

Borrow Source *BS899* **Geotechnical Data Report**

Mackenzie Valley Highway Project **Sahtú Settlement Area, Northwest Territories**



PRESENTED TO
Government of the Northwest Territories
K'alo-Stantec Limited

SEPTEMBER 11, 2025
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FILE: 704-ENG.EARC03299-03

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
ASTM	American Society for Testing and Materials
GNWT-INF	Government of the Northwest Territories, Department of Infrastructure
GSC	Geological Survey of Canada
K'alo-Stantec	K'alo-Stantec Limited
KM	Kilometre Marker
MVFL	Mackenzie Valley Fibre Link
MVH	Mackenzie Valley Highway
MVWR	Mackenzie Valley Winter Road
Northridge	Northridge Contracting Ltd.
NT	Northwest Territories
Ollerhead	Ollerhead & Associates Ltd.
Program	Borrow Source <i>BS899</i> Geotechnical Investigation Program
Project	Mackenzie Valley Highway Project
Tetra Tech	Tetra Tech Canada Inc.
TMS	Tulita Monitoring Service Ltd.
Willowlake	Willowlake Environmental Ltd.

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1.0 INTRODUCTION

The Government of the Northwest Territories, Department of Infrastructure (GNWT-INF) is advancing environmental permitting and engineering for the Mackenzie Valley Highway (MVH or the Project) from Wrigley to Tulita and Norman Wells, Northwest Territories (NT). The MVH is a proposed two-lane, all-season gravel highway approximately 321 km in length that is planned to replace the seasonal Mackenzie Valley Winter Road (MVWR). As part of the Project, the GNWT-INF is looking to identify and evaluate potential granular borrow sources to support construction of the MVH in the Sahtú Settlement Area between MVWR Kilometre Marker (KM) 850 and Tulit'a (MVWR KM 940). In 2024, four potential granular borrow sources (the Borrow Sources) along this section of the MVH were selected for further investigation: 9.002 (MVWR KM 850), BS895 (MVWR KM 895), BS899 (MVWR KM 899), and BS900 (MVWR KM 900).

The team of Tetra Tech Canada Inc. (Tetra Tech) and K'alo-Stantec Limited (K'alo-Stantec) were retained under Standing Offer Agreement Contract SC-INF01-7455 to conduct a geotechnical investigation program (the Program) for the Borrow Sources in Winter 2025. The objective of the Program was to characterize the subsurface materials and extents at each Borrow Source to support future design and construction of the MVH. The Borrow Sources selected for this Program included one primary granular material source (9.002) identified in Table 5.4 of the 2023 *Mackenzie Valley Highway Project Developer's Assessment Report* (GNWT 2023) as well as three new potential granular borrow sources (BS895, BS899, BS900) identified by Tetra Tech and K'alo-Stantec within the "Tulita Gap" (Tetra Tech 2024).

This report presents the results of the data collected from the geotechnical investigation conducted at Borrow Source BS899, including geotechnical testpit logs, geotechnical laboratory test results, field photographs, and site figures. It also provides an engineering assessment of the borrow material quality and availability for use in the MVH construction.

1.1 Borrow Source Description

Borrow Source BS899 is located approximately 300 m east-northeast of the proposed MVH near KM 899 of the MVWR, as shown on Figure 1 (see Figures section). The potential granular borrow source was identified by K'alo-Stantec during a helicopter reconnaissance in September 2024. Then in November 2024, Tetra Tech completed terrain mapping of the Borrow Source BS899 area to delineate and characterize the potential granular borrow source (Tetra Tech 2024).

The borrow source was mapped as containing surficial materials consisting of *Till*, *blanket* (*Tb*) and *Eolian, undulating* (*Eu*) deposits underlain by a *Bedrock, ridge* [*Rr*]. The Till (*Tb*) material is a morainal deposit and is anticipated to comprise very poorly sorted silt, sand, and clay containing clasts (e.g., pebbles, cobbles, and boulders). The Eolian (*Eu*) deposit, interpreted as a deglacial wind-blown sediment, is anticipated to consist of fine-to medium-grained sand with trace silt. The underlying Bedrock [*Rr*] is assumed to be sedimentary bedrock such as sandstone, siltstone, or mudstone.

Borrow Source BS899 is situated on Lot 1001 which is privately-owned (Sahtú) land and is not anticipated to be a permanent granular borrow source. Nearby developments include the MVWR, the Mackenzie Valley Fibre Link (MVFL), and the Enbridge Line 21 Pipeline. The MVWR and MVFL are located approximately 300 m west of the potential granular borrow source. Enbridge's Line 21 Pipeline is located 1 km to 2 km east of the potential granular borrow source.

1.2 Relevant Background Information

Several borrow source studies have previously been conducted for the Project and were referenced during the Program, as listed in Table 1-1. Other relevant background information provided to Tetra Tech included spatial data and aerial imagery for the Program's Borrow Sources.

Table 1-1: Relevant Background Information for Borrow Source BS899

Document Title	Date Issued	Reference	Key Information
<i>Mackenzie Valley Highway – Desktop Review of Prospect Borrow Sources</i>	September 11, 2020	K'alo-Stantec (2020a)	Desktop assessment and findings identifying MVH primary granular borrow sources.
<i>Mackenzie Valley Highway – Assessment of Prospective Borrow Sources – Geotechnical Engineering Recommendations</i>	December 11, 2020	K'alo-Stantec (2020b)	Geotechnical recommendations for granular borrow source investigation and characterization on the Project.
<i>Mackenzie Valley Highway Extension Project – Prospective Borrow Sources Assessment</i>	February 2021	K'alo-Stantec (2021a)	- Desktop evaluation of borrow sources supplemented by a field reconnaissance. - Identifies primary sources with substantial volume of high-quality granular material.
<i>Summary of Borrow Source / Quarry Evaluations Leading to Selection of 15 Primary Sources</i>	May 5, 2021	K'alo-Stantec (2021b)	Summarizes previous evaluations of MVH granular borrow sources and outlines technical, environmental, and land use considerations.
<i>Mackenzie Valley Highway Tulita Gap Borrow Sources Assessment</i>	November 14, 2024	Tetra Tech (2024)	Identifies Borrow Source BS899 as a potential borrow source and its associated surficial materials and terrain features.

1.3 Program Subcontractors

Support for the Program, including surveying, site access clearing, geotechnical testpitting, and environmental monitoring, was provided by the following NT-based subcontractors:

- Surveying:
 - Ollerhead & Associates Ltd. (Ollerhead) of Yellowknife, NT.
- Site Access Clearing:
 - Willowlake Environmental Ltd. (Willowlake) of Tulit'a, NT.
- Geotechnical Testpitting:
 - Northridge Contracting Ltd. (Northridge) of Norman Wells, NT.
- Environmental Monitoring:
 - Tulita Monitoring Service Ltd. (TMS) of Tulit'a, NT.

2.0 GEOTECHNICAL INVESTIGATION

The geotechnical investigation of Borrow Source *BS899* was conducted from March 17 to 26, 2025 and included three main activities: surveying, site access clearing, and geotechnical testpitting. Environmental monitoring was conducted throughout the Program to ensure all activities were environmental and wildlife compliant.

Surveying for Borrow Source *BS899* was performed by Ollerhead on March 12, 2025. Surveying consisted of layout of the testpit locations and their associated outline alignments for site access. Site access clearing, including vegetation mulching and snow clearing, was conducted on March 21 and 22, 2025 to facilitate access for the Program's geotechnical testpitting. The testpit locations and their associated outlines were mulched and hand cleared by Willowlake, under the supervision of Teri Brito, P.Eng. (BC) of Tetra Tech and an environmental monitor from TMS.

Geotechnical testpitting for Borrow Source *BS899* commenced and was completed on March 26, 2025. A total of five testpits were excavated as part of the Program by Northridge. Geotechnical logging, photographing, and sampling was performed by April Graves, E.I.T., of Tetra Tech.

The location of Borrow Source *BS899* and its associated testpits are shown on Figure 1 (see Figures section). Geotechnical testpit logs for Borrow Source *BS899* are presented in Appendix A.

2.1 Testpit Locations and Methodology

Five testpits were excavated as part of the geotechnical investigation for Borrow Source *BS899*, as shown on Figure 1 (see Figures section). Testpit coordinates are summarized in Table 2-1 and presented in Table A (see Tables section).

Table 2-1: Testpit Information for Borrow Source *BS899*

Testpit Number	Nearest MVWR Kilometre Marker (KM)	Testpit Coordinates (m, UTM Zone 10: NAD83)		Ground Elevation (m)	Completion Depth (m)
		Northing	Easting		
TP25-BS899-01	898.8	7,184,529.2	406,040.1	149.1	6.0
TP25-BS899-02	898.8	7,184,452.0	406,052.0	150.9	6.0
TP25-BS899-03	898.7	7,184,343.3	406,064.5	150.9	6.0
TP25-BS899-04	898.6	7,184,231.0	406,051.0	149.1	3.2
TP25-BS899-05	898.6	7,184,060.5	406,037.4	144.7	3.2

Ollerhead surveyed and staked the testpit locations in the field prior to geotechnical testpitting. Following the completion of geotechnical testpitting, the as-excavated testpit coordinates and elevations were surveyed by Ollerhead, as shown on the geotechnical testpit logs in Appendix A.

The geotechnical testpitting was completed using a CAT 329E hydraulic excavator, owned and operated by Northridge. Each testpit was excavated to the maximum depth achievable by the excavator or until effective refusal was encountered. Following completion, the testpits were backfilled with the excavated material in the reverse sequence it was removed (i.e., organics on top). The material was nominally compacted and mounded over the testpit excavation to match the original ground surface.

2.2 Geotechnical Logging and Sampling

All recovered soils were logged and photographed at their respective testpit locations, allowing for accurate classification and sampling of the subsurface materials encountered.

Soils were classified according to the *Modified Unified Soil Classification* system. The frozen state of the soils was described according to the National Research Council Canada's *Ground Ice Classification* system. Soil logging consisted of identifying the following parameters:

- Soil Composition
- Particle Size
- Angularity/Shape
- Moisture
- Plasticity
- Colour
- Frozen/Unfrozen State
- Ground Ice Description

Representative soil samples (i.e., grab samples) were taken at approximately 1 m intervals or where a change in stratigraphy was noted as the testpit was excavated. The disturbed samples were placed in plastic bags, double-bagged for moisture preservation, and transported to Tetra Tech's materials laboratory in Yellowknife for geotechnical laboratory testing.

2.3 Geotechnical Laboratory Testing

Geotechnical laboratory testing on recovered soil samples from Borrow Source *BS899* was completed at Tetra Tech's materials laboratory in Yellowknife, NT. The geotechnical laboratory testing program included:

- Moisture Contents (per ASTM D2216);
- Particle Size Analyses (Sieves, per ASTM D6913); and
- Moisture-Density Relationship (Standard Proctor, per ASTM D698).

Geotechnical laboratory testing results for Borrow Source *BS899* are summarized in Table B (see Tables section) and are shown on the geotechnical testpit logs in Appendix A. Detailed results for all geotechnical laboratory testing for Borrow Source *BS899* are provided in Appendix B.

