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Final Pavement Design Report

Ferguson Lake Road – Kennelly Mountain Road
Southerly 5.8 Kms

August 27, 2021
AG File No: 20553-1

Submitted To:
Greenview Environmental Management Limited
13 Commerce Court,
Bancroft, Ontario
K0L 1C0

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1.0 INTRODUCTION

Ainley Group was retained by Greenview Environmental Management (Greenview) to prepare a Pavement Design Report for Ferguson Lake Road, scheduled for reconstruction in 2022. The project limits are from Kennelly Mountain Road southerly for a distance of 5.8 km. It is expected that the roadway will be reconstructed for a design speed of 60 to 70 km/h resulting in some horizontal and vertical curve realignment, roadway widening and associated works. The existing bridge and dual culverts at Constant Creek are not included within the scope of the geotechnical work.

The purpose of this Pavement Design Report is to provide strategies for the reconstruction of the pavement. The strategies are to be based on a review of available historical pavement management and contract data, field review, and field investigations.

The following project limits and stationing are pertinent to this assignment:

South Paving Limit (Southerly 5.8 km):	*Station 2+830*
Constant *Creek Bridge and Culverts*	*Station 5+000 to 6+200 (excluded)*
Northern Limit (Kennelly Mountain Road):	*Station 8+520*

2.0 DESIGN CRITERIA

The following general information concerning cross section and traffic volumes has been extracted from available sources provided by Greenview.

2.1 Present Conditions

Within the project limits, Ferguson Lake Road is a two-lane, undivided rural roadway connecting Calabogie Road to Kennelly Mountain Road. The existing surface treated surface is approximately 7.0 m wide with 1.0 m granular shoulders.

There are a few sideroad, private and commercial entrances throughout the project limits.

2.2 Traffic Volume

The following traffic information has been provided by the Township through Greenview.

Ferguson Lake Road

AADT: 280 (15% Truck Traffic)

2.3 Existing Pavement Performance

The existing surface treated roadway was evaluated during our site visit on May 11, 2020. In general, the main distresses include:

- frequent, ravelling and coarse aggregate loss
- frequent, severe potholes
- intermittent, pavement edge break
- frequent, slight wheel track rutting
- intermittent, severe distortion
- intermittent, moderate transverse cracking

In general, the pavement performance on the section north of Constant Creek is in worse condition than the section to the south. The excluded section at Constant Creek (Station 4+870 to Station 6+200 is paved and is in good condition.

In general, the roadway is constructed on a shallow fill section throughout with the exception of deep cut sections where exposed native subsoil and bedrock is evident. Ditching through these areas is shallow and may be contributing to the overall pavement performance. The cut sections tend to be exposed subsoil with little to no vegetation on the slope. No erosion issues with these exposed slopes was noted during the field investigation and roadway review.

3.0 PROPOSED WORK

The general scope of highway improvements associated with this assignment is as follows:

- Minor Horizontal and Vertical Realignment
- Pavement Reconstruction
- Reinstatement of residential and commercial entrances, “like for like”.
- Crossfall correction.

4.0 FIELD INVESTIGATION

The fieldwork completed for this project consisted of the following activities:

1. A soils investigation was completed in May, 2020. Twenty-four (24) boreholes were advanced within the existing roadway and/or edge of pavement alternating left and right of the centreline. With six (6) boreholes advanced at existing cross culverts. Nine (9) test pits were completed throughout the project limits within the roadway embankments at proposed roadway realignment areas requiring earth/rock cuts. Thirty-nine (39) probe holes were also advanced in the area of the test pits. A copy of the borehole, test pit and probe hole logs is included as **Appendix I.**

2. Representative samples of the base, subbase and subgrade materials were retrieved from selected boreholes and forwarded to SNC Lavalin in Kingston for gradation analysis and moisture content determination. In addition, extraction and penetration testing was also conducted on select asphalt cores retrieved during the field investigation. The laboratory testing results are included as **Appendix II**.

5.0 SUBSOIL CONDITIONS AND PAVEMENT STRUCTURE

5.1 Subsoil Conditions

A review of the soils data obtained from the field investigation indicates that the underlying subsoils within the project limits consists predominately of sand with varying amounts of silt, gravel, clay and cobbles. The existing subsoils are considered to have a Low Susceptibility to Frost Heave (LSFH).

5.2 Existing Pavement Structure

The typical pavement structure encountered from the borehole information consisted of the following:

Main Lanes

15 mm	Surface Treatment (ranged from 15 mm to 30 mm)
255 mm	Sand and Gravel (ranged from 75 mm to 505 mm)
645 mm	Gravelly Sand some Cobbles (ranged from 210 mm to 1300 mm) Sand varying amounts of Gravel, Silt and Clay

5.3 Laboratory Data

A copy of the laboratory results is included as **Appendix II**.

5.4 Existing Granular Base

Gradation analysis on two (2) samples of the granular base material indicated that the samples tested generally met OPSS 1010 specifications for Granular ‘A’. The percent passing the 4.75 mm sieve ranged from 50.8% to 51.6% (35% to 55% allowable) and the percent passing the 75 µm sieve ranged from 9.5% to 10.3% (2% to 10% allowable). In general, the base layer was lacking in course aggregate and was generally on the fine side of the gradation envelope.

5.5 Existing Granular Subbase

Gradation analysis on two (2) samples of the granular subbase material indicated that the samples tested failed to meet the OPSS 1010 specifications for Granular ‘B’, Type I. The percent passing the 4.75 mm sieve ranged from 60.1% to 69.7% (20% to 100% allowable) and the percent passing the 75 µm sieve ranged from 11.2% to 15.3% (0% to 8% allowable). The material meets the OPSS specifications for Select Subgrade Material (SSM).

5.6 Existing Subgrade

The subgrade predominantly consists of sand with varying amounts of gravel, silt and clay. This material is very similar in nature to the sand subbase and in some instances, it was difficult to determine the difference in zone horizon. The subgrade material is considered to have a low susceptibility to frost heave.

Organic peat (fibrous and amorphous) was encountered at the following locations and depths:

Station/Offset	Depth	Soil	Comments
3+590, 1.5 m Rt	1.0 - 2.4 m	Co & Med Fib & Amor Org	Culvert location
4+302, 2.1 m Lt	1.2 – 2.7 m	Sa so Gr w Fib & Amor Org	Alignment shift left
6+030, 1.0 m Lt	1.5 – 4.0 m	Si Sa so Gr & Fib & Amor Org	Culvert location
7+624, 1.2 m Rt	1.2 – 1.8 m	Amor Peat	Exist. Alignment

5.7 Granular Base Equivalency

The following factors were utilized to calculate the existing and proposed design Granular Base Equivalency (GBE):

Existing Pavement Component	GBE Factor
Old Surface Treatment	0.0
Old Granular Base	0.75
Old Granular Subbase	0.50
New Pavement Component	**GBE Factor**
New Hot Mix	2.0
In-Place Processing	1.0

The average Granular Base Equivalency (GBE) based on the information obtained from the borehole investigation is 513 mm.

In consideration of the existing and projected traffic volume, percentage of commercial traffic (15%), the typical subgrade material (sands and silts with <40% between 5 and 75 µm) in comparison to the Ministry of Transportation Ontario's Pavement Design and Rehabilitation Manual for secondary highways, a GBE of **200** is recommended.

5.8 Centreline Culverts

Three (3) centreline culverts were investigated to determine the typical underlying subsoil conditions. Based on the borehole investigation, the following typical pavement and subsoil structure was encountered:

15 mm	Surface Treatment
255 mm	Sand and Gravel
645 mm	Gravelly Sand some Cobbles over Sand varying amounts of Gravel, Silt and Clay

6.0 DESIGN CONSIDERATIONS

The scope of this assignment is to determine a pavement rehabilitation strategy in consideration of both structural and functional performance. Based on the results of the field and laboratory testing programs, the existing pavement structure is considered structurally adequate for existing and future anticipated traffic loading.

Based on the proposed minor horizontal and vertical realignment under consideration and the conditions of the existing surface treatment, it is recommended that in-place processing of the existing surface treatment and underlying granular base material be completed.

A return to a granular surface will enable ease of construction during grading operations associated with the horizontal widening required for the horizontal realignment and any grade raise or grade cuts due to vertical realignment.

Based on the traffic volume, a surface treatment wearing course is adequate however, it is understood that the Township has requested a hot mix surface throughout the project.

In-place processing to a depth of 150 mm throughout, fine grading to correct crossfall and paving with 50 mm HL4 Surface Course will result in a design GBE of 650 mm (Target GBE: 250 mm).

7.0 RECOMMENDATIONS

7.1 Existing Ferguson Lake Road and Sideroad Intersections

In-place process to a depth of 150 mm throughout.

7.2 Grading

At the time of report preparation, a proposed 60 to 70 km/h design speed was under consideration resulting in horizontal and vertical realignment. The realignment will result in a horizontal shift of the existing centreline that generally remains within the width of the existing roadbed.

To construct the new roadbed, widening of the existing roadbed will be completed through existing fill sections (on existing roadbed embankment side slopes) and cut sections (soil and bedrock side cuts). The field investigation determined that the existing roadway base and subbase material is suitable as earth fill material or reuse as a subbase material. Through the existing cut sections, the soil generally consists of sand with gravel and cobbles in varying amounts. The silt content is generally low (ie. less than 10%) and as such, this material could be considered for use as granular fill provided the operation is closely monitored during construction.

