



FINAL REPORT

Foundation Investigation Report

Replacement of Underpass Structure No. 11X-0160/B0

Highway 401 / Highway 62, Belleville, Ontario

MTO GWP 4053-18-00; WP 4075-18-01; Agreement 4020-E-0012

Submitted to:

Ministry of Transportation Ontario

1355 John Counter Boulevard

Kingston, Ontario K7K 0E5

Submitted by:

WSP Canada Inc.

1931 Robertson Road

Ottawa K2H 5B7

GEOCRE No.: 31C03-005

Latitude: 44.191880°

Longitude: -77.398170°

20148061B-Hwy 62

October 11, 2024



Distribution List

1 e-copy: MTO Eastern Region

1 e-copy: MTO Foundations Section

1 e-copy: WSP Canada Inc.

Table of Contents

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION AND GEOLOGY 1

 2.1 Site Description 1

 2.2 Regional Geology 1

3.0 INVESTIGATION PROCEDURES 2

 3.1 Previous (2020) Desktop Study Report 3

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS 3

 4.1 Site Stratigraphy Overview 3

 4.1.1 Surface Cover / Surficial Materials 4

 4.1.2 Fill 4

 4.1.3 Till 5

 4.1.4 Bedrock 5

 4.2 Groundwater Conditions 6

 4.3 Analytical Laboratory Testing Results 6

5.0 CLOSURE 7

TABLES

Table 1: Summary of Borehole Locations 3

Table 2: Summary of Bedrock Surface Depths and Elevations 5

Table 3: Summary of Groundwater Conditions 6

Table 4: Steel Corrosion and Sulphate Attack, Chemical Analysis 6

DRAWING

Drawing 1 – Borehole Locations and Soil Strata

APPENDICES

APPENDIX A

Borehole Records and Bedrock Core Photographs

APPENDIX B

Geotechnical Laboratory Test Results

APPENDIX C

Previous Investigation Results

APPENDIX D

Analytical Laboratory Test Results

APPENDIX E

Site Photographs

1.0 INTRODUCTION

WSP Canada Inc. (WSP, formerly Golder Associates Ltd., amalgamated with WSP in 2023) has been retained by the Ministry of Transportation, Ontario (MTO) to support future procurement-ready design phases of the widening of Highway 401 from 1 km west of Wallbridge-Loyalist Road to 4.3 km east of Highway 37 in Belleville, Ontario as part of GWP 4053-18-00, with foundation investigation services delivered under MTO Agreement No. 4020-E-0012. The overall project includes the replacement of six bridges, several structural and non-structural culverts, and operational improvements and reconfiguration of existing interchanges.

This report presents the results of the detailed foundation investigation carried out for the replacement of the Highway 401 / Highway 62 underpass (MTO Structure Site No. 11X-0160/B0).

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 Site Description

Site No. 11X-0160/B0 is located at about Station 11+150 on Highway 401 in Belleville, Ontario. The site location is shown on Drawing 1 – Key Plan.

At this location, Highway 401 has a six-lane cross-section with two eastbound and two westbound through lanes, with paved shoulders eastbound and westbound on/off ramps in a cloverleaf configuration. The through lanes are separated by a concrete median wall and steel beam guiderails present along both sides of the highway in the vicinity of the underpass structure.

Highway 62 is an undivided road with two travel lanes in each direction with an urban cross-section. Parapet walls with railing are present along the bridge and steel beam guiderails are present along both sides of Highway 62 beyond the structure. Stormwater drainage on Highway 62 is directed to existing roadside gutters and catch basins.

The existing ramps have rural cross-sections with a single lane with paved and gravel shoulders. The lands north and south of the ramps are generally grass-covered with some mature trees. Parking lots for commercial developments are present on the northeast and southwest sides of the on-ramps beyond the MTO right-of-way. A hotel is present to the southeast beyond the MTO right-of-way. The stormwater drainage in the area is directed to existing catch basins.

Site photographs showing the general conditions of the site are presented in Appendix E.