2.3.1 Moisture Contents

Moisture contents were determined, in accordance with ASTM D2216, on a total of 25 soil samples from Borrow Source *BS899*. Moisture content values ranged from 0.3% to 15.2% and are presented in Table B (see Tables section) and on the geotechnical testpit logs in Appendix A.

2.3.2 Particle Size Analyses

Particle size analyses (i.e., sieves) were performed on select soil samples from Borrow Source *BS899* to characterize the borrow material. A total of 12 Sieves were completed, in accordance with ASTM D6913, as summarized in Table 2-2.

Table 2-2: Particle Size Analyses Test Results for Borrow Source BS899

Testpit Number	Sample Depth (m)		Moisture Content (%)	Particle Size Distribution (%)		
	From	To		Gravel	Sand	Silt and Clay
TP25-BS899-01	0.9	1.0	4.1	0	93	7
	2.7	3.0	3.5	0	97	3
TP25-BS899-02	0.9	1.0	4.4	0	91	9
	1.8	2.0	3.6	0	98	2
	4.5	5.0	3.0	0	97	3
TP25-BS899-03	0.9	1.0	4.6	0	94	6
	3.0	4.0	0.3	0	97	3
	4.5	5.0	2.6	0	98	2
TP25-BS899-04	0.9	1.0	6.3	0	89	11
	1.8	2.0	9.0	0	96	4
TP25-BS899-05	0.9	1.0	5.9	0	92	8
	2.7	3.0	6.4	0	94	6

2.3.3 Moisture-Density Relationship

Moisture-Density Relationship (Standard Proctor) testing, in accordance with ASTM D698, was performed on one representative sample from Borrow Source BS899, as summarized in Table 2-3.

Table 2-3: Moisture-Density Relationship Test Result for Borrow Source BS899

Testpit Number	Sample Depth (m)		Moisture Content (%)	Maximum Dry Density (kg/m ³)	Optimum Moisture Content (%)
	From	To			
TP25-BS899-03	3.0	4.0	0.3	1690	15.5

3.0 SUBSURFACE CONDITIONS

The subsurface conditions at Borrow Source BS899 are summarized herein based on the geotechnical findings from the Program. Testpit locations are shown on a site plan of the borrow source on Figure 1 (see Figures section). Geotechnical data is presented on the geotechnical testpit logs provided in Appendix A.

3.1 Stratigraphy

The subsurface conditions identified for Borrow Source BS899 consisted of two primary layers:

- Organics
- Sand

At ground surface, Borrow Source BS899 was overlain with a 100 mm-thick layer of Organics. The surface organics were frozen at the time of the investigation and brown in colour.

Below the Organics, a Sand layer was encountered in all testpits at Borrow Source *BS899* and was the predominant stratigraphic layer. This layer extended from 0.1 m below ground surface to the depth of excavation in each testpit (i.e., 3.2 m to 6.0 m below ground surface). The Sand was fine-grained and contained trace silt, trace to some gravel, and occasional cobbles. Gravels and cobbles were rounded to subrounded in shape and were typically encountered above 1 m below ground surface. The layer varied in colour from brown to dark brown. When unfrozen, moisture contents of the material ranged from 0.3% to 15.2% and were described as *Dry* to *Damp*.

Bedrock was not encountered in any of the testpits completed for Borrow Source *BS899*. Two of the testpits (*TP25-BS899-04* and *TP25-BS899-05*) were terminated at 3.2 m below ground surface due to excavator refusal on suspected permafrost soils.

3.2 Groundwater

Groundwater was not encountered in any of the testpits completed for Borrow Source *BS899*.

3.3 Active Layer

The depth of the active layer (i.e., seasonal thaw depth) is anticipated to vary locally across Borrow Source *BS899* depending on the surficial materials, depth of bedrock, and depth of groundwater as well as the thickness of vegetation and snow cover. During the Program, the depth of the active layer was not accurately determined due to the dryness of the Sand and the limited frozen/unfrozen indicators.

The Geological Survey of Canada (GSC) maintains a series of active layer monitoring sites within the Mackenzie Valley, several of which have been in operation since the early 1990s (K'alo-Stantec 2023). GSC Site ID *OFF-01* is located near MVWR KM 881 and is considered the closest and most relevant active layer monitoring site to Borrow Source *BS899*. The site is located within a *Till, plain (Tp)* deposit and has similar vegetation cover to Borrow Source *BS899*. The active layer thaw depth has been measured to range up to 3.1 m below ground surface and is considered similar to the active layer depth anticipated at Borrow Source *BS899*.

3.4 Permafrost

No permafrost soils were identified in the testpits completed for Borrow Source *BS899*; however, Testpits *TP25-BS899-04* and *TP25-BS899-05* encountered excavator refusal at 3.2 m below ground surface on suspected permafrost soils. If permafrost soils are present in Borrow Source *BS899*, they are expected to be deeper than 3.2 m below ground surface.

4.0 BORROW SOURCE ASSESSMENT

Findings from the geotechnical investigation of Borrow Source *BS899* were used to characterize and assess the subsurface materials and extents of the potential granular borrow source for future use on the MVH. Geotechnical data is presented on the geotechnical testpit logs in Appendix A.

All of the testpits completed for Borrow Source *BS899* were confined to the south-southwest portion of the potential granular borrow source, as shown on Figure 1 (see Figures section), due to regulatory permitting approvals being limited to within the MVH right-of-way during Winter 2025. Further geotechnical investigation is required to adequately characterize the north-northeast portion of the potential granular borrow source and delineate its full extents.

4.1 Estimated Granular Material Quantities

The approximate area of Borrow Source BS899 that was sufficiently investigated during Winter 2025 is 93,026 m², as shown on Figure 1 (see Figures section). Combining this information with results from the geotechnical investigation, estimated material volumes were calculated based on the surface area of the potential granular borrow source that was previously mapped (Tetra Tech 2024).

Testpit findings are assumed to be representative of the subsurface conditions within this south-southwest portion of Borrow Source BS899; however, granular materials may extend beyond or be smaller than the potential granular source boundary identified. The estimated granular material quantities for each subsurface material type are summarized in Table 4-1.

Table 4-1: Estimated Granular Material Quantities for Borrow Source BS899

Granular Material Type	Surface Area ¹ (m ²)	Average Granular Material Thickness ² (m)	Estimated Granular Material Quantity (m ³)
Sand (Fine-Grained)	93,026	4.9	455,827
TOTAL			455,827

¹ Surface Area based on south-southwest portion of Borrow Source BS899 presented on Figure 1.

² Sand (Fine-Grained) layer extended to the depth of investigation in each testpit; however, the thickness of the deposit may be greater.

4.2 Granular Material Suitability

The primary granular material encountered in Borrow Source BS899 was fine-grained, poorly-graded Sand with trace silt and trace to some gravel. Tetra Tech reviewed and assessed the granular material encountered in Borrow Source BS899 against the crushed aggregate types specified for NT highways in the GNWT-INF's *Standard Specifications for Highway Construction* (GNWT 2021). Below is an assessment of the granular material suitability for each crushed aggregate type and gradation outlined in *Division 5 (Granular Materials), Section 1 (Crushed Aggregate Production)* of the standard specification:

- Embankment Rock Fill (5.1.3.4b, i):
 - Not Suitable (All Classes, including Class 150 mm, Class 200 mm, and Class 300 mm)
- Granular Base Course (5.1.3.4b, ii):
 - Not Suitable (All Classes, including Class 12.5 mm, Class 16.0 mm, Class 19.0 mm, and Class 20.0 mm)
- Granular Subbase (5.1.3.4b, iii):
 - Class 40 mm: Not Suitable
 - Class 50 mm: Not Suitable
 - Class 76 mm: Suitable (screening required)
 - Class 80 mm: Not Suitable
 - Class 100 mm: Suitable (screening required)

For all suitable granular materials, oversize materials (i.e., cobbles and boulders) should be screened out or crushed prior to use. All organics and deleterious materials (e.g., vegetation, ice, snow) should be removed and stockpiled prior to the removal of granular materials.

5.0 CLOSURE

We trust this data report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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TABLES

Table A	Geotechnical Investigation Information Summary
Table B	Geotechnical Laboratory Test Results Summary

TABLE A: GEOTECHNICAL INVESTIGATION INFORMATION SUMMARY

Project: Mackenzie Valley Highway, Borrow Source BS899
 Project Number: 704-ENG.EARC03299-03
 Client: Government of the Northwest Territories (K'alo-Stantec)
 Location: Sahtú Settlement Area, Northwest Territories



Coordinate System: UTM with NAD83, Zone 10N
 Completion Dates: March 26, 2025
 Logged By: April Graves
 Total Testpits: 5

Testpit Number	Mackenzie Valley Highway Location (MVWR KM)	Coordinates (m, NAD83 [CSRS] Epoch 2010)		Ground Elevation (m)	Completion Depth (m)	Completion Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Completion Date
		Northing	Easting						
TP25-BS899-01	898.8	7,184,529.2	406,040.1	149.1	6.0	143.1	-	-	March 26, 2025
TP25-BS899-02	898.8	7,184,452.0	406,052.0	150.9	6.0	144.9	-	-	March 26, 2025
TP25-BS899-03	898.7	7,184,343.3	406,064.5	150.9	6.0	144.9	-	-	March 26, 2025
TP25-BS899-04	898.6	7,184,231.0	406,051.0	149.1	3.2	145.9	-	-	March 26, 2025
TP25-BS899-05	898.6	7,184,060.6	406,037.4	144.7	3.2	141.5	-	-	March 26, 2025

TABLE B: GEOTECHNICAL LABORATORY TEST RESULTS SUMMARY

Project: Mackenzie Valley Highway, Borrow Source BS899
Project Number: 704-ENG.EARC03299-03
Client: Government of the Northwest Territories (K'alo-Stantec)
Location: Sahtú Settlement Area, Northwest Territories

