APPENDIX ‘A’

GEOTECHNICAL REPORT

Quality Engineering | Valued Relationships

WSP Canada Group Ltd.

Bid No: 916-2020 Street Renewals
Geotechnical Investigation / Coring Report

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

Project Number: 1000-043-16

Date: June 2, 2021

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TREK GEOTECHNICAL Quality Engineering | Valued Relationships

June 2, 2021 Our File No. 1000-043-16

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

RE: Bid No: 916-2020 Street Renewals – Geotechnical Investigation / Coring Report

TREK Geotechnical Inc. is pleased to submit our Final Report for the geotechnical investigation for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

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

Encl.

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Revision History

Revision No.	Author	Issue Date	Description
0	MK	June 2, 2021	Final Report

Authorization Signatures

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June 2, 2021
REGISTERED PROFESSIONAL ENGINEER

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

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877 Date: June 2, 2021

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1.0 Introduction

This report summarizes the results of the road investigation completed for the 2021 Local Streets Package (Bid No: 916-2020) project. The project included drilling test holes along Pioneer Ave, William Stephenson Way, and St. Mary Ave., and collecting pavement cores along Colony St. The investigation was carried out in accordance with the City of Winnipeg geotechnical investigation requirements (Bid No: 916-2020).

2.0 Road Investigation

The investigation included coring of pavement at 14 locations on 4 different local streets with drilling of test holes at the core locations at 10 locations along three streets. The WSP Canada Group Ltd. selected the investigation locations as shown on Figure 01 to 02 (attached) and the table below summarizes the investigation program per street. The original program was to drill 11 test holes, but TH21-01 could not be drilled at the proposed location due to proximity to buried utilities.

Table 1: Road Investigation Program

Street	# of Locations	Investigation
Pioneer Ave. and William Stephenson Way (Between Main St. and Westbrook St.)	5	Pavement Cores and Sub-surface
St. Mary Ave (Between Memorial Blvd. and Portage Ave.)	5	Pavement Cores and Sub-surface
Colony St. (Between St. Mary Ave. and Portage Ave)	4	Pavement Cores

The road investigation was conducted between May 6th and 7th, 2021. The pavement structure (asphalt and/or concrete) was cored by Asad Dustmamatov of TREK Geotechnical Inc. (TREK) using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bit. The test holes were drilled to a depth of 3.0 m below road surface by Maple Leaf Drilling Ltd. 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 Asad Dustmamatov 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. 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 0.5 and 1.0 m below pavement as well as Standard Proctor and CBR testing. Information gathered for each street package is included in separate appendices (Appendices A through C). The information provided in the Appendices includes test hole logs, laboratory testing summary tables and results, and photos of the concrete cores.

Three CBR's were completed on bulk samples of the soil units present below the pavement. Only silt and clay was encountered within the prescribed sample depth for CBR testing and the results are shown in the table below.

Table 2: CBR Testing Summary

Sample Description	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	Pioneer Ave	0.3-1.5	1615	20.7	94.4	22.4	7.1%	5.3%
Silt	William Stephenson Way	0.3-1.5	1876	14.5	94.7	14.4	10.9%	10.0%
Clay	St. Mary Ave.	0.3-1.5	1531	24.4	94.7	27.2	3.0%	2.3%

* Testing completed on combined grab samples from the top 1.5 m of each test hole.

Two concrete cores were selected for concrete compressive strength breaks and the length to diameter ratio ranged between 1.22 to 1.29 for the cores collected. The core compressive strength tests were tested in accordance with CSA A23.2-14C – air 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 C.

Concrete Core Compressive Strength Results

Core ID	Uncorrected Comp. strength	L/D Corr.	Dia. Corr. Factor	Moisture Corr.	Damage Corr.	Rebar Corr. Factor	Corr. Comp. Strength (MPa)
PC20-05	65.2	.94	0.98	0.96	1.06	-	61.1
PC20-06	57.8	.94	0.98	0.96	1.06	-	54.2

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 (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

TREK GEOTECHNICAL

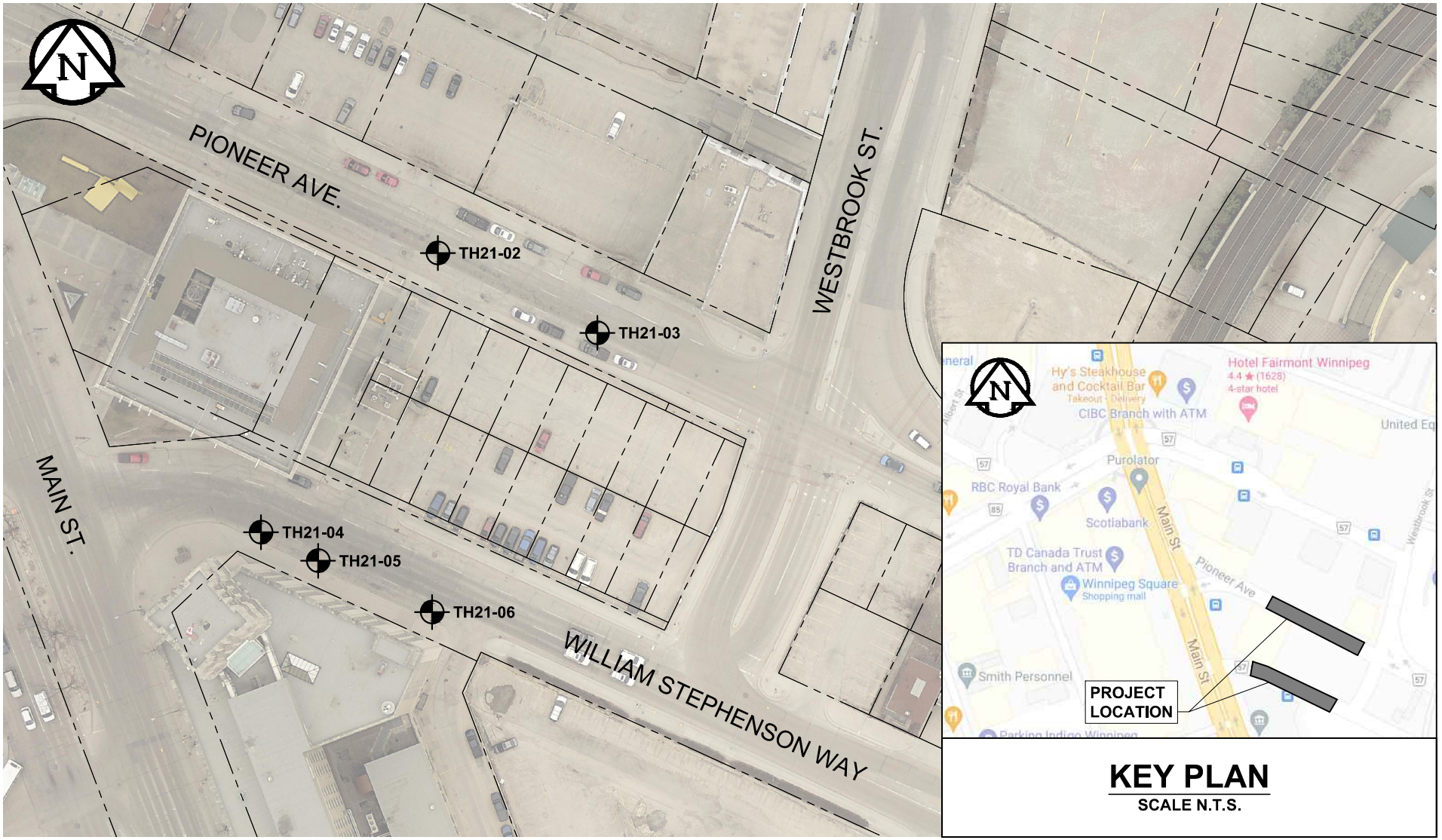
1000 043 16

WSP Canada Group Ltd.

Bid No: 916-2020 Street Renewals Geotechnical Investigation

ANSI full bleed A (11.00 x 8.50 Inches)

FIG_Street Renewal_0_A_BT_1000-043-16.dwg, 2021-05-28 1:28:24 PM



0 10 20 30 40 50 m

SCALE = 1 : 1 000 (216 mm x 279 mm)

LEGEND: TEST HOLE (TREK, MAY 10, 2021)

NOTES:

1. AERIAL IMAGE FROM CITY OF WINNIPEG, FALL 2016
2. TEST HOLE TH21-01 AT PROPOSED LOCATION WAS NOT DRILLED DUE TO PROXIMITY TO BURIED UTILITIES

Figure 01

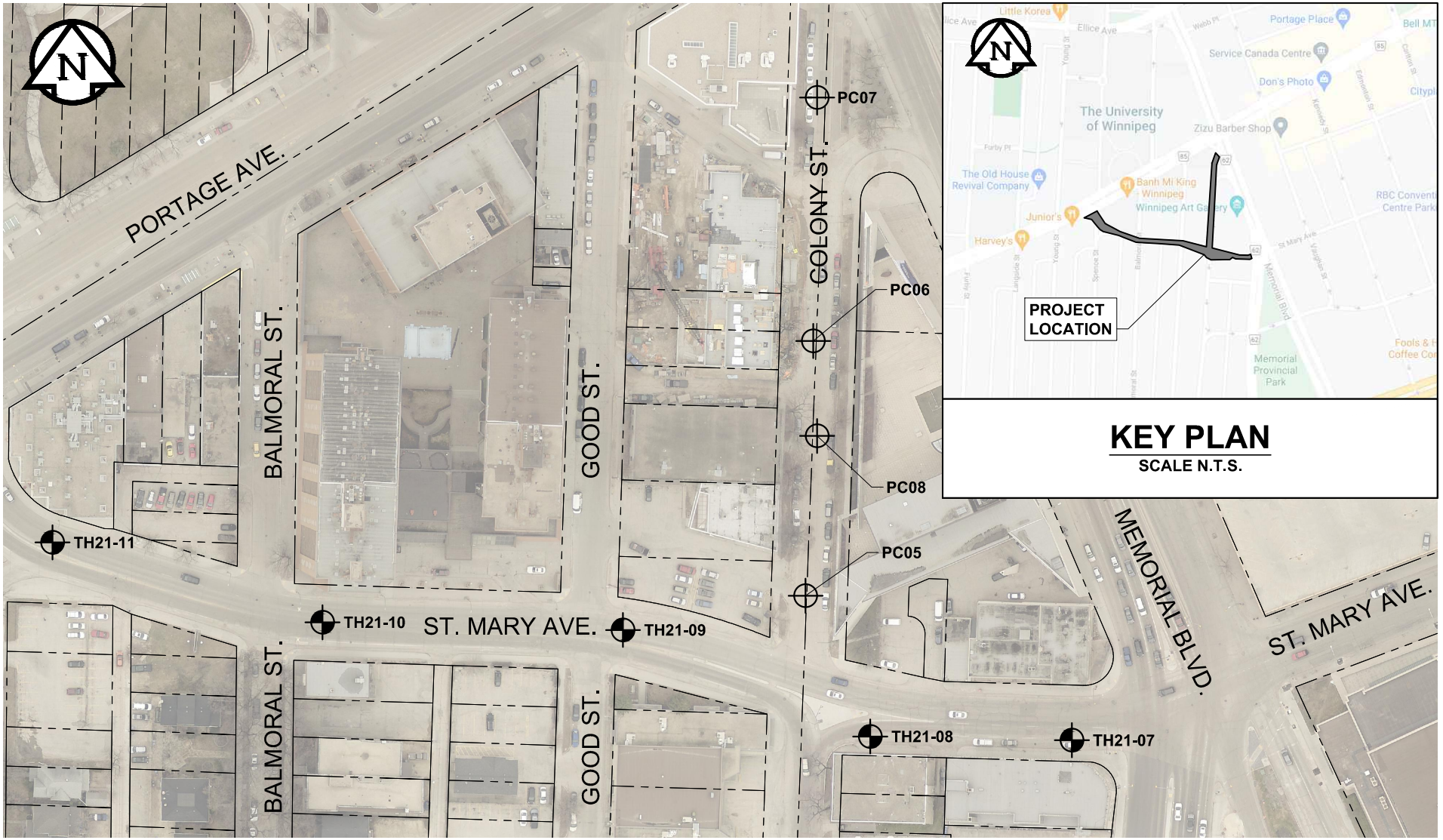
Test Hole Location Plan

Pioneer and William Stephenson Way

TREK GEOTECHNICAL

1000 043 16
WSP Canada Group Ltd.
Bid No: 916-2020 Street Renewals Geotechnical Investigation

ANSI full bleed A (11.00 x 8.50 Inches)



FIG_Street Renewal_0_A_BT_1000-043-16.dwg, 2021-05-28 1:28:40 PM

0 25 50 75 m
SCALE = 1 : 1 500 (216 mm x 279 mm)

LEGEND: TEST HOLE (TREK, MAY 10, 2021) PAVEMENT CORE (TREK, MAY 10, 2021)

NOTES:
1. AERIAL IMAGE FROM CITY OF WINNIPEG, FALL 2016

Figure 02
Test Hole Location Plan
St. Mary Ave (Test Hole) and Colony St. (Pavement Core)

Appendix A

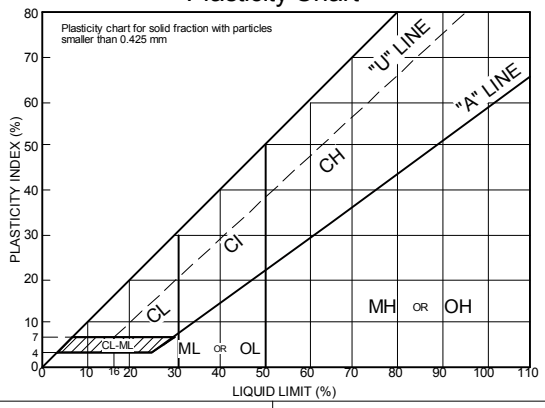
Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos – Pioneer Ave. and William Stephenson Way

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent..... GW, GP, SW, SP; More than 12 percent..... GM, GC, SM, SC; 6 to 12 percent..... Borderline case4s requiring dual symbols*
			GP		Poorly-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
		Gravel with fines (Appreciable amount of fines)	GM		Silty gravels, gravel-sand-silt mixtures	Not meeting all gradation requirements for GW
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / 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
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM		Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / 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
			SC		Clayey sands, sand-clay mixtures	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL		Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts	
			CH		Inorganic clays of high plasticity, fat clays	
			OH		Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt		Peat and other highly organic soils	Von Post Classification Limit: Strong colour or odour, and often fibrous texture



Particle Size	Material	ASTM Sieve sizes	mm
	Sand		
	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
	Silt or Clay	< #200	< 0.075

Particle Size	Material	ASTM Sieve Sizes	mm
	Boulders	> 12 in.	> 300
	Cobbles	3 in. to 12 in.	75 to 300
	Gravel		
	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

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

Sub-Surface Log

Test Hole TH21-02

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5528525, E-633844 (Pioneer Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type: Torvane, Pocket Pen., Qu, Field Vane 0 50 100 150 200 250
		ASPHALT - 175 mm thick				
		CONCRETE - 200 mm thick		PC21-13		
0.5		GRAVEL - crushed limestone (<50 mm diam.) sandy, some fines - brown - compact to dense - poorly graded - sub-angular to angular - AASHTO: A-1-b		G61		
1.0		CLAY - silty, trace sand - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (42)		G62		
				G63		
1.5		SILT - trace clay, trace sand - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-4 (I)		G64		
2.0				G65		
2.5		CLAY - silty - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G66		
3.0		END OF TEST HOLE AT 3.0 m IN CLAY				

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 5 m North of South curb, 73 m West of Westbrook St. and Pioneer Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-03

