165.1	193.2	166.9	166.7	176.3	189.3
Mass water	43.3	25.7	50.9	54.5	47.9	61.6
Mass dry soil	158.2	185.8	158.3	158.3	167.7	180.8
Moisture %	27.4%	13.8%	32.2%	34.4%	28.6%	34.1%

Test Hole	TH22-07	TH22-07	TH22-08	TH22-08	TH22-08	TH22-08
Depth (m)	2.3 - 2.6	2.7 - 3.0	0.2 - 0.3	0.3 - 0.5	0.8 - 1.1	1.4 - 1.5
Sample #	G87	G88	G76	G77	G78A	G79A
Tare ID	H80	N41	D34	N112	AB100	W25
Mass of tare	8.7	8.5	8.7	8.4	7.0	8.4
Mass wet + tare	237.6	210.7	223.6	238.4	219.6	197.7
Mass dry + tare	183.8	171.8	200.8	214.1	195.4	156.3
Mass water	53.8	38.9	22.8	24.3	24.2	41.4
Mass dry soil	175.1	163.3	192.1	205.7	188.4	147.9
Moisture %	30.7%	23.8%	11.9%	11.8%	12.8%	28.0%



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Moisture Content Report ASTM D2216-10

Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Panet Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-08	TH22-08	TH22-08	TH22-08		
Depth (m)	1.7 - 1.8	2.1 - 2.3	2.4 - 2.7	2.7 - 2.9		
Sample #	G78B	G79B	G80	G81		
Tare ID	Z103	AB09	Z90	Z23		
Mass of tare	8.7	6.9	8.5	8.7		
Mass wet + tare	218.0	234.3	255.2	220.1		
Mass dry + tare	167.9	180.5	204.9	165.6		
Mass water	50.1	53.8	50.3	54.5		
Mass dry soil	159.2	173.6	196.4	156.9		
Moisture %	31.5%	31.0%	25.6%	34.7%		



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Atterberg Limits
ASTM D4318-10e1

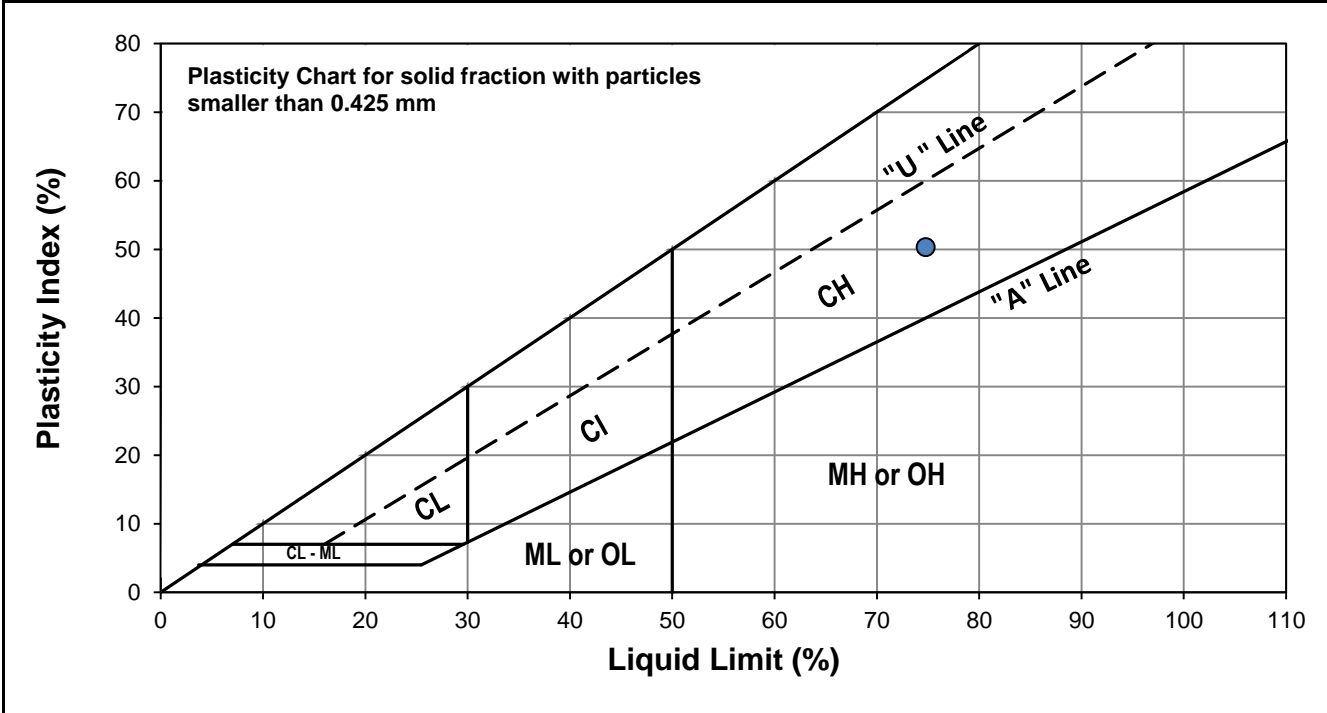
Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local and Industrial Streets Renewal Package (23-RI-02)
Test Hole TH22-07
Sample # G83
Depth (m) 1.1 - 1.2
Sample Date 25-Nov-22
Test Date 06-Dec-22
Technician MT



Liquid Limit	75
Plastic Limit	25
Plasticity Index	50

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	21	27	31
Mass Tare (g)	14.221	14.237	14.128
Mass Wet Soil + Tare (g)	25.607	23.458	23.838
Mass Dry Soil + Tare (g)	20.681	19.532	19.742
Mass Water (g)	4.926	3.926	4.096
Mass Dry Soil (g)	6.460	5.295	5.614
Moisture Content (%)	76.254	74.145	72.960



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.209	14.112			
Mass Wet Soil + Tare (g)	24.852	25.070			
Mass Dry Soil + Tare (g)	22.753	22.918			
Mass Water (g)	2.099	2.152			
Mass Dry Soil (g)	8.544	8.806			
Moisture Content (%)	24.567	24.438			

Note: Additional information recorded/measured for this test is available upon request.



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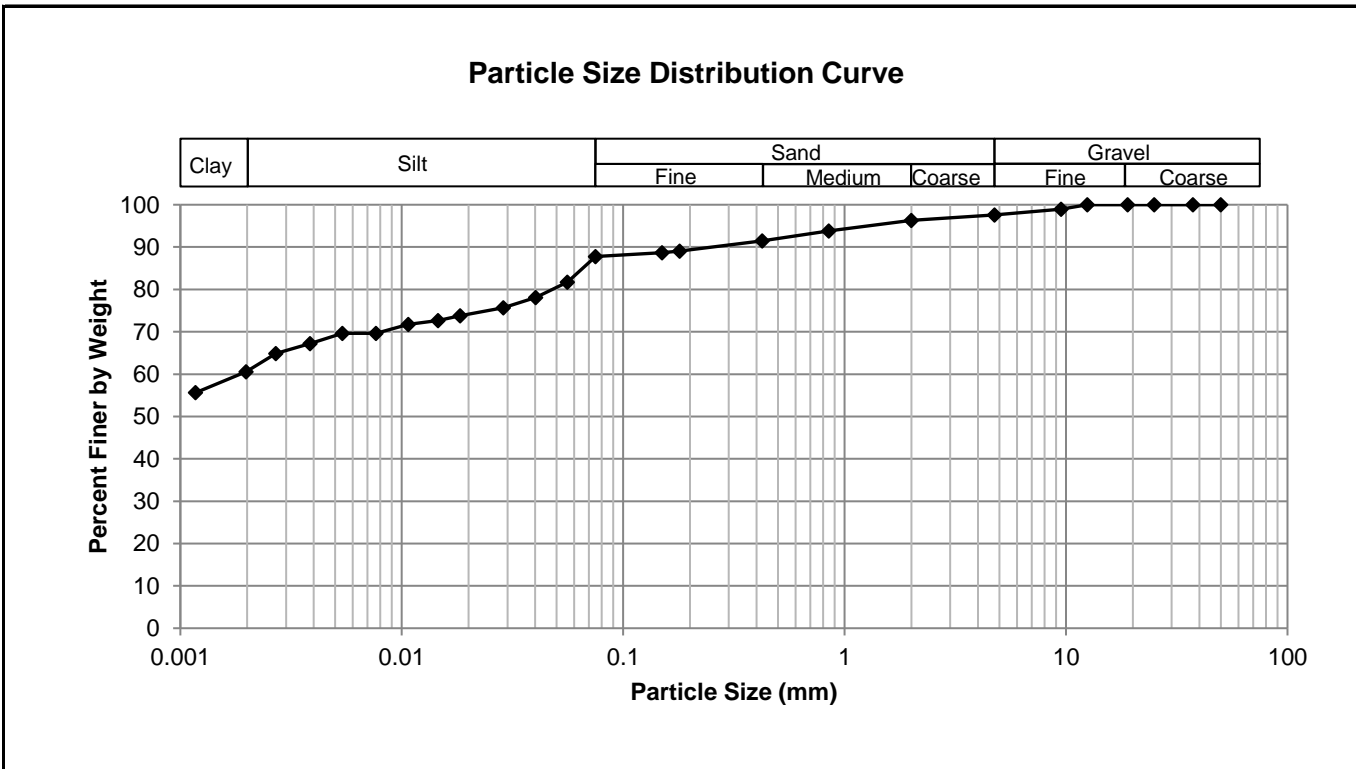
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local Street and Industrial Package (23-RI-02) Panet Rd