Typical OPSD grading sections should be followed with the exception that roadway side slopes should not exceed 2H:1V. Backslopes beyond the ditch line should be designed to a maximum of 1.5H:1V. All exposed side slopes should be treated with topsoil and seed and mulch as soon as possible upon completion of fine grading operations.

7.2.1 Horizontal Realignment

Excavate vertically at the existing edge of pavement and provide for:

150 mm OPSS 1010 Granular 'A'
Acceptable granular fill

It is noted that depending on the contractor's staging operation, the existing roadway base and subbase may be used as granular fill. In addition, fill material generated from any earth or rock cut excavation is also suitable as granular fill material to achieve the necessary widening. Refer to typical fill section depicted in **Appendix III.**

Through earth cut sections, the existing material is considered suitable as subgrade beneath the proposed Granular 'A' base layer. In sections where bedrock subgrade will be encountered during widening, the bedrock should be shattered to a depth of 0.3 m prior to placing the Granular 'A' base and/or granular fill layers.

7.2.2 Vertical Realignment:

At the time of preparation of the report, the extent of the maximum vertical realignment was 0.6 m cut or fill. We offer the following general recommendations:

Cuts

Provide for the following minimum pavement structure:

150 mm OPSS 1010 Granular 'A'

At Sta. 6+550+/-, due to the depth of the proposed vertical cut (0.57 m), increase the Granular 'A' thickness to 300 mm.

Fills

For fills less than 300 mm, place all Granular 'A'.

For fills over 300 mm, place acceptable granular fill and a minimum of 150 Granular 'A'.

7.2.3 Subgrade Preparation due to Organic Soil

As noted previously, subsoil consisting of a mix of sand and gravel with fibrous and amorphous organic material was identified at some of the borehole locations. We recommend the following for consideration:

Station/Offset	Depth	Recommendation
Centreline Culverts	N/A	See Section 7.4
4+302, 2.1 m Lt	1.2 – 2.7 m	Alignment shift is minor (less than 1 m), roadway is in good condition, no action necessary.
7+624, 1.2 m Rt roadway	1.2 – 1.8 m	Excavate to the existing peat layer, place a non-woven, Class II geotextile for the full width of the proposed (ditch line to ditch line), place a biaxial geogrid and backfill with granular fill to the underside of the new granular 'A' base layer. Assume treatment length Sta. 7+614+/- to Sta. 7+634+/-.

7.3 Hot Mix Paving

Pave with 50 mm HL4 Surface Course throughout. The recommended asphalt cement is PG58-34.

7.4 Centreline Culvert Replacements

Based on our observations, the existing centreline culverts are relatively shallow (less than 1 m depth to invert). It is recommended that embedment, bedding, and cover materials consist of Granular 'A', as per OSPD 800 series. For flexible and rigid circular pipes, a minimum bedding depth of 200 mm should be provided (Class C bedding for rigid pipes).

Prior placing the bedding, it is recommended to place a non-woven, Class II geotextile on the exposed subgrade and continue the cloth placement up the trench wall to the roadway

subgrade level. Backfill shall consist of the existing native subsoil material excavated at the culvert locations. Bedding and backfill should be placed in accordance with OPSD 800 series for the applicable culvert type.

In general, the base, subbase, and subsoil materials encountered may be considered as Type 3 soil for excavation purposes. Site conditions at the time of construction may deviate from what was encountered at the time of the field investigation and the contractor should support the excavations based on the condition of the materials encountered at the time of construction.

7.5 Frost Penetration Depth

The frost penetration depth for this project is 1.8 m.

7.6 Soil Erodibility

As indicated, there are several exposed soil cut slopes throughout the roadway section. It is understood in discussion with the Township that soil erosion of these exposed slopes has not been an issue historically. Based on the existing native subsoil encountered (sand with silt trace gravel and clay), a soil erodibility factor (K) of 0.35 has been established. Highly erodible soils have a K value of 0.6 or higher while non-erodible soils have a K value of 0.2 or lower.

7.7 Topsoil Depth

It is recommended that all cut slopes be treated with a minimum of 50 mm of topsoil.

8.0 CONCLUSIONS

We trust the attached information meets your needs at this time and should you have any questions or concerns, please do not hesitate to contact our office.

Yours very truly,

AINLEY GRAHAM & ASSOCIATES LIMITED

Lois-Ann L. Hayes

Lois-Ann L. Hayes, P.Eng.
Geotechnical Project Engineer

Appendix I – Borehole, Test Pit and Probe Hole Logs and Location Plan

LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

0+000 - 0+580

SCALE: 1:750 (22X34) 1:1500 (11X17)

Ainley GROUP
CONSULTING
ENGINEERS
PLANNERS

CONTRACT No. 20553-1 | DATE: JULY 2020

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

0+580 - 1+260

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD
GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON
1+260 - 1+900
SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

1+900 - 2+560

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT

BANCROFT, ON

2+560 - 3+200

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

3+200 - 3+780

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT

BANCROFT, ON

3+780 - 4+420

SCALE: 1:750 (22X34) 1:1500 (11X17)

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DATE: JULY 2020

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

4+420 - 5+060

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

5+060 - 5+680

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

5+680 - 6+660

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT

BANCROFT, ON

6+660 - 6+960

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT

BANCROFT, ON

6+960 - 7+560

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD
GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON
7+560 - 8+140
SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT
BANCROFT, ON

8+140 - 8+780

SCALE: 1:750 (22X34) 1:1500 (11X17)

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LEGEND:

EXISTING ALIGNMENT

60 KM/H ALIGNMENT

90 KM/H ALIGNMENT

FERGUSON LAKE ROAD

GREENVIEW ENVIRONMENTAL MANAGEMENT

BANCROFT, ON

8+780 - 9+322

SCALE: 1:750 (22X34) 1:1500 (11X17)

Ainley GROUP

CONSULTING ENGINEERS PLANNERS

CONTRACT No. 20553-1

DATE: JULY 2020

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BOREHOLE LOGS

BH1, SBL, 8+550 1.2 Lt CL (Mt. St. Patrick) (219.50)

0	-	30	Surface Treatment
30	-	230	Br Sa w Gr, compact
230	-	1.10	Br Sa w Gr so Cobs, compact
	-	1.10	NFP, INF BR

BH2, SBL, 8+240 1.2 m Lt CL (205.30)

0	-	15	Surface Treatment
15	-	200	Br Sa & Gr, compact, JC004
			% Passing JC004
			4.75 mm = 50.8
			75 µm = 9.5
			Moisture Content = 2.7%
200	-	1.50	Br Sa w Si tr Gr & Cl & Cobs, compact, JC005
	-	1.50	NFP, refusal on Cobs

BH3, SBL, 7+960 1.5 m Lt CL (192.63)

0	-	15	Surface Treatment
15	-	300	Br Sa & Gr, compact
300	-	710	Br Gr Sa, compact
710	-	1.50	Br Sa w Si tr Gr & Cl & Cobs, moist, loose
	-	1.50	End of BH

BH4, SBL, 7+870 1.5 m Lt CL, CV00468 (191.86)

0	-	15	Surface Treatment
15	-	260	Br Sa & Gr, compact
260	-	1.35	Br Gr Sa & Cobs, compact
	-	1.35	NFP, refusal on Cobs

BH5, NBL, 7+860 1.5 m Rt CL, CV00468 (191.53)

0	-	15	Surface Treatment
15	-	250	Br Sa &Gr, compact, JC006
250	-	1.10	Br Gr Sa & Cobs, loose, JC007
1.10	-	1.20	Dk Br Si Sa tr Gr, loose, moist
1.20	-	3.00	Br Sa w Si tr Gr & Cl & Cobs, compact, JC008
	-	3.00	End of BH

BH6, SBL, 7+624 1.2 m Lt CL (186.70)

0	-	15	Surface Treatment
15	-	240	Br Sa & Gr, compact
240	-	700	Br Gr Sa, compact
700	-	1.20	Br Gr Sa & Cobs, compact
1.20	-	1.80	Blk Amor Peat, moist
1.80	-	3.00	Br Sa w Si tr Gr & Cl & Cobs, loose, wet, compact at 2.75m, JC009
	-	3.00	End of BH, groundwater encountered at 1.5 m

BH7, NBL, 7+259 1.2 m Rt CL (185.55)

0	-	15	Surface Treatment
15	-	300	Br Sa & Gr, compact, JC010
300	-	800	Br Gr Sa & Cobs, compact, JC011
			% Passing JC011
			4.75 mm = 69.7
			75 µm = 15.3
			Moisture Content = 3.8%
800	-	1.50	Br Sa w Si tr Gr & Cobs, loose, compact, and 1.2m
	-	1.50	End of BH

BH8, SBL, 6+970 2.0 m Lt CL (184.26)

0	-	15	Surface Treatment
15	-	300	Br Sa & Gr, compact
300	-	800	Br Gr Sa, compact
800	-	1.50	Br Sa w Si tr Gr & Cl & Cobs, compact, JC012
			% Passing JC012
			4.75 mm = 98.5
			75 µm = 27.9
			Moisture Content = 7.3%
	-	1.50	End of BH

BH9, SBL, 6+710 1.8 m Lt CL (182.88)