2.2 Regional Geology

As delineated in *The Physiography of Southern Ontario*¹, the proposed underpass site lies within a physiographic region known as the Napanee Plain which is characterized as a flat-to-undulating plain of limestone of the Gull River and Bobcaygeon Formations overlain by glacially worked thin overburden deposits.

¹ Chapman, L. J. and Putnam, D. F., 1984. *The Physiography of Southern Ontario*, Ontario Geological Survey. Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000. Ontario Ministry of Natural Resources

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out in two mobilizations that included advancing a total five boreholes (H62-01 to H62-05). Boreholes H62-01 and H62-03 to H62-05 were advanced between September 6 and 12, 2022. To accommodate highway closure access, Borehole H62-02 was advanced on October 21, 2022. The borehole locations are shown on Drawing 1.

The boreholes were advanced using a CME 55 drill rig supplied and operated by CCC Geotechnical & Environmental Drilling Ltd. of Ottawa, Ontario.

Soil samples were obtained using a 50 mm outer diameter split-spoon sampler in general accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586²). Soil samples were obtained at vertical sampling intervals of about 0.76 m and 1.5 m. NQ-sized bedrock core samples were obtained using rotary diamond drilling technique and a triple-tube core-barrel at Boreholes H62-02 to H62-04.

Monitoring wells were installed at Boreholes H62-03 and H62-04 to observe the groundwater level at the site. The monitoring wells consist of a 52 mm outside diameter PVC tube with a 1.5 m long slotted screen. Installation details are shown on the borehole records for H62-03 and H62-04 provided in Appendix A.

The boreholes without monitoring wells were backfilled with bentonite within the bedrock, and bentonite mixed with soil cuttings within the overburden. The boreholes were backfilled in general accordance with the intent of Ontario Regulation (O.Reg.) 903, as amended. The site conditions were restored following the completion of the field work. The monitoring wells have been left in place to allow for the monitoring of groundwater levels up to the time of construction. As part of the construction, the monitoring wells will need to be decommissioned by qualified personnel in accordance with O.Reg. 903, as amended.

The field work was supervised on a full-time basis by members of WSP's technical staff who located the boreholes in the field, directed the drilling, sampling, and in-situ testing operations, and logged the boreholes. The soil and bedrock samples were identified in the field, placed in labelled containers, and transported to WSP's laboratory in Ottawa for further examination and testing. Index and classification tests consisting of water content determinations, grain size distribution analyses, and Atterberg limits testing were carried out on selected soil samples and uniaxial compressive strength (UCS) testing was carried out on selected samples of the bedrock. The laboratory tests were carried out to MTO LS and/or ASTM Standards, as applicable, at WSP's Ottawa laboratory.

Two soil samples were submitted to Eurofins Environmental Testing Canada Inc. (Eurofins) for basic chemical analysis related to the potential corrosion of buried steel elements and sulfate attack on buried concrete elements (corrosion and sulphate attack).

The borehole locations and elevations were surveyed by WSP using a Trimble R10 GPS unit referenced to the NAD83 CSRS CBNv6-2010.0 MTM Zone 9 geodetic datum. The Trimble R10 GPS data has a vertical accuracy of approximately 0.1 m and a horizontal accuracy of approximately 0.5 m. The borehole locations, including northing and easting coordinates, ground surface elevations, and drilled depths are summarized in Table 1.

² ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

Table 1: Summary of Borehole Locations

Borehole	NAD83 CSRS CBNv6-2010.0 MTM Zone 9		Ground Surface Elevation (m)	Drilled Depths (m)	Comments
	Northing (m) (Latitude)	Easting (m) (Latitude)			
H62-01	4895045.7 (44.191880°)	233000.8 (-77.398170°)	102.4	9.5	BH terminated in overburden
H62-02	4895070.5 (44.192000°)	232981.1 (-77.398420°)	95.5	7.4	Bedrock cored 4.2 m
H62-03	4895103.3 (44.192390°)	232959.9 (-77.398690°)	94.9	5.9	Bedrock cored 3.8 m
H62-04	4895050.3 (44.191920°)	232980.4 (-77.398430°)	94.6	4.7	Bedrock cored 3.1 m
H62-05	4895128.7 (44.192620°)	232972.5 (-77.398540°)	103.2	9.2	BH terminated in overburden