Test Hole TH22-07
Sample # G83
Depth (m) 1.1 - 1.2
Sample Date 25-Nov-22
Test Date 5-Dec-22
Technician DS

Gravel	2.4%
Sand	9.8%
Silt	27.1%
Clay	60.7%



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	97.58	0.0750	87.75
37.5	100.00	2.00	96.30	0.0560	81.70
25.0	100.00	0.850	93.85	0.0403	78.08
19.0	100.00	0.425	91.49	0.0288	75.67
12.5	100.00	0.180	89.06	0.0184	73.82
9.50	98.99	0.150	88.71	0.0146	72.66
4.75	97.58	0.075	87.75	0.0107	71.72
				0.0076	69.61
				0.0054	69.65
				0.0039	67.24
				0.0027	64.88
				0.0020	60.58
				0.0012	55.63



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Standard Proctor Compaction Test ASTM D698-12 (2021)

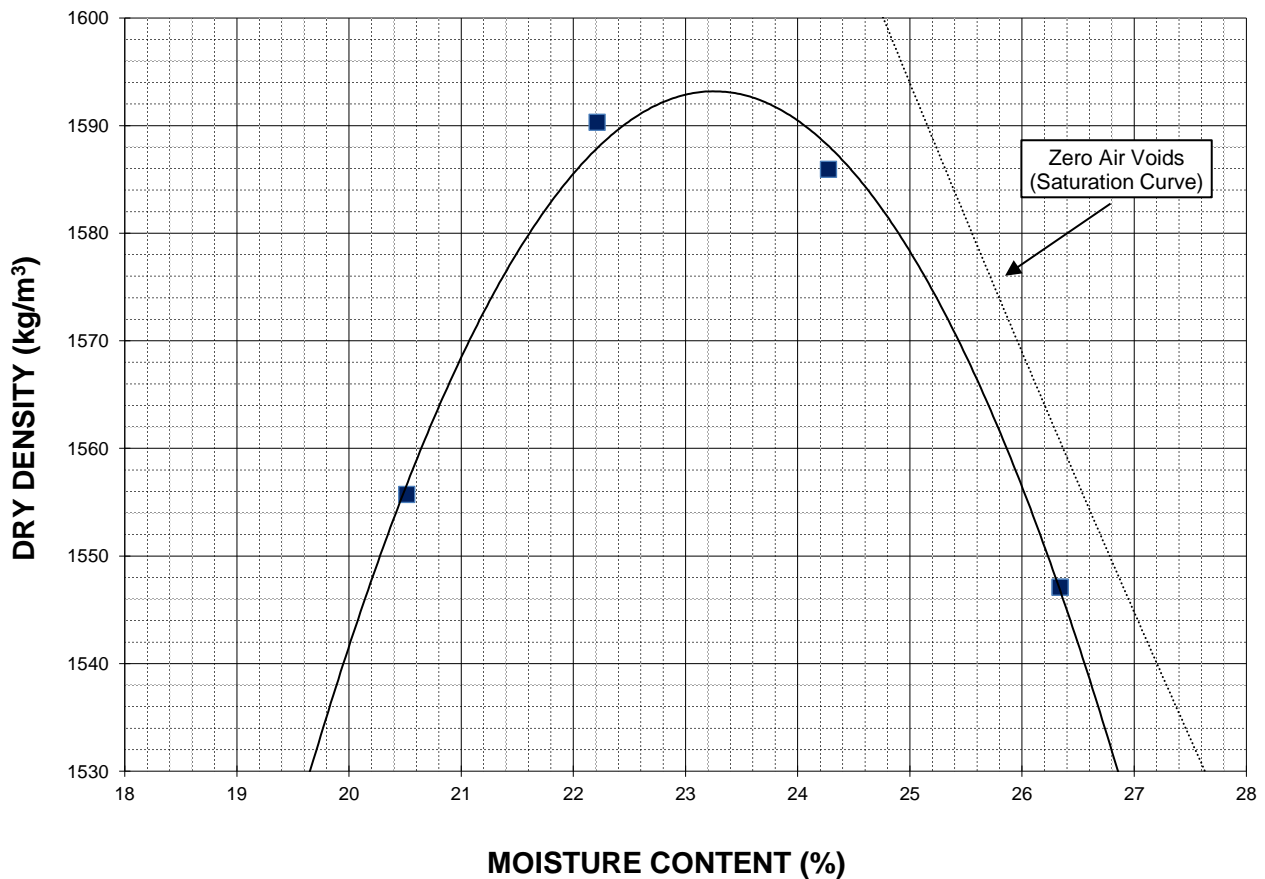


Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02)

Sample # TH22-07 & TH22-08 (combined)
Source Panet Rd.
Material Clay
Sample Date 20-Nov-22
Test Date 02-Dec-22
Technician JC

Maximum Dry Density (kg/m³)	1593
Optimum Moisture (%)	23.3

Trial Number	1	2	3	4
Wet Density (kg/m³)	1875	1944	1971	1955
Dry Density (kg/m³)	1556	1590	1586	1547
Moisture Content (%)	20.5	22.2	24.3	26.3



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.	1000-043-22	Source	Panet Road
Client	WSP Canada Group Ltd.	Material	Clay
Project	2023 Local Streets Renewal (23-RI-02)	Sample Date	2022-11-25
Sample #	TH22-07 & TH22-08 (combined)	Test Date	2022-12-05
		Technician	JC

Proctor Results (ASTM D698)

Maximum Dry Density 1598 kg/m³
 Optimum Moisture Content 23.2 %
 Material Retained on 19 mm Sieve 0.0 %

CBR Sample Compaction

Dry Density 1532 kg/m³
 Initial Moisture Content 22.1 %
 Relative Density 95.8 % SPMDD

Soaking Results

Surcharge 4.54 kg
 Swell 1.9 %
 Moisture Content in top 25 mm 37.3 %
 Immersion Period 96 h

