



Foundation Investigation Report

Culvert 50

~20.6 km North of the Corner of HWY 17 and 72

Township of McAree

Station 15+576, Lat: 49.845600, Lon: -92.403801

District of Kenora

Highway 72

6021-E-0045 & 0046

Geocres No. 52F16-002

Prepared for:

Ontario Ministry of Transportation NWR

615 James Street South

Thunder Bay, ON

P7E 6P6

Prepared By:

TBT Engineering Limited

1918 Yonge Street

Thunder Bay, ON

P7E 6T9

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Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by the Ontario Ministry of Transportation Northwest Region (MTO) to provide foundation investigation services under the Northwest Region (NWR) Geotechnical Retainer Assignment. The site is located on Highway 72, approximately 20.6 north of the intersection of Highway 17 and Highway 72. The site coordinates are as follows:

- Station 15+576, Latitude: 49.845600°, Longitude: -92.403801°

A Google Earth image illustrating the site location can be seen in Figure 1.1.

It is understood that this investigation is to facilitate the replacement of the culvert and a temporary protection system. The investigation consisted of two boreholes; one borehole was advanced at the top each side of the embankment and, two hand auger holes which were advanced at each of the invert and outlet of the culvert. The boreholes were advanced to depths of 15.9 and 10.6 m. Hand auger holes were advanced to depths of 1.1 and 2.0 m. Planned borehole locations were provided by the MTO in the Terms of Reference, however, final borehole locations were adjusted to suit field conditions. This report (Part A) describes the subsurface conditions encountered during the investigation.

The MTO Foundations Section has assigned Geocres No. 52F16-002 to this site.



Figure 1.1: A Google Earth Image Illustrating the Site Location.

2 Site Description

The existing embankments are within the MTO Right-of-Way with the toes extending to near the tree line. The photos below were taken by TBTE during site reconnaissance. The area is generally flat, with embankment side slope of approximately 2.5H:1V. The embankment is approximately 5.5 m high at the culvert location.



Figure 2.1: Left Embankment
Looking South, June 28, 2023.



Figure 2.2: Right Embankment
Looking East, June 28, 2023

2.1 Surficial Geology

As defined by the Ontario Ministry of Natural Resources' Northern Ontario Engineering Geology Terrain Study (NOEGTS), Map No. 52FNE, the site is in an area which primarily consists of a sand/gravel raised (abandoned) beach form. The area has low local relief and is generally dry.

Raised beaches are described in the NOEGTS as former shoreline deposits with sands and gravels.

The presence of the above soils were confirmed from the field investigation.

3 Investigation Procedures

A geotechnical site investigation was undertaken on September 19, 2023 to September 20, 2023. The field investigation consisted of advancing a total of two boreholes and two hand auger holes. Test Hole locations are illustrated on the Borehole Location and Soil Strata Drawings

(Appendix C). The boreholes were advanced to depths of 10.6 and 15.9 m. Hand auger holes were advanced to depths of 1.1 and 2.0 m.

The borehole locations were identified in the field by TBTE personnel and service clearances were completed prior to mobilizing the drill rig to site. The boreholes were advanced using a drill rig mounted on an all-terrain carrier equipped with hollow stem augers, a casing advancement system and apparatus used to carry out Standard Penetration Testing as per ASTM D1586.

During the drilling operations for the boreholes, soil samples were obtained from the auger flights and using the techniques of the Standard Penetration Test (SPT). The SPT involves driving a 51 mm O.D. thick walled split barrel sampler into the soils under a standardized energy (63.5 kg, falling 760 mm). The number of blows required to drive the sampler 0.3 m is known as the SPT blow count (N). Following completion of the test, a representative soil sample is obtained from within the sampler. SPTs are taken at a frequency of approximately every 0.75 m for the first 3 m of the borehole, and every 1.5 m afterwards, to the termination depth of the borehole. Sample frequency may vary due to circumstances experienced in the field.

In addition, thin-walled tube samples were taken within the cohesive materials, alternating with SPT samples. In-situ field vane testing was completed at select depths within the cohesive materials to obtain an indication of the material's undrained shear strength. In-situ field vane testing was completed as per ASTM D2573 with a tapered vane.

Test hole locations were surveyed by TBTE with a level and rod and referenced to a temporary benchmark at the centreline of the highway. The benchmark has an elevation of 388.4 m from the B&C-633-664-8 surface as provided by the client. A hand-held Garmin GPS device was used in the field to record coordinates of the borehole locations, based on North American Data 1983 NAD83 (CSRS) v6 (2010 epoch).

A summary of the borehole location data is provided below and on the Borehole Location and Soil Strata Drawings (Appendix C).

Table 3.1: Summary of Borehole Information.

Borehole Number	Co-ordinates	Surface Elevation (m)	Depth of Exploration (m)
1	Lat 49.84562 Lon -92.40386	388.2	15.9
2	Lat 49.8456238 Lon -92.4040386	388.6	10.6
HA-001	Lat 49.8455101 Lon -92.4036240	383.4	2.0
HA-002	Lat 49.8457153 Lon -92.4039886	383.3	1.1

All boreholes have been backfilled and/or decommissioned with auger cuttings and bentonite in accordance with the Ontario Ministry of the Environment's Regulation 903, as amended by Regulation 128/03 (water well regulation under the Ontario Water Resource Act).

4 Laboratory Testing

Soil samples obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, Atterberg limits tests, and grain size analysis. Typically, 100% of the recovered soil samples are tested for natural moisture content determination, and 25% of the recovered soil samples are chosen for grain size analysis and/or Atterberg limits testing, as applicable. The following test methods/standards are followed for the above testing: LS 602 (sieve analysis for aggregates), LS 701 (moisture content of soils), ASTM C136 (standard test method for sieve analysis of fine and coarse aggregates), ASTM D4318 (standard test for liquid, plastic, and plasticity index of soils), ASTM D2216 (standard test method for laboratory determination of water (moisture) content of soil and rock by mass). . The results of this testing are shown on the borehole logs (Appendix A) and on the laboratory data reports (Appendix B).

One soil sample was submitted to the ALS Canada Ltd. laboratory in Thunder Bay, Ontario which was subjected to corrosivity and conductivity testing. Results of this testing have been provided below and in Appendix B. It should be noted that the ALS Laboratory data sheet references BH 29, post sample submission the borehole number had been changed to BH 1 for Station 15+576.

5 Subsurface Conditions

Details of the subsurface conditions are provided on the borehole logs (Appendix A), and on the Borehole Location and Soil Strata Drawings (Appendix C).