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5528517 E-633875 (Pioneer Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) 0 50 100 150 200 250
		ASPHALT - 150 mm thick		PC21-12		
		CONCRETE - 100 mm thick				
		GRAVEL - coarse gravel (<50 mm diam.) sandy, some fines - brown, compact to dense - poorly graded, sub-angular, AASHTO: A-1-b (I)		G54		
0.5		CLAY - silty, trace sand, trace organics - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (64)		G55		
1.0				G56		
				G57		
1.5		SILT - trace clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-4 (I)		G58		
				G59		
2.0						
2.5		CLAY - silty - brown - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G60		
3.0		END OF TEST HOLE AT 3.0 m IN CLAY				

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 5 m North of South curb, 34 m West of Westbrook St. and Pioneer Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-04
1 of 1

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5528486, E-633815 (William Stephenson Way)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL	Undrained Shear Strength (kPa) 0 50 100 150 200 250
		ASPHALT - 100 mm thick				
		CONCRETE - 200 mm thick		PC21-10		
		SAND AND GRAVEL - silty, coarse gravel (<50 mm diam.) - brown - compact to dense - poorly graded - sub-angular to angular - AASHTO: A-1-b (I)		G34		
0.5						
		SILT - some clay, some sand, some gravel - light brown - moist, soft - intermediate plasticity - AASHTO: A-6 (11)		G35		
1.0				G36		
1.5				G37		
		CLAY - silty - brown - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)		G38		△ ✤
2.0						
2.5				G39		✤
3.0						

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 2 m North of South curb, 5 m East of West Corner of 269 Main St.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-05
1 of 1

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5528467, E-633822 (William Stephenson Way)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) 0 50 100 150 200 250 — Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○
		ASPHALT - 25 mm thick CONCRETE - 250 mm thick		PC21-09		
0.5		SAND AND GRAVEL - coarse gravel (<50 mm diam.), trace to some fines - reddish brown - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-1-b		G40		
				G41		
1.0		SAND - trace clay, trace silt, trace gravel (<25 mm diam.) - reddish brown - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-3		G42		
				G43		
1.5				G44		
		CLAY - silty - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G45		△ ✤
2.0						
2.5				G46		✤
3.0		END OF TEST HOLE AT 3.0 m IN CLAY				

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 2 m North of South curb, 21 m East of West corner of 269 Main St.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-06

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5528465, E-633842 (William Stephenson Way)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL	Undrained Shear Strength (kPa) Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
		ASPHALT - 75 mm thick				
		CONCRETE - 175 mm thick		PC21-11		
		SAND AND GRAVEL - trace silt, trace clay, coarse gravel (<50 mm diam.) - brown, compact to dense - poorly graded, rounded to sub-angular, AASHTO: A-1-b (I)		G47	●	
0.5		SILT - trace clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-4 (8)		G48	●	
1.0				G49	●	
				G50	●	
1.5				G51	●	
		CLAY - silty - brown - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G52	●	△ ✤
2.0						
2.5				G53	●	△✤
3.0						

END OF TEST HOLE AT 3.0 m IN CLAY

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 2 m North of South curb, 5 m West of East Corner of 269 Main St.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

916-2020 Street Renewals - Pioneer 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
TH21-02	UTM: 5528525 N, 633844 E Located 5 m North of South curb, 73 m West of Westbrook St. and Pioneer Ave. intersection.	Asphalt	175	Concrete	200		0.0	0.4								
						Sand and Gravel	0.6	0.8	6	18		25	57			
						Clay	0.9	1.1	29	55	32	11	2	21	65	44
						Clay	1.2	1.4	27							
						Silt	1.5	1.7	21							
						Silt	1.8	2.0	24							
						Clay	2.4	2.6	39							
TH21-03	UTM: 5528517 N,633875 E Located 5 m North of South curb, 34 m West of Westbrook St. and Pioneer Ave. intersection.	Asphalt	150	Concrete	100		0.0	0.3								
						Sand and Gravel	0.3	0.5	7							
						Clay	0.6	0.8	34							
						Clay	0.9	1.1	32	72	26	2	0	22	79	57
						Clay	1.2	1.4	28							
						Silt	1.5	1.7	20							
						Silt	1.8	2.0	25							
						Clay	2.4	2.6	33							

916-2020 Street Renewals - William Stephenson Way
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
TH21-04	UTM: 5528486 N, 633815 E Located 2 m North of South curb, 5 m East of West Corner of 269 Main St.	Asphalt	100	Concrete	200		0.0	0.3								
						Sand and Gravel	0.6	0.8	6							
						Silt	0.9	1.1	22	18	48	14	20	18	37	19
						SIlt	1.2	1.4	20							
						Silt	1.5	1.7	23							
						Clay	1.8	2.0	28							
						Clay	2.4	2.6	47							
TH21-05	UTM: 5528467 N, 633822E Located 2 m North of South curb, 21 m East of West corner of 269 Main St.	Asphalt	25	Concrete	250		0.0	0.3								
						Sand and Gravel	0.3	0.5	9.0	14		51	35			
						Sand and Gravel	0.6	0.8	8.0							
						Sand	0.9	1.1	12.0	12		77	11			
						Sand	1.2	1.4	13							
						Sand	1.5	1.7	12							
						Clay	1.8	2.0	34							
						Clay	2.4	2.6	51							
TH21-06	UTM: 55528465 N, 633842 E Located 2 m North of South curb, 5 m West of East Corner of 269 Main St.	Asphalt	75	Concrete	175		0.0	0.3								
						Sand and Gravel	0.3	0.5	7							
						Silt	0.6	0.8	18							
						Silt	0.9	1.1	21	18	73	8	1	17	27	10
						Silt	1.2	1.4	17							
						Silt	1.5	1.7	24							
						Clay	1.8	2.0	42							
						Clay	2.4	2.6	48							

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Moisture Content Report
ASTM D2216-10

Project No. 1000-043-16
Client WSP
Project 916-2020 Pavement Renewals - Pioneer Ave

Sample Date 10-May-21
Test Date 17-May-21
Technician ZS

Test Hole	TH21-02	TH21-02	TH21-02	TH21-02	TH21-02	TH21-02
Depth (m)	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6
Sample #	G61	G62	G63	G64	G65	G66
Tare ID	Peter	F153	G7	F137	AC39	W04
Mass of tare	303.7	8.5	8.4	8.5	6.7	8.5
Mass wet + tare	828.7	463.9	218.0	229.4	234.4	249.1
Mass dry + tare	797.2	362.7	173.7	190.5	190.3	181.2
Mass water	31.5	101.2	44.3	38.9	44.1	67.9
Mass dry soil	493.5	354.2	165.3	182.0	183.6	172.7
Moisture %	6.4%	28.6%	26.8%	21.4%	24.0%	39.3%

Test Hole	TH21-03	TH21-03	TH21-03	TH21-03	TH21-03	TH21-03
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G54	G55	G56	G57	G58	G59
Tare ID	DM-14	F98	E55	AB10	L17	D35
Mass of tare	304.3	8.4	8.7	6.7	8.7	8.5
Mass wet + tare	1386.0	211.3	468.2	231.3	217.9	222.8
Mass dry + tare	1317.5	159.5	356.2	182.0	182.7	180.5
Mass water	68.5	51.8	112.0	49.3	35.2	42.3
Mass dry soil	1013.2	151.1	347.5	175.3	174.0	172.0
Moisture %	6.8%	34.3%	32.2%	28.1%	20.2%	24.6%

Test Hole	TH21-03					
Depth (m)	2.4 - 2.6					
Sample #	G60					
Tare ID	A360					
Mass of tare	6.6					
Mass wet + tare	216.0					
Mass dry + tare	164.5					
Mass water	51.5					
Mass dry soil	157.9					
Moisture %	32.6%					

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Atterberg Limits
ASTM D4318-10e1

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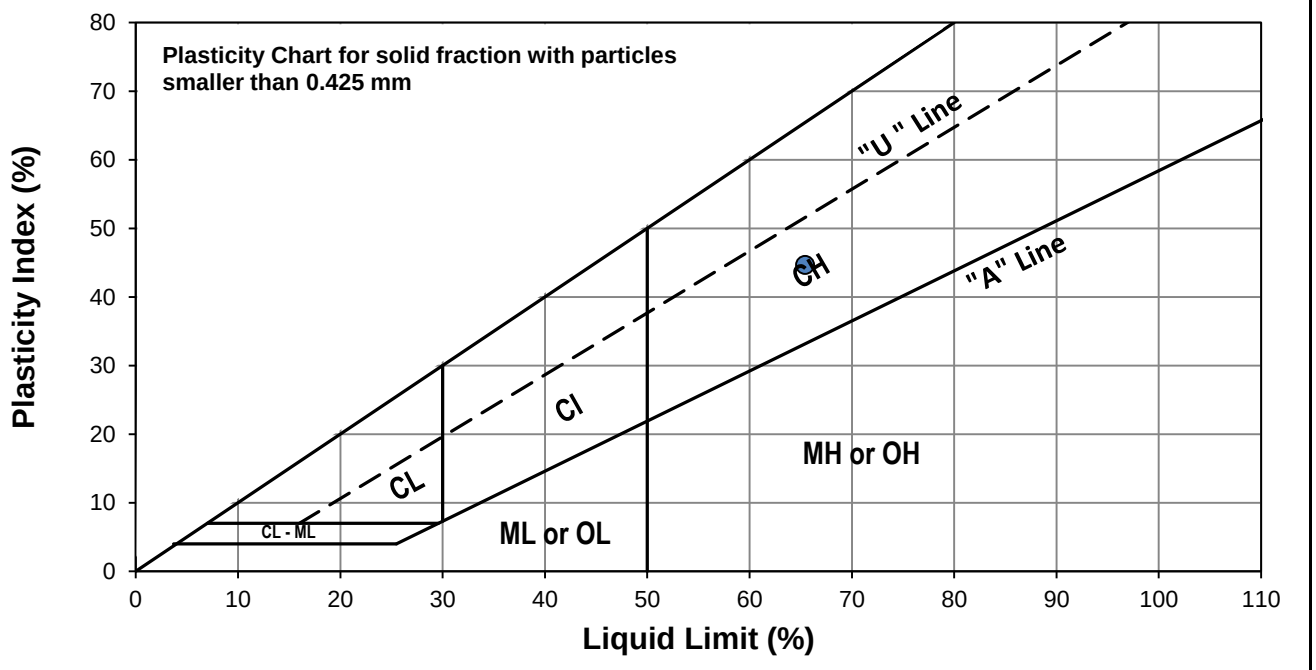
Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-02 - Pioneer Ave
Sample #	G62
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	20-May-21
Technician	AD

Liquid Limit	65
Plastic Limit	21
Plasticity Index	45

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	26	33		
Mass Tare (g)	14.168	14.178	14.229		
Mass Wet Soil + Tare (g)	24.837	24.642	26.558		
Mass Dry Soil + Tare (g)	20.496	20.510	21.763		
Mass Water (g)	4.341	4.132	4.795		
Mass Dry Soil (g)	6.328	6.332	7.534		
Moisture Content (%)	68.600	65.256	63.645		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.218	14.161			
Mass Wet Soil + Tare (g)	20.316	20.485			
Mass Dry Soil + Tare (g)	19.278	19.384			
Mass Water (g)	1.038	1.101			
Mass Dry Soil (g)	5.060	5.223			
Moisture Content (%)	20.514	21.080			

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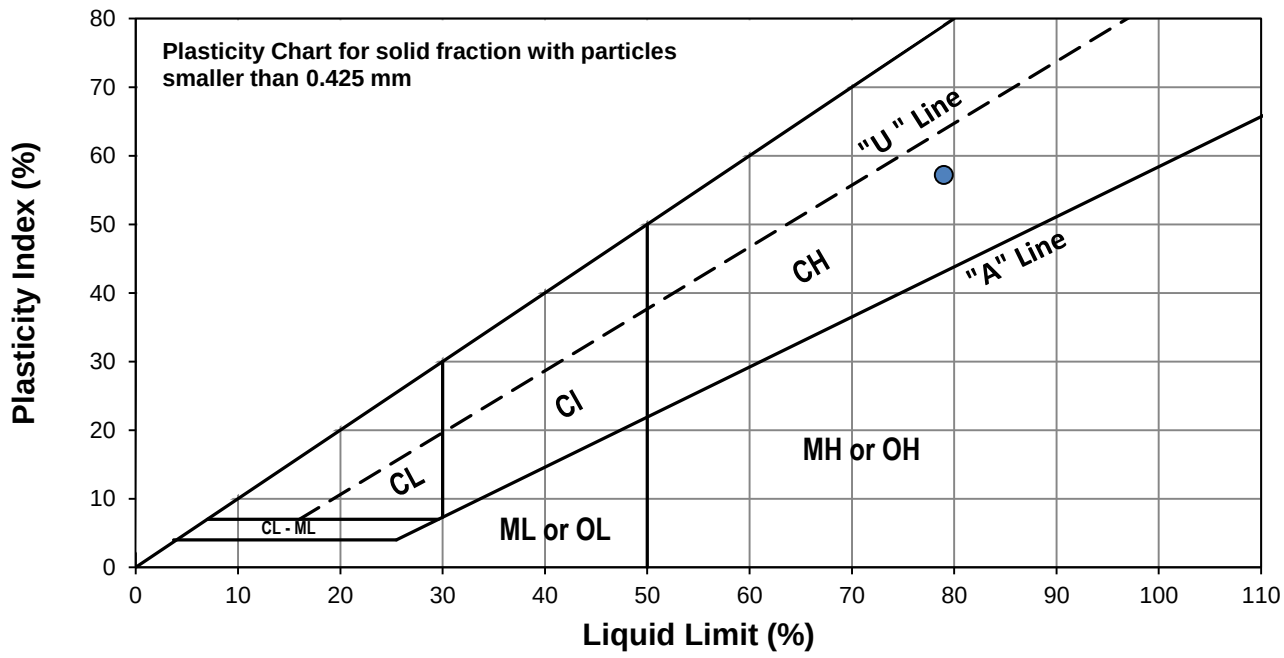
Atterberg Limits
ASTM D4318-10e1

Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-03 - Pioneer Ave
Sample #	G56
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Liquid Limit	79
Plastic Limit	22
Plasticity Index	57