3.1 Previous (2020) Desktop Study Report

A previous Desktop Study Report was carried out to summarize the existing subsurface information pertinent to Site No. 11X-0160/B0. The subsurface information and results of the original investigation are contained in the following report:

- **MTO GEOCREs No. 31C-294:** “Preliminary Foundation Investigation and Design Replacement of Highway 401 Underpass at Highway 62. Site No. 11X-0160/B0, Highway 401 Widening, Belleville, Ontario G.W.P. 4193-15-00” dated December 2020, prepared by Thurber Engineering Ltd.

The above Desktop Study Report references the four boreholes provided in following report:

- **MTO GEOCREs No. 31C-028:** Foundation Investigation, Thurlow Township, Bridge No. 2 Report No. S-500-501/55/T-61-1. Prepared by Racey, MacCallum, and Associates for the Department of Highways Ontario (DHO) dated March 17, 1955.

The original Foundation Investigation for the then proposed alignments have been reviewed and a copy of the Borehole Location and Soil Strata Drawing and borehole records are provided for reference in Appendix C. In general, the bedrock elevations encountered during the 1955 investigation are consistent with the current investigation.

4.0 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 Site Stratigraphy Overview

The subsurface soil, bedrock and groundwater conditions encountered in the boreholes and the results of in-situ testing from the investigation are shown on the Record of Borehole, and Drillhole sheets in Appendix A. The results of the in-situ field tests as presented in the borehole records and in Section 4.0, are uncorrected and are based on the use of an automatic hammer for the SPT. The results of the geotechnical laboratory testing carried out during the investigation are presented on the borehole records as well as on Figures B1 to B8 provided in Appendix B.

Photographs of the core recovered from the underlying bedrock at the boreholes are shown on Figures A1 to A6, provided in Appendix A. The results of the analytical testing completed on select soil samples are provided in Appendix D.

The borehole locations and the interpreted stratigraphic profile and cross-sections projected along the proposed underpass alignment are provided in Drawing 1.

The stratigraphic boundaries shown on the borehole and drillhole records and on the interpreted stratigraphic sections in Drawing 1 are inferred from observations of the drilling progress and non-continuous soil sampling and therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

At the borehole locations, the subsurface conditions consist of a topsoil or asphalt surface cover over a non-cohesive fill, and overlying glacial till, all underlain by limestone bedrock.

A more detailed description of the overburden soil deposits, and bedrock geology conditions encountered during the field investigation is provided in the following sections.

4.1.1 Surface Cover / Surficial Materials

Topsoil was encountered at the ground surface at Boreholes H62-03 and H62-04, with thickness of about 100 mm and 300 mm, respectively.

Asphaltic concrete with a thickness of approximately 200 mm was encountered at the ground surface at Boreholes H62-01, H62-02, and H62-05.

4.1.2 Fill

Fill consisting primarily of sand and gravel with varying amounts of silt and clay was encountered below the asphalt at Boreholes H62-01, H62-02, and H62-05. The top of this layer was encountered at elevations of 102.2 m and 103.2 m at Boreholes H62-01 and H62-05, respectively, which were advanced through the Highway 62 road surface overtop the approach embankments. The top of this layer was encountered at an elevation of 95.3 m at Borehole H62-02 which was advanced through the median of Highway 401. At Boreholes H62-01 and H62-05, the fill thickness was 6.5 m and 5.0 m while at Borehole H62-02, the fill thickness was 1.3 m.

The SPT N-values within the fill range from 3 to 61 blows per 0.3 m of penetration but more commonly 13 to 43 blows per 0.3 m of penetration, indicating a compact to dense state of compactness.

The measured water content of six samples of the fill tested ranged from 2% to 10%.