0	-	15	Surface Treatment
15	-	280	Br Sa & Gr, compact
280	-	670	Br Gr Sa so Cobs, compact
670	-	2.25	Br Sa w Si tr Gr & Cl & Cobs, compact
2.25	-	3.00	Grey Si Sa tr Gr & Cl, loose, moist, compact at 2.7m, JC013
			% Passing JC013
			4.75 mm = 98.0
			75 µm = 46.0
			5 µm = 13.0 LSFH
			2 µm = 10.0
			Moisture Content = 19.9%
	-	3.00	End of BH

BH10, NBL, 6+432 2.0 m Rt CL (190.12)

0	-	10	Surface Treatment
10	-	230	Br Sa & Gr, compact
230	-	1.50	Br Gr Sa so Cobs, compact
	-	1.50	End of BH

BH11, SBL, 6+140 1.5 m Lt CL (184.92)

0	-	15	Surface Treatment
15	-	260	Br Sa & Gr, compact
260	-	700	Br Gr Sa tr Cobs, compact
700	-	1.50	Br Sa w Si tr Gr & Cl & Cobs, compact, JC014
			% Passing JC014
			4.75 mm = 97.0
			75 µm = 37.0
			5 um = 10.0 LSFH
			2 µm = 8.0
			Moisture Content = 11.2%
	-	1.50	End of BH

BH12, SBL, 6+030 1.0 m Lt CL, CV00463 (181.36)

0	-	15	Surface Treatment
15	-	320	Br Sa & Gr, compact, JC015
320	-	930	Br Gr Sa so Cobs, compact, becoming wet, JC016
930	-	1.50	Grey Si Sa tr Gr & Cl, compact, wet, JC017
1.50	-	4.00	Dk Br Si Sa so Gr & Fib & Amor Org tr Cl, loose, wet, JC018
4.00	-	4.50	Grey Sa so Gr, compact, wet
	-	4.50	End of BH, groundwater encountered at 2.1 m

BH13, NBL, 6+020 1.1 m Rt CL, CV00463 (181.33)

0	-	15	Surface Treatment
15	-	500	Br Sa & Gr, compact
500	-	1.50	Br Gr Sa so Cobs, compact
1.50	-	1.80	Grey Si Sa tr Gr & Cl, compact, moist
1.80	-	4.50	Grey Si & Sa tr Gr & Cl, loose, wet, compact at 4.0 m, JC019
			% Passing JC019
			4.75 mm = 96.0
			75 µm = 56.0
			5 µm = 6.0 MSFH
			Moisture Content = 23.3%
	-	4.50	End of BH, groundwater encountered at 2.1 m

BH14, SBL, 4+837 1.8 m Lt CL (200.54)

0	-	15	Surface Treatment
15	-	260	Br Sa w Gr, compact
260	-	500	Br/Red Gr Sa, compact
500	-	1.50	Br Sa so Gr & Cobs, compact
	-	1.50	End of BH

BH15, SBL, 4+600 1.8 m Lt CL, Location of past artesian condition (202.50)

0	-	15	Surface Treatment
15	-	200	Br Sa & Gr, compact, JC020
200	-	1.10	Br Gr Sa so Cobs, compact, JC021
1.10	-	2.25	Br Sa so Gr & Gr, loose, wet, JC022
	-	2.25	NFP, INF BR, groundwater encountered at 1.1 m

BH16, SBL, 4+302 2.1 m Lt CL, Location of past report organic fill (203.95)

0	-	15	Surface Treatment
15	-	200	Grey Sa & Gr, compact
200	-	450	Br Sa & Gr, compact
450	-	750	Br Gr Sa so Cobs, compact
750	-	1.20	Br Sa, loose, wet
1.20	-	2.70	Blk Sa so Gr w Fib & Amor Org, loose, wet
2.70	-	3.00	Grey Si Sa so Gr & Cobs, compact, wet
	-	3.00	End of BH, groundwater encountered at 1.5 m

BH17, NLB, 3+937 2.0 m Rt CL (188.50)

0	-	15	Surface Treatment
15	-	150	Grey Sa & Gr, compact
150	-	540	Br Gr Sa, compact
540	-	1.50	Br Sa so Si & Gr & Cobs, compact
	-	1.50	End of BH

BH18, SBL, 3+674 1.9 m Lt CL (182.46)

0	-	15	Surface Treatment
15	-	200	Grey Sa & Gr, compact, JC023
			% Passing JC023
			4.75 mm = 51.6
			75 µm = 10.3
			Moisture Content = 1.8%
200	-	750	Br Gr Sa so Cobs, JC024
			% Passing JC024
			4.75 mm = 60.1
			75 µm = 11.2
			Moisture Content = 3.8%
	-	750	NFP, refusal on Blds

BH19, SBL, 3+604 1.2 m Lt CL, CV00454 (182.21)

0	-	15	Surface Treatment
15	-	280	Grey Sa & Gr, compact
280	-	600	Br Gr Sa, compact
600	-	1.00	Dk Br Sa so Si & Gr tr Amor Org, loose
1.00	-	3.00	Br Sa so Si & Gr, compact, wet, JC025
	-	3.00	End of BH, groundwater encountered at 0.75 m

BH20, NBL, 3+590 1.5 m Rt CL, CV00454 (182.25)

0	-	15	Surface Treatment
15	-	260	Grey Sa & Gr, compact
260	-	470	Br Gr Sa so Cobs, compact
470	-	1.00	Dk Br Sa w Si & Gr, loose, JC026
			% Passing JC026
			4.75 mm = 76.5
			75 µm = 22.1
			Moisture Content = 8.4%
1.00	-	2.40	Co & Mid Fib & Amor Org Peat
2.40	-	3.00	Br Sa w Si so Gr tr Cobs, compact, wet
	-	3.00	End of BH, groundwater encountered at 1.2 m

BH21, SBL, 3+371 1.2 m Lt CL (183.53)

0	-	15	Surface Treatment
15	-	250	Grey Sa & Gr, Compact
250	-	660	Br Gr Sa, compact
660	-	1.50	Br Sa so Si & Gr, compact
	-	1.50	End of BH

BH22, NBL, 3+120 1.75 m Rt CL (183.81)

0	-	15	Surface Treatment
15	-	220	Grey Sa & Gr, compact, JC027
220	-	450	Br Gr Sa, compact, JC028
450	-	1.50	Br Sa w Si tr Gr & Cl, compact, JC029
			% Passing JC029
			4.75 mm = 99.7
			75 µm = 36.5
			Moisture Content = 7.8%
	-	1.50	End of BH

BH23, SBL, 2+990 2.0 m Lt CL (184.51)

0	-	15	Surface Treatment
15	-	90	Grey Sa & Gr, compact
90	-	350	Br Gr Sa, compact
350	-	1.20	Br Sa so Si tr Gr & Cobs, compact
	-	1.20	NFP, INF BR

BH24, NBL, 2+875 1.8 m Rt CL (182.67)

0	-	15	Surface Treatment
15	-	100	Grey Sa & Gr, compact
100	-	520	Br Gr Sa, compact
520	-	1.50	Br Sa so Si & Gr & Cobs, compact
	-	1.50	End of BH

TEST PIT LOGS

TP1, 7+812 6.0 m Rt CL (188.89)

0	-	100	Br Si Sa w rootlets, TPS
100	-	600	Br Sa tr Gr loose
600	-	700	TPS Remnant
700	-	1.80	Br Sa so Gr & Si, compact
	-	1.80	End of TP

TP2, 7+390 6.0 m Lt CL (186.68)

0	-	150	DK Br Si Sa so Gr & rootlets, TPS
150	-	800	Br Sa so Gr & Cobs, loose
800	-	1.80	Lt Br Sa, loose, JC003
	-	1.80	End of TP

TP3, 6+625 8.0 m Rt CL (188.51)

0	-	100	Br Sa so Gr & rootlets, loose
100	-	1.80	Br Sa w Gr & Cobs tr Blds, loose, compact at 1.2, JC002
	-	1.80	End of TP

TP4, 4+570 8.0 m Rt CL (203.66)

0	-	450	Br Sa tr Si & Gr & Cobs & rootlets, loose
450	-	900	Br Sa tr Si & Gr & Cobs, loose
900	-	1.60	Br Sa so Gr& Cobs & Blds, compact
	-	1.60	NFP, Refusal on fractured BR

TP5, 4+167 8.0 m Rt CL (199.52)

0	-	100	Br Sa tr Gr, loose
	-	100	NFP, Refusal on fractured BR, BR face slopping down toward road 0.6 m to BR at north edge of TP

TP6, 4+100 8.0 m Rt CL (194.76)

0	-	1.80	Br Sa so Si & Gr & Cobs, compact, loose at times, JC001
	-	1.80	End of TP, increasing Cobs with depth

TP7, 3+324 8.0 m Lt CL (182.57)

0	-	150	Br Sa tr Gr & rootlets, TPS
150	-	900	Br Sa tr Gr, loose
900	-	1.80	Br Sa w Gr tr Cobs, compact
	-	1.80	End of TP

TP8, 2+997 7.0 m Lt CL (184.25)

0	-	100	Br Sa so Gr & Cobs & Blds, loose
	-	100	NFP, refusal on fractured BR, BR face slopping down toward road 0.65 m to BR at south edge of TP

TP9, 2+958 7.0 m Lt CL (184.63)