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	23	35		
Mass Tare (g)	14.076	14.333	14.132		
Mass Wet Soil + Tare (g)	24.040	24.936	24.555		
Mass Dry Soil + Tare (g)	19.555	20.239	20.035		
Mass Water (g)	4.485	4.697	4.520		
Mass Dry Soil (g)	5.479	5.906	5.903		
Moisture Content (%)	81.858	79.529	76.571		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.029	14.161			
Mass Wet Soil + Tare (g)	20.474	21.199			
Mass Dry Soil + Tare (g)	19.311	19.949			
Mass Water (g)	1.163	1.250			
Mass Dry Soil (g)	5.282	5.788			
Moisture Content (%)	22.018	21.596			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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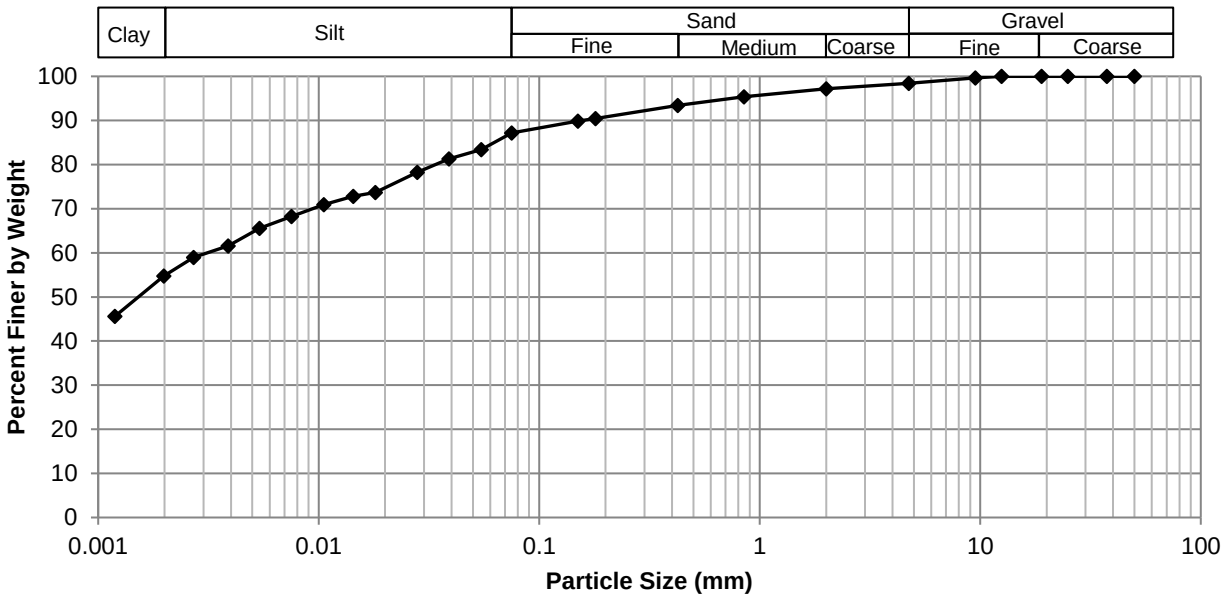
Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-02 - Pioneer Ave
Sample #	G62
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	19-May-21
Technician	AD

Gravel	1.6%
Sand	11.3%
Silt	32.3%
Clay	54.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	98.44	0.0750	87.19
37.5	100.00	2.00	97.22	0.0546	83.42
25.0	100.00	0.850	95.38	0.0390	81.30
19.0	100.00	0.425	93.39	0.0280	78.26
12.5	100.00	0.180	90.46	0.0181	73.70
9.50	99.62	0.150	89.87	0.0143	72.79
4.75	98.44	0.075	87.19	0.0106	70.96
				0.0075	68.28
				0.0054	65.54
				0.0039	61.54
				0.0027	58.96
				0.0020	54.76
				0.0012	45.63

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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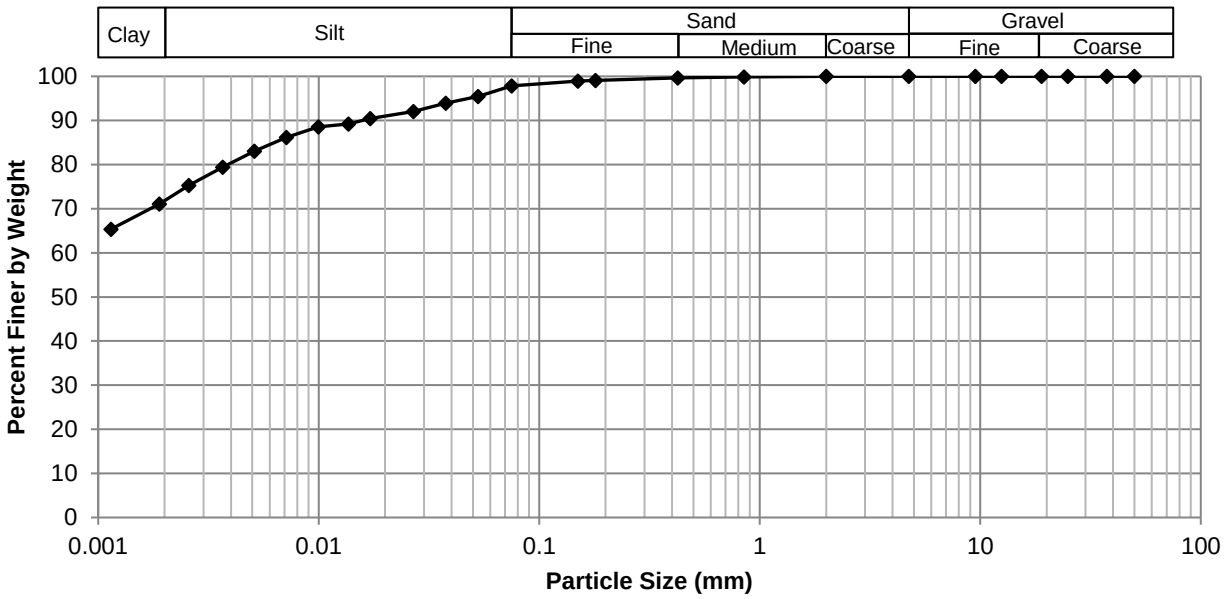
Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-03 - Pioneer Ave
Sample #	G56
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Gravel	0.0%
Sand	2.2%
Silt	26.1%
Clay	71.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	97.84
37.5	100.00	2.00	100.00	0.0528	95.45
25.0	100.00	0.850	99.86	0.0377	93.89
19.0	100.00	0.425	99.68	0.0269	92.01
12.5	100.00	0.180	99.10	0.0171	90.45
9.50	100.00	0.150	98.96	0.0136	89.20
4.75	100.00	0.075	97.84	0.0100	88.57
				0.0071	86.14
				0.0051	83.08
				0.0037	79.39
				0.0026	75.27
				0.0019	71.08
				0.0011	65.35

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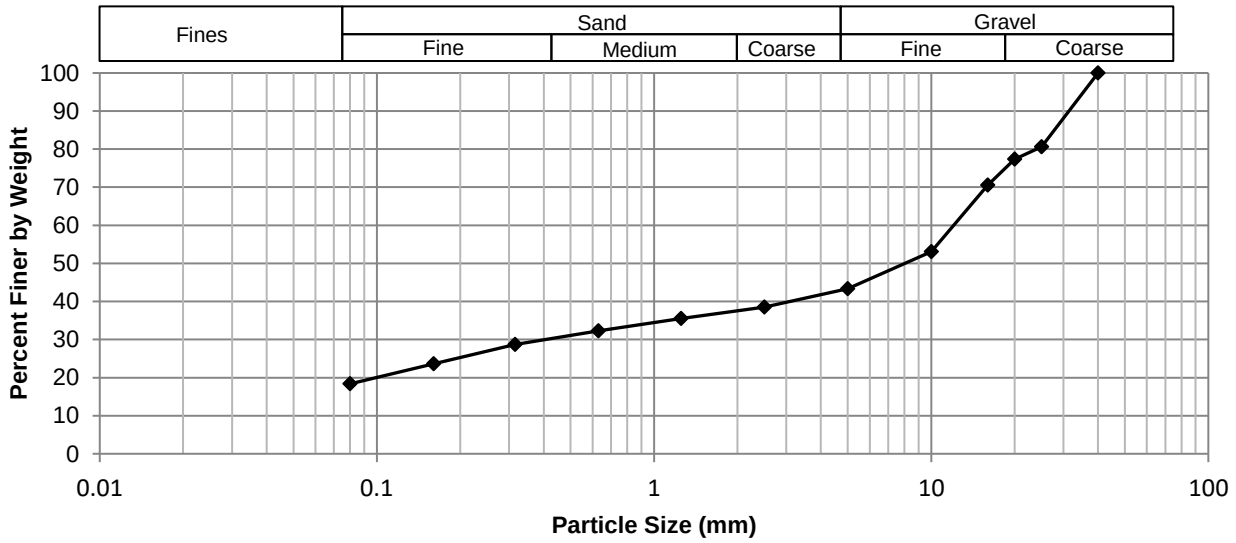
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-02 - Pioneer Ave
Sample #	G61
Depth (ft)	0.6-0.8
Date Sampled	10-May-21
Date Tested	18-May-21
Technician	AD

Total Weight (g)	493.5
Gravel %	56.6
Sand %	25.0
Fines %	18.4

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
40.0	100	-
25.0	81	-
20.0	77	-
16.0	71	-
10.0	53	-
5.0	43	-
2.50	39	-
1.25	36	-
0.630	32	-
0.315	29	-
0.160	24	-
0.080	18	-

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Standard Proctor Compaction Test

ASTM D698-12e2

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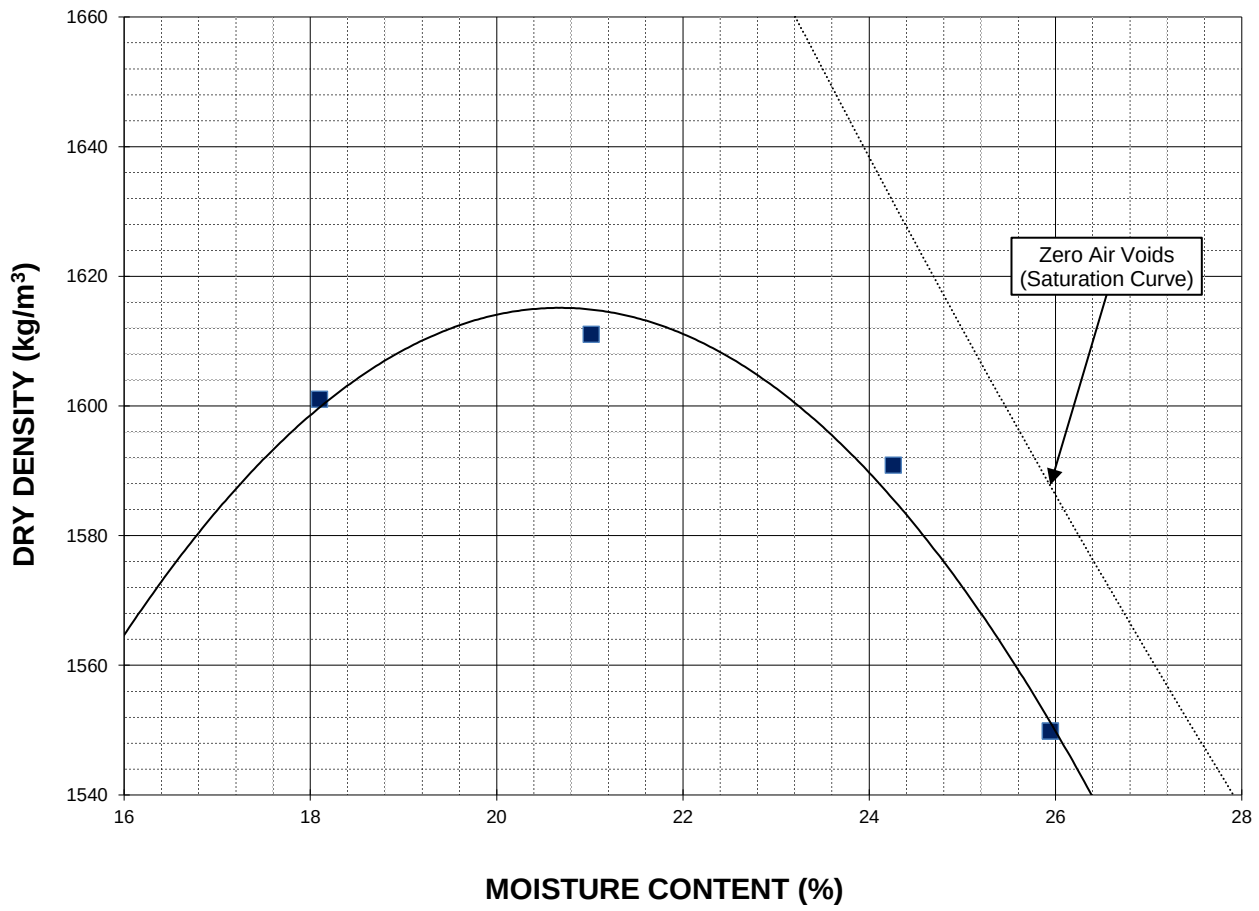
Project No.	1000-001-18
Client	WSP
Project	916-2020 Pavement Renewals
Sample #	L21-167
Source	Pioneer Ave
Material	Clay Sub-grade Material
Sample Date	10-May-21
Test Date	14-May-21
Technician	AD

Maximum Dry Density (kg/m3)	1615
Optimum Moisture (%)	20.7

Trial Number	1	2	3	4	
Wet Density (kg/m^3)	1891	1950	1977	1952	
Dry Density (kg/m^3)	1601	1611	1591	1550	
Moisture Content (%)	18.1	21.0	24.3	25.9	



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California Bearing Ratio Test Data Sheet

ASTM D1883-16

Project No.	1000-043-16	**Source**	TH21-02, TH21-03
Client	WSP	**Material**	Clay
Project	916-2020 Pavement Renewals	**Sample Date**	2021-05-10
Sample #	L21-167	**Test Date**	2021-05-18
		Technician	AD

Proctor Results (ASTM D698)

Maximum Dry Density	1615	kg/m3
Optimum Moisture Content	20.7	%
Material Retained on 19 mm Sieve	0.0	%

CBR Sample Compaction

Dry Density	1525	kg/m3
Initial Moisture Content	22.4	%
Relative Density	94.4	% SPMDD

Soaking Results

Surcharge	4.54	kg
Swell	1.0	%
Moisture Content in top 25 mm	30.3	%
Immersion Period	96	h

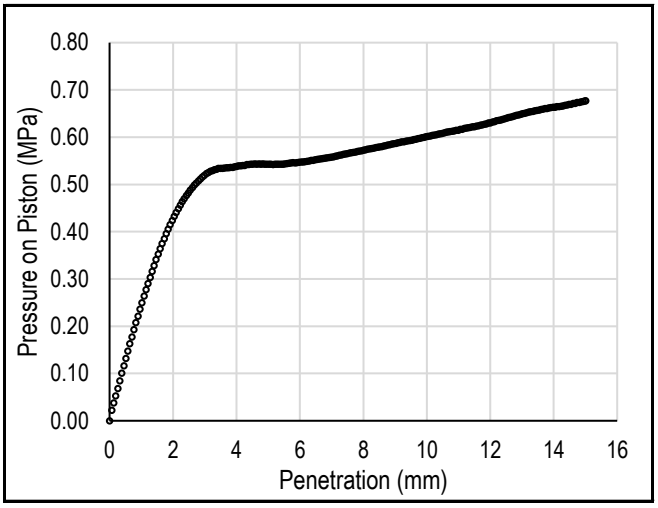
CBR Results

CBR at 2.54 mm	7.1	%
CBR at 5.08 mm	5.3	%
Zero Correction	0	mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.16	0.16
1.27	0.30	0.30
1.91	0.42	0.42
2.54	0.49	0.49
3.18	0.53	0.53
3.81	0.54	0.54
4.45	0.54	0.54
5.08	0.54	0.54
7.62	0.57	0.57
10.16	0.60	0.60
12.70	0.64	0.64

Load/Penetration Curve



Comments:

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Moisture Content Report
ASTM D2216-10

Project No. 1000-043-16
Client WSP
Project 916-2020 Pavement Renewals - William Stephenson Way

Sample Date 10-May-21
Test Date 17-May-21
Technician ZS

Test Hole	TH21-04	TH21-04	TH21-04	TH21-04	TH21-04	TH21-04
Depth (m)	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6
Sample #	G34	G35	G36	G37	G38	G39
Tare ID	C8	F7	Z104	D19	D44	W26
Mass of tare	8.4	8.4	8.4	8.5	8.5	8.4
Mass wet + tare	210.7	463.9	217.0	227.0	239.1	218.5
Mass dry + tare	199.3	381.4	182.1	186.0	189.1	150.9
Mass water	11.4	82.5	34.9	41.0	50.0	67.6
Mass dry soil	190.9	373.0	173.7	177.5	180.6	142.5
Moisture %	6.0%	22.1%	20.1%	23.1%	27.7%	47.4%

