

**REVISED FINAL FOUNDATION  
INVESTIGATION REPORT  
HIGHWAY 15/COUNTY ROAD 42 SIGNS  
(44.65345, -76.25741)  
Geocres No. 31C09-001**

Prepared For:

December 20, 2024

Ministry of Transportation Ontario, Eastern Region

Agreement 4021-E-0027 (Assignment #5)/GWP 4342-23-00

## EXECUTIVE SUMMARY

The Ministry of Transportation Ontario (MTO), Eastern Region retained Ainley Group (AGA) to provide supplemental geotechnical and foundation engineering services for the intended intersection improvements planned for the intersection of Highway 15 at County Road 42 located in the Village of Crosby, within the Township of Rideau Lakes and United Counties of Leeds and Grenville at four (4) proposed sign locations.

Highway 15 in the vicinity of County Road 42 carries both commuter and a large portion of tourist and recreational traffic. Highway 15 historical traffic volume for 2016 AADT was 3,750 vehicles while the 2016 SADT was 4,550 vehicles. Traffic volume has been on a steady decline since 1997 according to MTO Traffic Volume data. Heavy vehicles account for approximately 15% of the total volume.

This report provides supplemental foundation design information for the design of the four (4) new signs included in the proposed roundabout. The foundation investigation was completed in August 2024 and included the advancement of foundation boreholes and be rock coring.

Based on the findings, a modified footing for each sign location is recommended due to the shallow underlying bedrock encountered at each location.

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## 1.0 INTRODUCTION

The Ministry of Transportation Ontario (MTO), Eastern Region retained Ainley Group (AGA) to provide supplemental geotechnical and foundation engineering services for the intended intersection improvements planned for the intersection of Highway 15 at County Road 42 located in the Village of Crosby, within the Township of Rideau Lakes and United Counties of Leeds and Grenville at four (4) proposed sign locations. The locations of the proposed signs is detailed in **Figure No. 1** appended to this report.

The purpose of this assignment is to provide foundation recommendations for the design and construction of the four (4) proposed signs included within the new roundabout.

**Table 1: Sign Locations**

Sign No.	Roadway	Stationing (Latitude, Longitude)	Support Configuration	Footing Depth (m)
Sign 1	Highway 15	25+047 (44.65345,-76.25741)	2-2	2.2
Sign 2	Highway 15	25+246 (44.65481,-76.25594)	2-2	2.2
Sign 3	County Road 42	9+902 (44.65437,-76.25771)	2-3	1.9
Sign 4	County Road 42	10+103 (44.65411,-76.25583)	2-2	2.2

## 2.0 PHYSIOGRAPHY

The project is located in the Physiographic Region of Southern Ontario known as the Smith Falls Limestone Plain (The Physiography of Southern Ontario, Chapman and Putnum, 1984). The region is characterized by shallow soils varying from clays to silts, sands and gravel overlying limestone bedrock. Bedrock is of the Cambrian Group consisting of Potsdam and Nepean Formation sandstone.

## 3.0 GEOTECHNICAL FIELD INVESTIGATION

### 3.1 Soil Investigation and Laboratory Testing

A foundation investigation was conducted in August 2024 under the constant supervision of a member of the Ainley Group geotechnical team in accordance with our Terms of Reference. Before commencing the field program, Ainley Group contacted the local utility companies and appropriate site authorities to obtain clearances for all underground services and site access in the immediate area of the proposed field program.

The foundation investigation consisted of the advancement of one (1) foundation to 3.0 m or refusal whichever is less at each sign location. Due to the shallow overburden encountered (less

than 0.5 m), representative samples were collected using grab sampling techniques. Where auger refusal was encountered less than 3.0 m below existing site grades, coring procedures were completed to prove the inferred bedrock contact and confirm its quality.

Groundwater was encountered in the borehole at Sign 1 at a depth of 0.6 below existing grade. Groundwater was not encountered in the remaining borehole location.

Upon completion, each borehole was backfilled using native material and the core locations were sealed with a bentonite hole plug in accordance with Ontario MOE Regulation 903.