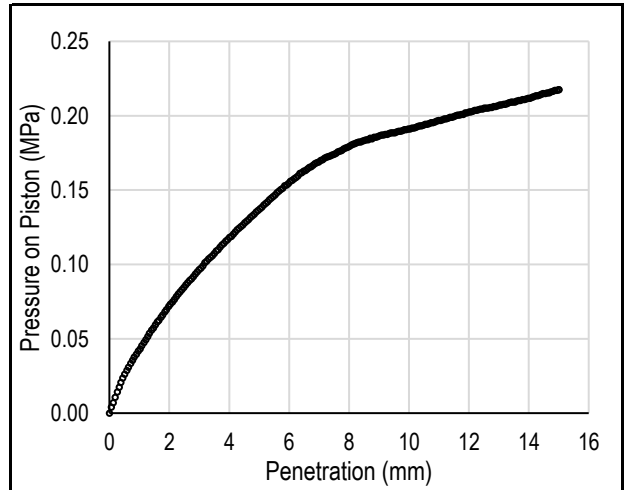
CBR Results

CBR at 2.54 mm 1.3 %
 CBR at 5.08 mm 1.3 %
 Zero Correction 0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.03	0.03
1.27	0.05	0.05
1.91	0.07	0.07
2.54	0.09	0.09
3.18	0.10	0.10
3.81	0.11	0.11
4.45	0.13	0.13
5.08	0.14	0.14
7.62	0.18	0.18
10.16	0.19	0.19
12.70	0.21	0.21

Load/Penetration Curve



Comments:



Photo 4: Pavement Core Sample at TH22-06



Photo 5: Pavement Core Sample at TH25-07



Photo 3: Pavement Core Sample at TH22-08

Appendix C

Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos – Springfield Rd.

GENERAL NOTES

- 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.
- 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.
- 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 Classification	Symbols	Typical Names	Laboratory Classification Criteria		Particle Size	Material			
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)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 Not meeting all gradation requirements for GW	mm #10 to #4 #40 to #10 #200 to #40 < #200	Sand Coarse Medium Fine Silt or Clay			
		GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines						
		GM		Silty gravels, gravel-sand-silt mixtures						
		GC		Clayey gravels, gravel-sand-silt mixtures						
	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 Not meeting all gradation requirements for SW	mm 2.00 to 4.75 0.425 to 2.00 0.075 to 0.425 < 0.075	Sand Coarse Medium Fine Silt or Clay		
			SP		Poorly-graded sands, gravelly sands, little or no fines					
		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 borderline cases requiring use of dual symbols	
			SC		Clayey sands, sand-clay mixtures					Atterberg limits above "A" line or P.I. greater than 7 Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
					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 cases requiring dual symbols*					
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 	mm > 300 75 to 300 19 to 75 4.75 to 19	Boulders Cobbles Gravel Coarse Fine			
		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	

* 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

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)	▽ Water Level at Time of Drilling
PL - Plastic Limit (%)	▼ Water Level at End of Drilling
PI - Plasticity Index (%)	▽ Water Level After Drilling as Indicated on Test Hole Logs
MC - Moisture Content (%)	
SPT - Standard Penetration Test	
RQD- Rock Quality Designation	
Qu - Unconfined Compression	
Su - Undrained Shear Strength	
VW - Vibrating Wire Piezometer	
SI - Slope Incliner	

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

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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>SPT (N) (Blows/300 mm)</u>
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:

<u>Descriptive Terms</u>	<u>Undrained Shear Strength (kPa)</u>
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200



Sub-Surface Log

Test Hole TH22-17 (Springfield Rd)

1 of 1

Client: WSP Canada Group Ltd. **Project Number:** 1000-043-22
Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) **Location:** UTM N-5532780, E-640485
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0		ASPHALT - 95 mm thick		PC22-17												
0.0		SAND AND GRAVEL (FILL) - trace silt, trace gravel (<50 mm diam.) - brown - frozen, moist and compact when thawed - sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)		G96												
0.5		CLAY (FILL) - silty, trace sand, trace gravel (< 50 diam.) - black - frozen to 0.9 m, moist and very stiff when thawed - high plasticity - AASHTO: A-7-6 (I)		G97												
1.0		CLAY - silty - grey - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G98												
1.5		CLAY - silty - grey - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G99												
2.0		SILT - clayey - brown - moist, firm - low plasticity, AASHTO: A-4 (I)		G100												
2.0		CLAY - silty - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)		G101												
2.5		- stiff below 2.3 m		G102												
3.0		- stiff below 2.3 m		G103												

END OF TEST HOLE AT 3.0 m IN CLAY.

- Seepage or sloughing not observed.
- Test hole dry and open to 3.0 m depth immediately after drilling.
- Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
- Test hole located in front of #1100 Springfield Rd, 1.4 m North of South edge of road.
- The bulk sample was collected between 0.4 to 1.5 m and 1.8 to 3.0 m depth.

Logged By: Jashandeep Singh Bhullar **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 SPRINGFIELD RD 23-R-02 0. B. JSB 1000.043.22.GPJ TREK.GDT 12/15/22



Sub-Surface Log

Client: WSP Canada Group Ltd. **Project Number:** 1000-043-22
Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) **Location:** UTM N-5532792, E-641817
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)					
					16	17	18	19	20	21	Test Type					
					Particle Size (%)											
					0	20	40	60	80	100						
					PL MC LL 0 20 40 60 80 100											
					0	20	40	60	80	100	0	50	100	150	200	250
0.0 - 0.1		ASPHALT - 105 mm thick	PC22-19													
0.1 - 0.6		SAND AND GRAVEL (FILL) - trace silt, trace clay, trace gravel (< 50 mm diam.) - brown - frozen, moist and compact to dense when thawed - no to low plasticity - sub-rounded to angular crushed "pit run", AASHTO: A-1-b (I)	G111													
0.6 - 1.0		CLAY (FILL) - silty, trace sand, trace gravel (< 50 diam.) - black - frozen to 0.9 m, moist and stiff when thawed - high plasticity, AASHTO: A-7-6 (I)	G112													
1.0 - 1.5		CLAY - silty, trace silt inclusions (< 15 mm diam.), trace gravel (< 20 mm diam.) - grey - moist, very stiff - high plasticity - AASHTO: A-7-6 (57)	G113													
1.5 - 1.8		- stiff below 1.5 m	G114													
1.8 - 2.0		- brown below 1.8 m	G115													
2.0 - 2.5			G116													
2.5 - 3.0			G117													
3.0			G118													

END OF TEST HOLE AT 3.0 m IN CLAY.
 1) Seepage or sloughing not observed.
 2) Test hole open dry and open to 3.0 m depth immediately after drilling.
 3) Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
 4) Test hole located in front of #1100-1180 Springfield Rd, 1.1 m South of North edge of road.
 5) The bulk sample was collected between 0.8 and 3.0 m depth.

SUB-SURFACE LOG LOGS 2022-12-09 SPRINGFIELD RD 23-R-02 0_B JSB 1000_043_22.GPJ TREK.GDT 12/15/22



Sub-Surface Log

Client: WSP Canada Group Ltd. **Project Number:** 1000-043-22
Project Name: 2023 Local and Industrial Streets Renewal Package (23-RI-02) **Location:** UTM N-5532787, E-641090
Contractor: Maple Leaf Drilling Ltd. **Ground Elevation:** Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount **Date Drilled:** November 15, 2022

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

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	Bulk Unit Wt (kN/m ³)						Undrained Shear Strength (kPa)				
					16	17	18	19	20	21	Test Type				
					Particle Size (%)										
					0	20	40	60	80	100					
					PL MC LL 0 20 40 60 80 100										
					0 50 100 150 200 250										
0.0 - 0.1		ASPHALT - 120 mm thick	PC22-18												
0.1 - 0.5		SAND AND GRAVEL (FILL) - trace silt, trace gravel (<50 mm diam.) - brown - frozen, moist and compact when thawed - sub-rounded to angular crushed "pit run" - AASHTO: A-1-b (I)	G104												
0.5 - 0.9		CLAY (FILL) - silty, trace sand, trace gravel (< 50 diam.) - black - frozen to 0.9 m, moist and stiff when thawed - high plasticity, AASHTO: A-7-6 (I)	G105												
0.9 - 1.8		CLAY - silty, trace silt inclusions (< 25 mm diam.), trace gravel (< 20 mm diam.) - grey - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	G106												
1.8 - 2.1		- brown below 1.8 m	G107												
2.1 - 3.0		- stiff below 2.1 m	G108												
			G109												
			G110												

END OF TEST HOLE AT 3.0 m IN CLAY.