Test Hole	TH21-05	TH21-05	TH21-05	TH21-05	TH21-05	TH21-05
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G40	G41	G42	G43	G44	G45
Tare ID	NN0	AC16	Tiger	D39	W101	W45
Mass of tare	317.8	7.0	293.2	8.4	8.5	8.6
Mass wet + tare	1801.7	212.5	719.5	209.0	217.3	236.1
Mass dry + tare	1680.0	196.5	674.8	186.7	195.6	178.1
Mass water	121.7	16.0	44.7	22.3	21.7	58.0
Mass dry soil	1362.2	189.5	381.6	178.3	187.1	169.5
Moisture %	8.9%	8.4%	11.7%	12.5%	11.6%	34.2%

Test Hole	TH21-05	TH21-06	TH21-06	TH21-06	TH21-06	TH21-06
Depth (m)	2.4 - 2.6	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G46	G47	G48	G49	G50	G51
Tare ID	F116	Z114	H70	N42	E35	E100
Mass of tare	8.4	8.5	9.0	8.6	8.5	8.6
Mass wet + tare	209.6	242.6	223.4	464.2	225.7	220.1
Mass dry + tare	141.7	227.5	190.3	384.9	194.6	178.9
Mass water	67.9	15.1	33.1	79.3	31.1	41.2
Mass dry soil	133.3	219.0	181.3	376.3	186.1	170.3
Moisture %	50.9%	6.9%	18.3%	21.1%	16.7%	24.2%

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Moisture Content Report
ASTM D2216-10

Project No. 1000-043-16
Client WSP
Project 916-2020 Pavement Renewals - William Stephenson Way

Sample Date 10-May-21
Test Date 17-May-21
Technician ZS

Test Hole	TH21-06	TH21-06				
Depth (m)	1.8 - 2.0	2.4 - 2.6				
Sample #	G52	G53				
Tare ID	P37	H12				
Mass of tare	8.6	8.8				
Mass wet + tare	213.2	211.1				
Mass dry + tare	153.1	145.9				
Mass water	60.1	65.2				
Mass dry soil	144.5	137.1				
Moisture %	41.6%	47.6%				

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Atterberg Limits
ASTM D4318-10e1

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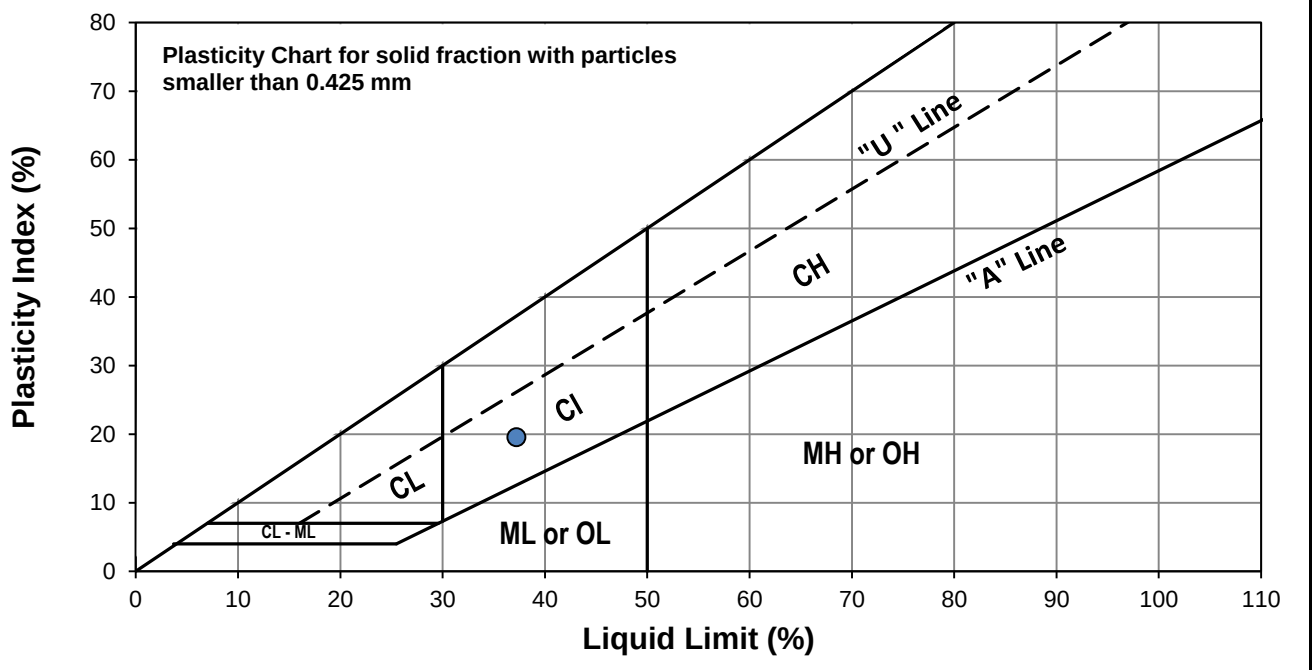
Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-04 - William Stephenson Way
Sample #	G35
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	18-May-21
Technician	AD

Liquid Limit	37
Plastic Limit	18
Plasticity Index	20

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	18	23	30		
Mass Tare (g)	14.335	14.127	14.050		
Mass Wet Soil + Tare (g)	29.269	28.860	31.156		
Mass Dry Soil + Tare (g)	25.125	24.855	26.567		
Mass Water (g)	4.144	4.005	4.589		
Mass Dry Soil (g)	10.790	10.728	12.517		
Moisture Content (%)	38.406	37.332	36.662		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.058	14.091			
Mass Wet Soil + Tare (g)	24.932	25.034			
Mass Dry Soil + Tare (g)	23.292	23.397			
Mass Water (g)	1.640	1.637			
Mass Dry Soil (g)	9.234	9.306			
Moisture Content (%)	17.760	17.591			

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Atterberg Limits
ASTM D4318-10e1

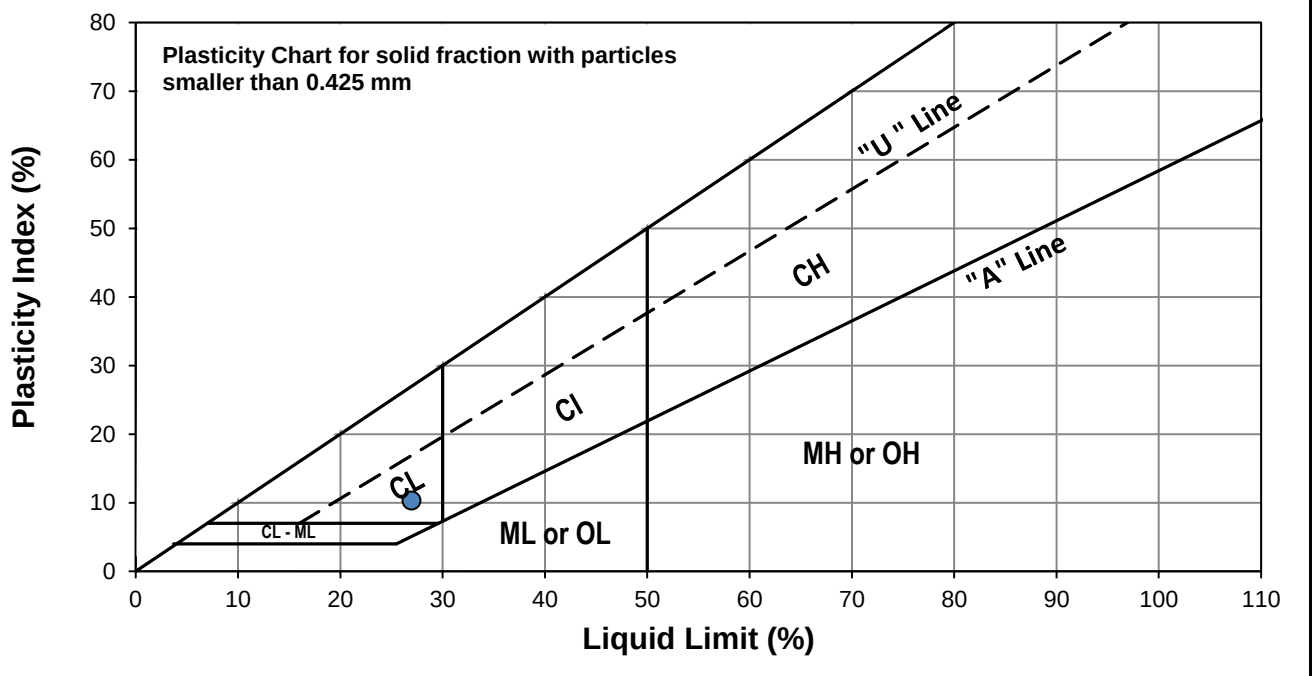
CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-06 - William Stephenson Way
Sample #	G49
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	20-May-21
Technician	AD

Liquid Limit	27
Plastic Limit	17
Plasticity Index	10

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	26	33		
Mass Tare (g)	13.951	14.314	13.973		
Mass Wet Soil + Tare (g)	28.228	26.419	27.669		
Mass Dry Soil + Tare (g)	25.061	23.872	24.819		
Mass Water (g)	3.167	2.547	2.850		
Mass Dry Soil (g)	11.110	9.558	10.846		
Moisture Content (%)	28.506	26.648	26.277		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.067	13.987			
Mass Wet Soil + Tare (g)	20.411	22.218			
Mass Dry Soil + Tare (g)	19.509	21.040			
Mass Water (g)	0.902	1.178			
Mass Dry Soil (g)	5.442	7.053			
Moisture Content (%)	16.575	16.702			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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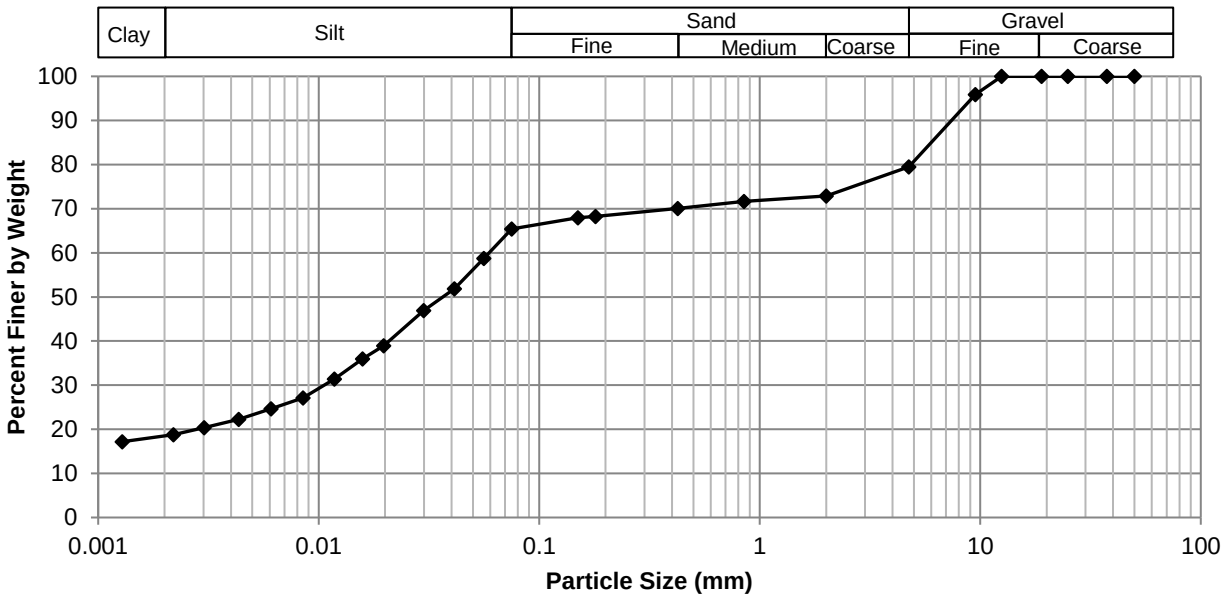
For specific tests as listed on www.ccil.com

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-04 - William Stephenson Way
Sample #	G35
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	19-May-21
Technician	AD

Gravel	20.5%
Sand	14.0%
Silt	47.7%
Clay	17.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	79.48	0.0750	65.45
37.5	100.00	2.00	72.92	0.0560	58.72
25.0	100.00	0.850	71.66	0.0412	51.88
19.0	100.00	0.425	70.09	0.0299	46.91
12.5	100.00	0.180	68.22	0.0197	38.93
9.50	95.91	0.150	67.95	0.0158	35.97
4.75	79.48	0.075	65.45	0.0118	31.41
				0.0085	27.13
				0.0061	24.62
				0.0043	22.29
				0.0030	20.38
				0.0022	18.79
				0.0013	17.18

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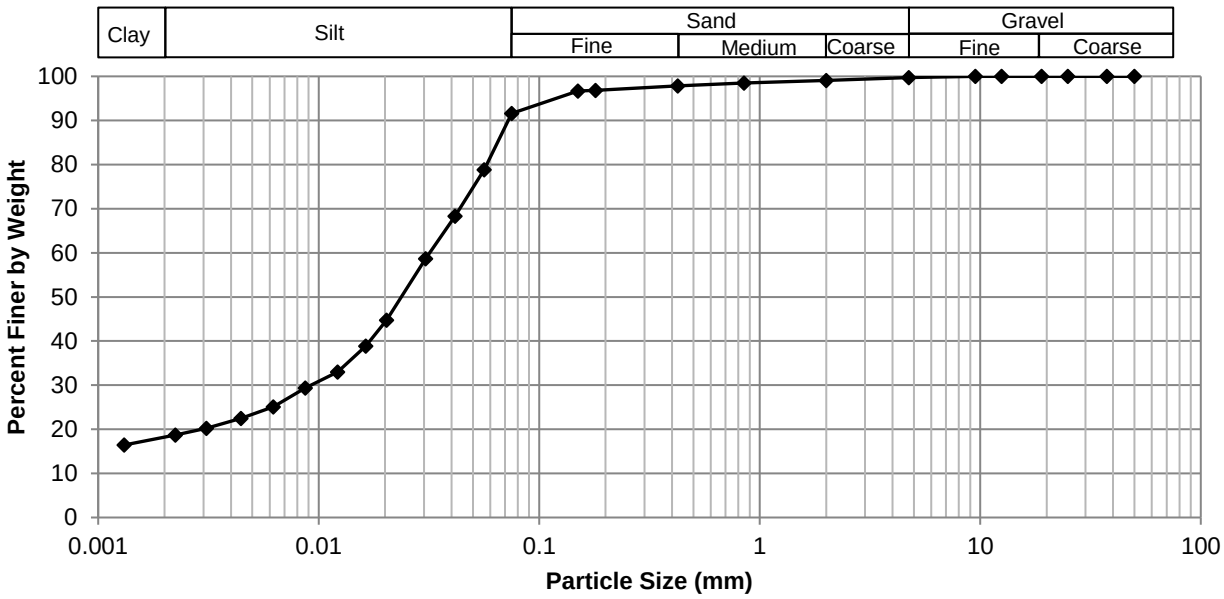
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-06 - William Stephenson Way
Sample #	G49
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	19-May-21
Technician	AD

Gravel	0.2%
Sand	8.2%
Silt	73.4%
Clay	18.1%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.76	0.0750	91.58
37.5	100.00	2.00	99.05	0.0562	78.83
25.0	100.00	0.850	98.47	0.0416	68.30
19.0	100.00	0.425	97.81	0.0305	58.70
12.5	100.00	0.180	96.86	0.0203	44.76
9.50	100.00	0.150	96.68	0.0164	38.87
4.75	99.76	0.075	91.58	0.0122	32.99
				0.0087	29.35
				0.0062	25.08
				0.0044	22.46
				0.0031	20.20
				0.0022	18.73
				0.0013	16.43