Full details of the subsurface conditions encountered at the borehole locations are presented on the individual borehole logs included in **Appendix A**. It is emphasized, however, that the soil types, their sequence, thickness and physical properties may vary between test locations and samples both vertically and horizontally.

Representative samples of materials encountered at each borehole location were secured during the investigation and select samples were forwarded to Aikens Realis in Kingston for laboratory analysis. A copy of the individual test results are attached to this report as **Appendix B**.

## 4.0 SOIL AND BEDROCK DATA

### 4.1 Sign 1, Highway 15, 25+047

One (1) borehole was advanced at this sign location. The borehole was advanced to a depth of 3.15 m below existing site grades and terminated within granite bedrock.

The subsoil conditions encountered at the borehole location consisted of surficial topsoil overlying compact, brown, silty sand till (SM) extending to a depth of 1.50 m below the existing grade where refusal to auger was encountered. Coring techniques were employed at a depth of 1.50 m and terminated at a depth of 3.15 m below the existing grade proving the presence of bedrock. The bedrock was found to be fair quality, white, granite bedrock with some horizontal fractures and few sand seams with an RQD of 66% and a recovery of 97%.

Groundwater infiltration was encountered at the time of the site investigation at a depth of 0.6 m below existing site grades. This groundwater level is assumed not to be stabilized, recorded only upon completion of the borehole, before reinstatement.

One (1) soil sample was submitted for laboratory analysis (SP006, 0.45 – 1.50 m). The results of the laboratory analysis are summarized below:

SP006 - Silty Sand trace Clay and Gravel

% Passing      4.75 mm = 99.0

                    75 µm = 41.0

                    5 µm = 11.0 LSFH

                    2 µm = 8.0

Moisture Content = 20.2%

#### **4.2 Sign 2, Highway 15, 25+246**

One (1) borehole was advanced at this sign location. The borehole was advanced to a depth of 1.90 m below existing site grades and terminated within granite bedrock.

The subsoil conditions encountered at the borehole location consisted of surficial topsoil overlying compact, brown, silt and clay till (CL) extending to a depth of 0.40 m below the existing grade where refusal to auger was encountered. Coring techniques were employed at a depth of 0.40 m and terminated at a depth of 1.90 m below the existing grade proving the presence of bedrock. The bedrock was found to be poor quality, red and white, granite bedrock with frequent horizontal fractures and few vertical fractures with an RQD of 42% and a recovery of 96%.

Groundwater infiltration was not encountered at the time of the site investigation.

One (1) soil sample was submitted for laboratory analysis (SP001, 0.10 – 0.40 m). The results of the laboratory analysis are summarized below:

SP001 - Silt and Clay with Sand trace Gravel

% Passing 4.75 mm = 98.0

75 µm = 72.0

5 µm = 44.0 LSFH

2 µm = 37.0

Moisture Content = 29.9%

#### **4.3 Sign 3, County Road 42, 9+902**

One (1) borehole was advanced at this sign location. The borehole was advanced to a depth of 2.00 m below existing site grades and terminated within granite bedrock.

The subsoil conditions encountered at the borehole location consisted of surficial topsoil overlying compact, brown, gravelly sand till (SW) extending to a depth of 0.50 m below the existing grade where refusal to auger was encountered. Coring techniques were employed at a depth of 0.50 m and terminated at a depth of 2.00 m below the existing grade proving the presence of bedrock. The bedrock was found to be poor quality, red and white, granite bedrock with frequent horizontal fractures with an RQD of 31% and a recovery of 100%.

Groundwater infiltration was not encountered at the time of the site investigation.

One (1) soil sample was submitted for laboratory analysis (SP003, 0.10 – 0.50 m). The results of the laboratory analysis are summarized below:

**SP003 - Gravelly Sand trace Silt and Clay**

% Passing    4.75 mm = 39.0  
                  75 µm = 15.0  
                  5 µm = 7.0 LSFH  
                  2 µm = 6.0  
Moisture Content = 4.1%

**4.4 Sign 4, County Road 42, 10+103**

One (1) borehole was advanced at this sign location. The borehole was advanced to a depth of 2.03 m below existing site grades and terminated within granite bedrock.