The results of grain size distribution testing carried out on six samples of the fill material are provided in Figures B1 and B3 in Appendix B. The results of Atterberg limits testing completed on one sample of the fill material indicate a liquid limit of 17, a plastic limit of 12, and a plasticity index of 4. The Atterberg limits analysis results are provided on Figure B2 in Appendix B and indicate the fines fraction of the fill consists of clayey silt-silt (CL-ML).

4.1.3 Till

A till deposit varying in composition from sandy silty clay to gravelly clayey sand-silty sand to sandy clayey gravel-silty gravel, containing cobbles and boulders, was encountered below the fill material at Boreholes H62-01, H62-02, and H62-05; and below the topsoil at Boreholes H62-03 and H62-04. The top of this deposit was encountered at elevations ranging from 94.0 m to 98.0 m. Boreholes H62-01 and H62-05 were terminated within this layer. Where fully encountered, the thickness of this layer ranges from about 1.0 m to 2.0 m. The SPT N-values recorded in this layer range from 11 to greater than 100 blows per 0.3 m of penetration but more commonly 19 to 34 indicating a generally compact to dense state of compactness. The higher blow counts (e.g., 146/180 mm) recorded in the till may have been influenced by the presence of cobbles or boulders within the till, rather than the consistency of the soil matrix.

The measured water content of seven samples of the till ranged from 8% to 18%. The results of grain size distribution testing carried out on seven samples of this material are provided in Figures B4 and B6 in Appendix B. The results of Atterberg limits testing completed on two samples of the till material indicate liquid limits of 36 and 19, plastic limits of 20 and 14, and plasticity indices of 17 and 6. The Atterberg limits analysis results are provided on Figures B5 and B7 in Appendix B and indicate the fines fraction of this deposit consists of clayey silt – silt (CL-ML) to a silty clay (CI).

4.1.4 Bedrock

The overburden soils are underlain by limestone bedrock.

Table 2 summarizes the depths and the elevations of the bedrock surface as encountered at the borehole locations from both the current and 1955 investigations.

Table 2: Summary of Bedrock Surface Depths and Elevations

Borehole	Existing Ground Surface Elevation (m)	Depth to Bedrock Surface (m)	Bedrock Surface Elevation (m)
H62-02	95.5	3.2	92.3
H62-03	94.9	2.1	92.8
H62-04	94.6	1.6	93.0
TWP-01	94.9	2.3	92.6
TWP-02	94.4	1.5	92.9
TWP-03	94.3	0.9	93.4
TWP-04	94.5	1.2	93.3

Rock Quality Designation (RQD) values measured on the recovered limestone bedrock core samples range from about 10% to 97%, but more commonly 40% to 90% indicating poor to excellent rock quality. The results of UCS testing carried out on three limestone bedrock core samples measured UCS values ranging from 98 MPa to 123 MPa, indicating a strong to very strong bedrock. The results of UCS testing are provided in Figure B8 in Appendix B.

4.2 Groundwater Conditions

Monitoring wells were installed at Boreholes H62-03 and H62-04 to measure the stabilized groundwater level at the site. The groundwater levels measured in the monitoring wells, and the open-hole water levels measured upon completion of drilling, are presented in Table 3.

It is expected that the groundwater levels will be subject to fluctuations both seasonally and as a result of precipitation events.

Table 3: Summary of Groundwater Conditions

Borehole	Screened Interval	Ground Surface Elevation (m)	Depth to Groundwater Level (m)	Groundwater Elevation (m)	Date
Monitoring Well Water Levels					
H62-03	Till	94.9	0.9	94.0	September 23, 2022
			0.9	94.0	December 14, 2022
			0.8	94.1	February 16, 2024
H62-04	Till	94.6	0.6	94.0	September 21, 2022
			0.5	93.9	December 14, 2022
			0.9	93.7	February 16, 2024
Open Borehole Water Levels					
H62-01	N/A	102.4	8.8	93.6	September 8, 2022
H62-02	N/A	95.5	1.7	93.8	October 21, 2022
H62-05	N/A	103.2	8.2	95.0	September 6, 2022

4.3 Analytical Laboratory Testing Results

Two soil samples were submitted to Eurofins for chemical testing/analysis related to the potential corrosion of exposed buried steel and potential sulphate attack on buried concrete elements (corrosion and sulphate attack). The test results are provided in Appendix D and are summarized in Table 4.