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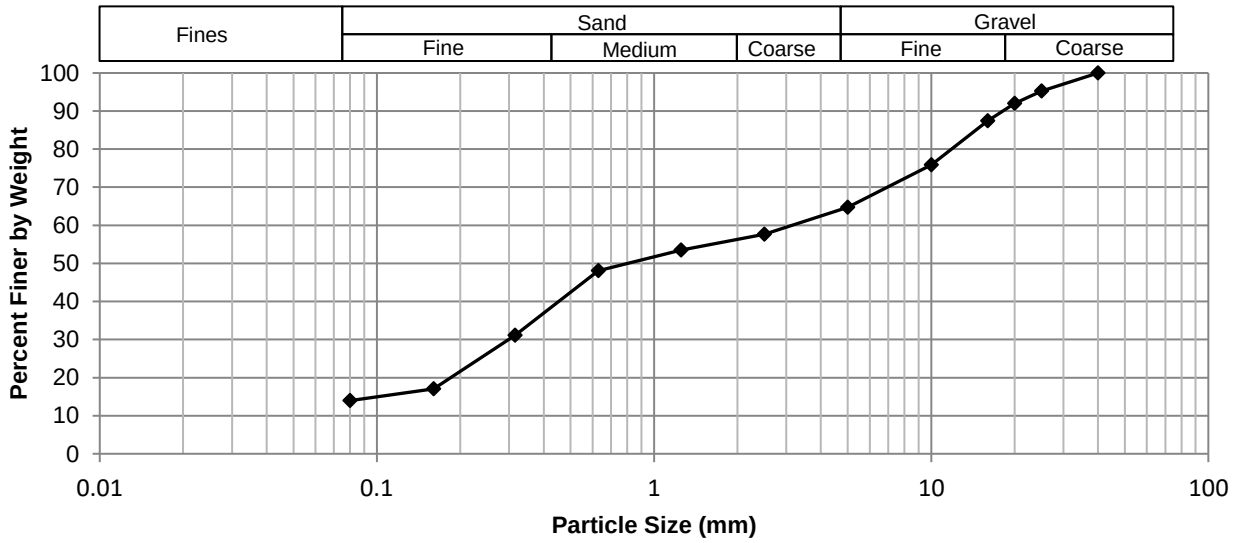
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-05 - William Stephenson Way
Sample #	G40
Depth (m)	0.3-0.5
Date Sampled	10-May-21
Date Tested	18-May-21
Technician	AD

Total Weight (g)	1362.2
Gravel %	35.3
Sand %	50.8
Fines %	14.0

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
40.0	100	-
25.0	95	-
20.0	92	-
16.0	87	-
10.0	76	-
5.0	65	-
2.50	58	-
1.25	53	-
0.630	48	-
0.315	31	-
0.160	17	-
0.080	14	-

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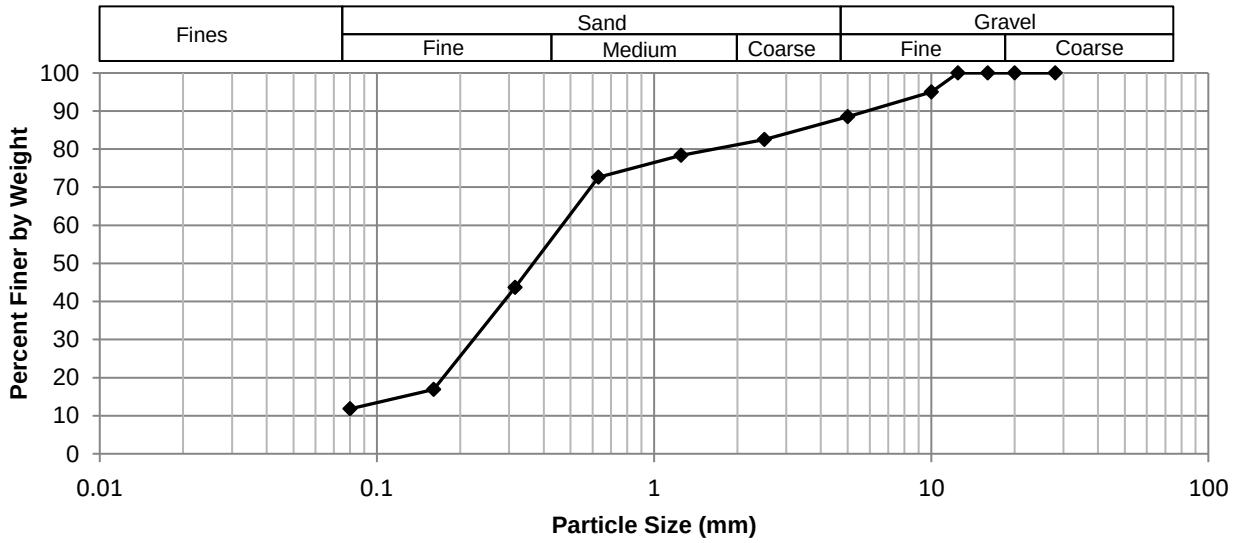
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-05 - William Stephenson Way
Sample #	G42
Depth (m)	0.9-1.1
Date Sampled	10-May-21
Date Tested	18-May-21
Technician	AD

Total Weight (g)	381.6
Gravel %	11.5
Sand %	76.7
Fines %	11.8

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
16.0	100	-
10.0	95	-
5.0	89	-
2.50	82	-
1.25	78	-
0.630	73	-
0.315	44	-
0.160	17	-
0.080	12	-

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Standard Proctor Compaction Test

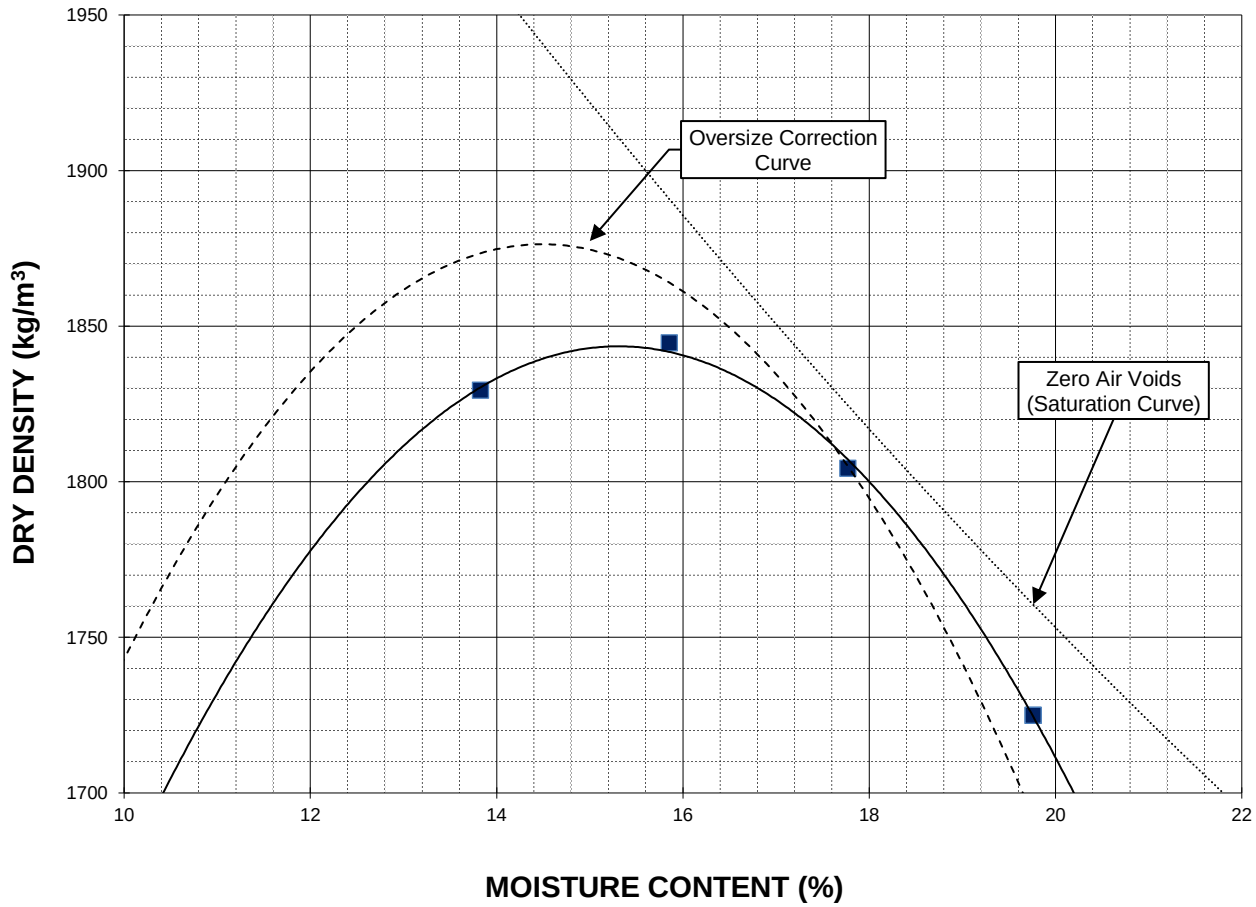
ASTM D698-12e2

Project No.	1000-001-18
Client	WSP
Project	916-2020 Pavement Renewals

Sample #	L21-167
Source	William Stephenson Way
Material	Silt
Sample Date	10-May-21
Test Date	14-May-21
Technician	AD

Corrected Max. Dry Density (kg/m3)	1876
Corrected Optimum Moisture (%)	14.5
Oversize Material (%)	6
Maximum Dry Density (kg/m3)	1844
Optimum Moisture (%)	15.3

Trial Number	1	2	3	4	
Wet Density (kg/m^3)	2082	2137	2125	2066	
Dry Density (kg/m^3)	1829	1845	1804	1725	
Moisture Content (%)	13.8	15.9	17.8	19.8	



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California Bearing Ratio Test Data Sheet

ASTM D1883-16

Project No.	1000-043-16	**Source**	TH21-04, TH21-06
Client	WSP	**Material**	Silt
Project	916-2020 Pavement Renewals	**Sample Date**	2021-05-10
Sample #	L21-167	**Test Date**	2021-05-18
		Technician	AD

Proctor Results (ASTM D698)

Maximum Dry Density	1876	kg/m3
Optimum Moisture Content	14.5	%
Material Retained on 19 mm Sieve	6.0	%

CBR Sample Compaction

Dry Density	1777	kg/m3
Initial Moisture Content	14.4	%
Relative Density	94.7	% SPMDD

Soaking Results

Surcharge	4.54	kg
Swell	0.3	%
Moisture Content in top 25 mm	19.6	%
Immersion Period	96	h

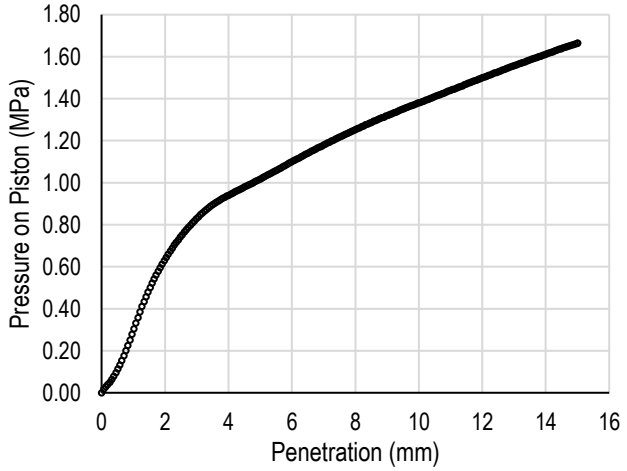
CBR Results

CBR at 2.54 mm	10.9	%
CBR at 5.08 mm	10.0	%
Zero Correction	0	mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.16	0.16
1.27	0.41	0.41
1.91	0.61	0.61
2.54	0.75	0.75
3.18	0.86	0.86
3.81	0.93	0.93
4.45	0.98	0.98
5.08	1.02	1.02
7.62	1.23	1.23
10.16	1.39	1.39
12.70	1.54	1.54

Load/Penetration Curve



Comments:

Photo 1: Pavement Core Sample at Test Hole TH21-02

Photo 2: Pavement Core Sample at Test Hole TH21-03

Photo 1: Pavement Core Sample at Test Hole TH21-04

Photo 2: Pavement Core Sample at Test Hole TH21-05

Photo 3: Pavement Core Sample at Test Hole TH21-06

Appendix B

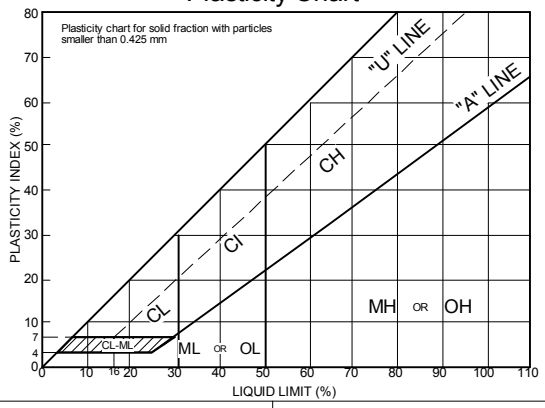
Test Hole Logs, Summary Table & Lab Testing Results and Pavement Core Photos – St. Mary Ave.