The subsoil conditions encountered at the borehole location consisted of surficial topsoil overlying firm, brown, sandy silt till (MI) extending to a depth of 0.40 m below existing grade where refusal to auger was encountered. Coring techniques were employed at a depth of 0.40 m and terminated at a depth of 1.90 m below the existing grade proving the presence of bedrock. The bedrock was found to be poor quality, red and white, granite bedrock with frequent horizontal fractures with an RQD of 26% and a recovery of 100%.

Groundwater infiltration was not encountered at the time of the site investigation.

One (1) soil sample were submitted for laboratory analysis (SP005, 0.10 – 0.40 m). Results of the laboratory analysis are summarized below:

**SP005 - Sandy Silt with Clay trace Gravel**

% Passing    4.75 mm = 98.0  
                  75 µm = 65.0  
                  5 µm = 31.0 LSFH  
                  2 µm = 23.0  
Moisture Content = 30.8%

**5.0 FOUNDATION DESIGN – GEOTECHNICAL PARAMETERS**

It is understood that the individual footings for each leg of the proposed signs will be a pier footing designed to a minimum specified footing depth provided the founding soils are suitable based on the current MTO Sign Support Manual. Based on our findings, a modified footing bearing on the shallow bedrock is recommended.

The following tables shown below, summarize the soil engineering parameters for the subsoils encountered. All soil information and laboratory analysis information has been attached to this report. A soils consultant should be retained should the field construction results differ than what has been assumed in this report.

**Sign 1, Highway 15, 25+047**

Soil Type	Depth (m)	Unit Weight of Soil (kN/m <sup>3</sup> )	Angle of Internal Friction (φ)	Rankine Passive Earth Pressure Coefficient (Kp)	Undrained Shear Strength (cu) (kPa)	End Bearing Capacity (ULS) (kPa)
Silty Sand trace Clay and Gravel, Compact	0.50 – 1.50	18.0	30.0	3.0	-	-
Granite Bedrock, Fair	1.50 – 3.00	-	-	-	-	2000

**Sign 2, Highway 15, 25+246**

Soil Type	Depth (m)	Unit Weight of Soil (kN/m <sup>3</sup> )	Angle of Internal Friction (φ)	Rankine Passive Earth Pressure Coefficient (Kp)	Undrained Shear Strength (cu) (kPa)	End Bearing Capacity (ULS) (kPa)
Silt and Clay with Sand trace Gravel, Firm	0.10 – 0.40	19.0	0	1.0	75	-
Granite Bedrock, Poor	0.40 – 1.90	-	-	-	-	1000

**Sign 3, County Road 42, 9+902**

Soil Type	Depth (m)	Unit Weight of Soil (kN/m <sup>3</sup> )	Angle of Internal Friction (φ)	Rankine Passive Earth Pressure Coefficient (Kp)	Undrained Shear Strength (cu) (kPa)	End Bearing Capacity (ULS) (kPa)
Gravelly Sand trace Silt and Clay, Compact	0.10 – 0.50	18.0	30	3.0	-	-
Granite Bedrock, Poor	0.50 – 2.00	19.0	-	-	-	1000



**Sign 4, County Road 42, 10+103**

Soil Type	Depth (m)	Unit Weight of Soil (kN/m <sup>3</sup> )	Angle of Internal Friction (φ)	Rankine Passive Earth Pressure Coefficient (K <sub>p</sub> )	Undrained Shear Strength (c <sub>u</sub> ) (kPa)	End Bearing Capacity (ULS) (kPa)
Sandy Silt with Clay trace Gravel, Firm	0.00 – 0.40	19.0	0	1.0	75	-
Granite Bedrock, Poor	0.40 – 1.90	-	-	-	-	1000

A bond stress between sound bedrock and anchor grout of 500 kPa may be used. An unfactored ultimate lateral resistance of 30 MPA for the bedrock can be utilized for footings socketed into the bedrock. Please use the standard bulking factor for the bedrock.