0	-	200	Br Sa so Gr & Cobs & Blds, loose
	-	200	NFP, refusal on BR, BR face slopping down toward road 1.20 m to BR at south edge of TP

PROBE HOLE LOGS

Group 1, String 1 (TP8-TP9) (2+958 to 2+997 12.5 m Lt CL)

1	-	+1.5 m overburden
2	-	+1.5 m overburden
3	-	+1.5 m overburden
4	-	0.3 m to refusal

Group 1, String 2 (TP8-TP9) (2+958 to 2+997 20.0 m Lt CL)

1	-	0.6 m to refusal
2	-	BR at surface
3	-	0.4 m to refusal
4	-	0.7 m to refusal

Group 2, String 1 (TP5-TP6) (4+100 to 4+167 13.0 m Rt CL)

1 - +1.5 m overburden
2 - +1.5 m overburden
3 - +1.5 m overburden
4 - +1.5 m overburden
5 - +1.5 m overburden

Group 2, String 2 (TP5-TP6) (4+100 to 4+167 22.0 m Rt CL)

1 - +1.5 m overburden
2 - 1.35 m to refusal
3 - +1.5 m overburden
4 - +1.5 m overburden
5 - 0.2 m to refusal
6 - 0.75 m to refusal
7 - +1.5 m overburden

Group 3, String 1 (TP4) (4+536 to 4+611 11.0 m Rt CL)

1 - 0.6 m to refusal
2 - 0.6 m to refusal
3 - 0.75 m to refusal
4 - 0.1 m to refusal (Blds)
5 - 0.15 m to refusal (Blds)
6 - 0.3 m to refusal
7 - 0.45 m to refusal
8 - 0.15 m to refusal
9 - 0.45 m to refusal
10 - 0.3 m to refusal

Group 4, String 1 (TP2) (7+355 to 7+420 12.0 m Rt CL)

1 - +1.5 m overburden
2 - 1.15 m to refusal (Blds)
3 - +1.5 m overburden
4 - 1.2 m to refusal
5 - 1.0 m to refusal (Blds)
6 - 1.0 m to refusal (Blds)
7 - 0.3 m to refusal (Blds)
8 - 0.6 m to refusal
9 - 0.15 m to refusal

Appendix II – Laboratory Results

SNC·LAVALIN

Lab # 19955 Client Ainley

Project Name: 20553-1 Ferguson Lake Road Date: June 5,2020

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 (%)
JC004	A	566.4	553	13.4	499.6	53.4	2.7
JC011	B	479	466.2	12.8	340.2	126	3.8
JC023	C	395	389.2	5.8	315.3	73.9	1.8
JC024	D	508.8	493.1	15.7	412.8	80.3	3.8
JC026	E	514.8	485.5	29.3	349	136.5	8.4
JC029	F	381.2	363.7	17.5	224.6	139.1	7.8
JC019	G	525.2	451.7	73.5	315.4	136.3	23.3
JC013	H	579.2	506.1	73.1	367.5	138.6	19.9
JC012	I	459.4	437.3	22.1	301	136.3	7.3
JC014	J	606.5	559.1	47.4	423.6	135.5	11.2

ENGINEERING

MOISTURE CONTENT

(LS-701)

PROJECT # 20-1690-01 DATE JUNE 5/20

PROJECT NAME 20553-1 FERGUSON LAKE RD LAB # 19955

SAMPLE DESCRIPTION Soil

SAMPLE	WEIGHT OF SAMPLE WET & TARE (g)	WEIGHT OF SAMPLE DRY & TARE (g)	WEIGHT OF WATER (g) A	WEIGHT OF DRY SOIL (g) B	WEIGHT OF TARE (g)	MOISTURE CONTENT A÷B (%) ×100
A	566.4	553.0		499.6	53.4	
B	479.0	466.2		340.2	126.0	
C	395.0	389.2		315.3	73.9	
D	508.8	493.1		412.8	80.3	
E	514.8	485.5		349.0	136.5	
F	381.2	363.7		224.6	139.1	
G	525.2	451.7			136.3	
H	579.2	506.1			138.6	
I	459.4	437.3		301.0	136.3	
J	606.5	559.1			135.5	

TECHNICIAN: _____ SUPERVISOR: _____

SNC·LAVALIN

SNC-Lavalin GEM Ontario Inc.
1164 Clyde Court
Kingston, Ontario K7P 2E4
(613) 389-1781 (613) 389-4204

Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Granular
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC004,BH#2,0.015-0.2M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-A **Date Tested:** Jun 11, 2020
Specification: OPSS, Granular A

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		60
% Asphalt Coated:		30
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	2.37

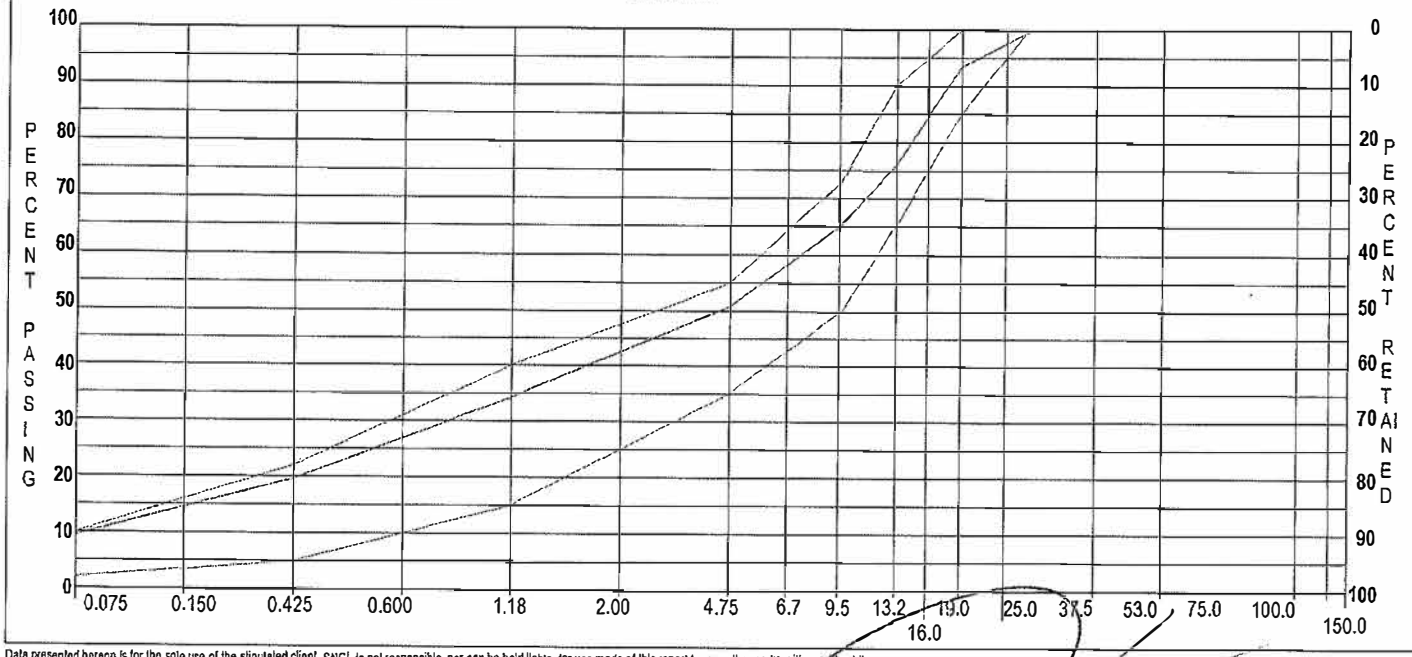
Comments: Moisture Content is 2.7%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0		-
100.0		-
75.0		-
53.0		-
50.0		-
37.5		-
26.5	100	100 - 100
25.0		-
19.0	93.4	85 - 100
16.0		-
13.2	76	65 - 90
9.5	65.3	50 - 73
6.7		-
4.75	50.8	35 - 55
2.36		-
2.00		-
1.18	34.2	15 - 40
0.600		-
0.425		-
0.300	19.6	5 - 22
0.150		-
0.075	9.5	2 - 10

* Indicates Out of Specification

Sample: ..... **Specs:** .....