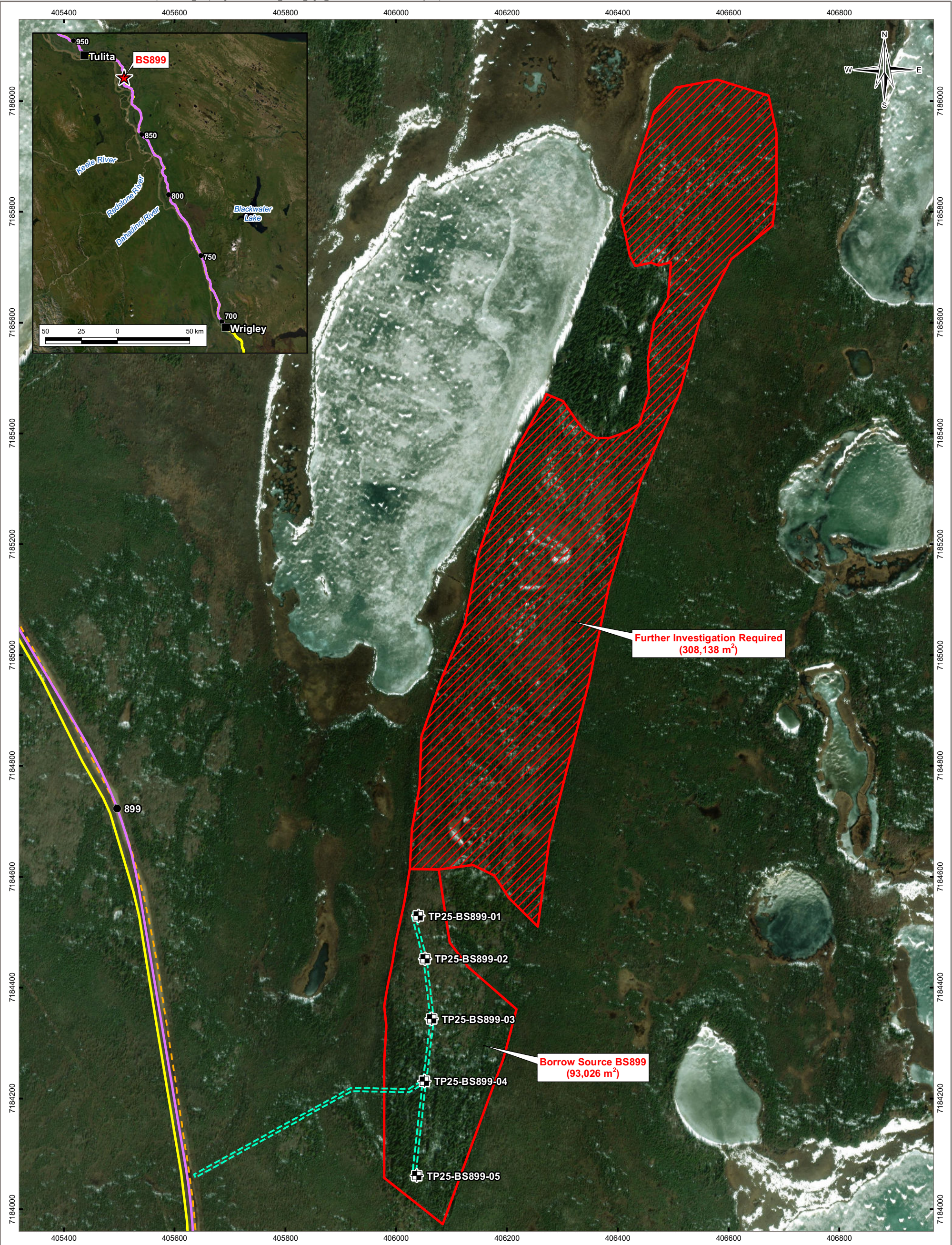


Sampled By: April Graves
Sample Date: March 26, 2025
Tested By: Yellowknife Materials Laboratory
Total Testpits: 5

Testpit Number	Sample Number	Sample Type	Sample Depth (m)		Moisture Content (%)	Particle Size Distribution (%)				Modified Unified Soil Classification	C _u	C _c	Maximum Dry Density (kg/m ³)	Optimum Moisture Content (%)
			From	To		Gravel	Sand	Silt	Clay					
TP25-BS899-01	G1	Grab	0.9	1.0	4.1	0	93	7		SP	2.5	1.3	-	-
	G2	Grab	1.7	2.0	3.7	-	-	-		-	-	-	-	-
	G3	Grab	2.7	3.0	3.5	0	97	3		SP	2.2	1.2	-	-
	G4	Grab	3.5	4.0	2.9	-	-	-		-	-	-	-	-
	G5	Grab	4.5	5.0	3.4	-	-	-		-	-	-	-	-
	G6	Grab	5.5	6.0	2.0	-	-	-		-	-	-	-	-
TP25-BS899-02	G1	Grab	0.9	1.0	4.4	0	91	9		SP	2.8	1.3	-	-
	G2	Grab	1.8	2.0	3.6	0	98	2		SP	2.1	1.2	-	-
	G3	Grab	2.7	3.0	3.5	-	-	-		-	-	-	-	-
	G4	Grab	3.5	4.0	3.7	-	-	-		-	-	-	-	-
	G5	Grab	4.5	5.0	3.0	0	97	3		SP	2.2	1.2	-	-
	G6	Grab	5.5	6.0	3.1	-	-	-		-	-	-	-	-
TP25-BS899-03	G1	Grab	0.9	1.0	4.6	0	94	6		SP	2.5	1.2	-	-
	G2	Grab	1.8	2.0	3.1	-	-	-		-	-	-	-	-
	G3	Grab	2.7	3.0	3.3	-	-	-		-	-	-	-	-
	G4	Grab	3.0	4.0	0.3	0	97	3		SP	2.3	1.2	1690	15.5
	G5	Grab	3.5	4.0	3.0	-	-	-		-	-	-	-	-
	G5	Grab	4.5	5.0	2.6	0	98	2		SP	2.2	1.2	-	-
	G5	Grab	5.5	6.0	4.0	-	-	-		-	-	-	-	-
TP25-BS899-04	G1	Grab	0.9	1.0	6.3	0	89	11		SM	-	-	-	-
	G2	Grab	1.8	2.0	9.0	0	96	4		SP	2.4	1.1	-	-
	G3	Grab	2.7	3.0	15.2	-	-	-		-	-	-	-	-
TP25-BS899-05	G1	Grab	0.9	1.0	5.9	0	92	8		SP	2.9	1.2	-	-
	G2	Grab	1.8	2.0	11.8	-	-	-		-	-	-	-	-
	G3	Grab	2.7	3.0	6.4	0	94	6		SP	2.6	1.2	-	-

FIGURES

Figure 1 Borrow Source *BS899* Site Plan



LEGEND

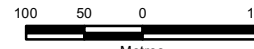
- Testpit (Tetra Tech, 2025)
- Proposed Mackenzie Valley Highway Alignment Kilometre Marker
- Potential Borrow Source
- Further Investigation Required
- Access Trail
- Proposed Mackenzie Valley Highway Alignment (2022 IFEA)
- Mackenzie Valley Winter Road
- Mackenzie Valley Fibre Link

NOTES

Base data source:
Imagery provided by ESRI; Maxar (2024)

MACKENZIE VALLEY HIGHWAY
WINTER 2025 GEOTECHNICAL

Borrow Source BS899
Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	
Scale: 1:6,500		
		

FILE NO.
EARC03299-03_BS899_Fig01_TPs.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-EDM	SL	MRB	TB	1

DATE
September 11, 2025

PROJECT NO.
ENG.EARC03299-03



Figure 1

PHOTOGRAPHS

Photo 1	Site access clearing completed for Testpit <i>TP25-BS899-02</i>
Photo 2	Site access clearing completed for Testpit <i>TP25-BS899-03</i>
Photo 3	Excavating for Testpit <i>TP25-BS899-03</i>
Photo 4	Completed and backfilled Testpit <i>TP25-BS899-03</i>
Photo 5	Fine-Grained Sand recovered from Testpit <i>TP25-BS899-01</i>
Photo 6	Fine-Grained Sand observed in Testpit <i>TP25-BS899-01</i>
Photo 7	Fine-Grained Sand recovered from Testpit <i>TP25-BS899-02</i>
Photo 8	Fine-Grained Sand observed in Testpit <i>TP25-BS899-02</i>
Photo 9	Fine-Grained Sand recovered from Testpit <i>TP25-BS899-03</i>
Photo 10	Fine-Grained Sand observed in Testpit <i>TP25-BS899-03</i>
Photo 11	Fine-Grained Sand recovered from Testpit <i>TP25-BS899-04</i>
Photo 12	Fine-Grained Sand observed in Testpit <i>TP25-BS899-04</i>
Photo 13	Fine-Grained Sand recovered from Testpit <i>TP25-BS899-05</i>
Photo 14	Fine-Grained Sand observed in Testpit <i>TP25-BS899-05</i>



Photo 1: Borrow Source BS899, Site Access Clearing
Site access clearing completed for Testpit *TP25-BS899-02*
(Photo Date: March 21, 2025)



Photo 2: Borrow Source BS899, Site Access Clearing
Site access clearing completed for Testpit *TP25-BS899-03*
(Photo Date: March 21, 2025)



Photo 3: Borrow Source BS899, Testpit Excavating
Excavating for Testpit *TP25-BS899-03*
(Photo Date: March 26, 2025)



Photo 4: Borrow Source BS899, Testpit Excavating
Completed and backfilled Testpit *TP25-BS899-03*
(Photo Date: March 26, 2025)



Photo 5: Borrow Source BS899, Testpit *TP25-BS899-01*
Fine-Grained Sand recovered from Testpit *TP25-BS899-01*
(Photo Date: March 26, 2025)



Photo 6: Borrow Source BS899, Testpit *TP25-BS899-01*
Fine-Grained Sand observed in Testpit *TP25-BS899-01*
(Photo Date: March 26, 2025)



Photo 7: Borrow Source BS899, Testpit *TP25-BS899-02*
Fine-Grained Sand recovered from Testpit *TP25-BS899-02*
(Photo Date: March 26, 2025)



Photo 8: Borrow Source BS899, Testpit *TP25-BS899-02*
Fine-Grained Sand observed in Testpit *TP25-BS899-02*
(Photo Date: March 26, 2025)



Photo 9: Borrow Source BS899, Testpit *TP25-BS899-03*
Fine-Grained Sand recovered from Testpit *TP25-BS899-03*
(Photo Date: March 26, 2025)



Photo 10: Borrow Source BS899, Testpit *TP25-BS899-03*
Fine-Grained Sand observed in Testpit *TP25-BS899-03*
(Photo Date: March 26, 2025)



Photo 11: Borrow Source BS899, Testpit *TP25-BS899-04*
Fine-Grained Sand recovered from Testpit *TP25-BS899-04*
(Photo Date: March 26, 2025)



Photo 12: Borrow Source BS899, Testpit *TP25-BS899-04*
Fine-Grained Sand observed in Testpit *TP25-BS899-04*
(Photo Date: March 26, 2025)



Photo 13: Borrow Source BS899, Testpit *TP25-BS899-05*
Fine-Grained Sand recovered from Testpit *TP25-BS899-05*
(Photo Date: March 26, 2025)

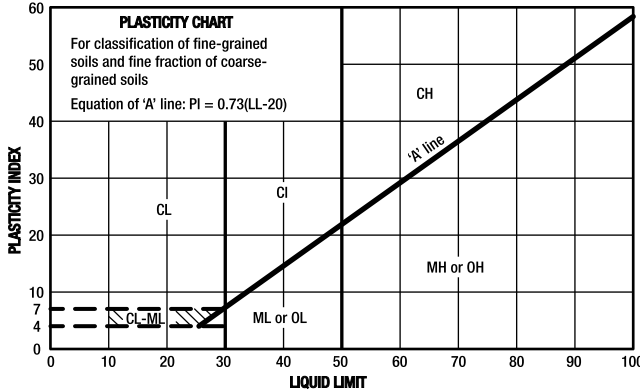


Photo 14: Borrow Source BS899, Testpit *TP25-BS899-05*
Fine-Grained Sand observed in Testpit *TP25-BS899-05*
(Photo Date: March 26, 2025)