A frost depth of 1.6 m may be used for all sign locations per OPSD 3090.

## 6.0 CLOSURE

We trust this report provides sufficient information for your present requirements in accordance with our Term of Reference. We trust this report is to your satisfaction. Should you have any questions concerning the above, please feel free to contact our office.

Sincerely,

**AINLEY GRAHAM & ASSOCIATES LIMITED**



Lois-Ann L. Hayes, P.Eng.  
 Vice President & Branch Manager



Bill McLatchie, P.Eng  
 Senior Engineer



## **Figure No. 1**

### Borehole Location Plan





LEGEND  
● = BOREHOLE LOCATION



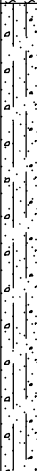



## **Appendix A**

### **Borehole Logs**

RECORD OF BOREHOLE No. BH1 - SIGN #1 1 OF 1 METRIC

W.P. 4021-E-0027 #5 LOCATION 25+047, NBL Ditch, 16.5 m Rt CL, 18T 400301.170E 4945223.186N ORIGINATED BY SCP  
DIST Eastern HWY 15 BOREHOLE TYPE Truck-Mounted CME-55 COMPILED BY JRC  
DATUM NAD 1983 DATE 2024.07.22 LATITUDE 44.65345 LONGITUDE -76.25741 CHECKED BY LAH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)			
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	×	LAB VANE	W <sub>p</sub>	W	
						20	40	60	80	100	20	40	60			
0.0	Topsoil; Sandy silt with rootlets Loose Brown															
0.5	(SM) Till; Silty sand trace clay and gravel Compact Brown		SP006	AUGER	-											
1.5	Bedrock; Fair quality white granite bedrock with some horizontal fractures and few sand seams  Recovery = 97% R.Q.D. = 66%		RC1	RC	-											
3.0	End of borehole 3.00 m below existing grade within fair quality bedrock.  Groundwater was encountered at a depth of 0.60 m during the field investigation.															

MTD - NO ENVIRO 22589-5 - HWY 15 ROUNDABOUT SIGNS.GPJ DATA TEMPLATE - 2024\_09\_06.GDT 6-12-24

RECORD OF BOREHOLE No. BH2 - SIGN #2

1 OF 1

METRIC

W.P. 4021-E-0027 #5 LOCATION 25+246, NBL Shoulder, 12.0 m Rt CL, 18T 400420.053E 4945372.459N ORIGINATED BY SCP  
DIST Eastern HWY 15 BOREHOLE TYPE Truck-Mounted CME-55 COMPILED BY JRC  
DATUM NAD 1983 DATE 2024.07.22 LATITUDE 44.65481 LONGITUDE -76.25594 CHECKED BY LAH


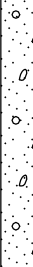
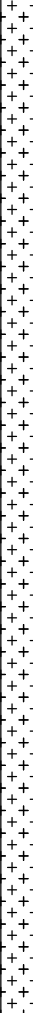
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100					W <sub>p</sub> W W <sub>L</sub>					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
						20 40 60 80 100					20 40 60					
0.0	Topsoil; Sandy silt with rootlets Loose Brown															
0.1	(CL) Till; Silt and clay with sand trace gravel Compact Brown/Grey		SP001	AUGER	-								○	2 26 35 37 L.S.F.H. (28)		
0.4	Bedrock; Poor quality red and white granite bedrock with frequent horizontal and few vertical fractures  Recovery = 96% R.Q.D. = 42%		RC2	RC	-											
1.9	End of borehole 1.90 m below existing grade within poor-quality bedrock.  Groundwater was not encountered during the field investigation.															