Table 4: Steel Corrosion and Sulphate Attack, Chemical Analysis

Borehole	Sample Depth (m)	Chloride (%)	Sulphate (%)	Electrical Conductivity (mS/cm)	pH	Resistivity (ohm-cm)
H62-01	3.8 - 4.4	0.135	0.03	2.93	8.33	341
H62-05	1.5 - 2.1	0.083	0.02	2.03	8.89	493

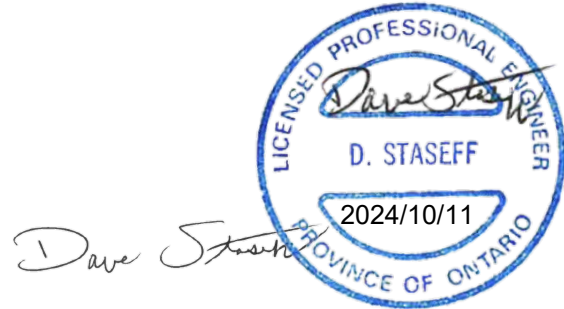
5.0 CLOSURE

This report was prepared by Ben Waechter, EIT and Kinjal Gajjar and was reviewed by Kenton Power, P.Eng., a senior geotechnical engineer with WSP. David Staseff, P.Eng., a Senior Principal Geotechnical Engineer and a MTO Principal Foundations Contact for WSP conducted an independent technical and quality review of this report.

WSP Canada Inc.