The subsurface soils at the borehole locations generally consist of fill overlying sand and silt or clay. The clay in turn overlies sand and silt to the termination of the boreholes. The subsurface soils at the hand auger locations generally consist of organics overlying sands and silts, which in turn overlies clay and sand to the termination of the hand augers.

5.1 Fill

Sand and gravel with trace silt to silt with some sand and trace gravel was encountered at surface of both boreholes and extended to depths ranging from 4.9 to 5.6 m (elev. 383.0 to 383.3 m). Wood debris was noted within Borehole 1 at a depth of 4.7 m (elev. 383.5 m). The results of two grain size analysis indicates that this material can consist of 4 to 11% gravel, 59 to 77% sand, 12 to 37% silt/clay sized particles. The condition of this material is loose to compact with SPT N-values ranging from 9 to 27 blow per 0.3 m.

5.2 Organics

30 to 150 mm of organics was identified at the surface of both hand augers. Moisture contents varied from 62 to 71 %.

5.3 Upper Sands and Silts

Silty sand to silt with trace sand was present underlying the organics at Hand Auger Holes 001 and 002 and extended to depths ranging from 0.7 to 1.1 m (elev. 382.2 to 382.7 m). It should be noted that Hand Auger 002 terminated within this material.

5.4 Clay and Sand

Clay and sand to silty clay was encountered underlying the fill at both boreholes locations and underlying the silty sand at Hand Auger Hole 2. This material was encountered at depths ranging from 4.9 to 5.3 m (elev. 383.0 to 383.3 m) at the borehole locations and 0.7 m (elev. 382.7 m) at the Hand Auger Hole and extended to depths ranging from 10.6 to 11.5 m (elev. 376.7 to 378.0 m). It should be noted that Hand Auger Hole terminated within this material at a depth of 2.0 m (elev. 381.4 m). Atterberg limits testing indicates that this material is silty clay to clay of medium plasticity, with the natural moisture content approaching or above the liquid limit. The results of three grain size analyses indicate that this material can consist of 0 % gravel, 11 to 44 % sand, 56 to 89 % silt/clay sized particles. This material generally has a very soft to stiff

consistency based on SPT N-values ranging from 1 to 8 blows per 0.3 m and firm based on a single field vane of 30 kPa.

5.5 Lower Sands and Silts

Silty sand with trace gravel to sand and silt was present underlying the clay and sand at Borehole 1 at a depth of 11.5 m (elev. 376.7 m) and extended to a depth of 15.9 m (elev. 372.3 m). The condition of this material is very loose to compact with an SPT N-values ranging from 4 to 23 blows per 0.3 m.

5.6 Refusal

Spoon refusal and/or auger refusal was encountered at both borehole locations at depths ranging from 10.6 to 15.9 m (elev. 372.3 to 378.0 m). Refusal to hand operated equipment was at depths of 1.1 to 1.2 m (elev. 381.4 to 382.2 m).

5.7 Corrosivity and Conductivity Testing

One soil sample from fill at approximate elevation 387.1 m was submitted for corrosivity and conductivity testing, results of which are summarized in the table below. Detailed results are provided in Appendix B.

Table 5.1: Analytical Testing Results.

Test	Unit	Result
Conductivity	mS/cm	465
Moisture	%	9.92
Acidity/Basicity	pH	7.83
Redox Potential	mV	284
Resistivity	ohm-cm	2150
Chloride	mg/kg	197
Sulphide (as S)	mg/kg	<0.22
Sulphate	mg/kg	<20

5.8 Groundwater

Casing advancement with water was utilized at the boreholes during drilling operations. Elevated water levels may have been recorded due to this drilling method and water levels may not have stabilized. Water level readings were taken upon completion as shown below. Observed groundwater levels have been provided in the table below. Groundwater levels may vary from season to season and from the effects of heavy precipitation events.

Table 5.2: Observed Groundwater Levels.

Location	Surface Elevation (m)	Groundwater Level on Completion of Drilling	
		Depth (m)	Elev. (m)
Borehole 1	388.2	1.2	386.0
Borehole 2	388.6	2.0	386.6
Hand Auger 001	383.4	Surface	383.4
Hand Auger 002	383.3	Surface	383.3

6 Miscellaneous

Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The drill equipment for this investigation was operated by TBT Engineering Limited. The field operations were supervised by Ian Baumann and Allan Finke. Laboratory testing was supervised by Forch Valela, C.Tech. This report was prepared and reviewed by Dean Vale, P.Eng., and Steven Seller, P.Eng. (TBTE's designated principal contact identified for MTO Foundation Engineering).

7 Limitations

Conclusions and recommendations presented in this report are based on the information determined at a limited number of borehole locations. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during construction that were not detected and could not be anticipated at the time of the site investigation.

Groundwater levels indicated are based on the information described within the report. The presence of all conditions that could affect the type and scope of the dewatering procedures which may be considered during construction cannot readily be determined from site investigation or boreholes. These conditions include local and seasonal fluctuations of the groundwater level, changes in soil conditions between borehole locations, thin and/or discontinuous layers of highly permeable soils, etc.

In no way does the information contained within this report reflect any environmental aspect of the site or soil.

8 Closure

We trust the above addresses your project requirements at this time. Should you have any questions or comments, please do not hesitate to contact us at your convenience.

Yours truly,

For TBT ENGINEERING



Dean Vale, P.Eng.
Geotechnical Engineer



Steve Steller, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

9 References

Braja M. Das, *Fundamentals of Geotechnical Engineering*, 4th ed. Stamford, CT, USA: Cengage Learning, 2013.

D.E. Becker *et al.*, *Canadian Foundation Engineering Manual*, 4th ed. Richmond, BC, Canada: The Canadian Geotechnical Society, 2006.

Ontario Ministry of Northern Development and Mines; Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS), 2000

APPENDIX A

Borehole Logs

EXPLANATION OF TERMS

N Value: The Standard Penetration Test (SPT) N value is the number of blows required to cause a standard 51mm O.D. split barrel sampler to penetrate 0.3m into undisturbed ground in a borehole when driven by a hammer with a mass of 63.5 kg, falling freely a distance of 0.76m. For penetrations of less than 0.3m N values are indicated as the number of blows for the penetration achieved. Average N value is denoted thus \bar{N} .

Dynamic Cone Penetration Test: Continuous penetration of a conical steel point (51mm O.D. 60° cone angle) driven by 475 J impact energy on 'A' size drill rods. The resistance to cone penetration is measured as the number of blows for each 0.3m advance of the conical point into the undisturbed ground.