- Seepage or sloughing not observed.
- Test hole dry and open to 3.0 m depth immediately after drilling.
- Test hole backfilled with auger cuttings, bentonite chips and cold patch asphalt.
- Test hole located in front of #1867 Springfield Rd, 0.5 m South of North edge of road.
- The bulk sample was collected between 0.6 and 3.0 m depth.

Logged By: Jashandeep Singh Bhullar **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 SPRINGFIELD RD 23-R-02 0_B JSB 1000_043_22.GPJ TREK.GDT 12/15/22



2023 Local and Industrial Streets Renewal Project - 23-RI-02
Sub-Surface Investigation
Springfield Rd - Lagimodiere Blvd / Cox Blvd

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits				
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index		
TH22-17	UTM: 14U 5532780 N, 640485 E Located in front of #1100 Springfield Rd, 1.4 m North of South edge of road.	Asphalt	95	Concrete	-	Sand And Gravel (Fill); AASHTO: A-1-b (I)	0.1	0.5	5									
						Clay (Fill); AASHTO: A-7-6 (I)	0.5	0.6	13									
						Clay (Fill); AASHTO: A-7-6 (I)	0.9	1.1	15									
						Clay; AASHTO: A-7-6 (I)	1.1	1.4	34									
						Silt; AASHTO: A-4 (I)	1.5	1.8	25									
						Clay; AASHTO: A-7-6 (I)	2.0	2.1	27									
						Clay; AASHTO: A-7-6 (I)	2.3	2.4	37									
						Clay; AASHTO: A-7-6 (I)	2.6	2.9	41									
TH22-18	UTM: 14U 5532787 N, 641090 E Located in front of #1100-1180 Springfield Rd, 1.1 m South of North edge of road.	Asphalt	105	Concrete	-	Sand And Gravel (Fill); AASHTO: A-1-b (I)	0.1	0.6	28									
						Clay (Fill); AASHTO: A-7-6 (I)	0.8	1.1	16									
						Clay; AASHTO: A-7-6 (57)	1.1	1.2	28	62	34	3	1	22	75	53		
						Clay; AASHTO: A-7-6 (57)	1.4	1.5	28									
						Clay; AASHTO: A-7-6 (57)	1.7	1.8	28									
						Clay; AASHTO: A-7-6 (57)	2.0	2.1	29									
						Clay; AASHTO: A-7-6 (57)	2.3	2.5	35									
						Clay; AASHTO: A-7-6 (57)	2.7	3.0	41									
TH22-19	UTM: 14U 5532792 N, 641817 E Located in front of #1867 Springfield Rd, 0.5 m South of North edge of road.	Asphalt	120	Concrete	-	Sand And Gravel (Fill); AASHTO: A-1-b (I)	0.1	0.6	8									
						Clay (Fill); AASHTO: A-7-6 (I)	0.6	0.9	23									
						Clay; AASHTO: A-7-6 (I)	1.1	1.4	36									
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	37									
						Clay; AASHTO: A-7-6 (I)	2.0	2.1	39									
						Clay; AASHTO: A-7-6 (I)	2.3	2.4	42									
						Clay; AASHTO: A-7-6 (I)	2.7	3.0	45									

(I) - AASHTO classification was interpreted based on visual classification.



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Moisture Content Report ASTM D2216-10

Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Springfield Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17	TH22-17
Depth (m)	0.1 - 0.5	0.5 - 0.6	0.9 - 1.1	1.1 - 1.4	1.5 - 1.8	2.0 - 2.1
Sample #	G96	G97	G98	G99	G100	G101
Tare ID	A16	W41	K29	D47	F110	H70
Mass of tare	8.7	8.6	8.5	8.9	8.3	8.8
Mass wet + tare	260.1	232.1	235.8	256.6	253.3	235.6
Mass dry + tare	247.3	206.3	205.8	194.1	203.8	188.0
Mass water	12.8	25.8	30.0	62.5	49.5	47.6
Mass dry soil	238.6	197.7	197.3	185.2	195.5	179.2
Moisture %	5.4%	13.1%	15.2%	33.7%	25.3%	26.6%

Test Hole	TH22-17	TH22-17	TH22-18	TH22-18	TH22-18	TH22-18
Depth (m)	2.3 - 2.4	2.6 - 2.9	0.1 - 0.6	0.8 - 1.1	1.1 - 1.2	1.4 - 1.5
Sample #	G102	G103	G111	G112	G113	G114
Tare ID	F35	Z01	Z40	E87	Z107	AC03
Mass of tare	8.6	8.7	8.5	8.8	7.0	6.8
Mass wet + tare	230.6	212.3	319.2	296.9	235.8	223.1
Mass dry + tare	170.4	152.9	250.9	257.3	185.7	176.0
Mass water	60.2	59.4	68.3	39.6	50.1	47.1
Mass dry soil	161.8	144.2	242.4	248.5	178.7	169.2
Moisture %	37.2%	41.2%	28.2%	15.9%	28.0%	27.8%

Test Hole	TH22-18	TH22-18	TH22-18	TH22-18	TH22-19	TH22-19
Depth (m)	1.7 - 1.8	2.0 - 2.1	2.3 - 2.5	2.7 - 3.0	0.1 - 0.6	0.6 - 0.9
Sample #	G115	G116	G117	G118	G104	G105
Tare ID	W111	F42	N75	F31	W22	W80
Mass of tare	8.6	8.6	8.9	8.7	8.6	8.9
Mass wet + tare	209.3	217.7	272.0	224.2	243.4	223.6
Mass dry + tare	165.6	170.9	203.3	161.2	225.8	184.1
Mass water	43.7	46.8	68.7	63.0	17.6	39.5
Mass dry soil	157.0	162.3	194.4	152.5	217.2	175.2
Moisture %	27.8%	28.8%	35.3%	41.3%	8.1%	22.5%



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Moisture Content Report ASTM D2216-10

Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02) - Springfield Rd.

Sample Date 25-Nov-22
Test Date 29-Nov-22
Technician TR

Test Hole	TH22-19	TH22-19	TH22-19	TH22-19	TH22-19	
Depth (m)	1.1 - 1.4	1.5 - 1.7	2.0 - 2.1	2.3 - 2.4	2.7 - 3.0	
Sample #	G106	G107	G108	G109	G110	
Tare ID	F124	AC37	N01	W102	N35	
Mass of tare	8.7	6.9	8.6	8.7	8.7	
Mass wet + tare	224.4	239.5	258.1	233.5	225.4	
Mass dry + tare	166.9	176.8	188.3	167.5	158.0	
Mass water	57.5	62.7	69.8	66.0	67.4	
Mass dry soil	158.2	169.9	179.7	158.8	149.3	
Moisture %	36.3%	36.9%	38.8%	41.6%	45.1%	



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Atterberg Limits
ASTM D4318-10e1

Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local and Industrial Streets Renewal Package (23-RI-02)