Kenton Power, P.Eng.
Geotechnical Engineer



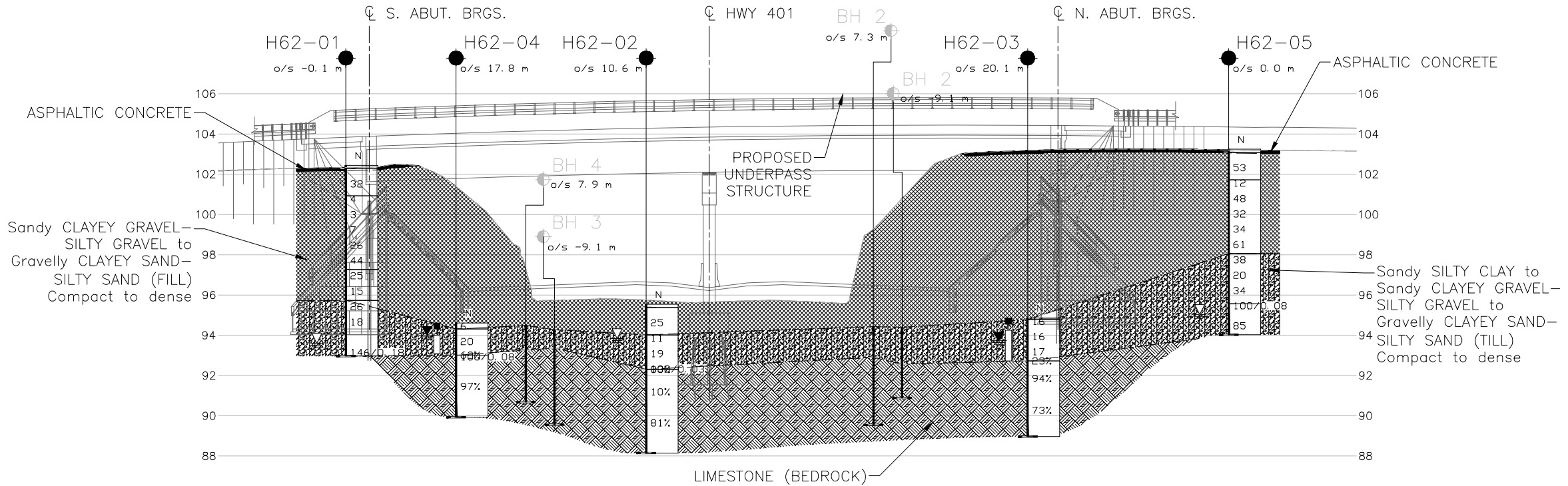
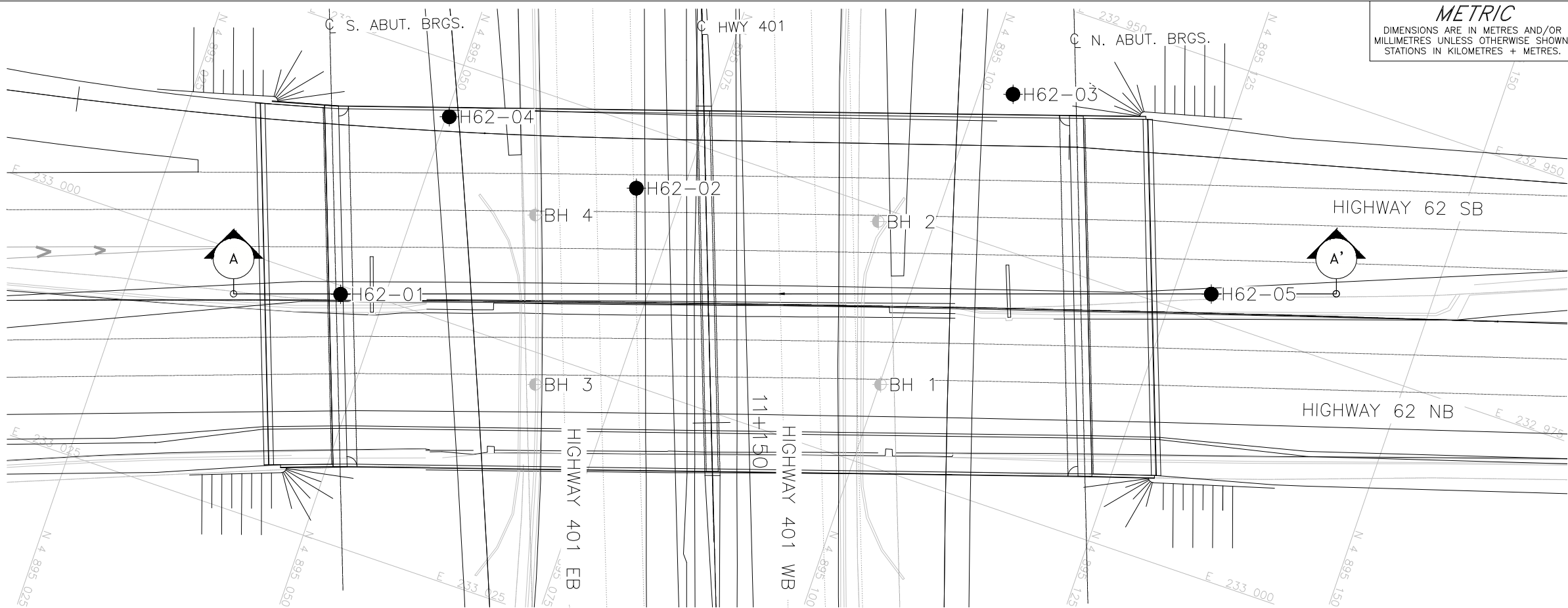
David Staseff, P.Eng.
MTO Principal Foundations Contact

BW/KG/KCP/DS/yj

[https://wsponline.sharepoint.com/sites/gld-152692/project files/6 deliverables/04-hwy 62 up/final/gwp 4053-18-00 rev0 final fir site 11x-0160 \(20148061b-hwy 62\) 2024-10-08.docx](https://wsponline.sharepoint.com/sites/gld-152692/project%20files/6%20deliverables/04-hwy%2062%20up/final/gwp%204053-18-00%20rev0%20final%20fir%20site%2011x-0160%20(20148061b-hwy%2062)%202024-10-08.docx)