APPENDIX A

GEOTECHNICAL TESTPIT LOGS

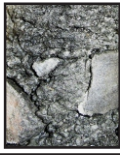
MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA					
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_u = D_{60} / D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3				
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW				
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols			
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7				
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve	$C_u = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3			
			SP	Poorly graded sands and gravelly sands, little or no fines			Not meeting both criteria for SW			
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures			Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols		
			SC	Clayey sands, sand-clay mixtures			Atterberg limits plot above "A" line or plasticity index greater than 7			
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS	Liquid limit	<50	ML						
			>50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts				
	CLAYS	Above "A" line on plasticity chart negligible organic content	<30	CL		Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays				
			30-50	CI		Inorganic clays of medium plasticity, silty clays				
			>50	CH		Inorganic clays of high plasticity, fat clays				
	ORGANIC SILTS AND CLAYS	Liquid limit	<50	OL		Organic silts and organic silty clays of low plasticity				
			>50	OH		Organic clays of medium to high plasticity				
	HIGHLY ORGANIC SOILS			PT		Peat and other highly organic soils	* Based on the material passing the 75 mm sieve † ASTM Designation D 2487, for identification procedure see D 2488 USC as modified by PFRA			
	SOIL COMPONENTS					OVERSIZE MATERIAL				
	FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded				
GRAVEL coarse fine	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR	COBBLES 75 mm to 300 mm BOULDERS > 300 mm					
	75 mm 19 mm	19 mm 4.75 mm	>35 % 21 to 35 %	"and" "y-adjective"	Not rounded ROCK FRAGMENTS >75 mm ROCKS > 0.76 cubic metre in volume					
SAND coarse medium fine	4.75 mm 2.00 mm 425 µm	2.00 mm 425 µm 75 µm	11 to 20 % >0 to 10 %	"some" "trace"						
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior							

TETRA TECH

GROUND ICE DESCRIPTION

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
V	Vx	Individual ice crystals or inclusions		
	Vc	Ice coatings on particles		
	Vr	Random or irregularly oriented ice formations		
	Vs	Stratified or distinctly oriented ice formations		
	Vu	Ice formations uniformly distributed throughout frozen soil		

ICE NOT VISIBLE

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
N	Nf	Poorly-bonded or friable		
	Nbn	No excess ice, well-bonded		
	Nbe	Excess ice, well-bonded		

LEGEND:

Soil  Ice 

NOTES:

1. Dual symbols are used to indicate borderline or mixed ice classifications.
2. Visual estimates of ice contents indicated on borehole logs $\pm 5\%$
3. This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions (greater than 25 mm thick)		
	ICE	Ice without soil inclusions (greater than 25 mm thick)		

BOREHOLE KEYSHEET

Water Level Measurement



Measured in standpipe,
piezometer or well



Inferred

Sample Types



A-Casing



Core



Disturbed, Bag,
Grab



HQ Core



Jar



Jar and Bag



75 mm SPT



No Recovery



Split Spoon/SPT



Tube



CRREL Core

Backfill Materials



Asphalt



Bentonite



Cement/
Grout



Drill Cuttings



Grout



Gravel



Sand



Slough



Topsoil Backfill

Lithology - Graphical Legend¹



Asphalt



Bedrock



Cobbles/Boulders



Clay



Coal



Concrete



Fill



Gravel



Limestone



Mudstone



Organics



Peat



Sand



Sandstone



Shale



Silt



Siltstone



Conglomerate



Topsoil



Till

1. The graphical legend is an approximation and for visual representation only. Soil strata may comprise a combination of the basic symbols shown above. Particle sizes are not drawn to scale



TETRA TECH

Testpit No: TP25-BS899-01

Project: Mackenzie Valley Highway Geotechnical

Project No: ENG.EARC03299-03

Location: Borrow Source BS899

Ground Elev: 149.1 m

Sahtú Settlement Area, Northwest Territories

UTM: 406040.1 E; 7184529.2 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution				Moisture Content (%)	Moisture Content (%)			Elevation (m)
						Gravel (%)	Sand (%)	Silt & Clay (%)						
								Silt (%)	Clay (%)					
0		ORGANICS - brown, (100 mm thick) SAND - trace silt, fine grained sand, poorly graded, brown	Frozen								Plastic Limit	Moisture Content	Liquid Limit	
											20	40	60	80
1	Excavation	- dark brown		G1	0	93	7		4.1					
2				G2					3.7					
3		- damp	Unfrozen	G3	0	97	3		3.5					
4		- trace gravel		G4					2.9					
5		- no visible gravel		G5					3.4					
6		- dry		G6					2					
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing												
7														
7.5														



TETRA TECH

Contractor: Northridge Contracting Ltd.

Completion of Drilling: 6 m

Equipment Type: CAT 329E Hydraulic Excavator

Start Date: 2025 March 26

Logged By: AG

Completion Date: 2025 March 26

Reviewed By: TB

Page 1 of 1

Testpit No: TP25-BS899-02

Project: Mackenzie Valley Highway Geotechnical

Project No: ENG.EARC03299-03

Location: Borrow Source BS899

Ground Elev: 150.9 m

Sahtú Settlement Area, Northwest Territories

UTM: 406052 E; 7184452 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution				Moisture Content (%)	Moisture Content (%)			Elevation (m)	
						Gravel (%)	Sand (%)	Silt & Clay (%)							
								Silt (%)	Clay (%)						
0		ORGANICS - brown, (100 mm thick) SAND - trace gravel, trace silt, fine grained sand, brown	Frozen								Plastic Limit	Moisture Content	Liquid Limit		
											20	40	60	80	
1	Excavation	- no visible gravel			G1	0	91	9		4.4					150
2		- dark brown			G2	0	98	2		3.6					149
3					G3					3.5					148
4		- damp	Unfrozen		G4					3.7					147
5					G5	0	97	3		3					146
6					G6					3.1					145
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing													
7															144
7.5															



TETRA TECH

Contractor: Northridge Contracting Ltd.

Completion of Drilling: 6 m

Equipment Type: CAT 329E Hydraulic Excavator

Start Date: 2025 March 26

Logged By: AG

Completion Date: 2025 March 26

Reviewed By: TB

Page 1 of 1

Testpit No: TP25-BS899-03

Project: Mackenzie Valley Highway Geotechnical

Project No: ENG.EARC03299-03

Location: Borrow Source BS899

Ground Elev: 150.9 m

Sahtú Settlement Area, Northwest Territories

UTM: 406064.5 E; 7184343.3 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution				Moisture Content (%)	Moisture Content (%)			Elevation (m)
						Gravel (%)	Sand (%)	Silt & Clay (%)			Plastic Limit	Moisture Content	Liquid Limit	
								Silt (%)	Clay (%)					
0		ORGANICS - brown, (100 mm thick) SAND - trace gravel, trace silt, fine grained sand, rounded to subrounded gravel, brown	Frozen											
1	Excavation	- no visible gravel			G1	0	94	6		4.6				150
2					G2					3.1				149
3		- dark brown - (Proctor Testing - Max. Dry Density 1690 kg/m³, Optimum Moisture Content 15.5%) - dry - damp	Unfrozen		G3					3.3				148
4					P4 G5	0	97	3		0.3 3				147
5					G6	0	98	2		2.6				146
6					G7					4				145
6			END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing											
7													144	
7.5														

Testpit No: TP25-BS899-04

Project: Mackenzie Valley Highway Geotechnical

Project No: ENG.EARC03299-03

Location: Borrow Source BS899

Ground Elev: 149.1 m

Sahtú Settlement Area, Northwest Territories

UTM: 406051 E; 7184231 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution				Moisture Content (%)	Plastic Limit20Moisture Content4060Liquid Limit80	Elevation (m)
						Gravel (%)	Sand (%)	Silt & Clay (%)				
								Silt (%)	Clay (%)			
0												
1	Excavation	ORGANICS - brown, (100 mm thick) SAND - some silt, trace gravel, fine grained sand, rounded to subrounded gravel, brown	Frozen									149
		- no visible gravel, reddish brown		G1	0	89	11	6.3		148		
		- trace silt										
2		- dark brown		G2	0	96	4	9			147	
3				G3				15.2			146	
4		END OF TESTPIT (3.2 metres) Note: Stopped due to refusal on suspected permafrost soils										145
5												144
6												143
7												142
7.5												



TETRA TECH

Contractor: Northridge Contracting Ltd.

Completion of Drilling: 3.2 m

Equipment Type: CAT 329E Hydraulic Excavator

Start Date: 2025 March 26

Logged By: AG

Completion Date: 2025 March 26

Reviewed By: TB

Page 1 of 1

Testpit No: TP25-BS899-05

Project: Mackenzie Valley Highway Geotechnical

Project No: ENG.EARC03299-03

Location: Borrow Source BS899

Ground Elev: 144.7 m

Sahtú Settlement Area, Northwest Territories

UTM: 406037.4 E; 7184060.6 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution				Moisture Content (%)	Plastic Limit Moisture Content Liquid Limit 20 40 60 80	Elevation (m)	
						Gravel (%)	Sand (%)	Silt & Clay (%)					
								Silt (%)	Clay (%)				
0													
1	Excavation	ORGANICS - brown, (100 mm thick) SAND - trace silt, trace gravel, occasional cobbles, fine grained sand, rounded to subrounded gravel and cobbles, brown	Frozen										144
		- no visible gravel or cobbles, dark brown			G1	0	92	8	5.9				
2					G2				11.8			143	
3					G3	0	94	6	6.4			142	
4		END OF TESTPIT (3.2 metres) Note: Stopped due to refusal on suspected permafrost soils										141	
5												140	
6												139	
7												138	
7.5													



TETRA TECH

Contractor: Northridge Contracting Ltd.

Completion of Drilling: 3.2 m

Equipment Type: CAT 329E Hydraulic Excavator

Start Date: 2025 March 26

Logged By: AG

Completion Date: 2025 March 26

Reviewed By: TB

Page 1 of 1

APPENDIX B

GEOTECHNICAL LABORATORY TEST RESULTS

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project: Mackenzie Valley Highway Sathu Borrow Sources Borrow Source: BS899
Project Number: 704-ENG.EARC003299-03.007 Date Tested: June 14, 2025
Client: K'alo Stantec Limited Tested By: AH
Project Manager: Thomas Bradshaw Page: 1 of 2

T.P. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
TP25-BS899-01	0.9-1.0	4.1	SAND, trace silt, some organics, brown
TP25-BS899-01	1.7-2.0	3.7	SAND, trace silt, dark brown
TP25-BS899-01	2.7-3.0	3.5	SAND, trace silt, dark brown
TP25-BS899-01	3.5-4.0	2.9	SAND, trace silt, dark brown
TP25-BS899-01	4.5-5.0	3.4	SAND, trace silt, dark brown
TP25-BS899-01	5.5-6.0	2.0	SAND, trace silt, dark brown
TP25-BS899-02	0.9-1.0	4.4	SAND, trace silt, organics, brown
TP25-BS899-02	1.8-2.0	3.6	SAND, trace silt, dark brown
TP25-BS899-02	2.7-3.0	3.5	SAND, trace silt, dark brown
TP25-BS899-02	3.5-4.0	3.7	SAND, trace silt, dark brown
TP25-BS899-02	4.5-5.0	3.0	SAND, trace silt, dark brown
TP25-BS899-02	5.5-6.0	3.1	SAND, trace silt, dark brown
TP25-BS899-03	0.9-1.0	4.6	SAND, trace silt, brown
TP25-BS899-03	1.8-2.0	3.1	SAND, trace silt, brown
TP25-BS899-03	2.7-3.0	3.3	SAND, trace silt, dark brown
TP25-BS899-03	3.0-4.0	0.3	SAND, trace silt, dark brown
TP25-BS899-03	3.5-4.0	3.0	SAND, trace silt, dark brown
TP25-BS899-03	4.5-5.0	2.6	SAND, trace silt, dark brown
TP25-BS899-03	5.5-6.0	4.0	SAND, trace silt, dark brown

Reviewed By:  P.Eng.