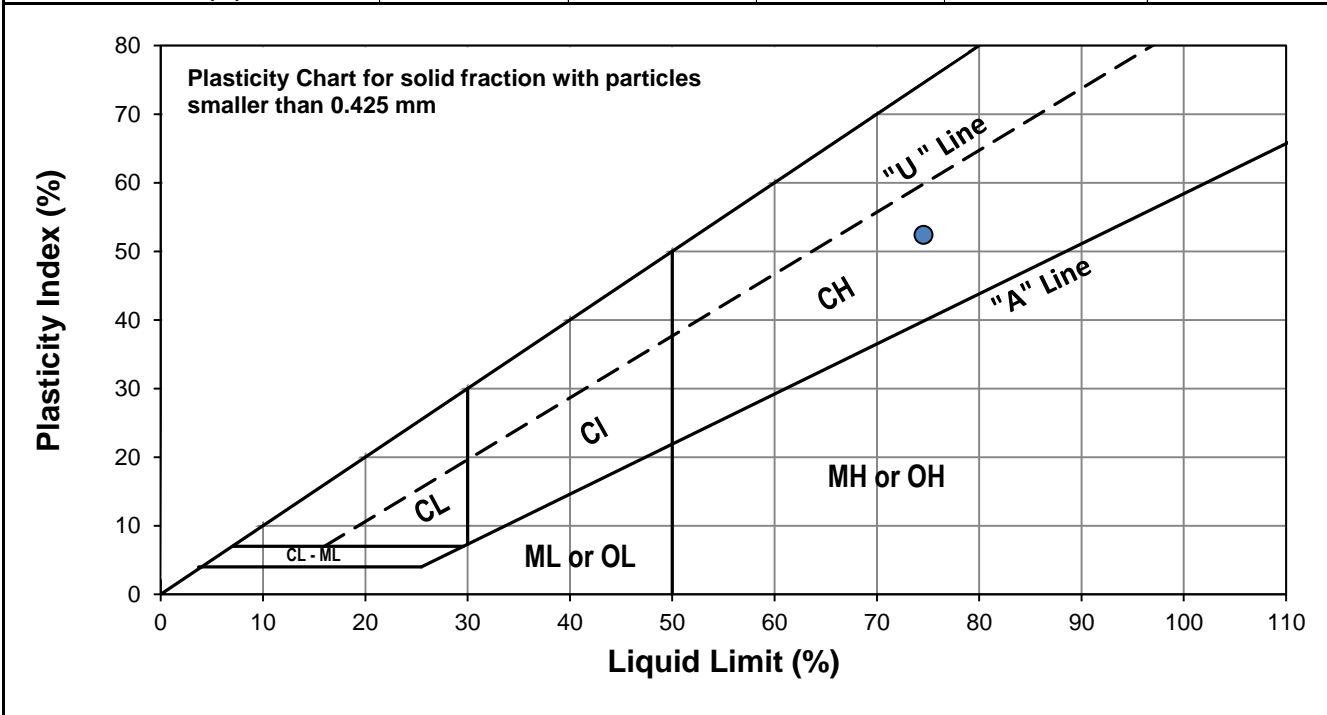
Test Hole TH22-18
Sample # G113
Depth (m) 1.1 - 1.2
Sample Date 25-Nov-22
Test Date 07-Dec-22
Technician DS



Liquid Limit	75
Plastic Limit	22
Plasticity Index	52

Liquid Limit

Trial #	1	2	3
Number of Blows (N)	18	21	28
Mass Tare (g)	14.080	14.222	14.226
Mass Wet Soil + Tare (g)	22.774	22.688	23.191
Mass Dry Soil + Tare (g)	18.959	19.022	19.397
Mass Water (g)	3.815	3.666	3.794
Mass Dry Soil (g)	4.879	4.800	5.171
Moisture Content (%)	78.192	76.375	73.371



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.179	14.016			
Mass Wet Soil + Tare (g)	23.325	22.488			
Mass Dry Soil + Tare (g)	21.683	20.932			
Mass Water (g)	1.642	1.556			
Mass Dry Soil (g)	7.504	6.916			
Moisture Content (%)	21.882	22.499			

Note: Additional information recorded/measured for this test is available upon request.



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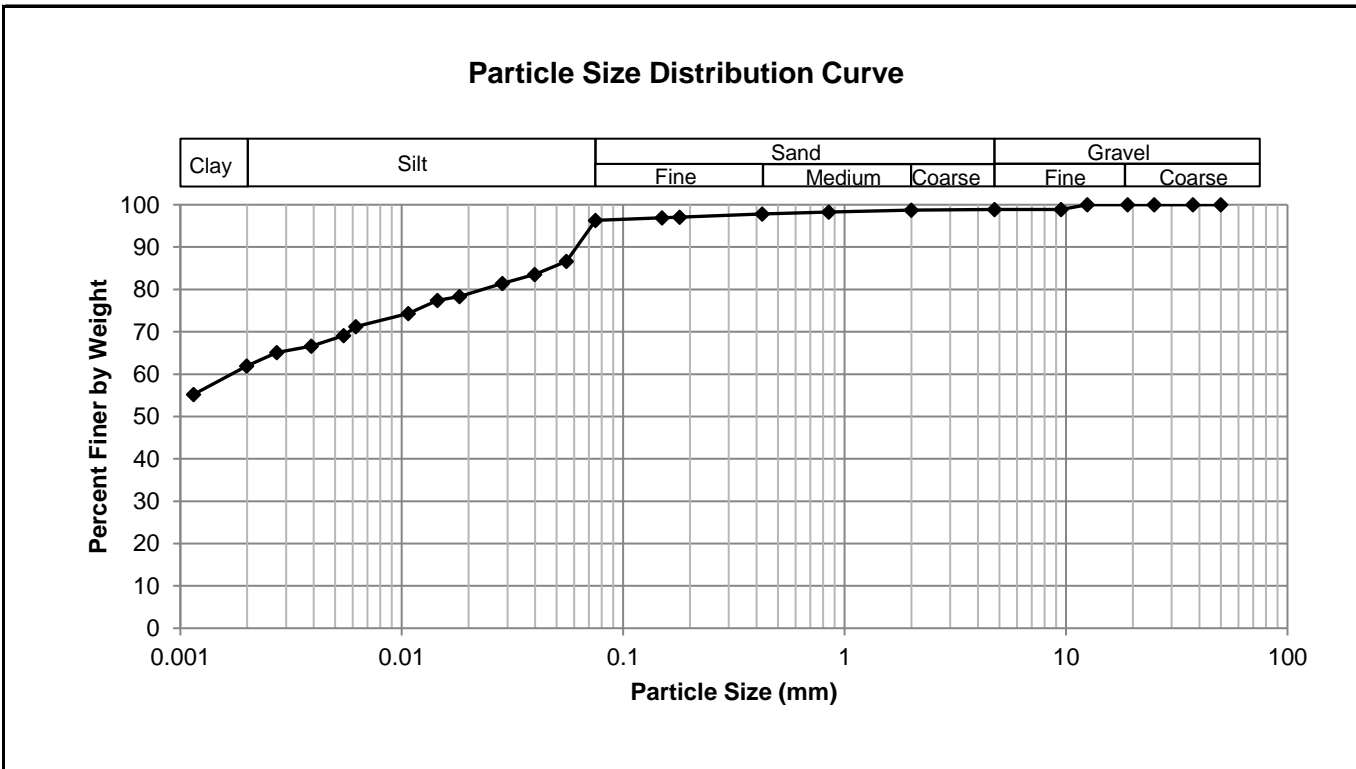
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No. 1000-043-22
Client WSP Canada Group Ltd.
Project 2023 Local Street and Industrial Package (23-RI-02) Springfield Rd



Test Hole TH22-18
Sample # G113
Depth (m) 1.1 - 1.2
Sample Date 25-Nov-22
Test Date 6-Dec-22
Technician DS

Gravel	1.1%
Sand	2.5%
Silt	34.4%
Clay	61.9%



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	98.85	0.0750	96.31
37.5	100.00	2.00	98.71	0.0555	86.65
25.0	100.00	0.850	98.26	0.0398	83.56
19.0	100.00	0.425	97.81	0.0284	81.40
12.5	100.00	0.180	97.08	0.0182	78.32
9.50	98.85	0.150	96.92	0.0145	77.39
4.75	98.85	0.075	96.31	0.0107	74.31
				0.0062	71.22
				0.0055	69.10
				0.0039	66.63
				0.0027	65.09
				0.0020	61.92
				0.0012	55.23



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Standard Proctor Compaction Test ASTM D698-12 (2021)