Project Manager: Mark McClelland, C.E.T

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1164 Clyde Court
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(613) 389-1781 (613) 389-4204

Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Granular
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC011,BH#7,0.3-0.8M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-B **Date Tested:** Jun 11, 2020
Specification: OPSS1010, Granular B Type I

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		30
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	1.54

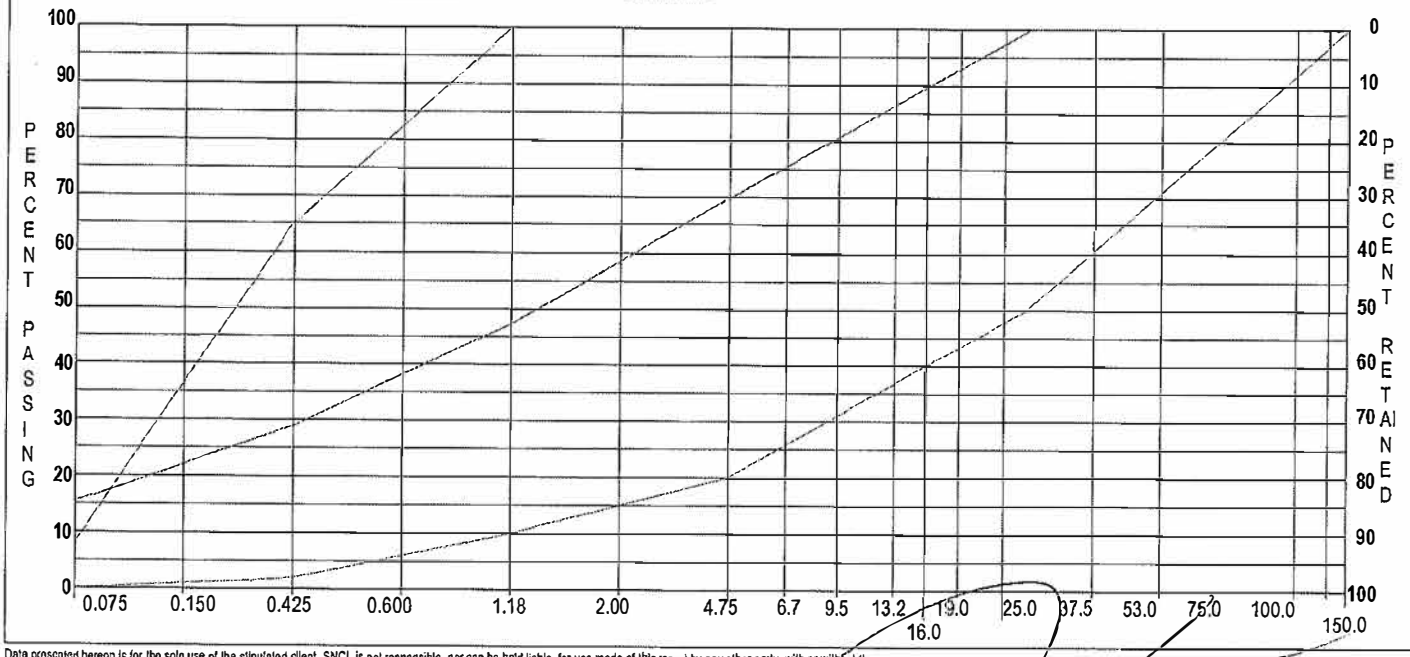
Comments: Moisture Content is 3.8%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0	100	100 - 100
100.0		-
75.0		-
53.0		-
50.0		-
37.5		-
26.5	100	50 - 100
25.0		-
19.0		-
16.0		-
13.2		-
9.5		-
6.7		-
4.75	69.7	20 - 100
2.36		-
2.00		-
1.18	47.3	10 - 100
0.600		-
0.425		-
0.300	28.9	2 - 65
0.150		-
0.075	15.3*	0 - 8

* Indicates Out of Specification

Sample: ..... **Specs:** .....



Project Manager: Mark McClelland, C.E.T

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(613) 389-1781 (613) 389-4204

Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Granular
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC023,BH#18,0.015-0.2M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-C **Date Tested:** Jun 11, 2020
Specification: OPSS, Granular A

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		60
% Asphalt Coated:		30
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		
FINENESS MODULUS	2.26	

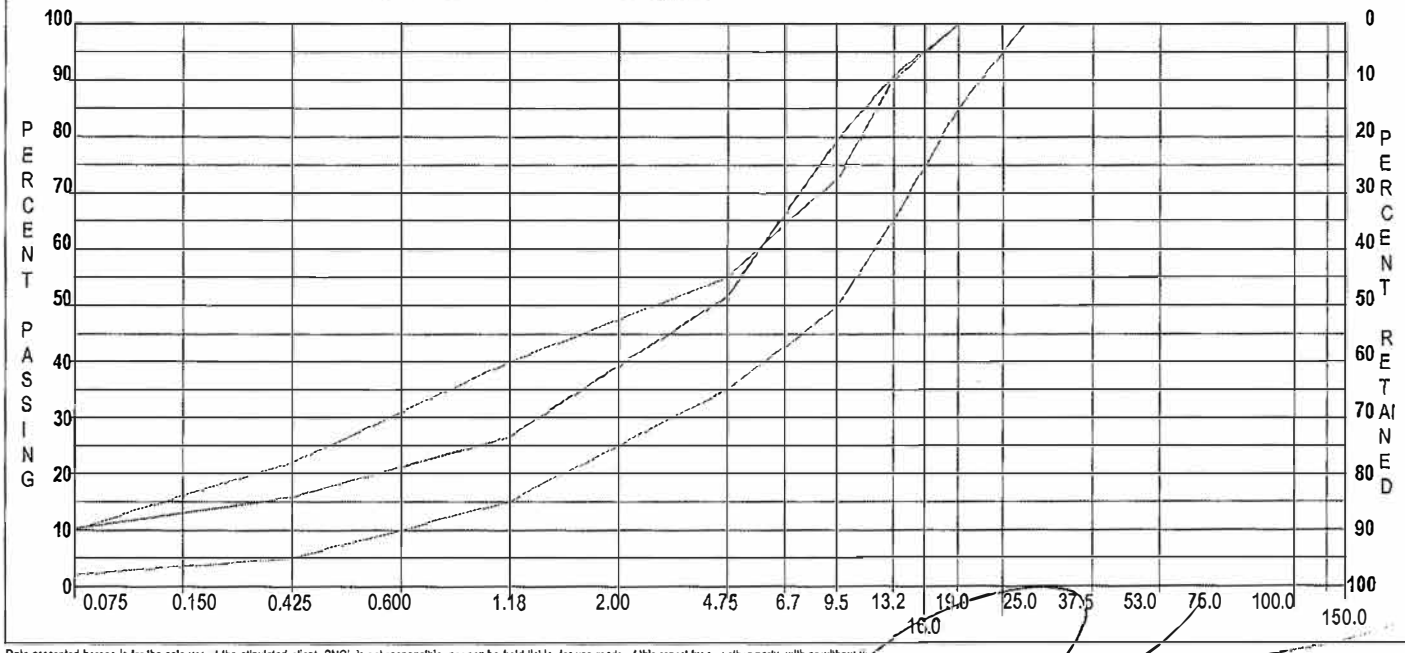
Comments: Moisture Content is 1.8%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0		-
100.0		-
75.0		-
53.0		-
50.0		-
37.5		-
26.5	100	100 - 100
25.0		-
19.0	100	85 - 100
16.0		-
13.2	90.8*	65 - 90
9.5	79.8*	50 - 73
6.7		-
4.75	51.6	35 - 55
2.36		-
2.00		-
1.18	26.6	15 - 40
0.600		-
0.425		-
0.300	15.8	5 - 22
0.150		-
0.075	10.3*	2 - 10

* Indicates Out of Specification

Sample: **Specs:**



Project Manager: Mark McClelland, C.E.T

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Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location:

Contract No.:

SAMPLE DATA

Material: Granular

Date Sampled: Jun 05, 2020

Time Sampled:

Sample Type: Borehole

Sample Location: JC024,BH#18,0.2-0.75M 20553-1 Ferguson Lake Road

Lot: **Sublot:**

Source: Ainley

Sampled By: Client

LAB DATA

Lab No.: 19955-D **Date Tested:** Jun 09, 2020

Specification: OPSS1010, Granular B Type I

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		30
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	1.75

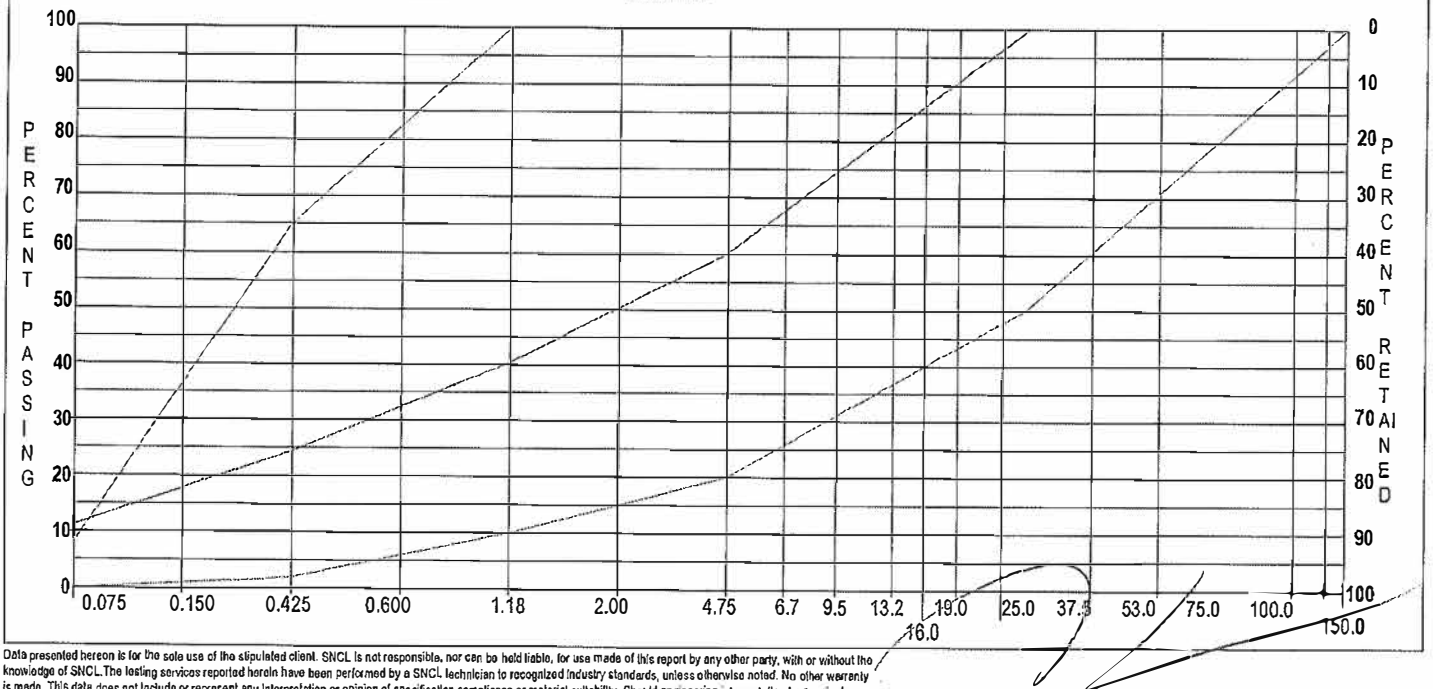
Comments: Moisture Content is 3.8%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0	100	100 - 100
100.0		-
75.0		-
53.0		-
50.0		-
37.5		-
26.5	100	50 - 100
25.0		-
19.0		-
16.0		-
13.2		-
9.5		-
6.7		-
4.75	60.1	20 - 100
2.36		-
2.00		-
1.18	40.4	10 - 100
0.600		-
0.425		-
0.300	24.4	2 - 65
0.150		-
0.075	11.2*	0 - 8