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MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project: Mackenzie Valley Highway Sathu Borrow Sources Borrow Source: BS899

Project Number: 704-ENG.EARC003299-03.007 Date Tested: June 16-17, 2025

Client: K'alo Stantec Limited Tested By: AH

Project Manager: Thomas Bradshaw

Page: 2 of 2

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Reviewed By: P.Eng.

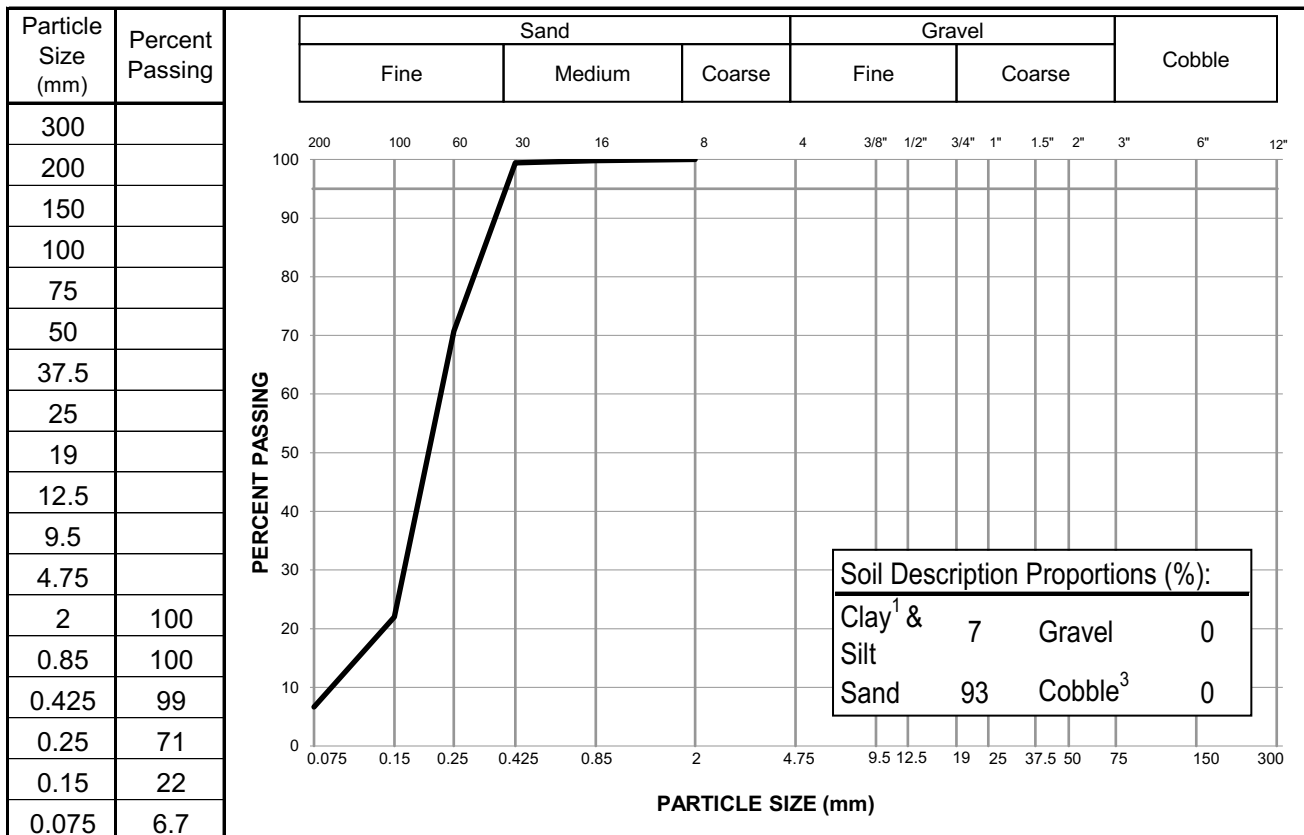
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project: MVH Sahtu Borrow Sources Sample No.: 1361-44
 Project No.: ENG.EARC03299-03.007 Material Type: In Situ
 Site: Sahtu Settlement area, NWT Sample Loc.: TP25-BS899-01
 Client: K'alo-Stantec Limited Sample Depth: 0.9-1.0 m
 Client Rep.: Dennis Kefalas Sampling Method: Grab
 Date Tested: June 14, 2025 By: AH Date sampled: March 26, 2025
 Soil Description²: SAND, trace silt, some organics, brown Sampled By: AG
 USC Classification: SP Cu: 2.5
 Moisture Content: 4.3% Cc: 1.3



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: Tong Y. Johnson P.Eng.

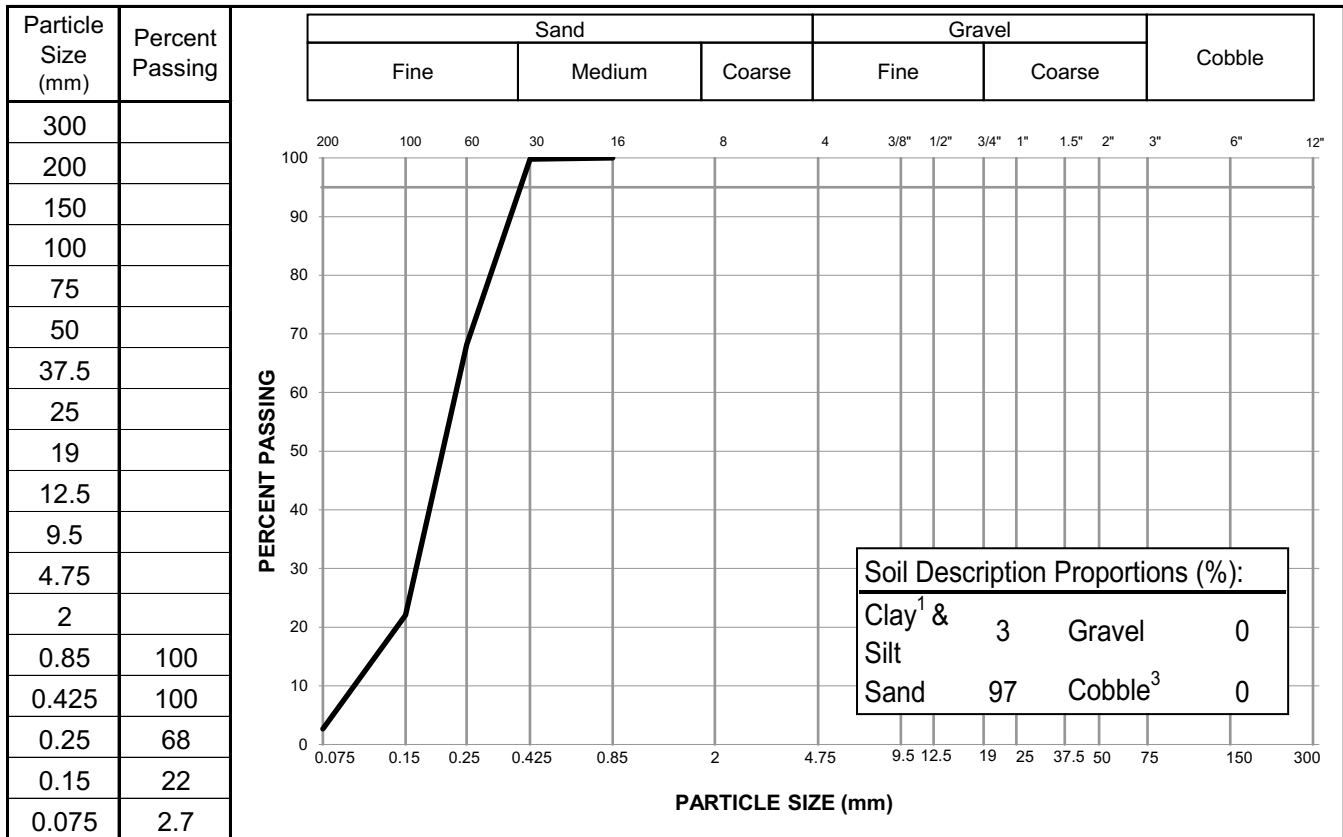
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-46
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-01
Client:	K'alo-Stantec Limited	Sample Depth:	2.7-3.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025	By:	AH
Date Tested:	June 15, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.2 Cc: 1.2
Moisture Content:	3.4%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By:  P.Eng.

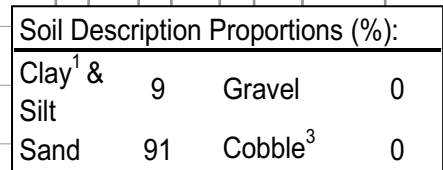
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ASTM D6913

Sample No.:	1361-50		
Material Type:	In Situ		
Sample Loc.:	TP25-BS899-02		
Sample Depth:	0.9-1.0 m		
Sampling Method:	Grab		
Date sampled:	March 26, 2025		
Sampled By:	AG		
USC Classification:	SP	Cu:	2.8