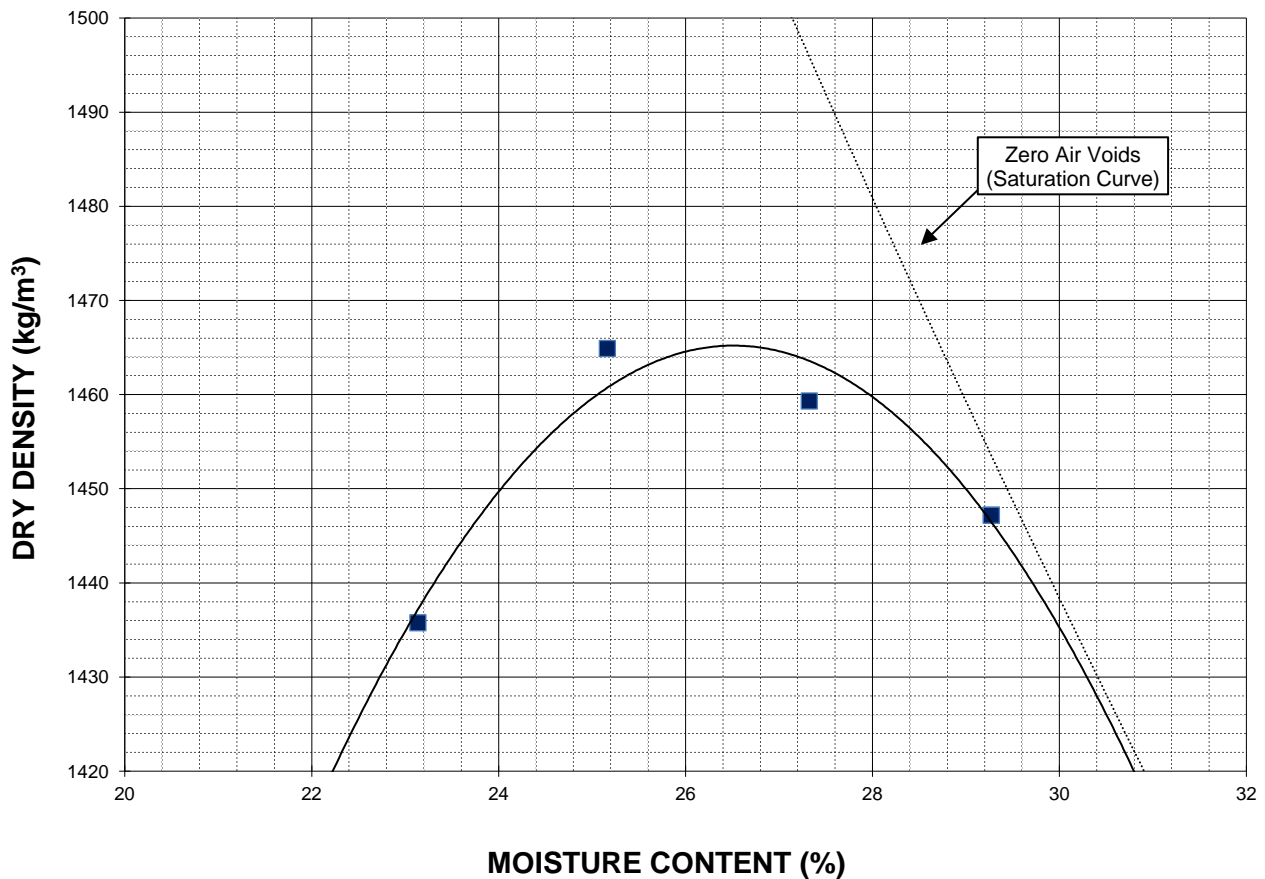


Project No. 1000-043-22
Client WSP Canada Group LTD
Project 2023 Local and Industrial Streets Package (23-RI-02)

Sample # TH22-18 & TH22-19 (combined)
Source Springfield Rd.
Material Clay
Sample Date 20-Nov-22
Test Date 02-Dec-22
Technician TG

Maximum Dry Density (kg/m³)	1465
Optimum Moisture (%)	26.5

Trial Number	1	2	3	4	
Wet Density (kg/m³)	1768	1834	1858	1871	
Dry Density (kg/m³)	1436	1465	1459	1447	
Moisture Content (%)	23.1	25.2	27.3	29.3	



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.	1000-043-22	Source	Springfield Rd.
Client	WSP Canada Group Ltd.	Material	Clay
Project	2023 Local Streets Renewal (23-RI-02)	Sample Date	2022-11-25
Sample #	TH22-18 & TH22-19 (combined)	Test Date	2022-12-05
		Technician	TG

Proctor Results (ASTM D698)

Maximum Dry Density	1465 kg/m ³
Optimum Moisture Content	26.5 %
Material Retained on 19 mm Sieve	0.0 %

CBR Sample Compaction

Dry Density	1392 kg/m ³
Initial Moisture Content	28.0 %
Relative Density	95.0 % SPMDD

Soaking Results

Surcharge	4.54 kg
Swell	2.3 %
Moisture Content in top 25 mm	39.8 %
Immersion Period	96 h

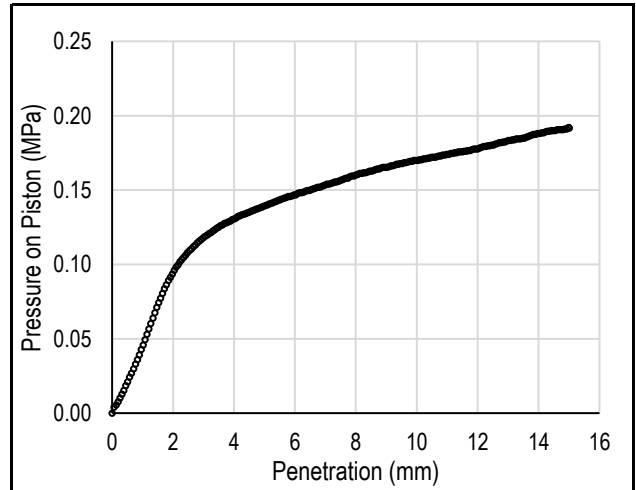
CBR Results

CBR at 2.54 mm	1.6 %
CBR at 5.08 mm	1.4 %
Zero Correction	0 mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.03	0.03
1.27	0.06	0.06
1.91	0.09	0.09
2.54	0.11	0.11
3.18	0.12	0.12
3.81	0.13	0.13
4.45	0.13	0.13
5.08	0.14	0.14
7.62	0.16	0.16
10.16	0.17	0.17
12.70	0.18	0.18

Load/Penetration Curve



Comments:



Photo 1: Pavement Core Sample at TH22-17



Photo 2: Pavement Core Sample at TH22-18



Photo 3: Pavement Core Sample at TH22-19

Appendix D

Summary Table and Pavement Core Photos – Dugald Rd.



2023 Local and Industrial Streets Renewal Package - 23-RI-02

Dugald Rd - Panet Rd / Dawson Rd N

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		
		Type	Thickness (mm)	Type	Thickness (mm)	Corrected Compressive Strength (Mpa)
PC22-09	UTM: 14U 5527708 N, 637445 E; Located in front of #811 Dugald Rd, 1.7 m South of North curb of the road.	Asphalt	-	Concrete	200	-
PC22-10	UTM: 14U 5527715 N, 637561 E; Located in front of #853 Dugald Rd, 1.5 m North of South curb of the road.	Asphalt	-	Concrete	205	62.49
PC22-11	UTM: 14U 5527715 N, 637719 E; Located in front of #901-807 Dugald Rd, 1.5 m North of South curb of the road.	Asphalt	-	Concrete	200	-
PC22-12	UTM: 14U 5527725 N, 637940 E; Located north of #110 Panet Rd, 1.4 m South of North curb of the road.	Asphalt	-	Concrete	180	-



Photo 1: Pavement Core Sample PC-09



Photo 2: Pavement Core Sample PC-10



Photo 1: Pavement Core Sample PC-11



Photo 2: Pavement Core Sample PC-12

Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-22
 Project 2023 Local Streets Package - 23-R1-02
 Client WSP Group Canada Inc.