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent..... GW, GP, SW, SP; More than 12 percent..... GM, GC, SM, SC; 6 to 12 percent..... Borderline case4s requiring dual symbols*
			GP		Poorly-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
		Gravel with fines (Appreciable amount of fines)	GM		Silty gravels, gravel-sand-silt mixtures	Not meeting all gradation requirements for GW
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / 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
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM		Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / 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
			SC		Clayey sands, sand-clay mixtures	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL		Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts	
			CH		Inorganic clays of high plasticity, fat clays	
			OH		Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt		Peat and other highly organic soils	Von Post Classification Limit: Strong colour or odour, and often fibrous texture



Particle Size	Material	ASTM Sieve sizes	mm
	Sand		
	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
	Silt or Clay	< #200	< 0.075

Particle Size	Material	ASTM Sieve Sizes	mm
	Boulders	> 12 in.	> 300
	Cobbles	3 in. to 12 in.	75 to 300
	Gravel		
	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

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

Sub-Surface Log

Test Hole TH21-07
1 of 1

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5527917, E-632880 (St Mary Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL	Undrained Shear Strength (kPa) Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
		ASPHALT - 275 mm thick		PC21-01		
		CONCRETE - 200 mm thick				
0.5		SAND AND GRAVEL - silty, fine gravel (<25 mm diam.), light brown, compact to dense - poorly graded, rounded to sub-angular, AASHTO: A-1-b (I)		G01		
		CLAY - silty, trace sand, trace organics - light brown to grey - moist, stiff - high plasticity - AASHTO: A-7-6 (49)		G02		
1.0				G03		
				G04		
1.5				G05		
				G06		
2.0		- dark grey, moist, firm below 2.1 m depth				
2.5				G07		
3.0		END OF TEST HOLE AT 3.0 m IN CLAY				

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 4 m North of South curb, 22 m West of Memorial Blvd. and St. Mary Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-08
1 of 1

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5527902, E-632827 (St Mary Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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
		ASPHALT - 300 mm thick		PC20-14
		CONCRETE - 100 mm thick		
0.5		CLAY - silty, trace organics - dark grey to black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)		G08
1.0				G09
				G10
1.5		SILT - trace sand, trace clay, trace oxidation - light brown - moist, soft - intermediate plasticity - AASHTO: A-4 (I)		G11
				G12
2.0		CLAY - silty, dark grey - moist, stiff, high plasticity, AASHTO: A-7-6 (I)		G13
		SILT - trace sand, trace clay, trace oxidation - light brown - moist, soft - low plasticity - AASHTO: A-4 (I)		G14
2.5		CLAY - silty - dark grey - moist, firm - high plasticity - AASHTO: A-7-6 (I)		G15
3.0		END OF TEST HOLE AT 3.0 m IN CLAY		

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ | ✤ Pocket Pen. ✤ | ☒ Qu ☒ | ○ Field Vane ○

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 5.5 m North of South curb, 16 m West of Colony St. and St. Mary Ave. intersection

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-09
1 of 1

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5527944, E-632764 (St Mary Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
		ASPHALT - 50 mm thick				
		CONCRETE - 175 mm thick		PC21-04		
		CLAY - silty, trace organics - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (61)				
0.5				G16		
		- dark grey, no organics below 0.9 m depth		G17		
1.0				G18		
1.5				G19		
		SILT - some clay, trace sand - light brown - moist, soft - low plasticity - AASHTO: A-4 (I)		G20		
2.0						
2.5		CLAY - silty - brown - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G21		
3.0						

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 4 m South of North curb, 19 m East of Good St. and St. Mary Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

Sub-Surface Log

Test Hole TH21-10

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5527937, E-632683 (St Mary Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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
		ASPHALT - 100 mm thick		
		CONCRETE - 250 mm thick		PC21-02
0.5		CLAY - silty, trace sand, trace organics - grey - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)		G22
1.0				G23
				G24
1.5		SILT - some clay, some sand - light brown - moist, soft - intermediate plasticity - AASHTO: A-4 (I)		G25
				G26
2.0		CLAY - silty - grey - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		
2.5				G27
3.0				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ | ✤ Pocket Pen. ✤ | ☒ Qu ☒ | ○ Field Vane ○

END OF TEST HOLE AT 3.0 m IN CLAY

1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 7 m South of North curb, 18 m West of Balmoral St. and St. Mary Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-11

Client:	WSP Canada Group Ltd.	**Project Number:**	1000-043-16
Project Name:	916-2020 Pavement Renewals	**Location:**	UTM N-5527961, E-632614 (St Mary Ave)
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	May 10, 2021

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/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type: Torvane, Pocket Pen., Qu, Field Vane 0 50 100 150 200 250
		ASPHALT - 150 mm thick				
		CONCRETE - 200 mm thick		PC21-03		
		CLAY - silty, trace sand, trace organics - dark grey to black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (66)				
0.5				G28	●	△ ✤
		- grey, no organics below 0.9 m depth		G29	●	△ ✤
1.0				G30	●	△ ✤
		SILT - trace clay, trace sand - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-4 (I)		G31	●	
1.5				G32	●	
2.0						
		CLAY - silty - brown to grey - moist, stiff - high plasticity - AASHTO: A-7-6 (I)		G33	●	✤
2.5						
3.0						

END OF TEST HOLE AT 2.9 m IN CLAY

1) No seepage or sloughing observed.
2) Test hole open to 2.9 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 3 m West of East curb, 53 m North of Memorial Blvd. and St. Mary Ave. intersection.

Logged By: Asad Dustmamatov **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-05-11_916-2020 PAVEMENT RENEWALS_1000-049-16_A_AD.GPJ TREK.GDT 5/28/21

916-2020 Street Renewals - St Mary 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
TH21-07	UTM: 5527917 N, 632880 E Located 4 m North of South curb, 22 m West of Memorial Blvd. and St. Mary Ave. intersection.	Asphalt	275	Concrete	200		0.0	0.5								
						Sand and Gravel	0.5	0.6	8							
						Silt and Clay	0.6	0.8	31							
						Silt and Clay	0.9	1.1	31	75	22	3	0	64	17	47
						Silt and Clay	1.2	1.4	33							
						Silt and Clay	1.5	1.7	28							
						Silt and Clay	1.8	2.0	24							
						Clay	2.4	2.6	35							
TH21-08	UTM: 5527902 N, 632827 E Located 5.5 m North of South curb, 16 m West of Colony St. and St. Mary Ave. intersection	Asphalt	300	Concrete	100		0.0	0.4								
						Clay	0.6	0.8	37.0							
						Clay	0.9	1.1	32.0							
						Clay	1.2	1.4	30.0							
						Silt	1.5	1.7	24.0							
						Silt	1.8	2.0	23.0							
						Clay	2.1	2.3	32							
						Silt	2.4	2.6	31							
						Clay	2.7	2.9	43							
TH21-09	UTM: 5527944 N, 632764 E Located 4 m South of North curb, 19 m East of Good St. and St. Mary Ave. intersection.	Asphalt	50	Concrete	175		0.0	0.2								
						Clay	0.6	0.8	35							
						Clay	0.9	1.1	31	70	29	1	0	77	23	54
						Clay	1.2	1.4	30							
						Clay	1.5	1.7	26							
						Silt	1.8	2.0	23							
						Clay	2.7	2.9	40							

916-2020 Street Renewals - St Mary 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
TH21-10	UTM: 5527937 N, 632683 E Located 7 m South of North curb, 18 m West of Balmoral St. and St. Mary Ave. intersection.	Asphalt	100	Concrete	250		0.0	0.4								
						Clay	0.6	0.8	24							
						Clay	0.9	1.1	29							
						Clay	1.2	1.4	24							
						Silt	1.5	1.7	23							
						Silt	1.8	2.0	30							
						Clay	2.4	2.6	42							
TH21-11	UTM: 5527961 N, 632614 E Located 3 m West of East curb, 53 m North of Memorial Blvd. and St. Mary Ave. intersection.	Asphalt	150	Concrete	200		0.0	0.4								
						Clay	0.6	0.8	33.0							
						Clay	0.9	1.1	29.0	70	28	2		79	21	58
						Clay	1.2	1.4	28.0							
						Silt	1.5	1.7	24							
						Silt	1.8	2.0	23							
						Clay	2.4	2.6	41							

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Moisture Content Report
ASTM D2216-10

Project No. 1000-043-16
Client WSP
Project 916-2020 Pavement Renewals - St Mary Ave

Sample Date 10-May-21
Test Date 17-May-21
Technician ZS

Test Hole	TH21-07	TH21-07	TH21-07	TH21-07	TH21-07	TH21-07
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	WV	AB95	F90	AA14	F58	Z102
Mass of tare	398.5	6.7	8.4	6.7	8.8	8.5
Mass wet + tare	1413.9	225.6	467.4	213.6	219.0	210.1
Mass dry + tare	1337.1	174.1	358.1	162.9	173.3	170.6
Mass water	76.8	51.5	109.3	50.7	45.7	39.5
Mass dry soil	938.6	167.4	349.7	156.2	164.5	162.1
Moisture %	8.2%	30.8%	31.3%	32.5%	27.8%	24.4%

Test Hole	TH21-07	TH21-08	TH21-08	TH21-08	TH21-08	TH21-08
Depth (m)	2.4 - 2.6	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0
Sample #	G07	G08	G09	G10	G11	G12
Tare ID	N112	F22	A105	AB56	W80	AB11
Mass of tare	8.4	8.7	8.6	6.7	8.7	6.9
Mass wet + tare	237.8	239.7	238.2	218.6	229.3	222.1
Mass dry + tare	177.9	177.8	182.3	169.9	187.0	181.5
Mass water	59.9	61.9	55.9	48.7	42.3	40.6
Mass dry soil	169.5	169.1	173.7	163.2	178.3	174.6
Moisture %	35.3%	36.6%	32.2%	29.8%	23.7%	23.3%

Test Hole	TH21-08	TH21-08	TH21-08	TH21-09	TH21-09	TH21-09
Depth (m)	2.1 - 2.3	2.4 - 2.6	2.7 - 2.9	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4
Sample #	G13	G14	G15	G16	G17	G18
Tare ID	Z37	F77	Z88	W57	Z121	AC35
Mass of tare	8.4	8.5	8.5	8.9	8.4	7.0
Mass wet + tare	209.9	210.2	215.8	211.2	412.0	211.7
Mass dry + tare	160.6	163.0	153.3	159.0	315.5	164.8
Mass water	49.3	47.2	62.5	52.2	96.5	46.9
Mass dry soil	152.2	154.5	144.8	150.1	307.1	157.8
Moisture %	32.4%	30.6%	43.2%	34.8%	31.4%	29.7%

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Moisture Content Report
ASTM D2216-10

Project No. 1000-043-16
Client WSP
Project 916-2020 Pavement Renewals - St Mary Ave

Sample Date 10-May-21
Test Date 17-May-21
Technician ZS

Test Hole	TH21-09	TH21-09	TH21-09	TH21-10	TH21-10	TH21-10
Depth (m)	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4
Sample #	G19	G20	G21	G22	G23	G24
Tare ID	A3	W95	H2	F61	W74	H64
Mass of tare	8.5	8.6	8.6	8.6	8.4	8.9
Mass wet + tare	225.0	229.8	214.8	217.5	220.0	215.1
Mass dry + tare	180.2	188.2	156.0	176.6	172.2	175.0
Mass water	44.8	41.6	58.8	40.9	47.8	40.1
Mass dry soil	171.7	179.6	147.4	168.0	163.8	166.1
Moisture %	26.1%	23.2%	39.9%	24.3%	29.2%	24.1%

Test Hole	TH21-10	TH21-10	TH21-10	TH21-11	TH21-11	TH21-11
Depth (m)	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4
Sample #	G25	G26	G27	G28	G29	G30
Tare ID	ZZZ	P21	W162	AB46	C11	E113
Mass of tare	8.3	8.5	8.5	6.8	8.3	8.6
Mass wet + tare	239.2	213.3	209.6	212.1	467.6	213.0
Mass dry + tare	195.4	166.6	150.5	161.4	363.5	168.5
Mass water	43.8	46.7	59.1	50.7	104.1	44.5
Mass dry soil	187.1	158.1	142.0	154.6	355.2	159.9
Moisture %	23.4%	29.5%	41.6%	32.8%	29.3%	27.8%

Test Hole	TH21-11	TH21-11	TH21-11			
Depth (m)	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6			
Sample #	G31	G32	G33			
Tare ID	W90	E22	N09			
Mass of tare	8.5	8.7	8.6			
Mass wet + tare	220.5	253.5	212.7			
Mass dry + tare	178.9	208.0	153.0			
Mass water	41.6	45.5	59.7			
Mass dry soil	170.4	199.3	144.4			
Moisture %	24.4%	22.8%	41.3%			

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Atterberg Limits
ASTM D4318-10e1

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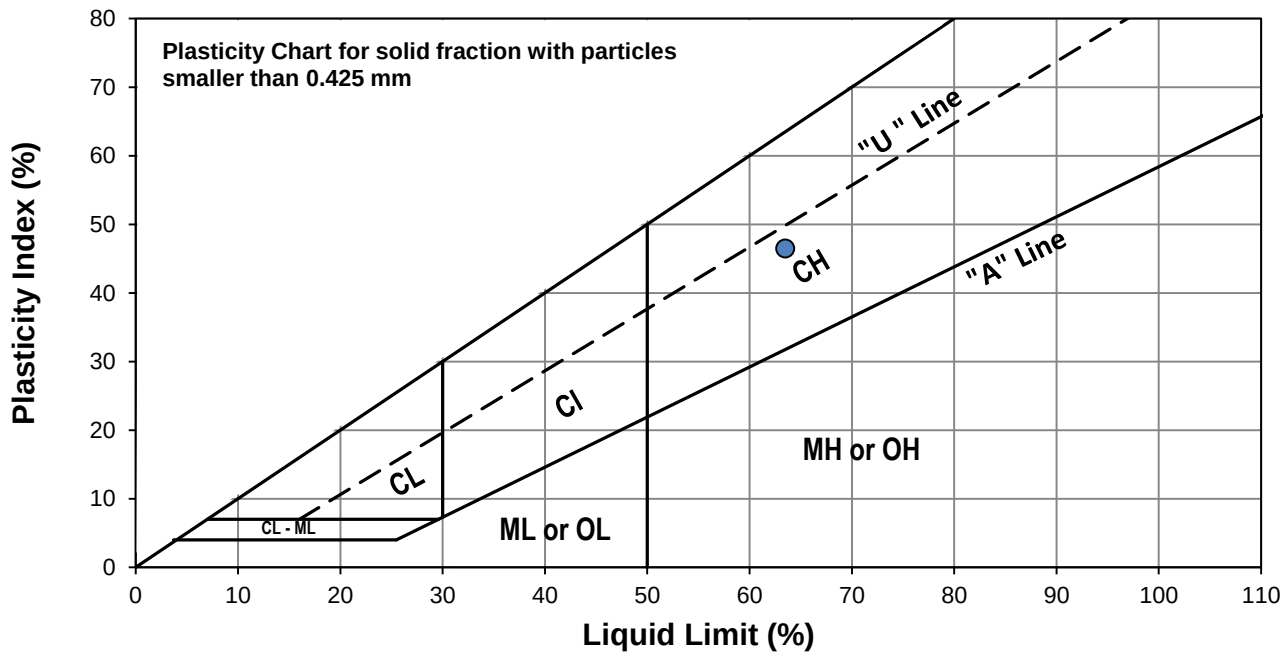
For specific tests as listed on www.ccil.com

Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-07 - St Mary Ave
Sample #	G03
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	20-May-21
Technician	AD

Liquid Limit	64
Plastic Limit	17
Plasticity Index	46

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	15	22	31		
Mass Tare (g)	13.992	14.298	14.010		
Mass Wet Soil + Tare (g)	26.096	25.679	25.016		
Mass Dry Soil + Tare (g)	21.224	21.221	20.807		
Mass Water (g)	4.872	4.458	4.209		
Mass Dry Soil (g)	7.232	6.923	6.797		
Moisture Content (%)	67.367	64.394	61.924		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.030	14.123			
Mass Wet Soil + Tare (g)	20.928	20.945			
Mass Dry Soil + Tare (g)	19.933	19.942			
Mass Water (g)	0.995	1.003			
Mass Dry Soil (g)	5.903	5.819			
Moisture Content (%)	16.856	17.237			

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Atterberg Limits
ASTM D4318-10e1

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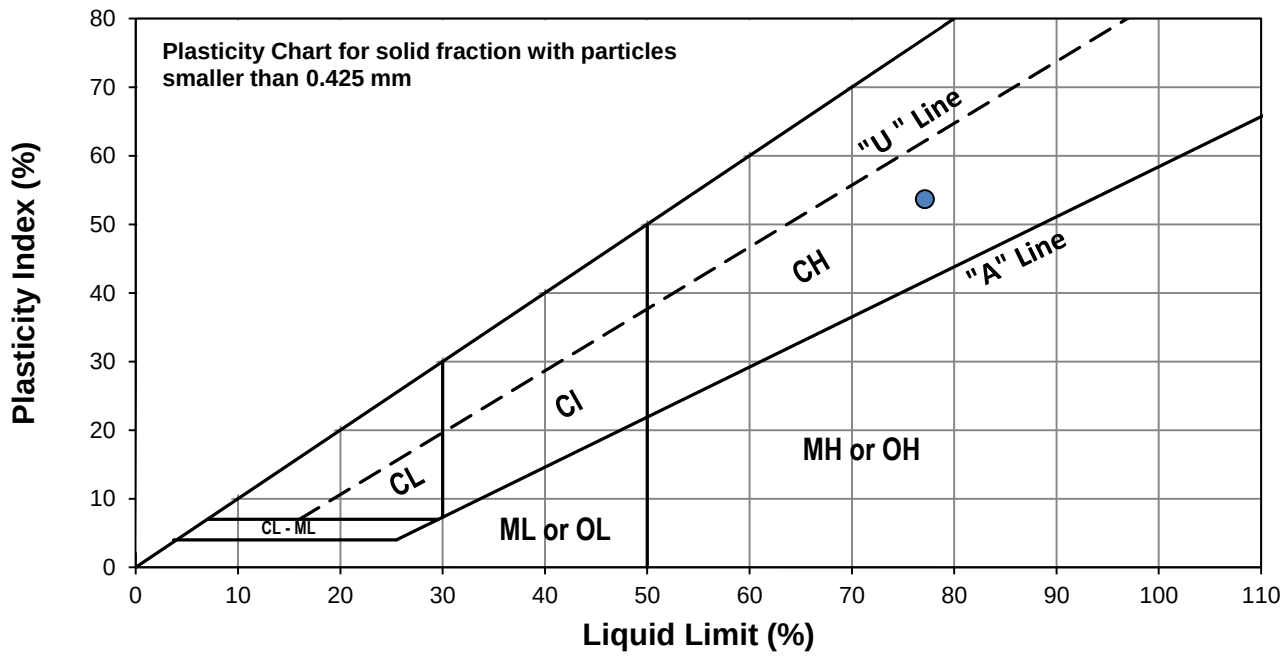
Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-09 - St Mary Ave
Sample #	G17
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Liquid Limit	77
Plastic Limit	23
Plasticity Index	54