* Indicates Out of Specification

Sample: ..... **Specs:** .....



Project Manager: Mark McClelland, C.E.T

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Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Soil
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC026 BH#20 0.47-1.0M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-E **Date Tested:** Jun 05, 2020
Specification:

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		
FINENESS MODULUS	2.48	

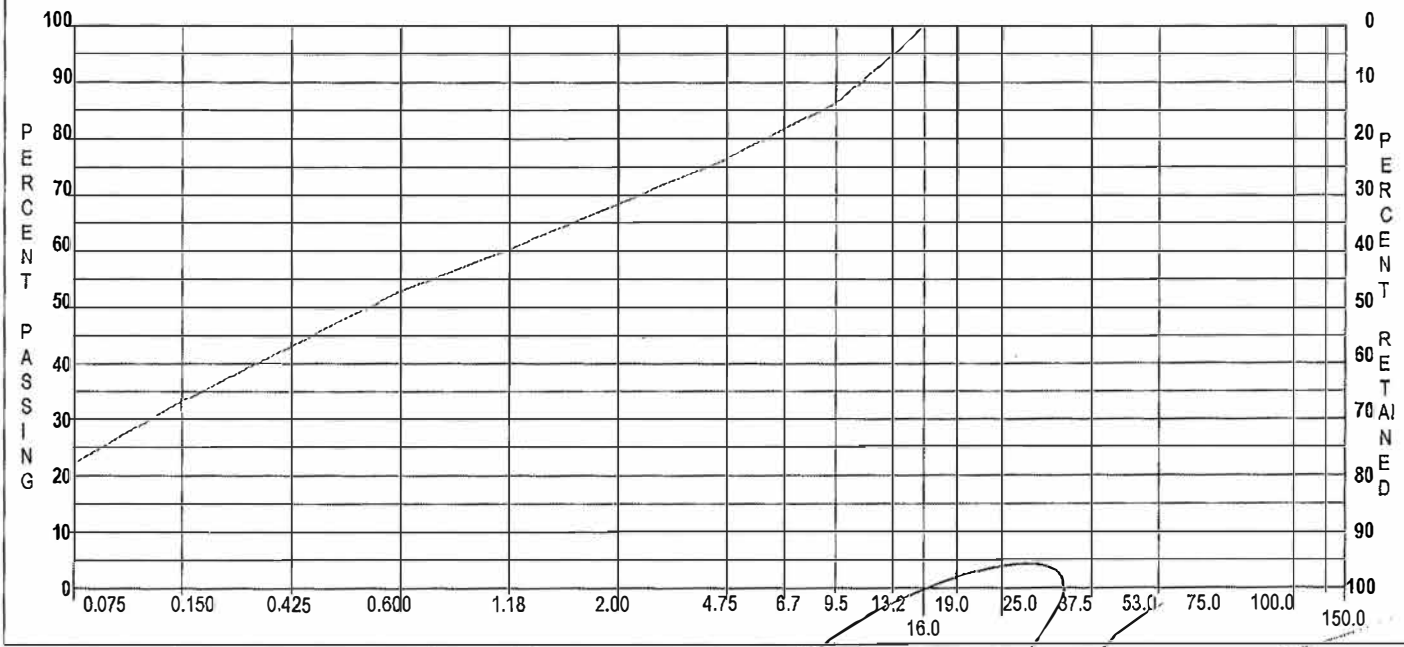
Comments: Moisture Content is 8.4%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0		
100.0		
75.0		
53.0		
50.0		
37.5		
26.5		
25.0		
19.0		
16.0	100	
13.2	94.8	
9.5	86.6	
6.7		
4.75	76.5	
2.36	67.6	
2.00		
1.18	60.3	
0.600	52.8	
0.425		
0.300	43.2	
0.150	33.1	
0.075	22.1	

* Indicates Out of Specification

Sample: Specs:



Project Manager: Mark McClelland, C.E.T

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Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Subsoil
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC029, BH#22, 0.45-1.5M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-F **Date Tested:** Jun 05, 2020

Specification:

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		
FINENESS MODULUS	0.18	

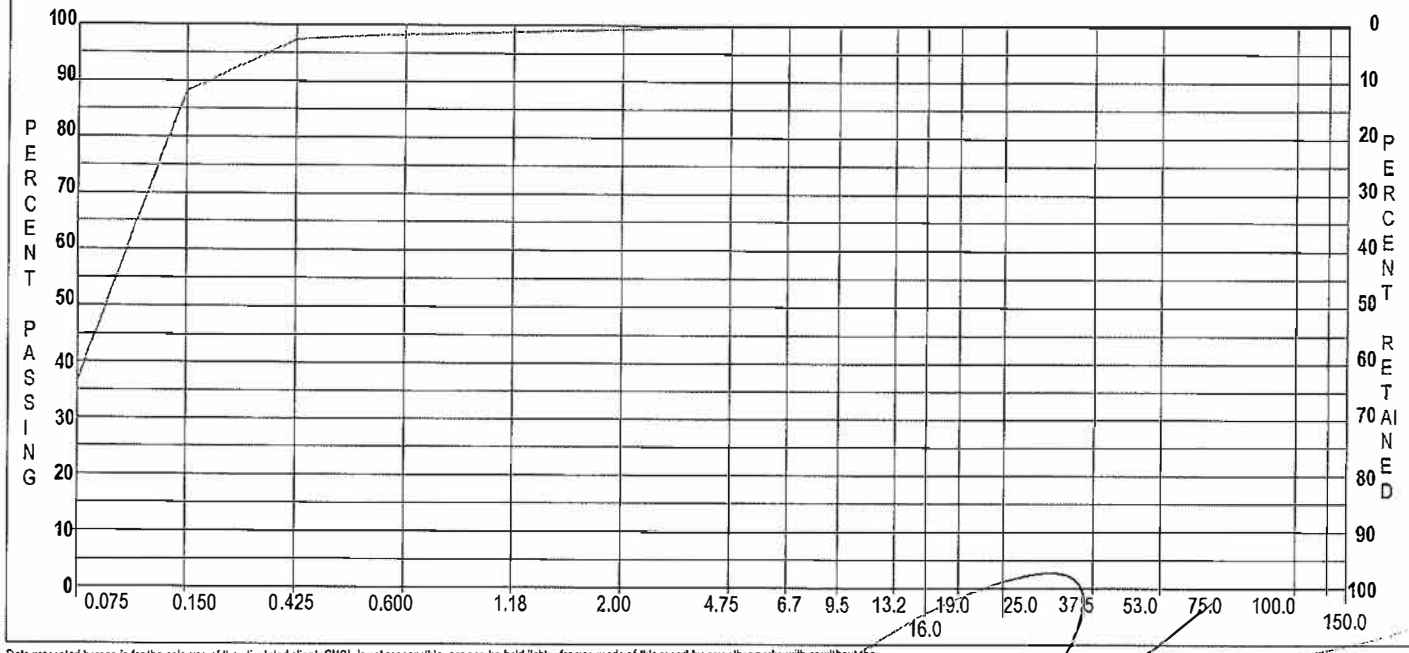
Comments: Moisture Content is 7.8%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0		
100.0		
75.0		
53.0		
50.0		
37.5		
26.5		
25.0		
19.0		
16.0		
13.2		
9.5		
6.7	100	
4.75	99.7	
2.36	99.2	
2.00		
1.18	98.8	
0.600	98.3	
0.425		
0.300	97.3	
0.150	88	
0.075	36.5	