Date December 14, 2022
 Technician KM

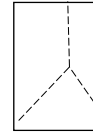
Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Dugald Road	PC-10	2022-11-08	2022-12-14	-	145	194	Soaked 48 h	53.30	62.49	1	0.9588	0.9802	1.0900	1.0600	1.0798

Comments

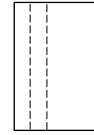
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc} F_{ld} F_{dia} F_{mc} F_D F_{reinf}$



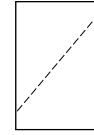
Type 1



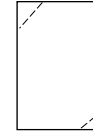
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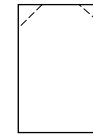
Type 3



Type 4



Type 5



Type 6

Reviewed by (print): Angela Fidler-Kliewer, C.Tech.

Signature: Angela Fidler-Kliewer

Table 1 Factors involved in interpretation of core results by different codes.

List	Code/standard	Edition	Factors Considered					
			Aspect ratio	Diameter	Reinforcing	Moisture	Damage	Direction
1	Egyptian Code/Standard Specification	2008	✓		✓			✓
2	British Code/Standard Specification	2003	✓		✓			✓
3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓	✓	
4	European Standard Specification	1998	✓	✓	✓		✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

3.2. American Concrete Institute (ACI)

3.2.1. Former ACI Code (2002) & Current ASTM (2009)

The methodology of core interpretation given in the former ACI code was remained without changes for decades and up to Year (2003). The in-place strength of concrete cylinder at the location from which a core test specimen was extracted can be computed using the equation:

$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

3.2.2. Current ACI Code (2012) [15]

Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

Table 2 Mean values for factor $F_{l/d}$ according to ACI Code (1998) and ASTM.

	Specimen length-to-diameter ratio, l/d			
	1.00	1.25	1.50	1.75
$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

● For cores containing a single bar:

$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

- For core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of ($\Phi_r \times d$) is considered. If the bars are further apart, their combined effect is assessed by replacing the term ($\Phi_r \times r$) by ($\sum \Phi_r \times r$) as follows:

multiple bars

$$F_{reinf} = \left[1 + 1.5 \frac{\sum [\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c \times L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (13)$$

where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

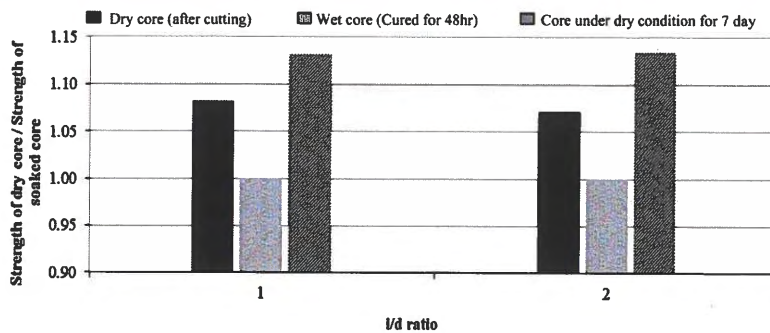


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).

Appendix E

Summary Table and Pavement Core Photos – Mazerod Rd.



2023 Local and Industrial Streets Renewal Package - 23-RI-02

Mazenod Rd SB nad NB - Dugald Rd / De Baets St

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		
		Type	Thickness (mm)	Type	Thickness (mm)	Corrected Compressive Strength (Mpa)
PC22-13	UTM: 14U 5527658 N, 640101 E; Located in front of Unit - 7 #16 Mazenod Rd, 1.6 m West of the median curb in Southbound median lane of the road.	Asphalt	45	Concrete	200	-
PC22-14	UTM: 14U 5527675 N, 640110 E; Located in front of Unit - 3 #16 Mazenod Rd, 1.7 m East of the median curb in Northbound median lane of the road.	Asphalt	45	Concrete	205	55.22



Photo 1: Pavement Core Sample PC-13



Photo 2: Pavement Core Sample PC-14

Concrete Core Compressive Strength Report

CSA A23.2-14C

Project No. 1000-043-22
Project 2023 Local Streets Package - 23-R1-02
Client WSP Group Canada Inc.

Date December 14, 2022
Technician KM

Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		F_{ld}	F_{dia}	F_{mc}	F_D	F_{reinf}
Mazenod Road	PC-14	2022-11-08	2022-12-14	-	145	191	Soaked 48 h	46.73	55.22	1	0.9548	0.9802	1.0900	1.0600	1.0929

Comments

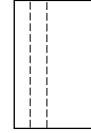
*Correction factors F_{ld} , F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc} F_{ld} F_{dia} F_{mc} F_D F_{reinf}$



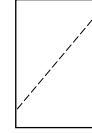
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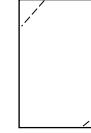
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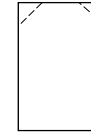
Type 3



Type 4



Type 5



Type 6

Reviewed by (print): Angela Fidler-Kliwer, C.Tech.

Signature: Angela Fidler-Kliwer

Table 1 Factors involved in interpretation of core results by different codes.

List	Code/standard	Edition	Factors Considered					
			Aspect ratio	Diameter	Reinforcing	Moisture	Damage	Direction
1	Egyptian Code/Standard Specification	2008	✓		✓			✓
2	British Code/Standard Specification	2003	✓		✓			✓
3	American Concrete Institute ACI	1998	✓					
		2012	✓	✓		✓		
4	European Standard Specification	1998	✓	✓			✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

It should be pointed out that above equations used to interpret the core concrete strength to the in-situ concrete cube strength have been developed based on a set of assumptions and through many converting process. It is also of interest to note that the damage effect is considered in the development of the formulas in indirect way. The subject derivation and detailed formulas may be seen elsewhere [14].

3.2. American Concrete Institute (ACI)

3.2.1. Former ACI Code (2002) & Current ASTM (2009)

The methodology of core interpretation given in the former ACI code was remained without changes for decades and up to Year (2003). The in-place strength of concrete cylinder at the location from which a core test specimen was extracted can be computed using the equation:

$$f_{cy} = F_{l/d} \cdot f_{core} \tag{4}$$

where f_{cy} is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, and $F_{l/d}$ is the strength correction factor for aspect ratio.

The former ACI code does not include any equation to calculate the correction factor ($F_{l/d}$); however, the code gives different values for this term that is associated with different aspect ratios (l/d) as given in Table 2. It should also be noted that the approach of current ASTM is similar to that mentioned above. The only considered variable is the aspect ratio (l/d). It should be noted that identical approach to that mentioned above is still effective in ASTM C42/C42M-03 [10].

3.2.2. Current ACI Code (2012) [15]

Starting from Year 2003, significant changes have been made to the relevant ACI Code provisions regarding the interpreta-

Table 2 Mean values for factor $F_{l/d}$ according to ACI Code (1998) and ASTM.

	Specimen length-to-diameter ratio, l/d			
	1.00	1.25	1.50	1.75
$F_{l/d}$	0.87	0.93	0.96	0.98

tion of core strength test results. New factors have been considered. These include core diameter, moisture content of core sample, core damage associated with drilling, in addition to the effect of aspect ratio that was previously considered in the former ACI edition (1998). According to the ACI 214.4R-03, the in-place concrete strength can be computed using the equation:

$$f_c = F_{l/d} \cdot F_{dia} \cdot F_{mc} \cdot F_D \cdot f_{core} \cdot \text{Front} \tag{5}$$

cc. 12 or cc. 15

where f_c is the equivalent in-place concrete cylinder strength, f_{core} is concrete core strength, $F_{l/d}$ is strength correction factor for aspect ratio, F_{dia} is strength correction factors for diameter, F_{mc} is strength correction factor for moisture condition of core sample, and F_D is the strength correction factor that accounts for effect of damage sustained during core drilling including micro-cracking and undulations at the drilled surface and cutting through coarse-aggregate particles that may subsequently pop out during testing.

The ACI committee considered the correction factors presented in Table 3 for converting core strengths into equivalent in-place strengths based on the work reported by Bartlett and MacGregor [6]. It should be noted that the magnitude of

Table 3 Strength correction factors according to ACI 214.4R-03.