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	24	33		
Mass Tare (g)	14.134	14.104	14.227		
Mass Wet Soil + Tare (g)	26.589	24.576	25.377		
Mass Dry Soil + Tare (g)	21.031	20.004	20.611		
Mass Water (g)	5.558	4.572	4.766		
Mass Dry Soil (g)	6.897	5.900	6.384		
Moisture Content (%)	80.586	77.492	74.655		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.250	14.241			
Mass Wet Soil + Tare (g)	20.631	20.428			
Mass Dry Soil + Tare (g)	19.411	19.259			
Mass Water (g)	1.220	1.169			
Mass Dry Soil (g)	5.161	5.018			
Moisture Content (%)	23.639	23.296			

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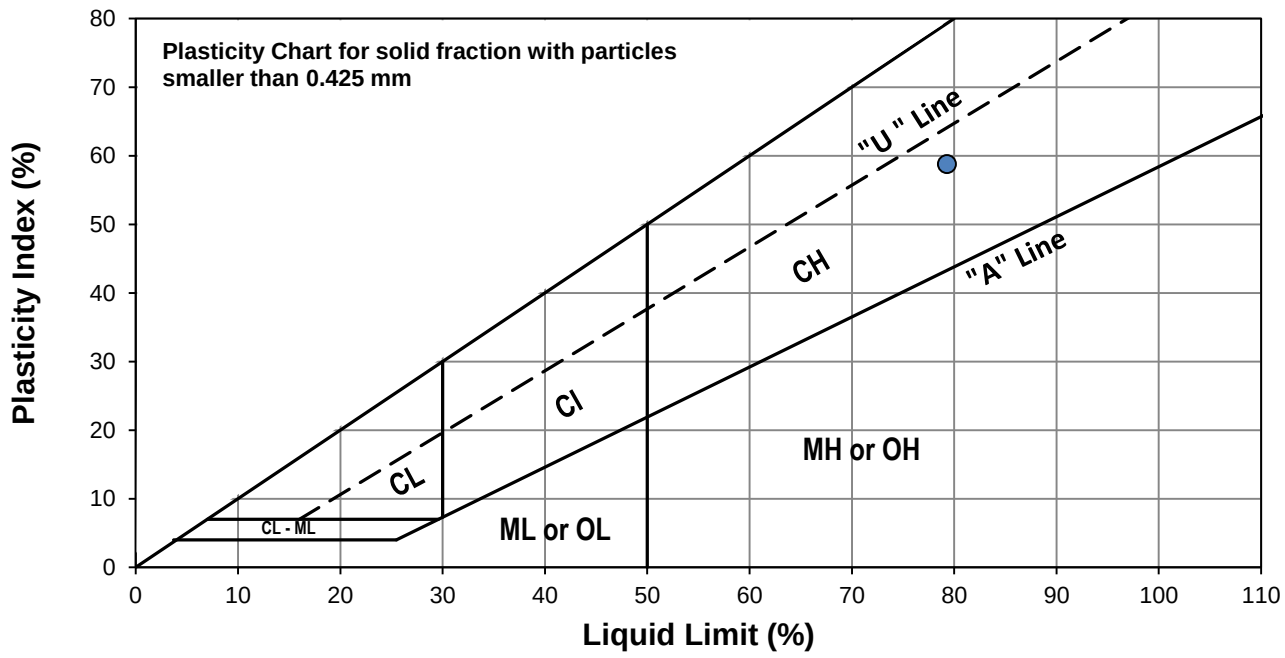
Atterberg Limits
ASTM D4318-10e1

Project No.	1000-043-16
Client	WSP
Project	916-2020 - Pavement Renewals
Test Hole	TH21-11 - St Mary Ave
Sample #	G29
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Liquid Limit	79
Plastic Limit	21
Plasticity Index	59

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	20	29		
Mass Tare (g)	14.219	14.148	14.114		
Mass Wet Soil + Tare (g)	25.093	26.044	25.433		
Mass Dry Soil + Tare (g)	20.176	20.703	20.475		
Mass Water (g)	4.917	5.341	4.958		
Mass Dry Soil (g)	5.957	6.555	6.361		
Moisture Content (%)	82.542	81.480	77.944		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	13.957	13.886			
Mass Wet Soil + Tare (g)	21.741	20.753			
Mass Dry Soil + Tare (g)	20.432	19.568			
Mass Water (g)	1.309	1.185			
Mass Dry Soil (g)	6.475	5.682			
Moisture Content (%)	20.216	20.855			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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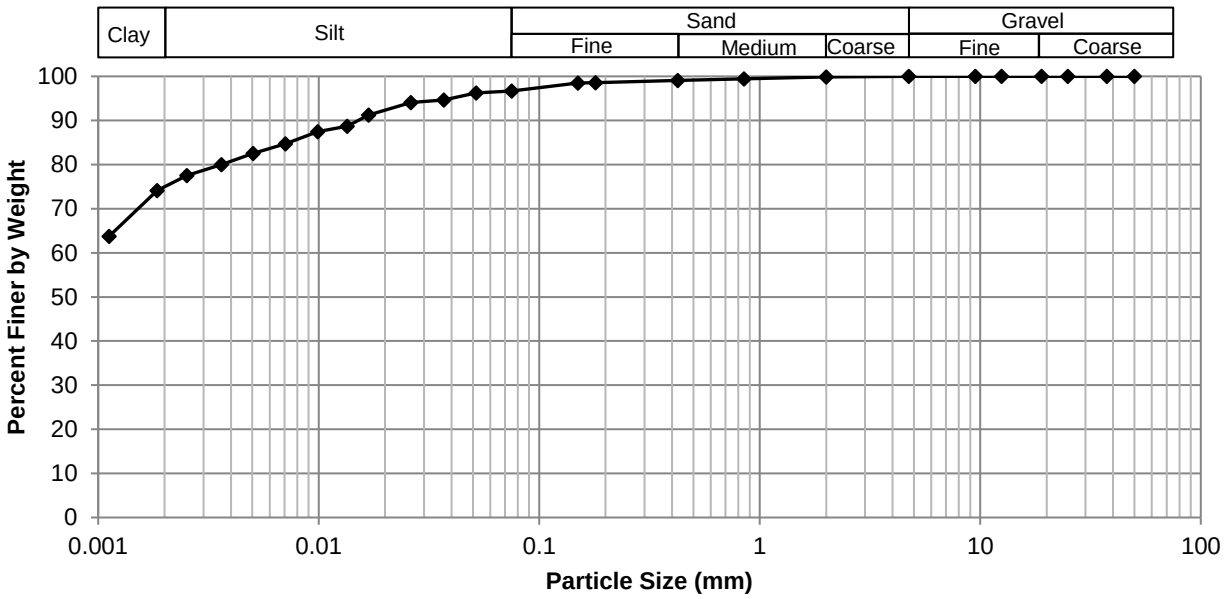
Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-07 - St Mary Ave
Sample #	G03
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	19-May-21
Technician	AD

Gravel	0.0%
Sand	3.3%
Silt	21.8%
Clay	74.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	96.68
37.5	100.00	2.00	99.85	0.0519	96.23
25.0	100.00	0.850	99.45	0.0370	94.67
19.0	100.00	0.425	99.07	0.0262	94.04
12.5	100.00	0.180	98.60	0.0168	91.24
9.50	100.00	0.150	98.47	0.0135	88.74
4.75	100.00	0.075	96.68	0.0099	87.49
				0.0071	84.69
				0.0050	82.51
				0.0036	80.00
				0.0025	77.53
				0.0018	74.10
				0.0011	63.75

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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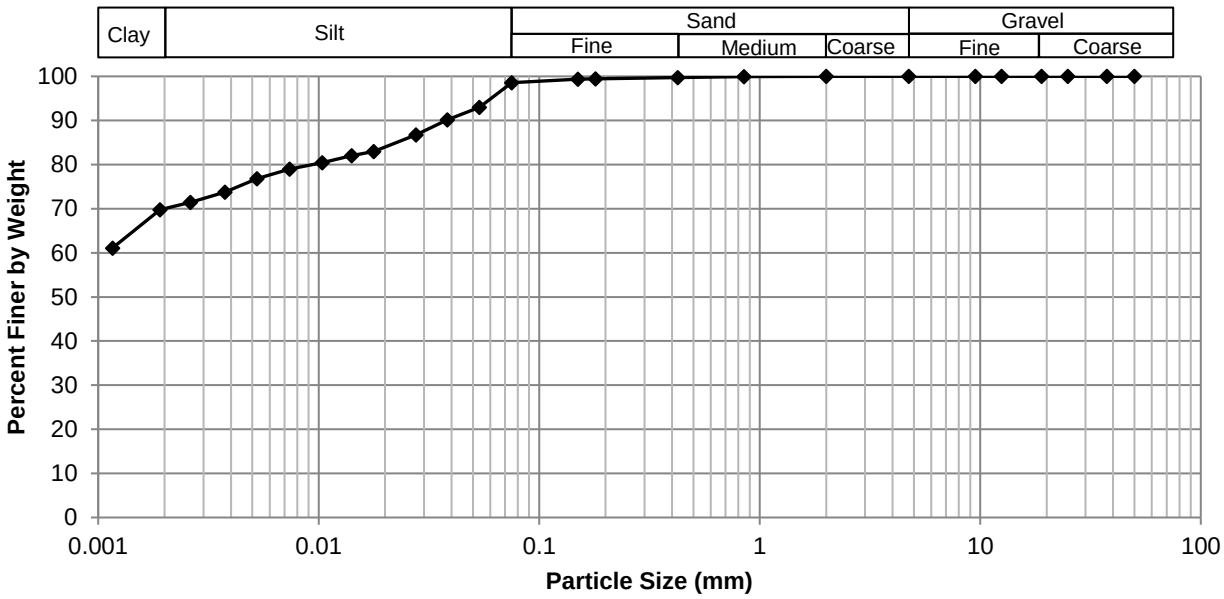
For specific tests as listed on www.ccil.com

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-09 - St Mary Ave
Sample #	G17
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Gravel	0.0%
Sand	1.4%
Silt	28.6%
Clay	70.0%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	98.57
37.5	100.00	2.00	100.00	0.0535	92.97
25.0	100.00	0.850	99.91	0.0384	90.15
19.0	100.00	0.425	99.69	0.0276	86.71
12.5	100.00	0.180	99.43	0.0178	82.96
9.50	100.00	0.150	99.37	0.0141	82.02
4.75	100.00	0.075	98.57	0.0104	80.46
				0.0074	78.95
				0.0053	76.82
				0.0038	73.75
				0.0026	71.46
				0.0019	69.79
				0.0012	61.09

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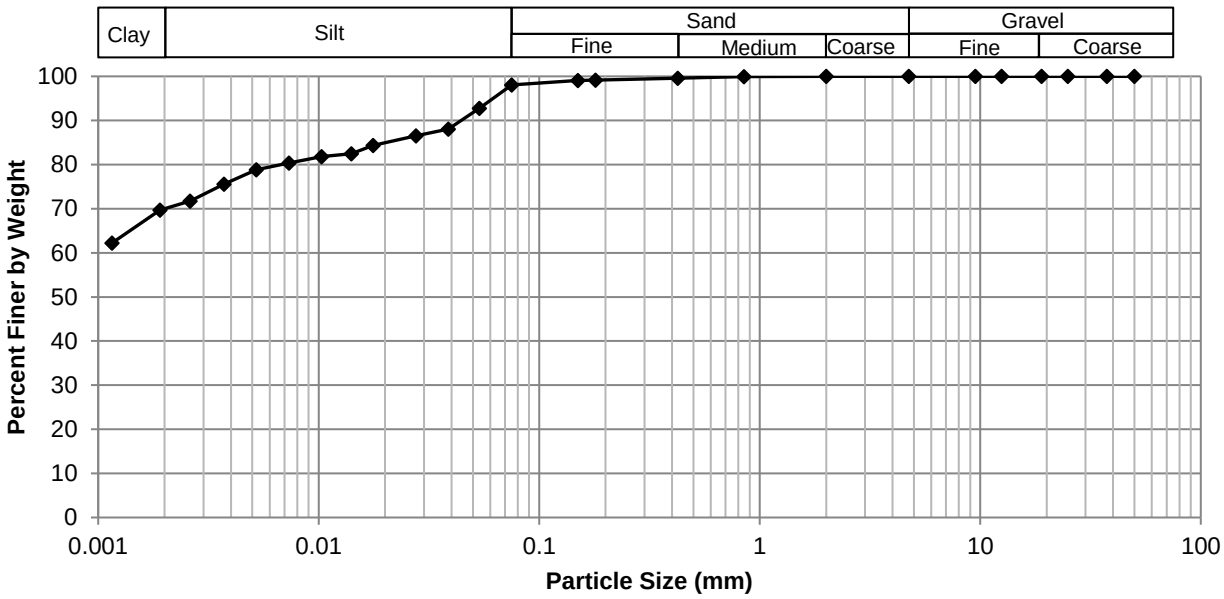
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

CERTIFIED BY CCIL Canadian Council of Independent Laboratories
For specific tests as listed on www.ccil.com

Project No.	1000-043-16
Client	WSP
Project	916-2020 Pavement Renewals
Test Hole	TH21-11 - St Mary Ave
Sample #	G29
Depth (m)	0.9 - 1.1
Sample Date	10-May-21
Test Date	21-May-21
Technician	AD

Gravel	0.0%
Sand	1.9%
Silt	28.1%
Clay	69.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	98.08
37.5	100.00	2.00	100.00	0.0536	92.76
25.0	100.00	0.850	99.97	0.0388	88.07
19.0	100.00	0.425	99.57	0.0276	86.51
12.5	100.00	0.180	99.17	0.0176	84.32
9.50	100.00	0.150	99.09	0.0141	82.44
4.75	100.00	0.075	98.08	0.0103	81.82
				0.0073	80.33
				0.0052	78.84
				0.0037	75.55
				0.0026	71.71
				0.0019	69.68
				0.0012	62.24

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Standard Proctor Compaction Test