Soils are described by their composition and consistency/condition.

Consistency: Cohesive soils are described on the basis of their undrained shear strength (c_u) as follows:

C_u (kPa)	0-12	12-25	25-50	50-100	100-200	>200
	Very Soft	Soft	Firm	Stiff	Very Stiff	Hard

Condition: Cohesionless soils are described on the basis of denseness as indicated by SPT N values as follows:

N (Blows/0.3m)	0-4	4-10	10-30	30-50	>50
	Very Loose	Loose	Compact	Dense	Very Dense

Minor Soil Components: Terminology used to represent the amount of minor components based on their percent of the sample by weight as follows:

% by weight	0-10	10-20	20-35	35-50
	Trace	Some	"ey" or "y"	And

ABBREVIATIONS AND SYMBOLS

Field Sampling, Insitu Testing, Laboratory Testing

S S	Split Spoon	T P	Thin Wall Piston
A S	Auger	O S	Osterberg
W S	Wash	R C	Rock Core
S T	Slotted Tube	P H	T W Advanced Hydraulically
B S	Block	P M	T W Advanced Manually
C S	Chunk	F S	Foil
V T	Vane Test (kPa)	P P	Pocket Penetrometer (kg/cm ²)
T W	Thin Wall Shelby Tube		

EXPLANATION OF TERMS Cont'd.

Stress and Strain

u_w	kPa	Pore Water Pressure
u		Pore Pressure Ratio
σ	kPa	Total Normal Stress
σ'	kPa	Effective Normal Stress
τ	kPa	Shear Stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal Stress
ϵ	%	Linear Strain
$\epsilon_1, \epsilon_2, \epsilon_3$	%	Principal Strains
E	MPa	Young's Modulus
G	kPa	Modulus of Shear Deformation
m	MPa	Constrained Modulus
μ		Coefficient of Friction

Mechanical Properties of Soil

m_v	kPa ⁻¹	Coefficient of Volume Change
C_c		Compression Index
C_s		Swelling Index
C_a		Rate of Secondary Consolidation
c_v	m ² /s	Coefficient of Consolidation
H	m	Drainage Path
T_v		Time Factor
U	%	Degree of Consolidation
P'_o	kPa	Effective Overburden Pressure
P'_c	kPa	Preconsolidation Pressure
τ_f	kPa	Shear Strength
c'	kPa	Effective Cohesion Intercept
ϕ'	°	Effective Angle of Internal Friction
c_u	kPa	Undrained Shear Strength
s		Sensitivity

Physical Properties of Soil


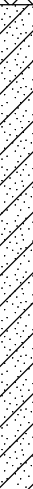

ρ_s	kg/m ³	Density of Solid Particles	e	%	Void Ratio	e_{min}	%	Void Ratio in Densest State
γ_s	kN/m ³	Unit Weight of Solid Particles	n	%	Porosity	I_D		Density Index $= \frac{e_{max}-e}{e_{max}-e_{min}}$
ρ_w	kg/m ³	Density of Water	w	%	Water Content	D	mm	Grain Diameter
γ_w	kN/m ³	Unit Weight of Water	s_r	%	Degree of Saturation	D_n	mm	n Percent Diameter
ρ	kg/m ³	Density of Soil	w_L	%	Liquid Limit	C_u		Uniformity Coefficient
γ	kN/m ³	Unit Weight of Soil	w_p	%	Plastic Limit	h	m	Hydraulic Head or Potential
ρ_d	kg/m ³	Density of Dry Soil	w_s	%	Shrinkage Limit	q	m ³ /s	Rate of Discharge
γ_d	kN/m ³	Unit Weight of Dry Soil	I_p	%	Plasticity Index = $w_L - w_p$	v	m/s	Discharge Velocity
ρ_{sat}	kg/m ³	Density of Saturated Soil	I_L		Liquidity Index = $\frac{w-w_p}{I_p}$	i		Hydraulic Gradient
γ_{sat}	kN/m ³	Unit Weight of Saturated Soil	I_c		Consistency Index = $\frac{w_L-w}{I_p}$	k	m/s	Hydraulic Conductivity
ρ'	kg/m ³	Density of Submerged Soil	e_{max}	%	Void Ratio in Loosest State	j	kN/m ³	Seepage Force
γ'	kN/m ³	Unit Weight of Submerged Soil						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 6033-19-00 LOCATION Station 15+575 o/s 4.7 m Lt of C/L N:5523294; E:347673 MTM Zone:16 ORIGINATED BY IB
DIST NWR HWY 72 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TG
DATUM Geodetic DATE 2023.12.02 - 2023.12.02 LATITUDE 49.84562 LONGITUDE -92.40386 CHECKED BY DV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE									
388.2 0.0	FILL - SAND & GRAVEL - occasional cobbles, brown, compact					▽	388								Water level @ 2.0 m on completion.			
			1	SS	14													
			2	SS	21													
			3	SS	11													
	- SAND & SILT - trace to some gravel, grey		4	SS	14			385								4 59 (37)		
								384										
383.3 4.9	- SILT - trace sand, wood fibre, grey, loose CLAY & SAND - grey, soft to firm		5	SS	9			383										
				6	SS		8		382								0 44 (56)	
									381									
				7	TW				380									
								379										
			8	SS	1			378										
	- some sand		9	SS	3		377							0 11 (89)				
376.7 11.5	SILT & SAND - grey, very loose						376											
				10	SS	4		375										
375.2 13.0	SAND - Silty, trace gravel, occasional cobbles, grey, compact							374										
				11	SS	23		373										
372.3 15.9	End of Borehole @ 15.9 m. Auger Refusal.		12	SS	14													

+³, ×³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

PP=Pocket Penetrometer (Kg/cm²)


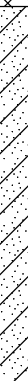
ONTARIO MTO MOD. CULVERT 50 HWY 72 15+576 MCAREE.GPJ ONTARIO MTO.GDT 4-15-24

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 6033-19-00 LOCATION Station 15+584 o/s 3.9 m Rt of C/L N:5523295; E:347685 MTM Zone:16 ORIGINATED BY IB
DIST NWR HWY 72 BOREHOLE TYPE Hollow Stem Auger COMPILED BY TG
DATUM Geodetic DATE 2023.12.03 - 2023.12.03 LATITUDE 49.8456328 LONGITUDE -92.4036864 CHECKED BY DV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				w _p	w	w _L				
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
						20	40	60	80	100	20	40	60					
388.6 0.0	FILL - SAND & GRAVEL - brown, compact ----- - SAND - brown, compact ----- - SAND - Silty, brown, compact ----- - SILT - some to trace sand, trace gravel, grey, compact					▽	388									Water level @ 1.2 m on completion.		
			1	SS	17													
			2	SS	20													
			3	SS	27													
			4	SS	18													
383.0 5.6	CLAY & SAND to CLAY - Sandy - very soft to firm						383									0 31 (69)		
			6	SS	6													
			7	TW														