List	Factors	Mean values
(1) ^b	$F_{l/d}$: l/d ratio	
	As-received	$1 - \{0.130 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
(3)	F_{mc} : core moisture content	
	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

^b Constant α equals $4.3(10^{-4})$ 1/MPa for f_{core} in MPa.

Table 6 List of comparisons between tested cores to determine.

	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●			■	▲				
A7								■	▲	●								
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
A17	◆																	
A18																		

- Diameter of steel bar.
- ▲ Distance of steel bar from nearly end of core.
- Number of steel bars and spacing between bars.
- ◆ Distance of steel bar from vertical axis of specimen.

This brief review indicated that the various proposed relationships for correction factors are all nonlinear. It should be noted that the equations given by the Egyptian Code takes into account most variables that may affect the interpretation of the results; however, the code ignores the deterioration of steel-concrete bond that may occur and also the position of the reinforcement from vertical axis of core specimens.

Weighted nonlinear regression analysis has been performed to determine the factor (F_{reinf}) with the use of the software "SAS" package and "Data Fit." This shows that the correction factor for reinforcement (F_{reinf}) is given by the following expression:

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$$F_{reinf} = \left[1 + 1.5 \frac{[\Phi_r \times r + \Phi_r \times (S/10)]}{\Phi_c * L} \right] \times \frac{1.13}{f_{core}^{0.015}} \quad (12)$$

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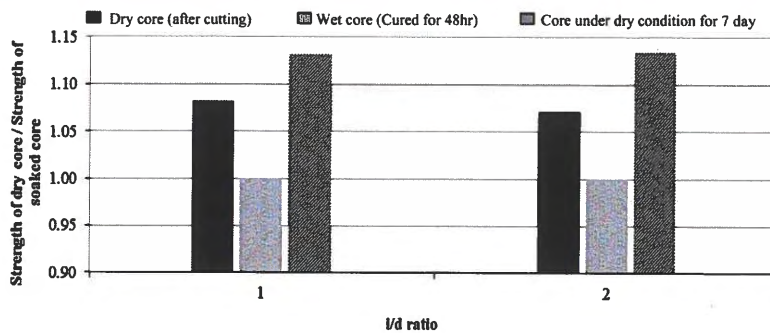


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).

Appendix F

Summary Table and Pavement Core Photos – Beghin Ave



2023 Local and Industrial Streets Renewal Package - 23-RI-02

Beghin Ave - De Baets St / Paquin Rd

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		
		Type	Thickness (mm)	Type	Thickness (mm)	Corrected Compressive Strength (Mpa)
PC22-15	UTM: 14U 5527224 N, 640429 E; Located in front of #150 Beghin Ave, 1.2 m West of East curb of the road.	Asphalt	60	Concrete	190	63.29
PC22-16	UTM: 14U 5527440 N, 640505 E; Located in front of #70 Beghin Ave, 1.9 m East of West curb of the road.	Asphalt	-	Concrete	210	55.91



Photo 1: Pavement Core Sample PC-15



Photo 2: Pavement Core Sample PC-16

Concrete Core Compressive Strength Report

CSA A23.2-14C

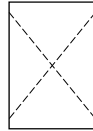
Project No. 1000-043-22
Project 2023 Local Streets Package - 23-R1-02
Client WSP Group Canada Inc.

Date December 14, 2022
Technician KM

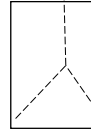
Core Location	Core ID	Date Received	Date of Break	Age at Break	Diam. (mm)	Length (mm)	Moisture Conditioning	Compressive Strength (MPa)		Break Type	Correction Factors*				
								Uncorrected f_{conc}	Corrected* f_c		$F_{l/d}$	F_{dia}	F_{mc}	F_D	F_{reinf}
Beghin Avenue	PC-15	2022-11-08	2022-12-14	-	145	174	Soaked 48 h	59.36	63.29	1	0.9415	0.9802	1.0900	1.0600	1.0000
Beghin Avenue	PC-16	2022-11-08	2022-12-14	-	145	188	Soaked 48 h	51.80	55.91	1	0.9531	0.9802	1.0900	1.0600	1.0000

Comments

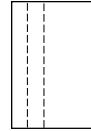
*Correction factors $F_{l/d}$, F_{dia} , F_{mc} , and F_D calculated as per ACI 214.4R-03, and correction factor F_{reinf} calculated as per Khoury et al. (2014): $f_c = f_{conc}F_{l/d}F_{dia}F_{mc}F_DF_{reinf}$



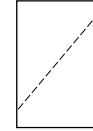
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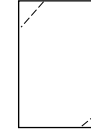
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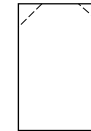
Type 3



Type 4



Type 5



Type 6

Reviewed by (print): Angela Fidler-Kliewer, C.Tech.

Signature: Angela Fidler-Kliewer

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		2012	✓	✓		✓	✓	
4	European Standard Specification	1998	✓	✓	✓		✓	
		2009	✓		✓			
5	Japanese Standard	1998	✓					
6	Concrete Society	1987	✓		✓		✓	✓

In addition, for core specimen containing two bars no further apart than the diameter of the larger bar, only the bar corresponding to the higher value of $(\Phi_r * d)$ is considered. If the bars are further apart, their combined effect should be assessed by replacing the term $(\Phi_r * d)$ by the term $(\sum \Phi_r * d)$.

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cc. 12 or cc. 15

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	Air dried ^a	$1 - \{0.144 - \alpha f_{core}\} (2 - \frac{1}{d})^2$
(2)	F_{dia} : core diameter	
	50 mm	1.06
	100 mm	1.00
	150 mm	0.98
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	As-received	1.00
	Soaked 48 h	1.09
	Air dried ^a	0.96
(4)	F_D : damage due to drilling	1.06

^a Standard treatment specified in ASTM C 42/C 42M.

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Table 6 List of comparisons between tested cores to determine.

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A1	●	●	●	●	●		●				●			▲	▲	■	▲	
A2																		
A3						■	●			■	●							
A4																		
A5																		
A6								■	▲	●		■	▲					
A7								■	▲	●			■	▲				
A8		●	◆	●	●													
A9																		
A10								■	▲	●								
A11																		
A12		●		●	●													
A13																		
A14		●		●														
A15		●																
A16	●	◆																
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A18																		

- Diameter of steel bar.
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where F_{reinf} is the correction factor for reinforcement, Φ_r is the diameter of the reinforcement, Φ_c is the diameter of the concrete specimen, r is the distance of axis of bar from nearer end of specimen, S is the distance of axis of bar from axis of core specimen, L is the length of the specimen after end preparation by grinding or capping, and f_{core} is the concrete core strength (kg/cm^2).

6.1.6. Effect of moisture condition of core

Results of about 100 cores indicate that the strength of cores left to dry in air for 7 days is on average 13% greater than that of cores soaked at least 40 h before testing. The strength of cores with negligible moisture gradient and tested after cutting is found to be 7–9% larger than that of soaked cores as shown in Fig. 20. The authors strongly recommend to use a correction factor accounting for moisture condition (F_m) equals to 1.09 and 0.96, respectively, for cores tested after 48 h soaked in water and for those tested after 7 days dry in air.

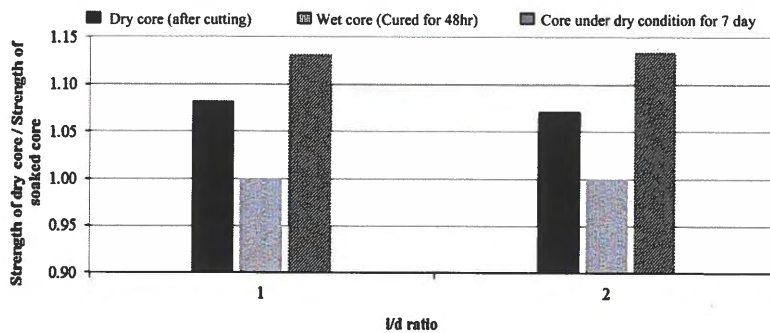


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).