RECORD OF BOREHOLE No. BH3 - SIGN #3

1 OF 1

METRIC

W.P. 4021-E-0027 #5 LOCATION 9+902, EBL Shoulder, 8.5 m Rt CL, 18T 400278.961E 49445325.747N ORIGINATED BY SCP  
DIST Eastern HWY CR42 BOREHOLE TYPE Truck-Mounted CME-55 COMPILED BY JRC  
DATUM NAD 1983 DATE 2024.07.22 LATITUDE 44.65437 LONGITUDE -76.25771 CHECKED BY LAH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	● QUICK TRIAXIAL	+	×	FIELD VANE				
20	40	60	80	100												
0.0	Topsoil; Sandy silt with rootlets Loose Brown															
0.1	(SW) Gravelly sand trace silt and clay Compact Brown		SP004	AUGER	-											39 46 9 6 L.S.F.H. (8)
0.5	Poor quality red and white granite bedrock with frequent horizontal fractures  Recovery = 100% R.Q.D. = 31%		RC3	RC	-											
2.0	End of borehole 2.02 m below existing grade within poor quality bedrock.  Groundwater was not encountered during the field investigation.															

RECORD OF BOREHOLE No. BH4 - SIGN #4

1 OF 1

METRIC

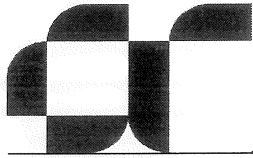
W.P. 4021-E-0027 #5 LOCATION 10+103, EBL Ditch, 14.5 m Rt CL, 18T 400427.577E 4945294.568N ORIGINATED BY SCP  
DIST Eastern HWY CR42 BOREHOLE TYPE Truck-Mounted CME-55 COMPILED BY JRC  
DATUM NAD 1983 DATE 2024.07.22 LATITUDE 44.65411 LONGITUDE -76.25583 CHECKED BY LAH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100					Wp W WL					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
						20 40 60 80 100					20 40 60					
0.0	Topsoil; Sandy silt with rootlets Loose Brown															
0.1	(M) Till; Sandy silt with clay trace gravel Compact Brown		SP005	AUGER	-										2 33 42 23 L.S.F.H. (35)	
0.4	Poor quality red and white granite bedrock with frequent horizontal fractures  Recovery = 100% R.Q.D. = 26%		RC4	RC	-											
1.9	End of borehole 1.92 m below existing grade within poor quality bedrock.  Groundwater was not encountered during the field investigation.															