ASTM D698-12e2

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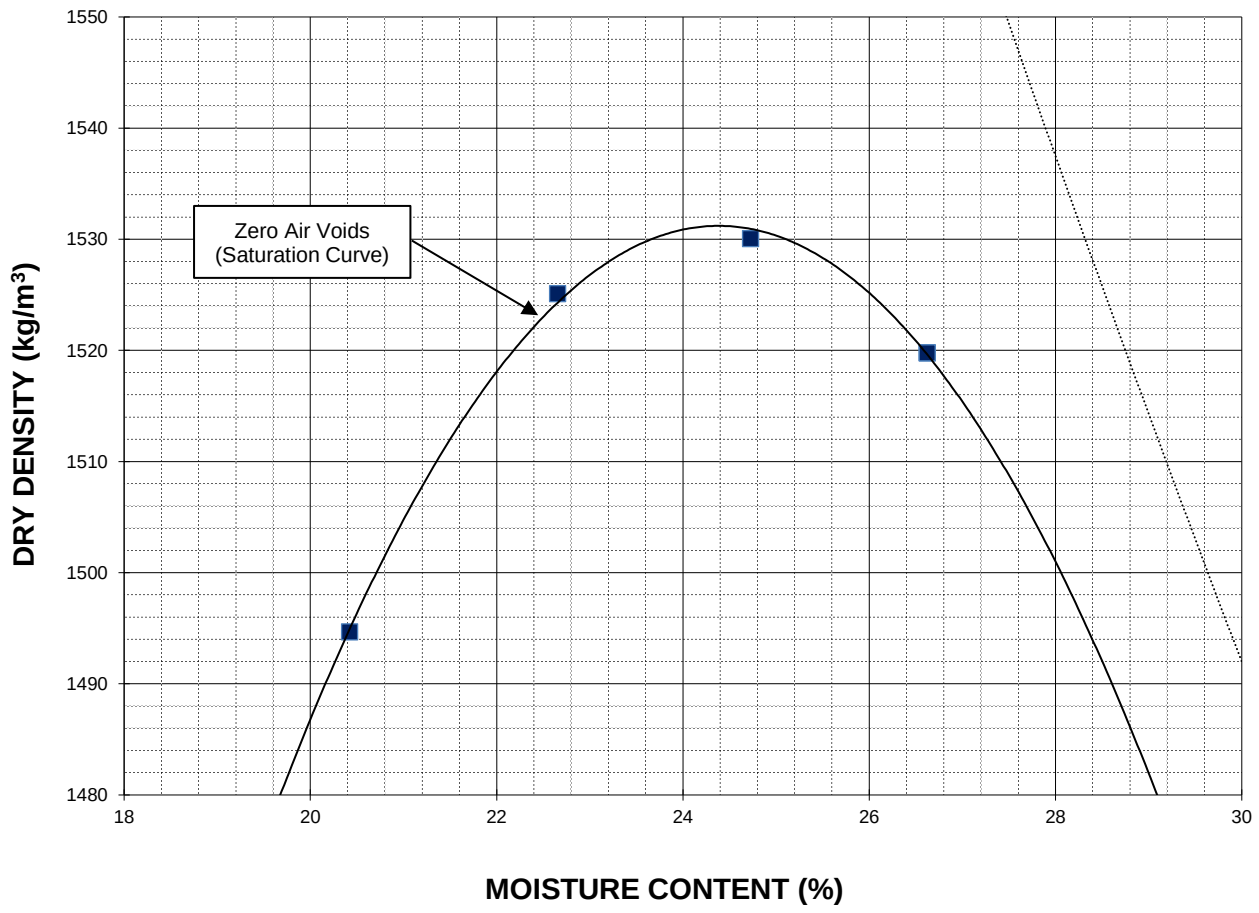
Project No.	1000-001-18
Client	WSP
Project	916-2020 Pavement Renewals
Sample #	L21-167
Source	St Mary Avenue
Material	Clay Sub-grade Material
Sample Date	10-May-21
Test Date	14-May-21
Technician	AD

Maximum Dry Density (kg/m3)	1531
Optimum Moisture (%)	24.4

Trial Number	1	2	3	4	
Wet Density (kg/m^3)	1800	1871	1908	1924	
Dry Density (kg/m^3)	1495	1525	1530	1520	
Moisture Content (%)	20.4	22.7	24.7	26.6	



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California Bearing Ratio Test Data Sheet

ASTM D1883-16

Project No.	1000-043-16	**Source**	TH21-07, TH21-08, TH21-10, TH21-11
Client	WSP	**Material**	Clay
Project	916-2020 Pavement Renewals	**Sample Date**	2021-05-10
Sample #	L21-167	**Test Date**	2021-05-18
		Technician	AD

Proctor Results (ASTM D698)

Maximum Dry Density	1531	kg/m3
Optimum Moisture Content	24.4	%
Material Retained on 19 mm Sieve	0.0	%

CBR Sample Compaction

Dry Density	1450	kg/m3
Initial Moisture Content	27.2	%
Relative Density	94.7	% SPMDD

Soaking Results

Surcharge	4.54	kg
Swell	3.4	%
Moisture Content in top 25 mm	37.2	%
Immersion Period	96	h

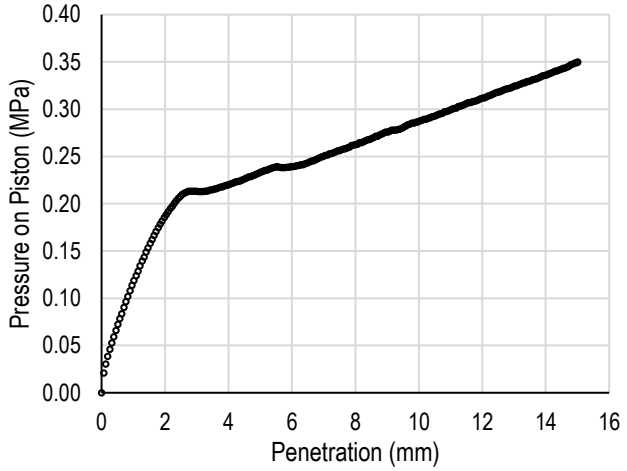
CBR Results

CBR at 2.54 mm	3.0	%
CBR at 5.08 mm	2.3	%
Zero Correction	0	mm

Test Data

Penetration (mm)	Measured Pressure (MPa)	Corrected Pressure (MPa)
0.64	0.08	0.08
1.27	0.14	0.14
1.91	0.18	0.18
2.54	0.21	0.21
3.18	0.21	0.21
3.81	0.22	0.22
4.45	0.23	0.23
5.08	0.23	0.23
7.62	0.26	0.26
10.16	0.29	0.29
12.70	0.32	0.32

Load/Penetration Curve



Comments:

Photo 1: Pavement Core Sample at Test Hole TH21-07

Photo 2: Pavement Core Sample at Test Hole TH21-08

Photo 3: Pavement Core Sample at Test Hole TH21-09

Photo 4: Pavement Core Sample at Test Hole TH21-10

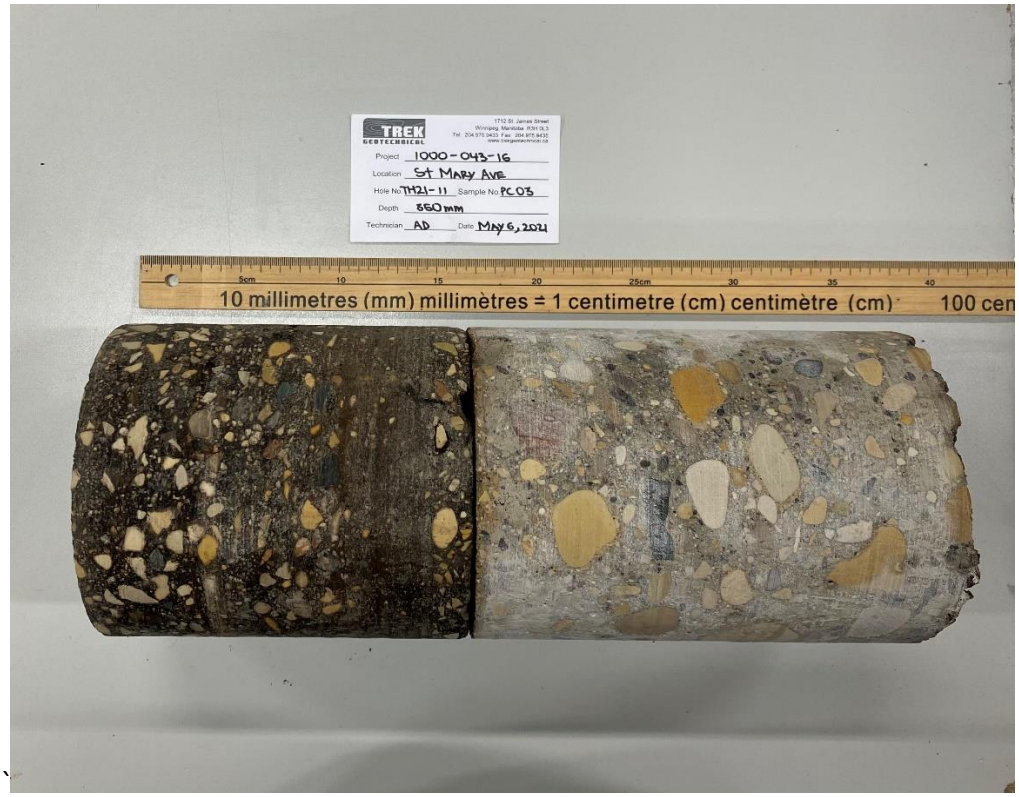


Photo 5: Pavement Core Sample at Test Hole TH21-11

Appendix C

Summary Table and Pavement Core Photos – Colony St.

916-2020 Pavement Renewals

Colony Street between Portage Avenue and St Mary Avenue

Pavement Core No.	Pavement Core Location	Pavement Surface		Pavement Structure Material		
		Type	Thickness (mm)	Type	Thickness (mm)	Corrected Compressive Strength (Mpa)
PC21-05	UTM : 5527939 m N, 632811 m E; Located at 21 m North of Colony St & St Mary Ave intersection, Northbound lane, 3 m West of the East curb.	Asphalt	-	Concrete	225	61.1
PC21-06	UTM : 5528002 m N, 632815 m E; Located at 20 m South of North corner of 300 Memorial Blvd, Northbound lane, 2.5 m West of East curb.	Asphalt	-	Concrete	200	54.2
PC21-07	UTM : 5528071 m N, 632811 m E; Located at 58 m South of Portage Ave & Memorial Blvd intersection, Southbound lane, 2.5 m East of West curb.	Asphalt	-	Concrete	200	-
PC21-08	UTM : 5527981 m N, 632810 m E; Located at 2 m South of North corner 0f 308 Colony St, Southbound lane, 4.5 m East of West curb.	Asphalt	-	Concrete	200	-

CONCRETE CORE REPORT

wood.

Client: Trek Geotechnical
Project No: WX12934
Project: Colony Street
Contractor: N/A
Lab No: X12934-01
Date Cored:
Date Received: 5/25/2021
Cored By: Client
Received By: RJ

Sample No.	Location	Mass In Air (g)	Mass In Water (g)	Density (kg/m^3)	Length (mm)		Average Diameter (mm)	Area (mm^2)	Length / Diameter	Corr. Factor	Load (kN)	Comp. Strength (MPa)	Date Tested	Age at time of Testing (Days)
					Cored	Tested								
1	PC21-05	7759.0	4467.0	2352	209	186	144.0	16286	1.29	0.94	1061.9	61.3	5/31/2021	
2	PC21-06	7637.0	4357.0	2324	205	175	144.0	16286	1.22	0.94	940.3	54.3	5/31/2021	

_ METHOD CSA A23.2-14C X METHOD: OTHER

x DIAMOND CORE __ CAST IN PLACE CYLINDER MOLD __ OTHER

__ MOISTURE CONDITIONED X DRY CONDITIONED __ OTHER

DIRECTION OF LOAD APPLICATION _ SAME AS COMPACTION X PERPENDICULAR TO COMP

Wood Environment & Infrastructure Solutions

R. Johnson

Per _____

For technical questions please contact;
Randell Johnson, C.E.T.

Remarks:

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request.

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 interpretation 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:

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

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 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

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	$1 - \{0.130 - \alpha f_{core}\}(2 - \frac{l}{d})^2$
	Soaked 48 h	$1 - \{0.117 - \alpha f_{core}\}(2 - \frac{l}{d})^2$
	Air dried[a]	$1 - \{0.144 - \alpha f_{core}\}(2 - \frac{l}{d})^2$
(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:

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

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.

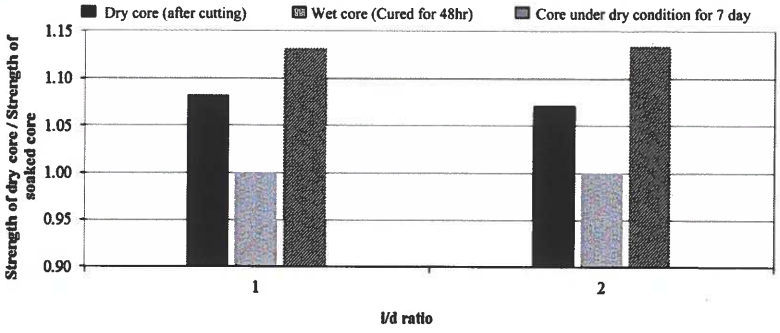


Figure 20 Effect of core moisture condition on core strength for different aspect ratios (l/d).

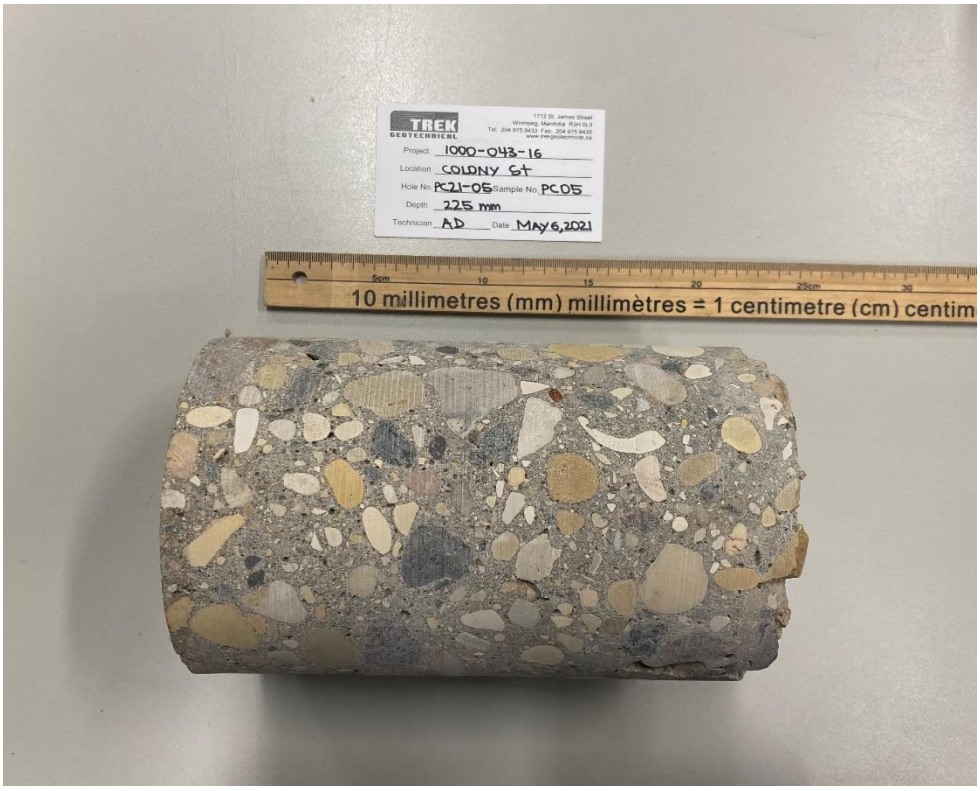


Photo 1: Pavement Core Sample at PC21-05

Photo 2: Pavement Core Sample at PC21-06

Photo 3: Pavement Core Sample at PC21-07

Photo 4: Pavement Core Sample at PC21-08