* Indicates Out of Specification

Sample: **Specs:**



Project Manager: Mark McClelland, C.E.T

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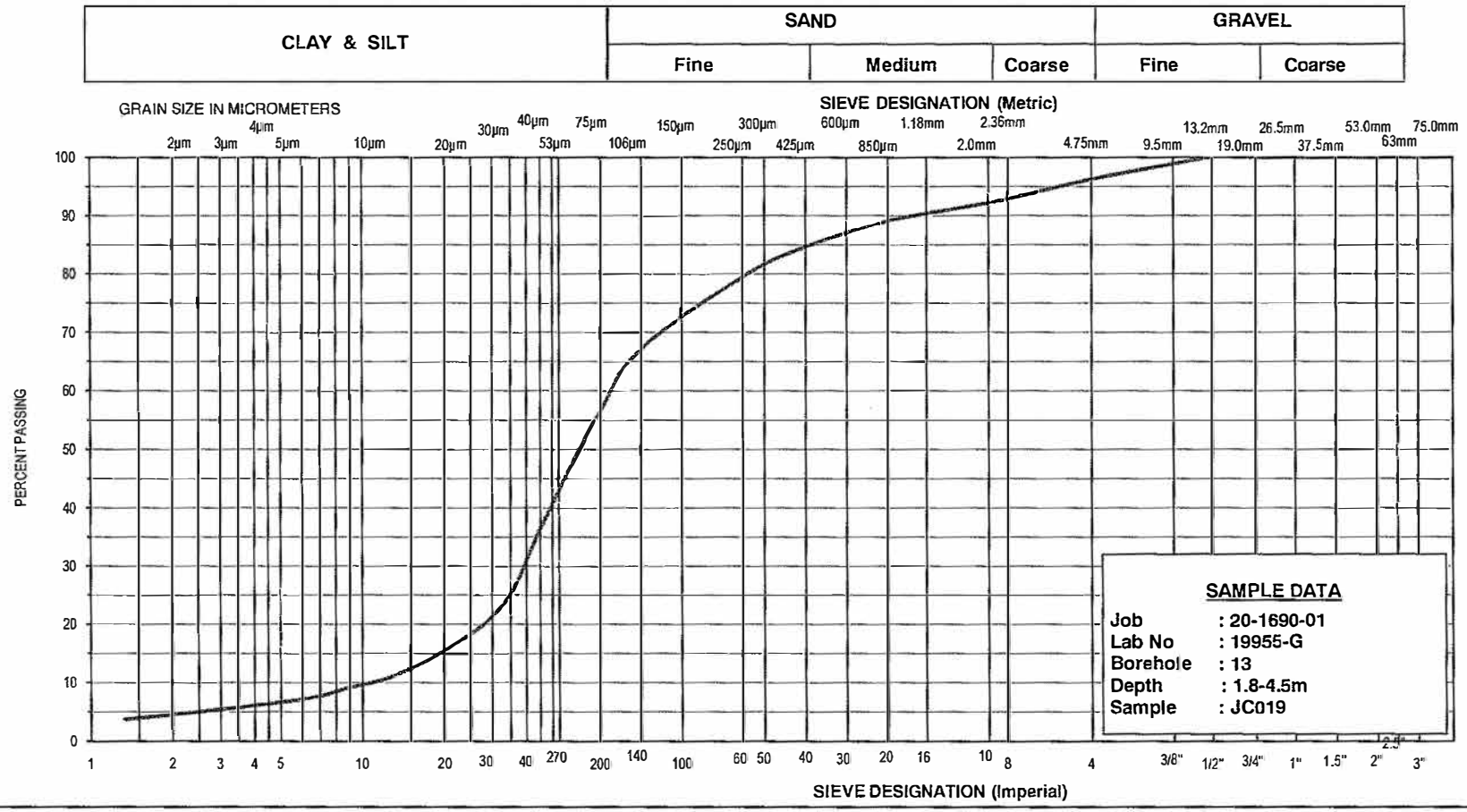
UNIFIED SOIL CLASSIFICATION SYSTEM



% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	0	4	4	8	28	51	5

SNC-LAVALIN 1164 Clyde Court Kingston, Ontario K7P 2E4	**GRAIN SIZE DISTRIBUTION**	Client: Ainley	
		Project: 20-1690-01	
	SAND SILT	20553-1 Ferguson Lake Road	
	Trace Clay,Trace Gravel	Date: June 5,2020	**Moisture Content is 23.3%**

SNC·LAVALIN

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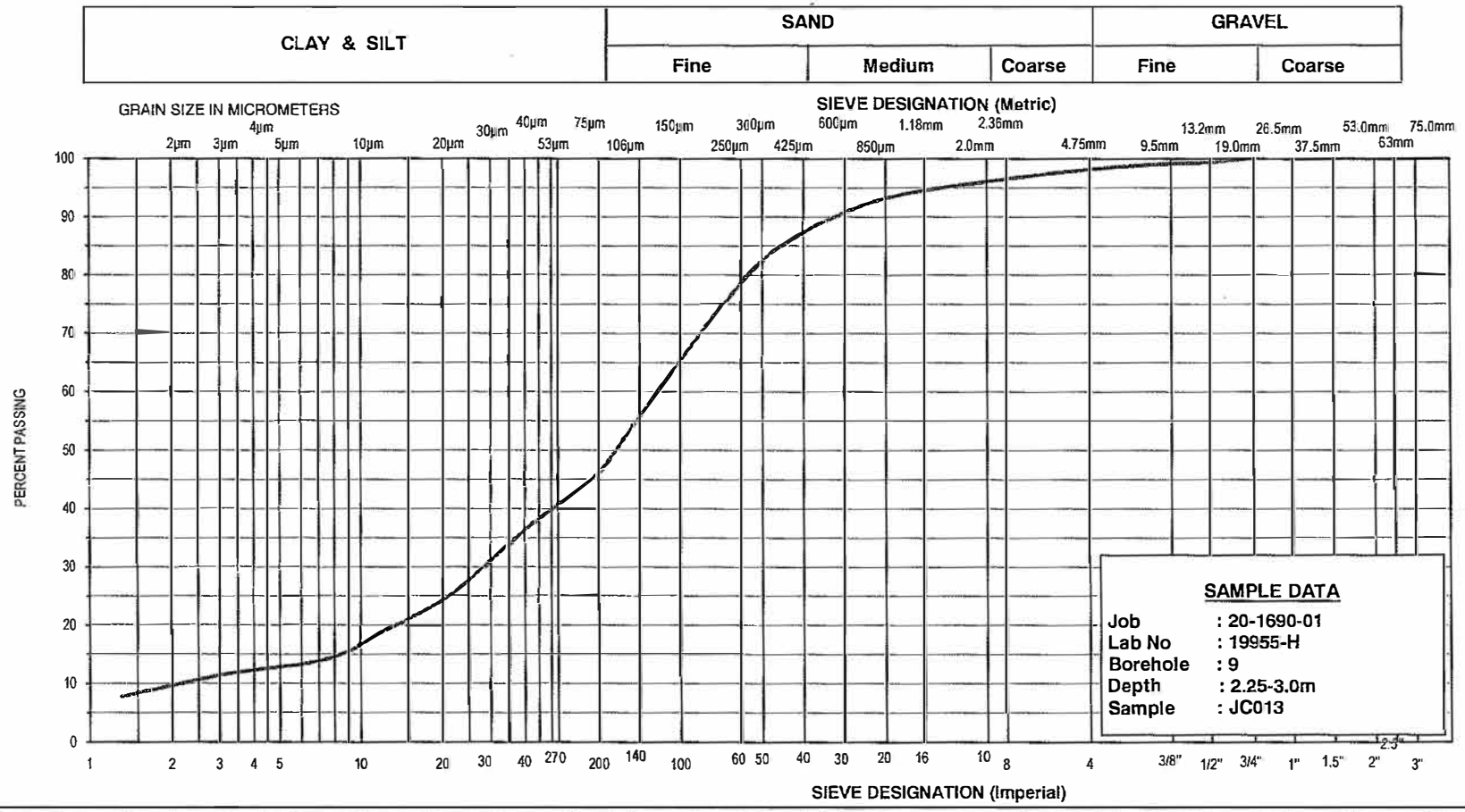
UNIFIED SOIL CLASSIFICATION SYSTEM



% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	0	2	2	9	41	36	10

SNC-LAVALIN 1164 Clyde Court Kingston, Ontario K7P 2E4	**GRAIN SIZE DISTRIBUTION**	**Client: Ainley**
		Project: 20-1690-01
	SILTY SAND	20553-1 Ferguson Lake Road
	Trace Clay,Trace Gravel	Date: June 5,2020 — **Moisture Content is 19.9%**

SNC·LAVALIN

SNC-Lavalin GEM Ontario Inc.
1164 Clyde Court
Kingston, Ontario K7P 2E4
(613) 389-1781 (613) 389-4204

Grain Size Analysis Test Report

Project No.: 20-1690-01 **Project Description:** Lab Testing **Date:** Jun 11, 2020

Project Location: **Contract No.:**

SAMPLE DATA

Material: Subsoil
Date Sampled: Jun 05, 2020
Time Sampled:
Sample Type: Borehole
Sample Location: JC012,BH#8,0.8-1.5M 20553-1 Ferguson Lake Road
Lot: **Sublot:**
Source: Ainley
Sampled By: Client

LAB DATA

Lab No.: 19955-I **Date Tested:** Jun 06, 2020

Specification:

PARTICLE ANALYSIS

TEST	Sample	Specification
Percent Crushed:		
% Asphalt Coated:		
% Flat and Elongated		

WASH PASS 0.075mm

TEST	Sample	Specs
Wash Pass 0.075 mm:		