Cc: 1.3



³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

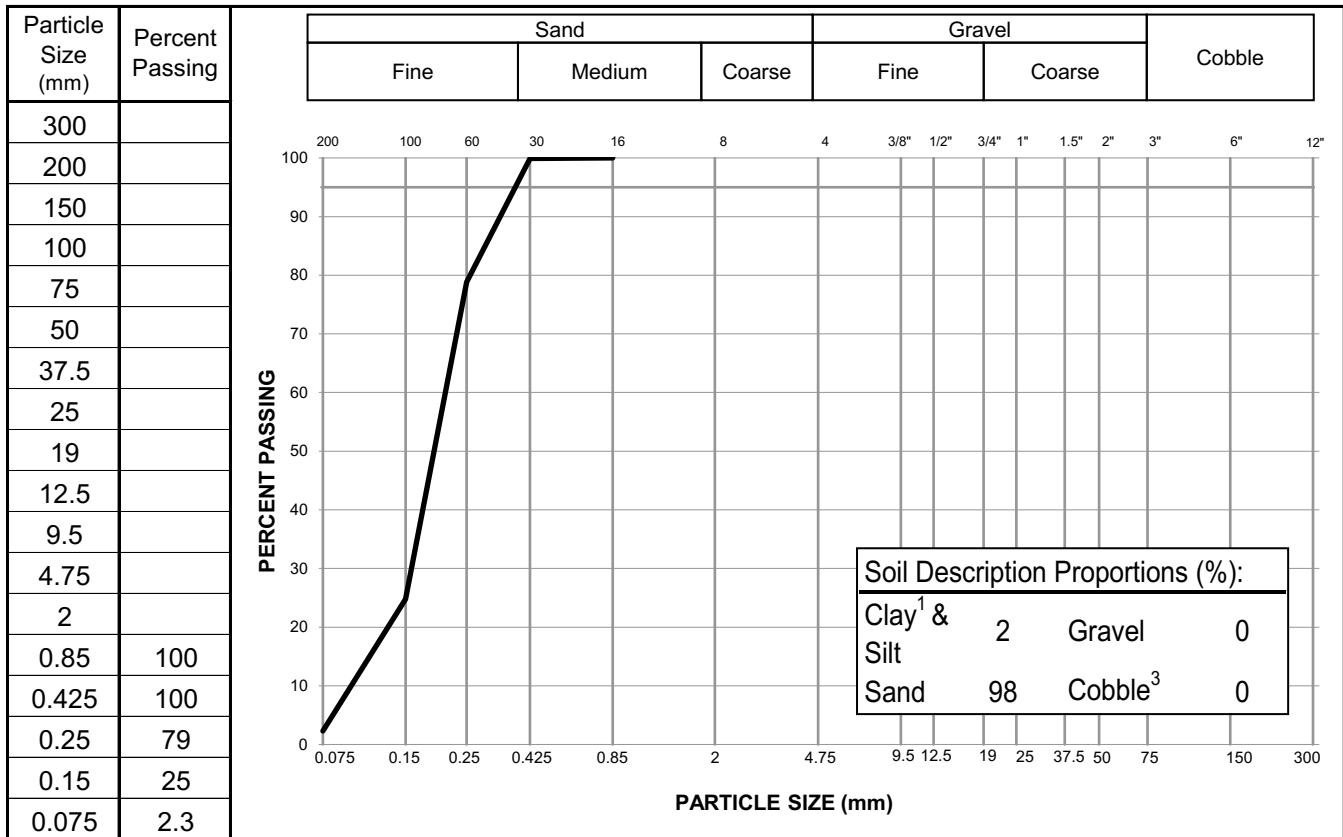
Remarks: _____

Reviewed By:  P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-51
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-02
Client:	K'alo-Stantec Limited	Sample Depth:	1.8-2.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025	By:	AH
Date Tested:	June 14, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.1 Cc: 1.2
Moisture Content:	3.3%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: Joy Yobayom P.Eng.

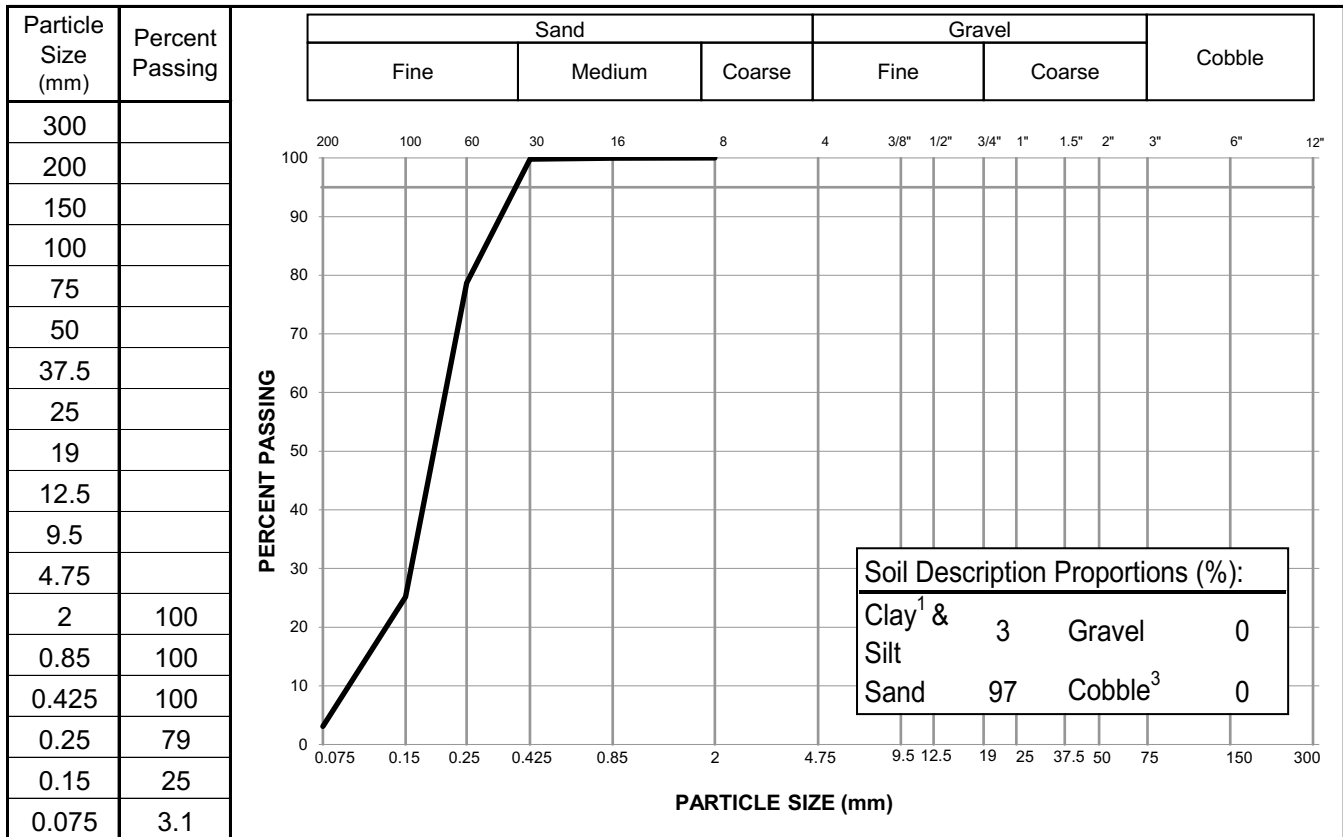
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-54
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement area, NWT	Sample Loc.:	TP25-BS899-02
Client:	K'alo-Stantec Limited	Sample Depth:	4.5-5.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 12, 2025	By:	AH
Date Tested:	June 12, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.2 Cc: 1.2
Moisture Content:	3.4%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By:  P.Eng.

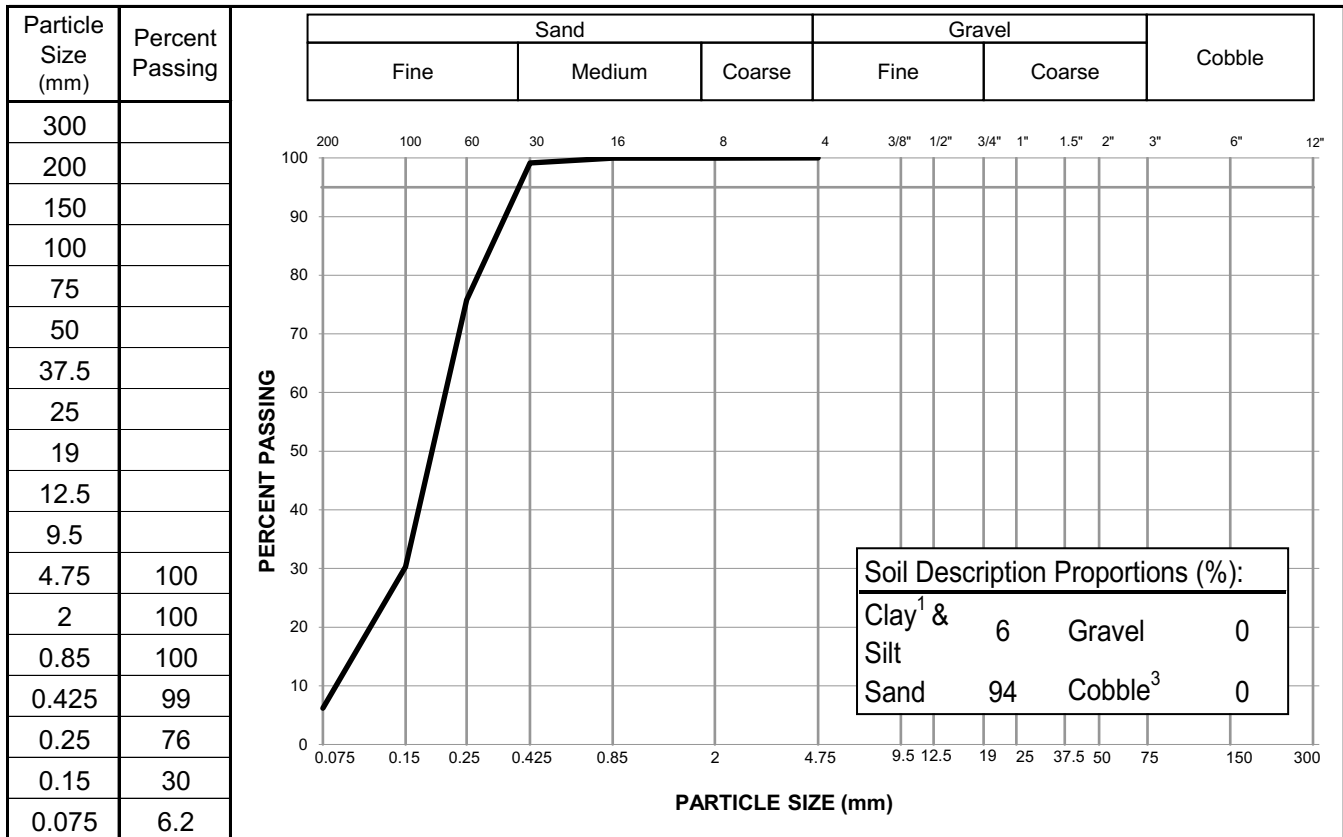
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-56
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement area, NWT	Sample Loc.:	TP25-BS899-03
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025	By:	AH
Date Tested:	June 15, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.5
Moisture Content:	4.7%		Cc: 1.2



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By:  P.Eng.