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PP=Pocket Penetrometer (Kg/cm²)

HIGHWAY 664/72
LAVAL TOWNSHIP

Station 15+576 16.2m Rt

23-FDN-HA-001

MTM15 5521624 N 542877 E

0	-	20	Water
20	-	50	Br Org
50	-	700	Gry Si Sa
700	-	2.0	Gry Clay & Sa
		2.0	NFP

Station 15+576 16.2m Rt

23-FDN-HA-001

Sample No. 23-IB-1064 (300-500)

FMC 24.1 %

Station 15+576 16.2m Rt

23-FDN-HA-001

Sample No. 23-IB-1065 (900-1.2)

FMC 31.9 %

Station 15+576 18.6m Lt

23-FDN-HA-002

MTM15 5521647 N 542850 E

0	-	150	Water
150	-	300	Br Org & Sa, Gr
300	-	1.1	Gry Si, Tr Sa
		1.1	NFP

Station 15+576 18.6m Lt

23-FDN-HA-002

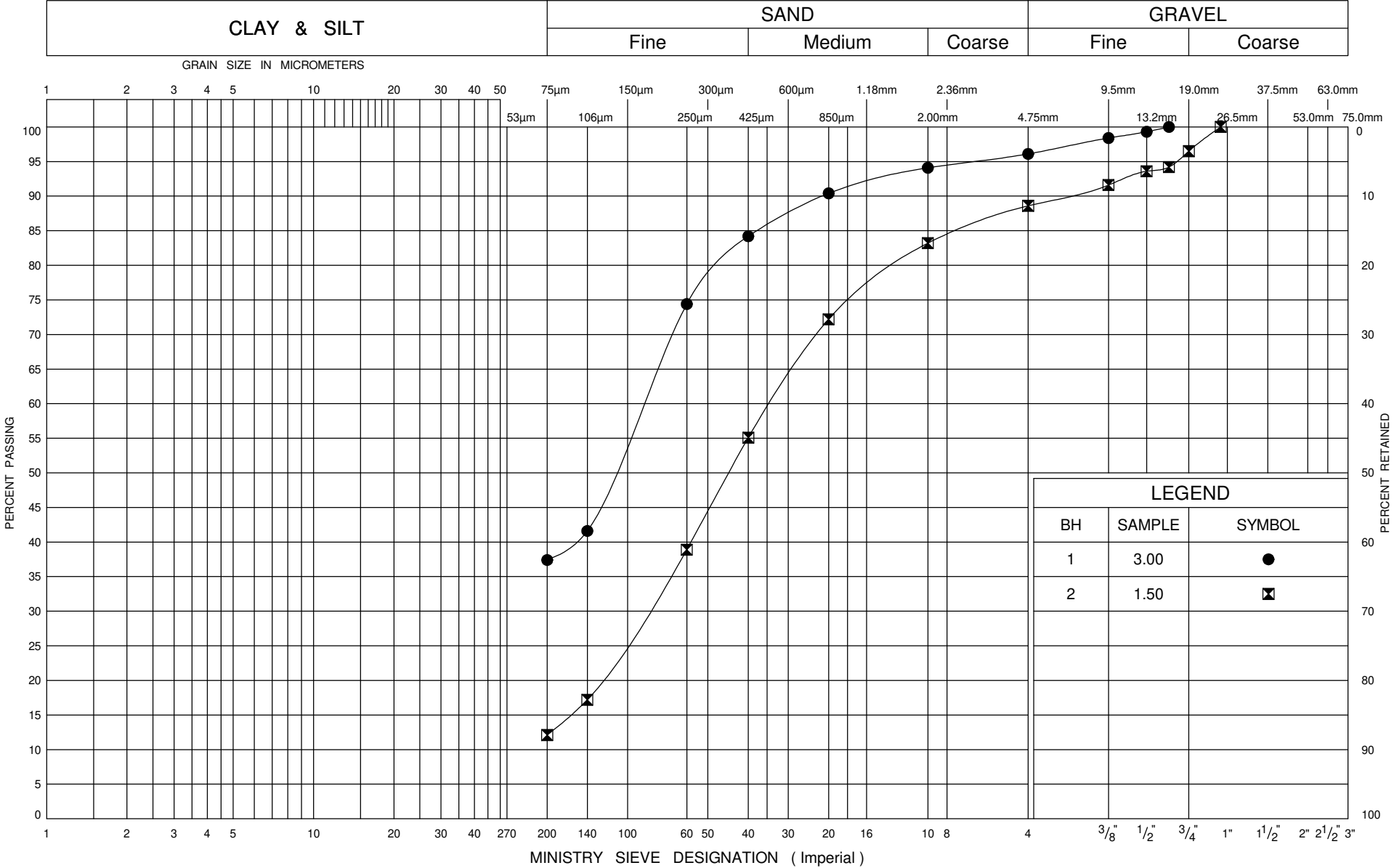
Sample No. 23-IB-1066 (600-700)