## **Appendix B**

### Laboratory Reports



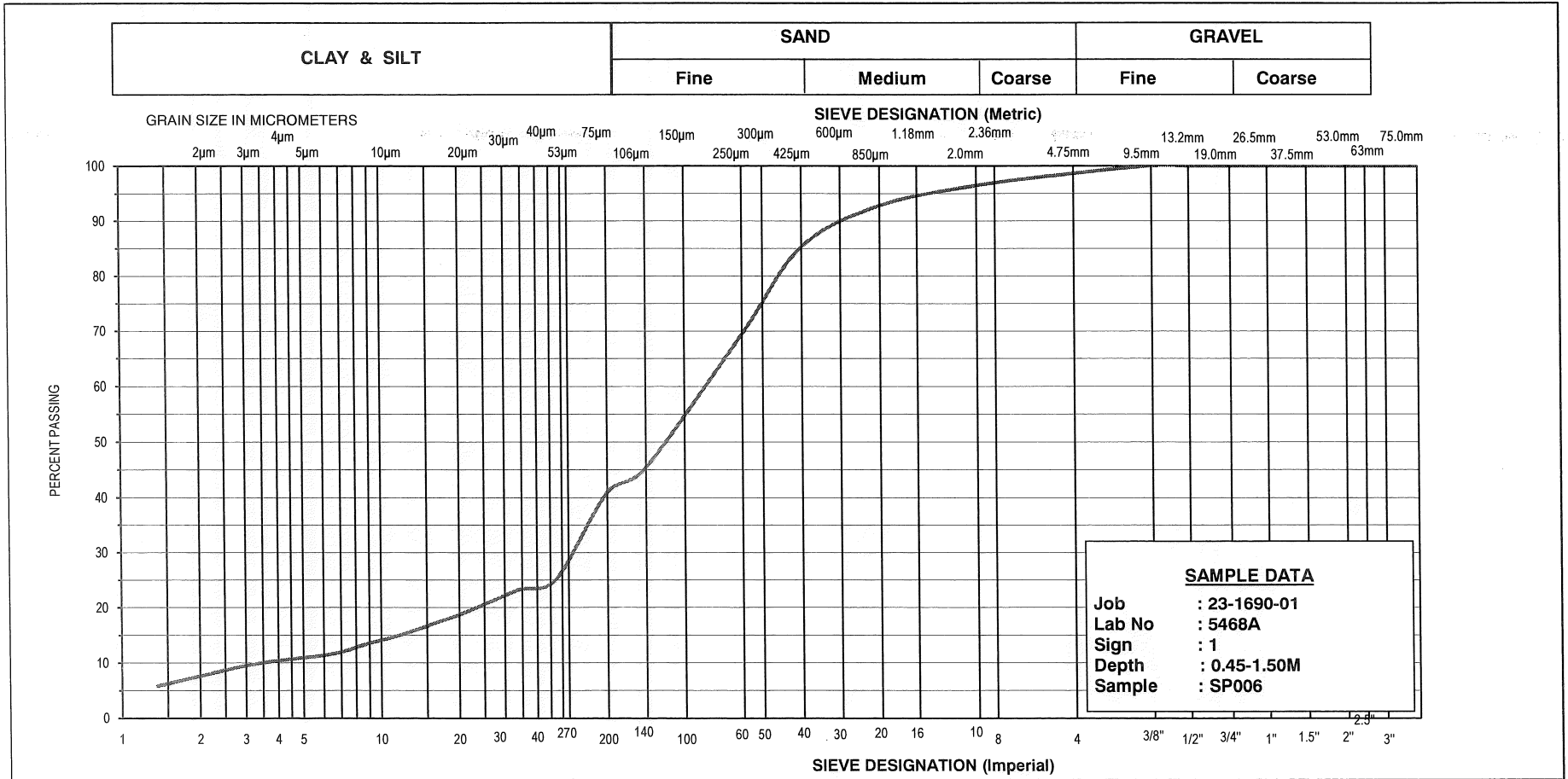
Lab #5468 Client: Ainley

Project Name: Highway #15 Roundabout Signs-22589-5 Date: July 22,2024

SAMPLE INFORMATION	SAMPLE	MASS OF SAMPLE WET & TARE (g)	MASS OF SAMPLE DRY & TARE (g)	MASS OF WATER (g)	MASS OF DRY SOIL (g)	MASS OF TARE (g)	MOISTURE CONTENT (%)
SP006	A	622.3	531.3	91	451.1	80.2	20.2
SP001	B	633.3	518.2	115.1	384.9	133.3	29.9
SP004	C	761.1	735.3	25.8	634.6	100.7	4.1
SP005	D	539.5	443.4	96.1	312.4	131	30.8