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ASTM D6913

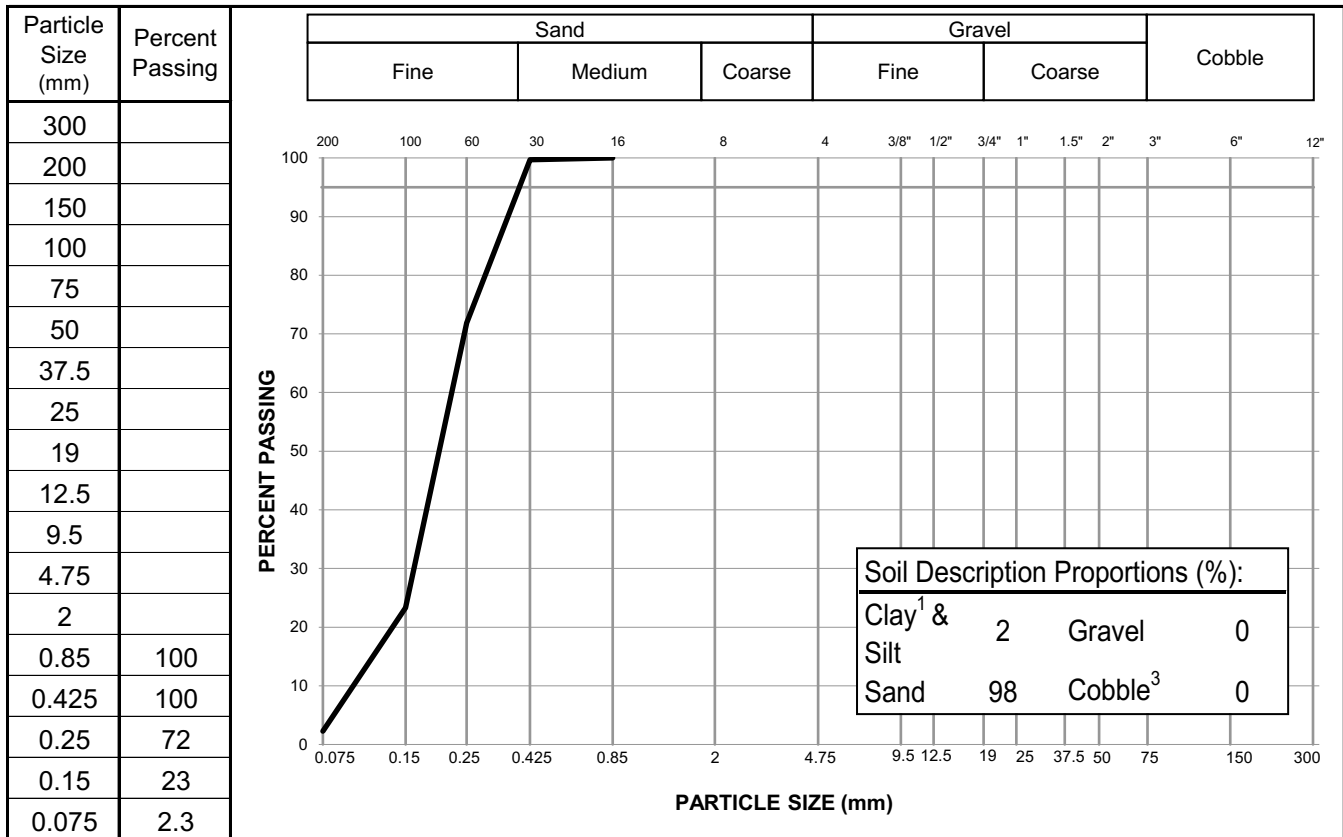
Moisture Content: 0.3% Cc: 1.2



PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-61
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-03
Client:	K'alo-Stantec Limited	Sample Depth:	4.5-5.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025	By:	AH
Date Tested:	June 15, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.2 Cc: 1.2
Moisture Content:	3.3%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: *Doug Yabon* P.Eng.

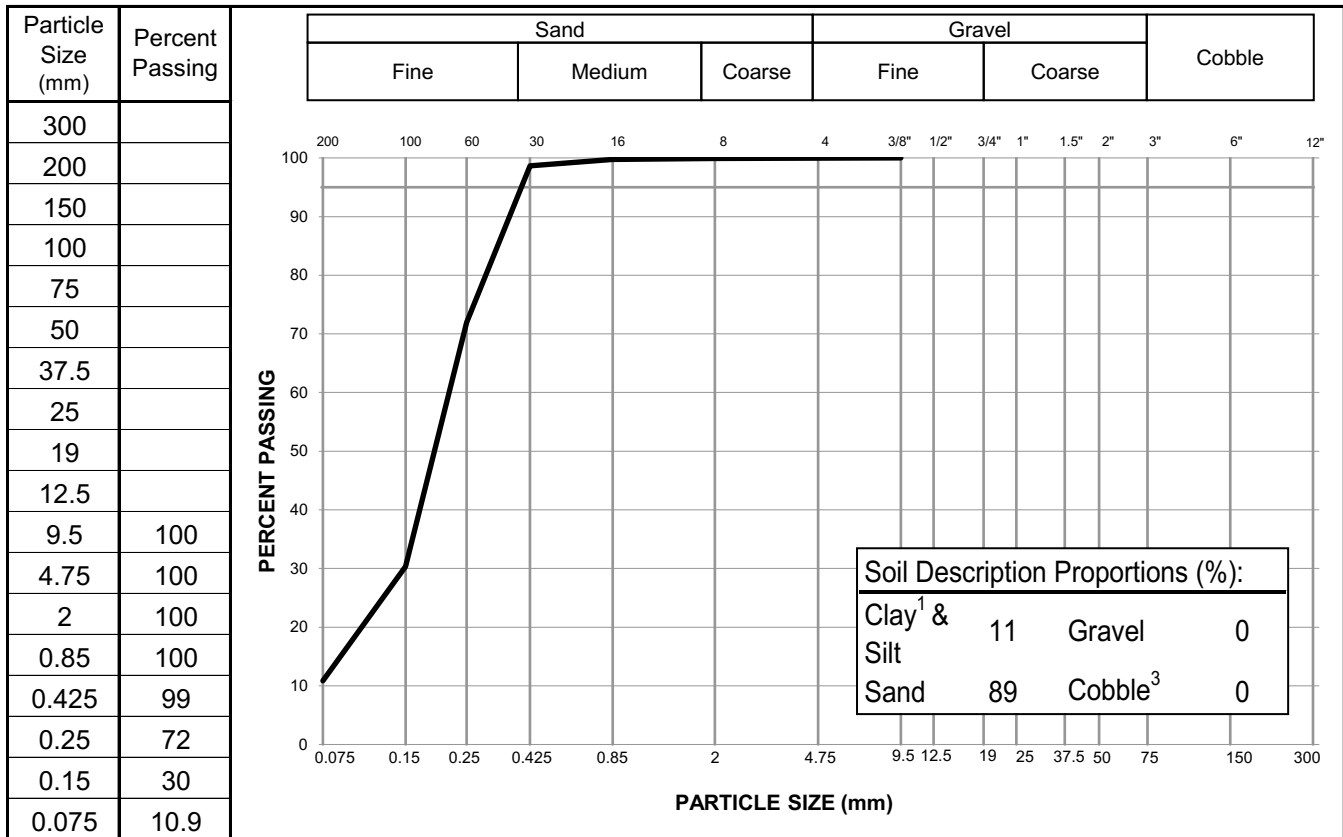
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project: MVH Sahtu Borrow Sources Sample No.: 1361-63
 Project No.: ENG.EARC03299-03.007 Material Type: In situ
 Site: Sahtu Settlement Area, NWT Sample Loc.: TP25-BS899-04
 Client: K'alo-Stantec Limited Sample Depth: 0.9-1.0 m
 Client Rep.: Dennis Kefalas Sampling Method: Grab
 Date Tested: June 15, 2025 By: AH Date sampled: March 26, 2025
 Soil Description²: SAND, some silt, trace organics, brown Sampled By: AG
 USC Classification: SM Cu: #N/A
 Moisture Content: 6.1% Cc: #N/A



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: *Tony M. Johnson* P.Eng.

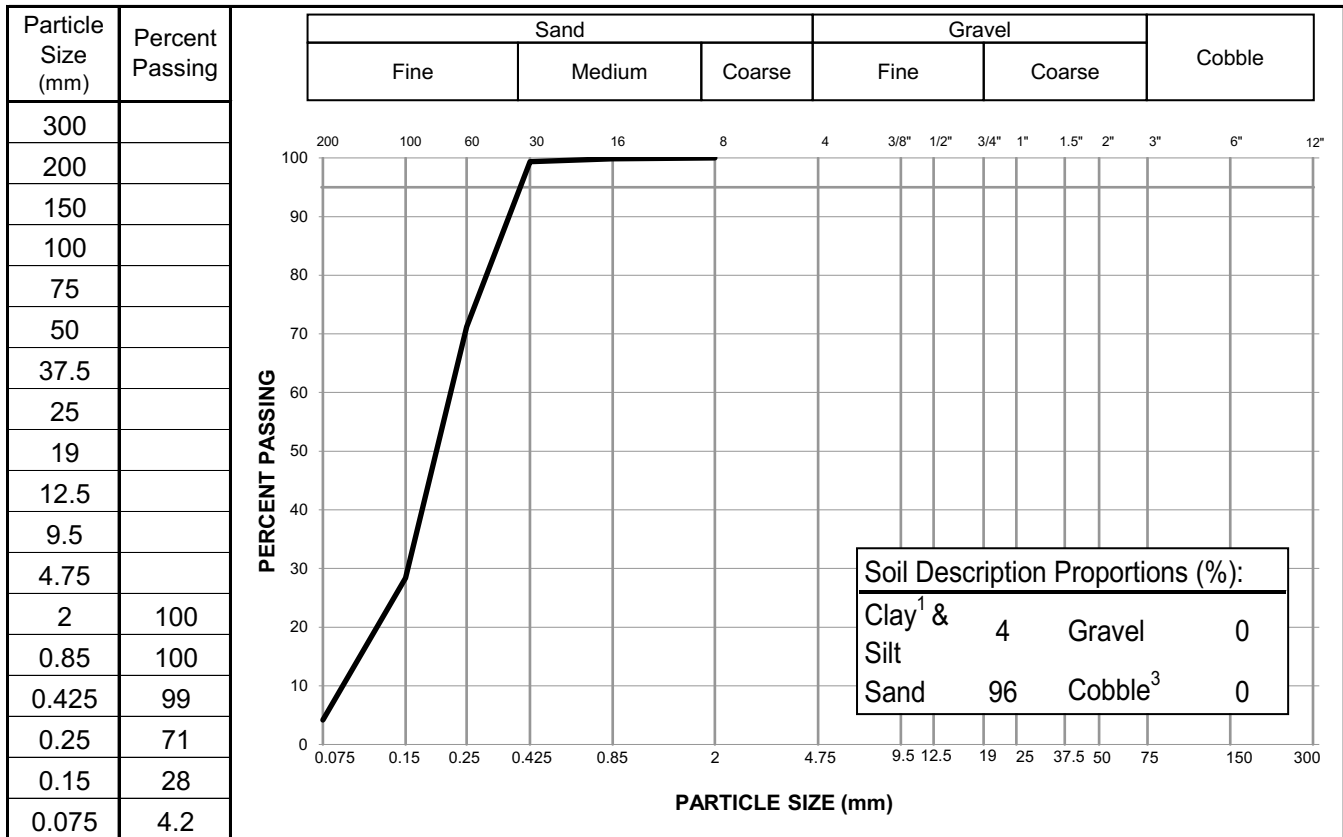
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-64
Project No.:	ENG.EARC03299-03.005	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-04
Client:	K'alo-Stantec Limited	Sample Depth:	1.8-2.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025	By:	AH
Date Tested:	June 14, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.4 Cc: 1.1
Moisture Content:	11.9%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: Joy Yohann P.Eng.