FMC 35.6 %

APPENDIX B

Laboratory Test Data

UNIFIED SOIL CLASSIFICATION SYSTEM



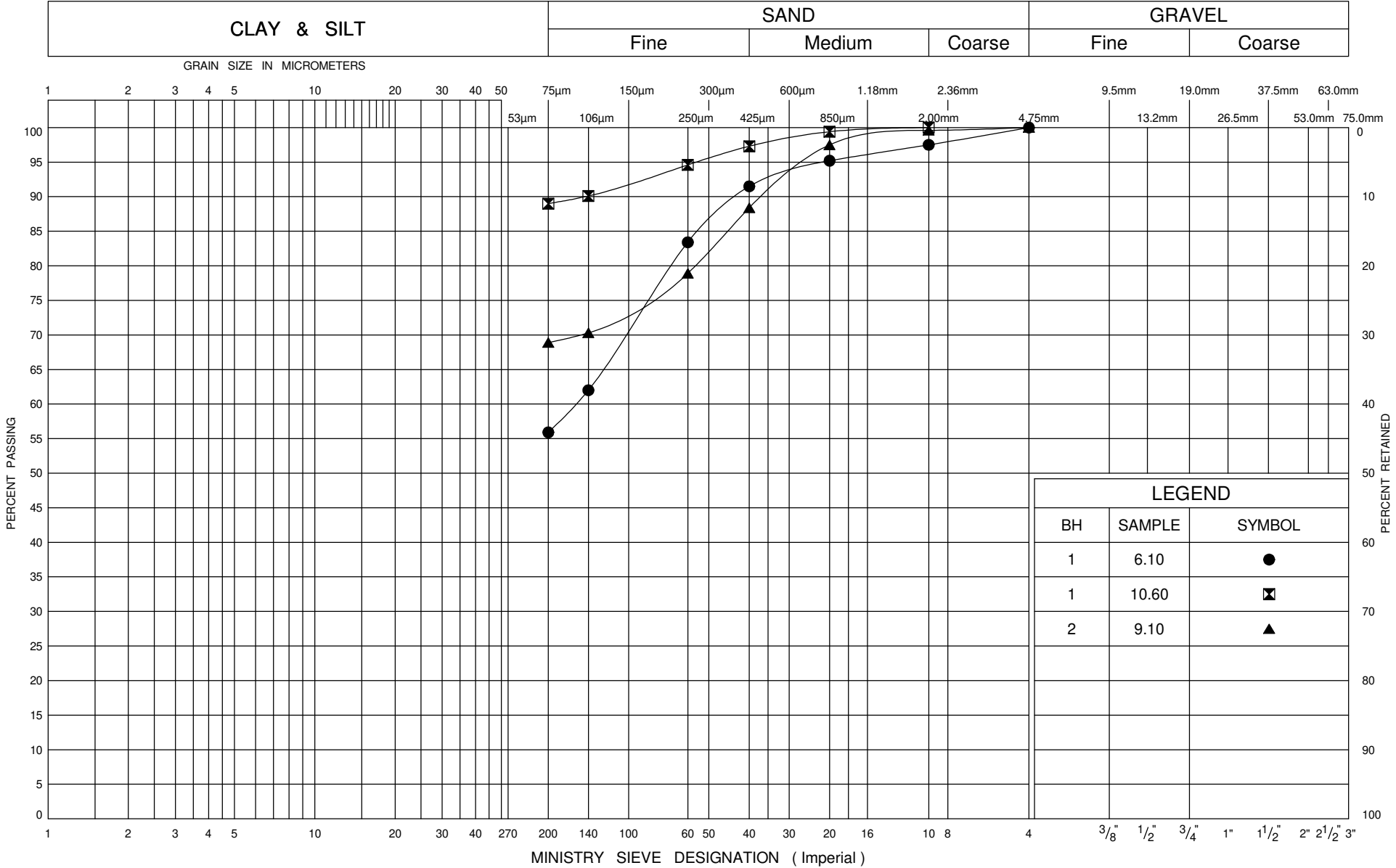
LEGEND		
BH	SAMPLE	SYMBOL
1	3.00	●
2	1.50	⊠