# Atkins Realis

## UNIFIED SOIL CLASSIFICATION SYSTEM



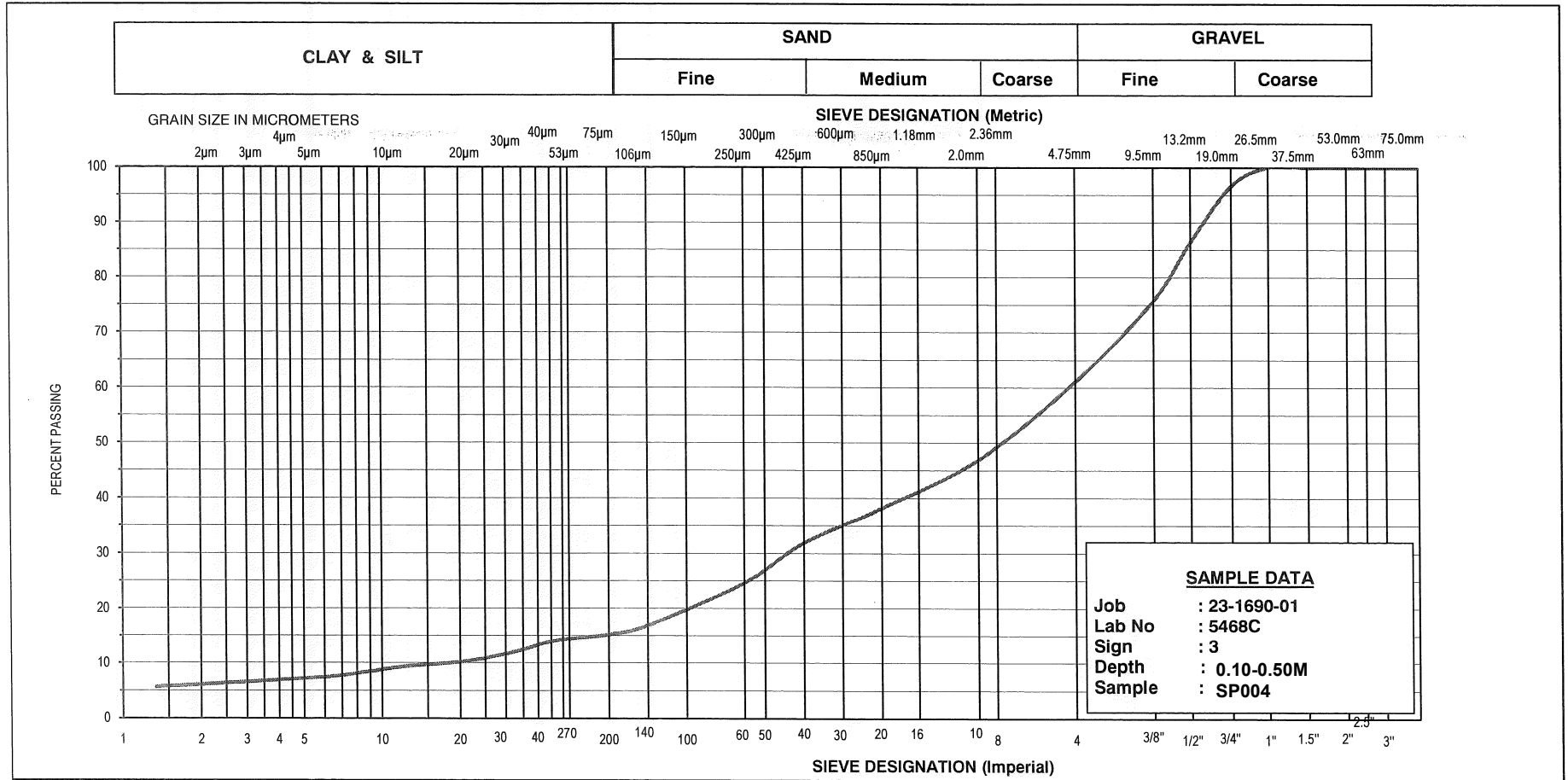
% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	0	1	2	11	44	33	8

<b>Atkins Realis</b> 1164 Clyde Court Kingston, Ontario K7P 2E4	<b>GRAIN SIZE DISTRIBUTION</b>		Client: Ainley	
	<b>SILTY SAND</b>		Project: 23-1690-01	
	Trace Clay, Trace Gravel		22589-5 Highway #15 Roundabout Signs	
	Date: July 22, 2024			Moisture Content is 20.2%