FINENESS MODULUS	0.71

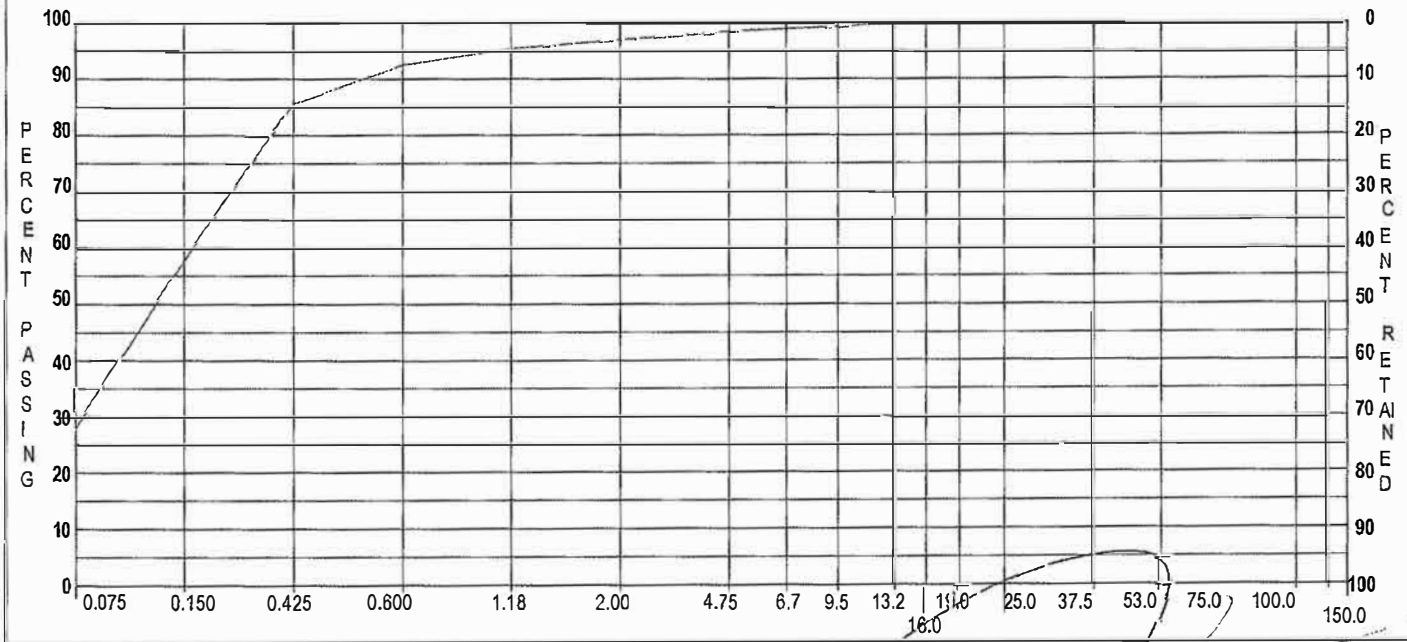
Comments: Moisture Content is 7.3%

Grain Size Analysis

Sieve Sizes (mm)	Percent Passing	
	Sample	Specification
150.0		
100.0		
75.0		
53.0		
50.0		
37.5		
26.5		
25.0		
19.0		
16.0		
13.2	100	
9.5	99.3	
6.7		
4.75	98.5	
2.36	97.2	
2.00		
1.18	95.4	
0.600	92.5	
0.425		
0.300	85.5	
0.150	57.6	
0.075	27.9	

* Indicates Out of Specification

Sample: **Specs:**



Project Manager: Mark McClelland, C.E.T

Infrastructure

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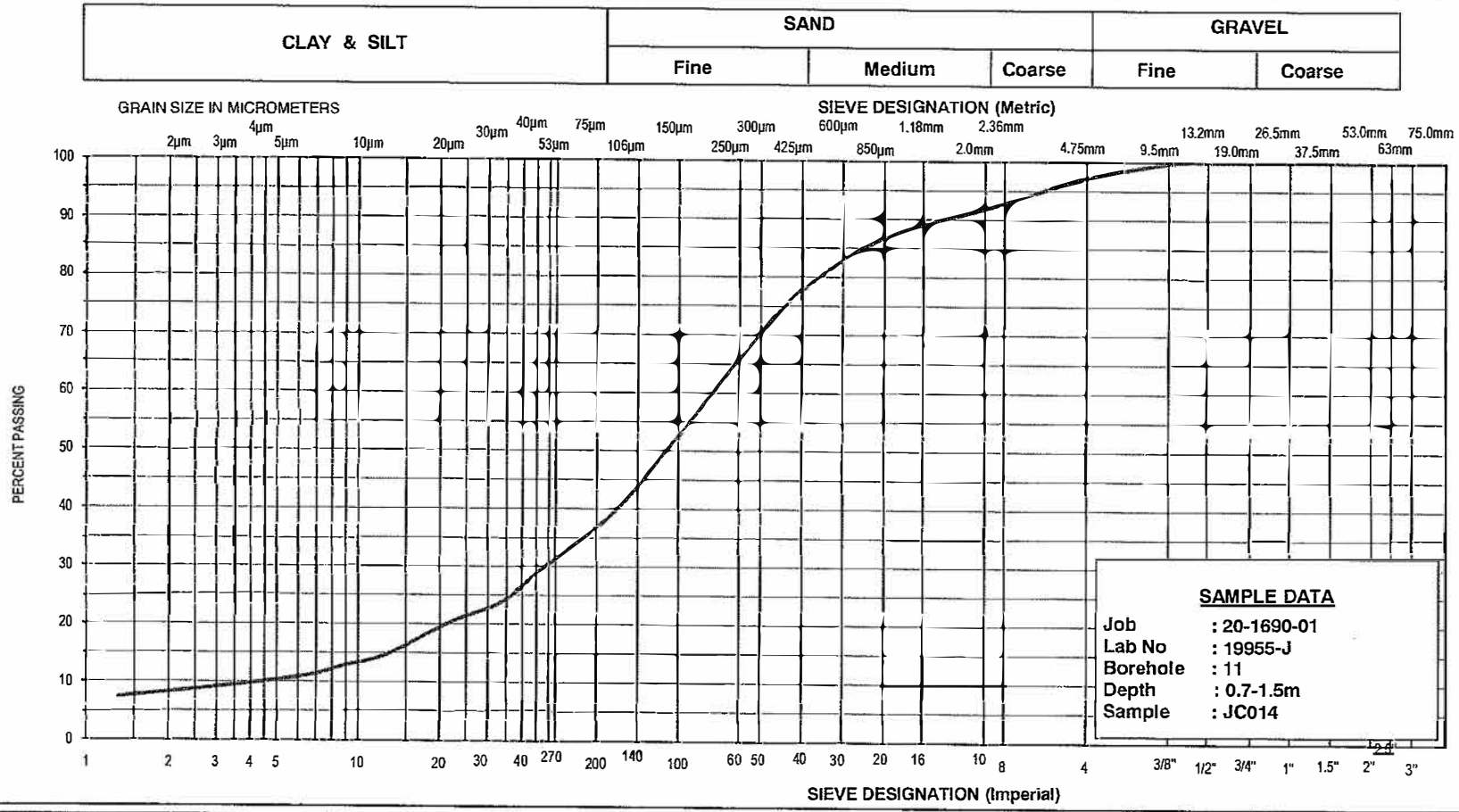
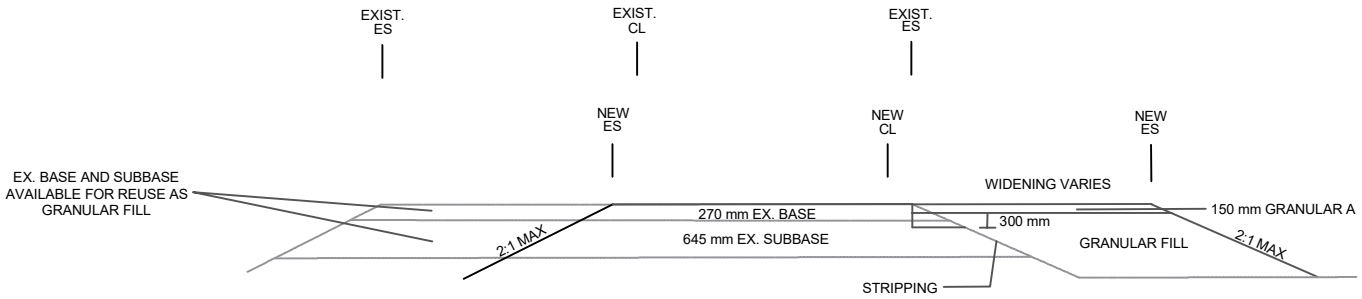
UNIFIED SOIL CLASSIFICATION SYSTEM



% +3"	% Gravel		% Sand			% Fines	
	Course	Fine	Course	Medium	Fine	Silt	Clay
	0	3	5	14	41	29	8

SNC-LAVALIN 1164 Clyde Court Kingston, Ontario K7P 2E4	**GRAIN SIZE DISTRIBUTION**	Client: Ainley
		Project: 20-1690-01
	SAND	20553-1 Ferguson Lake Road
	With Silt, Trace Clay,Trace Gravel	Date: June 5,2020 — **Moisture Content is 11.2%**

Appendix III – Typical Fill Section – Grading



TYPICAL FILL SECTION - GRADING