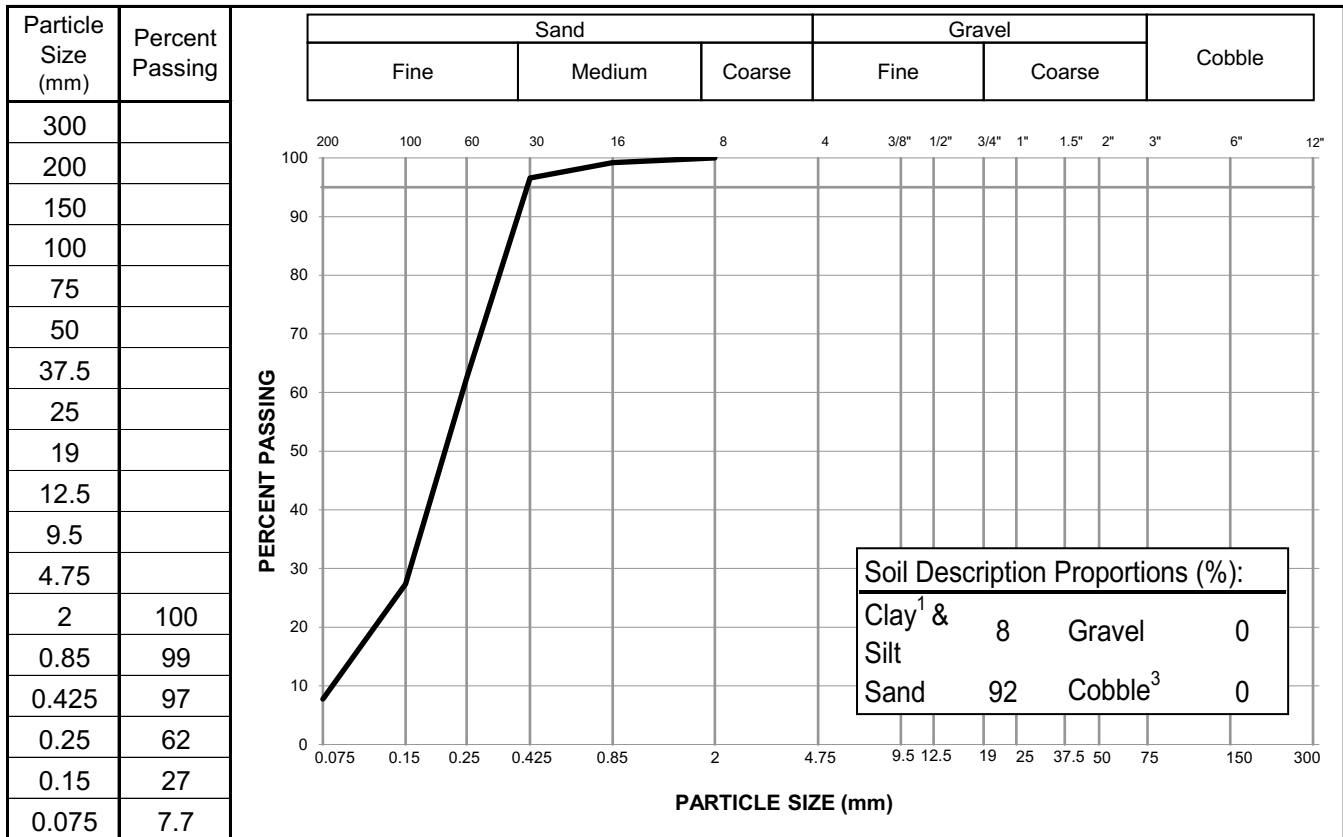
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-66
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-05
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025	By:	AH
Date Tested:	June 14, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, trace organics, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.9 Cc: 1.2
Moisture Content:	6.5%		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: Joy Mahajan P.Eng.

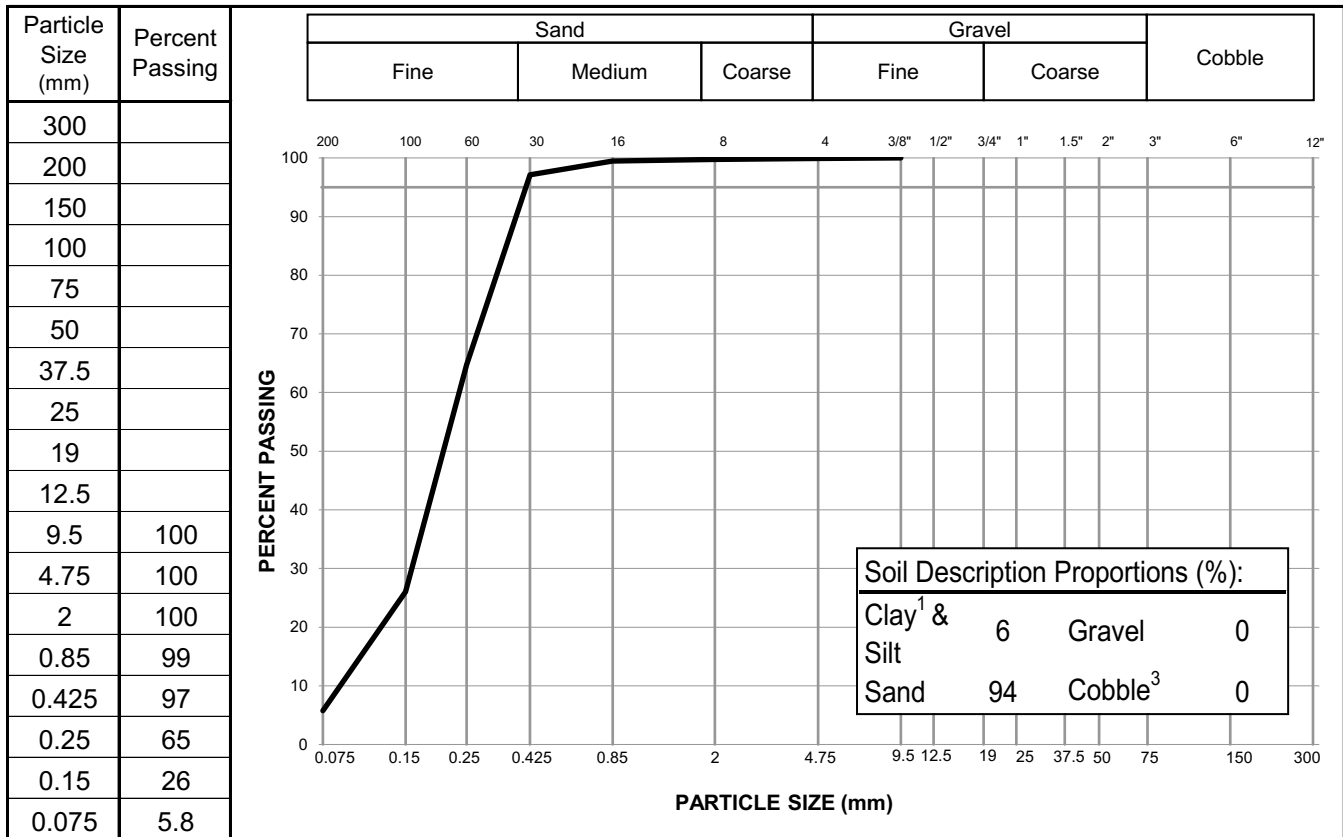
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PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-68
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-BS899-05
Client:	K'alo-Stantec Limited	Sample Depth:	2.7-3.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025	By:	AH
Date Tested:	June 15, 2025	Date sampled:	March 26, 2025
Soil Description ² :	SAND, trace silt, trace organics, dark brown	Sampled By:	AG
Moisture Content:	7.1%	USC Classification:	SP Cu: 2.6 Cc: 1.2



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to Tt WM4400 description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: *Doug M. [Signature]* P.Eng.

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MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 (Standard Proctor)

Project: Mackenzie Valley Highway Sahtu Borrow Sources

Sample No.: 1361-59

Project No.: 704-ENG.EARC03299-03.007

Sampled By: AG

Client: K'alo Stantec Limited

Date Received: 26-Mar-25

Source: BS899

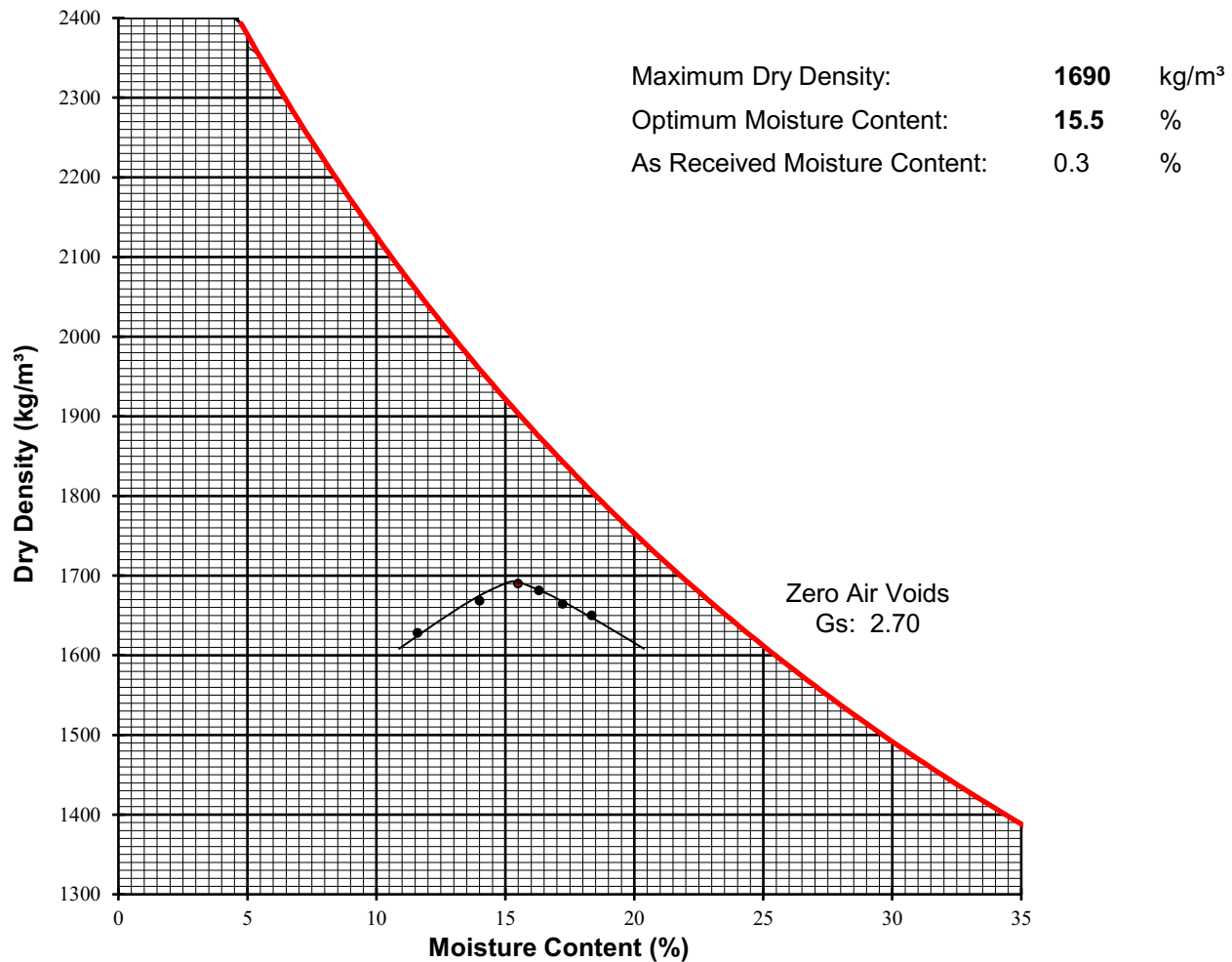
Test Date: 19-Jun-25

Test By: AH

Test Method: B (Manual)

Sample Location: TP25-BS899-03; 3.0 - 4.0 m

Sample Description: SAND, trace silt, dark brown



Remarks:

Reviewed By: Tony Y. G. G. G. P.Eng.

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APPENDIX C

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

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1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historical environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional exploration and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.