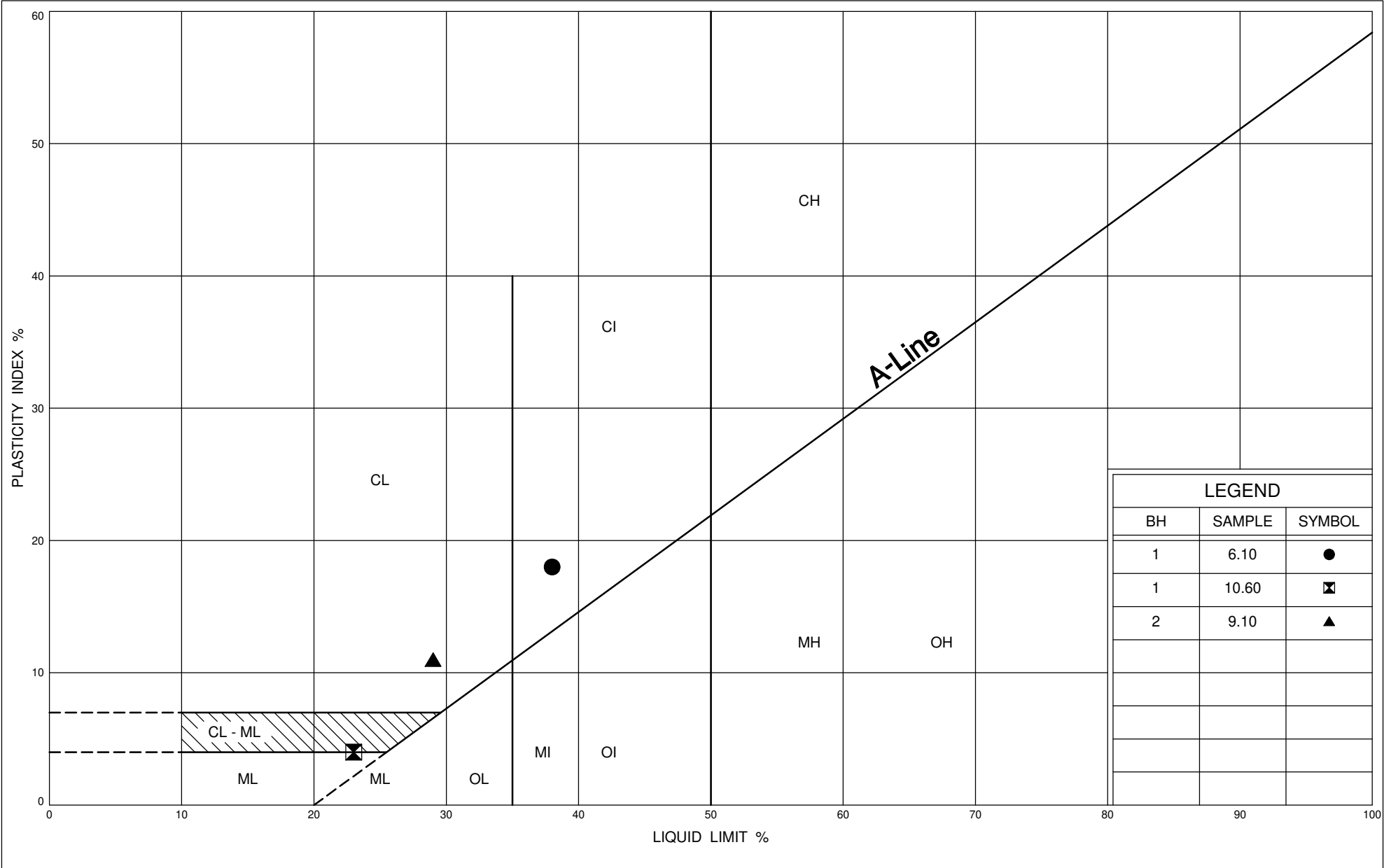


GRAIN SIZE DISTRIBUTION
FILL - SAND & SILT / SAND

FIG No 1
W P 6033-19-00
Culvert 50 McAree TWP 15+576

UNIFIED SOIL CLASSIFICATION SYSTEM





CERTIFICATE OF ANALYSIS

Work Order	: TY2312964	Page	: 1 of 3
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Younge Street	Address	: 1081 Barton Street
	Thunder Bay ON Canada P7E 6T9		Thunder Bay ON Canada P7B 5N3
Telephone	: (807)624-5160	Telephone	: +1 807 623 6463
Project	: 22-146-10	Date Samples Received	: 13-Dec-2023 13:55
PO	: 12078	Date Analysis Commenced	: 18-Dec-2023
C-O-C number	: ----	Issue Date	: 21-Dec-2023 13:54
Sampler	: ----		
Site	:		
Quote number	: Standing Offer - Soil - 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Greg Pokocky	Manager - Inorganics	Inorganics, Waterloo, Ontario
Niral Patel		Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Inorganics, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	Description
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.



Analytical Results

Sub-Matrix: Soil/Solid					Client sample ID	23-318-9 BH2-SS1	22-146-10 BH29-SS1	----	----	----
(Matrix: Soil/Solid)					Client sampling date / time	22-Nov-2023 12:00	04-Dec-2023 12:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	TY2312964-001	TY2312964-002	-----	-----	-----	-----
					Result	Result	----	----	----	----
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L/WT	5.00	µS/cm	461	465	----	----	----	----
Moisture	----	E144/WT	0.25	%	8.17	9.92	----	----	----	----
Oxidation-reduction potential [ORP]	----	E125/WT	0.10	mV	275	284	----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	7.89	7.83	----	----	----	----
Resistivity	----	EC100R/WT	100	ohm cm	2170	2150	----	----	----	----
Inorganics										
Sulfides, acid volatile	----	E396-L/WT	0.20	mg/kg	<0.22	<0.22	----	----	----	----
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	5.0	mg/kg	146	197	----	----	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT	20	mg/kg	28	<20	----	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: TY2312964	Page	: 1 of 7
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Young Street Thunder Bay ON Canada P7E 6T9	Address	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
Telephone	: (807)624-5160	Telephone	: +1 807 623 6463
Project	: 22-146-10	Date Samples Received	: 13-Dec-2023 13:55
PO	: 12078	Issue Date	: 21-Dec-2023 13:51
C-O-C number	: ----		
Sampler	: ----		
Site	:		
Quote number	: Standing Offer - Soil - 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E396-L	04-Dec-2023	19-Dec-2023	14 days	15 days	✖ EHT	19-Dec-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E396-L	22-Nov-2023	19-Dec-2023	14 days	26 days	✖ EHTR	19-Dec-2023	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E236.Cl	04-Dec-2023	20-Dec-2023	30 days	16 days	✓	20-Dec-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E236.Cl	22-Nov-2023	20-Dec-2023	30 days	28 days	✓	20-Dec-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E236.SO4	04-Dec-2023	20-Dec-2023	30 days	16 days	✓	20-Dec-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E236.SO4	22-Nov-2023	20-Dec-2023	30 days	28 days	✓	20-Dec-2023	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E100-L	04-Dec-2023	20-Dec-2023	30 days	16 days	✓	21-Dec-2023	30 days	17 days	✓



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E100-L	22-Nov-2023	20-Dec-2023	30 days	28 days	✓	21-Dec-2023	30 days	29 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E144	04-Dec-2023	----	----	----		18-Dec-2023	----	14 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E144	22-Nov-2023	----	----	----		18-Dec-2023	----	26 days	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E125	04-Dec-2023	18-Dec-2023	180 days	14 days	✓	18-Dec-2023	180 days	14 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E125	22-Nov-2023	18-Dec-2023	180 days	26 days	✓	18-Dec-2023	180 days	26 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] 22-146-10 BH29-SS1	E108A	04-Dec-2023	19-Dec-2023	30 days	15 days	✓	20-Dec-2023	30 days	16 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] 23-318-9 BH2-SS1	E108A	22-Nov-2023	19-Dec-2023	30 days	27 days	✓	20-Dec-2023	30 days	28 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1282206	1	10	10.0	4.7	✔
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1280437	1	10	10.0	5.0	✔
Moisture Content by Gravimetry	E144	1281677	1	20	5.0	5.0	✔
ORP by Electrode	E125	1280431	1	10	10.0	5.0	✔
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A	1281770	1	20	5.0	5.0	✔
Water Extractable Chloride by IC	E236.Cl	1280439	1	4	25.0	5.0	✔
Water Extractable Sulfate by IC	E236.SO ₄	1280440	1	4	25.0	5.0	✔
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1282206	1	10	10.0	4.7	✔
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1280437	2	10	20.0	10.0	✔
Moisture Content by Gravimetry	E144	1281677	1	20	5.0	5.0	✔
ORP by Electrode	E125	1280431	1	10	10.0	5.0	✔
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A	1281770	1	20	5.0	5.0	✔
Water Extractable Chloride by IC	E236.Cl	1280439	2	4	50.0	10.0	✔
Water Extractable Sulfate by IC	E236.SO ₄	1280440	2	4	50.0	10.0	✔
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1282206	1	10	10.0	4.7	✔
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1280437	1	10	10.0	5.0	✔
Moisture Content by Gravimetry	E144	1281677	1	20	5.0	5.0	✔
Water Extractable Chloride by IC	E236.Cl	1280439	1	4	25.0	5.0	✔
Water Extractable Sulfate by IC	E236.SO ₄	1280440	1	4	25.0	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Reduction Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO ₄ ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions



Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S ₂ J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