# Atkins Realis

## UNIFIED SOIL CLASSIFICATION SYSTEM

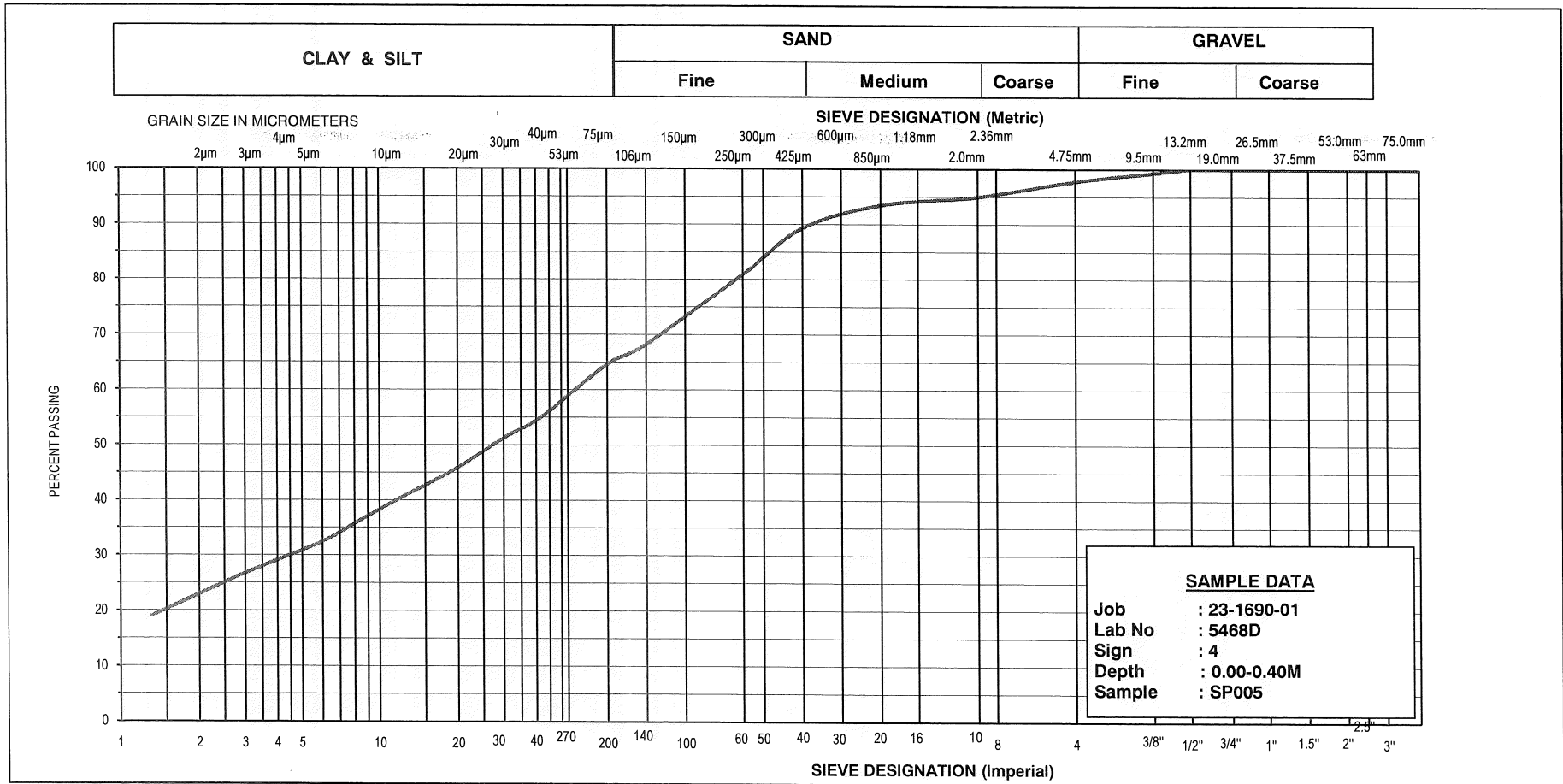


% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	3	36	14	15	17	9	6

<b>Atkins Realis</b> 1164 Clyde Court Kingston, Ontario K7P 2E4	<b>GRAIN SIZE DISTRIBUTION</b>		Client: Ainley
	<b>GRAVELLY SAND</b>		Project: 23-1690-01
	Trace Silt, Trace Clay		22589-5 Highway #15 Roundabout Signs
			Date: July 22, 2024
			Moisture Content is 4.1%

# Atkins Realis

## UNIFIED SOIL CLASSIFICATION SYSTEM



% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	0	2	3	6	25	42	23

<b>Atkins Realis</b> 1164 Clyde Court Kingston, Ontario K7P 2E4	<b>GRAIN SIZE DISTRIBUTION</b>		Client: Ainley	
			Project: 23-1690-01	
	<b>CLAYEY SANDY SILT</b>		22589-5 Highway #15 Roundabout Signs	
	<b>Trace Gravel</b>		Date: July 22,2024	Moisture Content is 30.8%