QUALITY CONTROL REPORT

Work Order	: TY2312964	Page	: 1 of 5
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Younge Street Thunder Bay ON Canada P7E 6T9	Address	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
Telephone	:	Telephone	: +1 807 623 6463
Project	: 22-146-10	Date Samples Received	: 13-Dec-2023 13:55
PO	: 12078	Date Analysis Commenced	: 18-Dec-2023
C-O-C number	: ----	Issue Date	: 21-Dec-2023 13:50
Sampler	: ---- (807)624-5160		
Site	:		
Quote number	: Standing Offer - Soil - 2023		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Greg Pokocky	Manager - Inorganics	Waterloo Inorganics, Waterloo, Ontario
Niral Patel		Waterloo Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1280431)											
EO2311425-001	Anonymous	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	329	326	0.916%	25%	----
Physical Tests (QC Lot: 1280437)											
WT2340689-006	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.0964 mS/cm	95.1	1.36%	20%	----
Physical Tests (QC Lot: 1281677)											
HA2301304-002	Anonymous	Moisture	----	E144	0.25	%	10.4	11.1	6.89%	20%	----
Physical Tests (QC Lot: 1281770)											
TY2312964-001	23-318-9 BH2-SS1	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.89	7.93	0.506%	5%	----
Inorganics (QC Lot: 1282206)											
WT2340374-001	Anonymous	Sulfides, acid volatile	----	E396-L	0.21	mg/kg	<0.21	<0.21	0.0002	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1280439)											
TY2312964-001	23-318-9 BH2-SS1	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	146	140	3.66%	30%	----
Leachable Anions & Nutrients (QC Lot: 1280440)											
TY2312964-001	23-318-9 BH2-SS1	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	28	25	2	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid						
Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1280437)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1281677)						
Moisture	----	E144	0.25	%	<0.25	----
Inorganics (QCLot: 1282206)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 1280439)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----
Leachable Anions & Nutrients (QCLot: 1280440)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1280437)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	102	90.0	110	----
Physical Tests (QCLot: 1281677)									
Moisture	----	E144	0.25	%	50 %	99.6	90.0	110	----
Physical Tests (QCLot: 1281770)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Inorganics (QCLot: 1282206)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	2.4 mg/kg	81.7	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1280439)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	98.9	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1280440)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	98.0	80.0	120	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

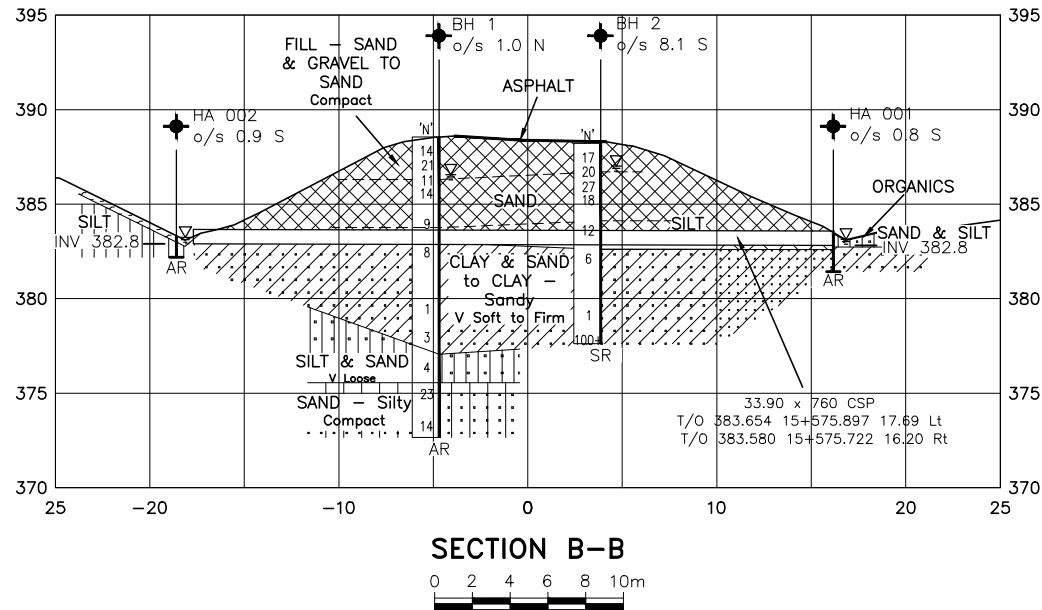
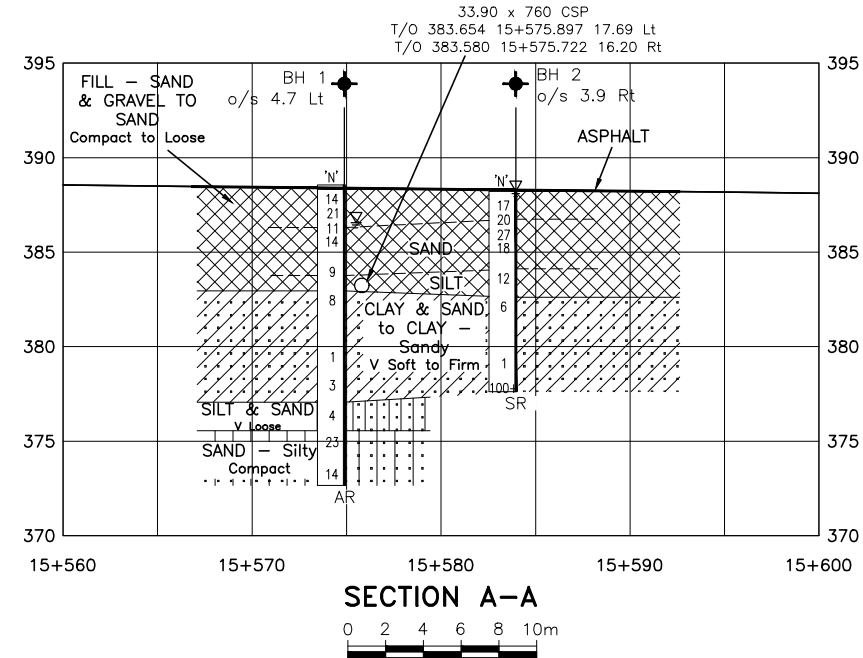
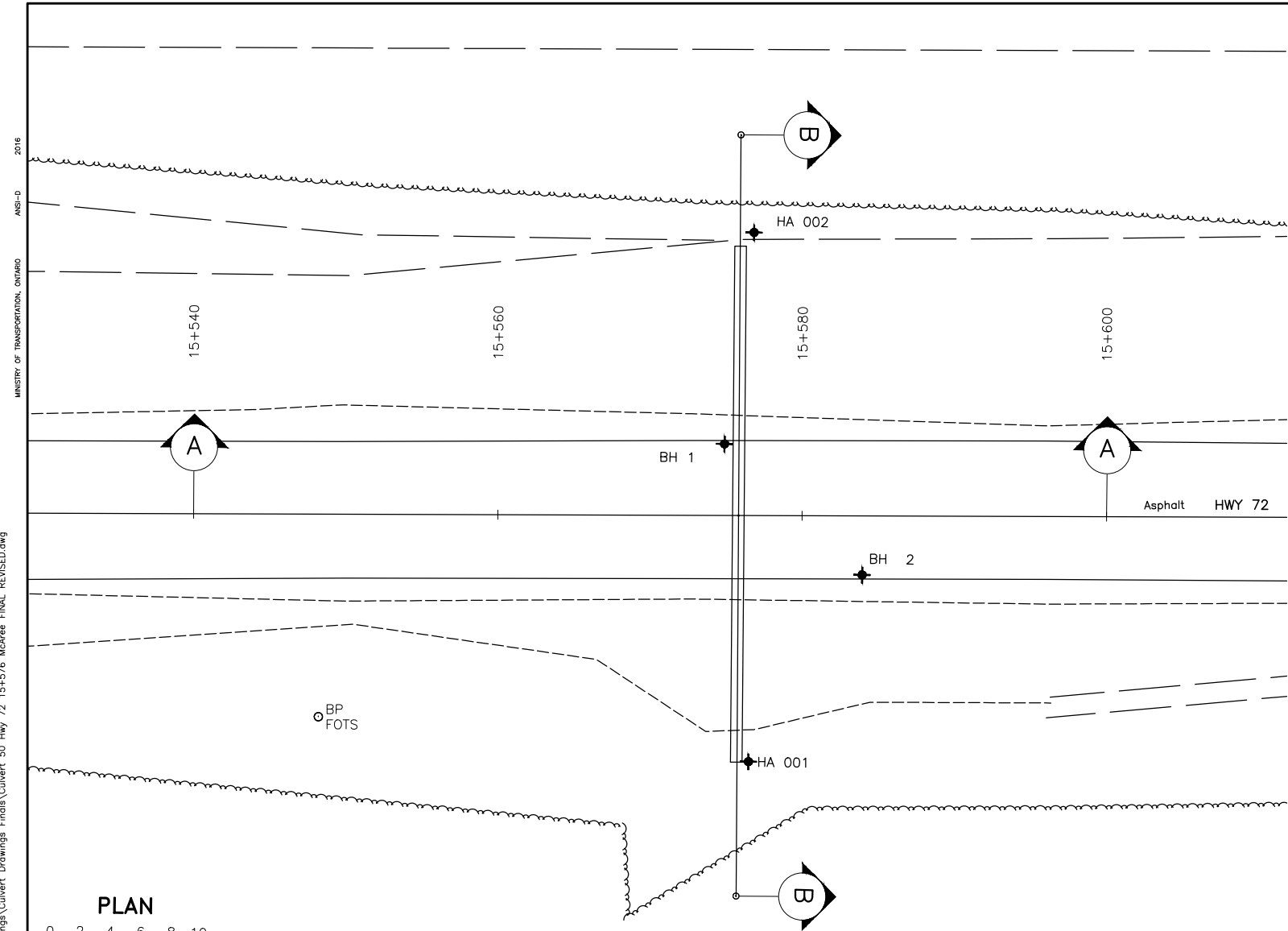
Sub-Matrix:

					Reference Material (RM) Report				
					RM Target	Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Concentration	RM	Low	High	Qualifier
Physical Tests (QCLot: 1280431)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	102	90.0	110	----
Physical Tests (QCLot: 1280437)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1970.3 µS/cm	71.2	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1280439)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	432 mg/kg	106	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1280440)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	1070 mg/kg	106	70.0	130	----



APPENDIX C
Borehole Location and Soil Strata Drawings

FILE NAME: Y:\Projects\2022\22-146 MTO, NMR Geotechnical Retainer\22-146-10 - Hwy 72 & 664 FND\Drawings\Culvert Drawings\Finals\Culvert 50 Hwy 72 15+576 McAree FINAL REVISED.dwg
MODIFIED: 2024-04-16 11:16



DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN

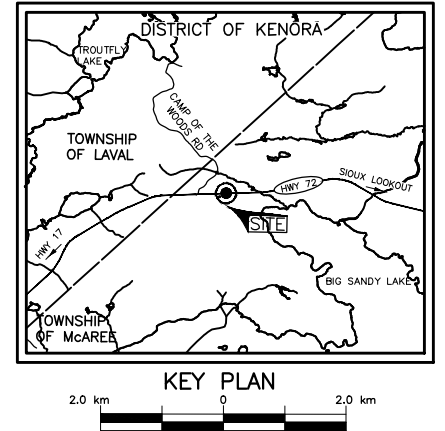
Ontario Ministry of Transportation

GEOCRES 52F16-002
CONT -
WP 6033-19-00

SOIL STRATA
STA 15+576 CULVERT #50
HIGHWAY 72, TOWNSHIP OF McAREE

SHEET
1

TBT ENGINEERING
CONSULTING GROUP



SOIL STRATA SYMBOLS			
	TOPSOIL		SAND & SILT
	FILL		SILT
	SAND & CLAY		SAND - Silty

LEGEND			
	Borehole		
	Hand Auger		
	Std Pen Test (Blows/0.3m)		
	Water Level on Completion		
	End of Hole		
	Auger Refusal		
	Spoon Refusal		
No	ELEVATION	CO-ORDINATES (MTM 16)	
		NORTH	EAST
BH 1	388.2	16 5 523 294	347 673
BH 2	388.6	16 5 523 295	347 685
HA 001	383.4	16 5 523 282	347 690
HA 002	383.3	16 5 523 304	347 664

NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS					
3	SS	CHANGES TO CULVERT NUMBER 16/04/24			
2	SS	ISSUED FOR FINAL 28/03/24			
1	SS	ISSUED FOR REVIEW			
DESIGN	XX	CHK	XX	CODE	XXXXXX
DRAWN	TG	CHK	SS	SITE	XXXXXX
				LOAD	XXXX
				DATE	19/01/24
				DWG	1

APPENDIX D
Site Photograph



Left Embankment
Looking South, June 28, 2023.



Right Embankment
Looking East, June 28, 2023.



Left Embankment
Looking West, June 28, 2023.



Right Embankment
Looking South, June 28, 2023.