DRAWING

Drawing – 1 Borehole Locations and Soil Strata



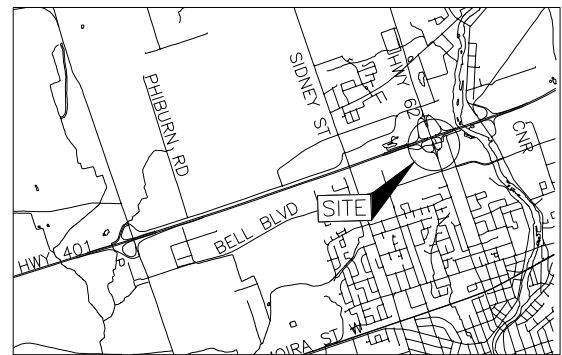
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 4075-18-01
WP No. 4075-18-01



HIGHWAY 401 WIDENING
REPLACEMENT OF STRUCTURE NO. 11X-0160/B0
BOREHOLE LOCATIONS AND SOIL
STRATA

SHEET



LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation Geocres 31C-294
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- WL in piezometer, measured on February 16, 2024
- WL upon completion of drilling

BOREHOLE CO-ORDINATES NAD83 (CSRS) MTM ZONE 9			
No.	ELEVATION	NORTHING	EASTING
H62-01	102.4	4895045.7	233000.8
H62-02	95.5	4895070.5	232981.1
H62-03	94.9	4895103.3	232959.9
H62-04	94.6	4895050.3	232980.4
H62-05	103.2	4895128.7	232972.5
BH 1	94.4	4895100.1	232991.9
BH 2	94.4	4895094.6	232976.4
BH 3	94.3	4895067.2	233003.1
BH 4	94.5	4895061.7	232986.9

Structural Site Location: Latitude: 44.191880 Longitude: -77.398170

NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Procurement-Ready Design Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCES

Base plans provided in digital format by MTO, drawing file nos 3216057_EP.dwg and 3216057_Hwy 401 _8 Lanes Design_ACAD.dwg, received Oct. 13 2022, and General Arrangement Drawing file no. S16M-01435-01-300-001XG.dwg, received January 30, 2023.



NO.	DATE	BY	REVISION
Geocres No. 31C03-005			
HWY. 401		PROJECT NO. 20148061B	
SUBM'D. BW		DATE: 10/9/2024	
DRAWN: SA		SITE: 11X-0160/B0	
CHKD. BW		APPD. DS	
CHKD. KCP		DWG. 1	

APPENDIX A

**Borehole Records and
Bedrock Core Photographs**

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse	19 to 75	0.75 to 3
	Fine	4.75 to 19	(4) to 0.75
		2.00 to 4.75	(10) to (4)
SAND	Coarse	0.425 to 2.00	(40) to (10)
	Medium	0.075 to 0.425	(200) to (40)
	Fine		
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS^{1,2}

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (<i>i.e.</i> , SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (<i>i.e.</i> , some sand)
≤ 10	trace (<i>i.e.</i> , trace fines)

1. Only applicable to components not described by Primary Group Name.

2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (*q_t*), porewater pressure (*u*) and sleeve friction (*f_s*) are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL, w _p	plastic limit
LL, w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

COARSE-GRAINED SOILS

Compactness¹

Term	SPT 'N' (blows/0.3m) ²
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

1. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grain size. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

2. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)

σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_P or PL	plastic limit
I_P or PI	plasticity index = $(w_L - w_P)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
$C_{a(e)}$	secondary compression index
C_a	rate of secondary compression
$C_{a(e)}$	modified secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
c'	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q or q'	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ .
where $\gamma = \rho \cdot g$ (i.e., mass density multiplied by
acceleration due to gravity)

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERING CLASSIFICATION

Fresh (W1): no visible sign of rock material weathering.

Slightly Weathered (W2): discoloration indicates weathering of rock mass material on discontinuity surfaces. **Less than 5%** of rock mass is altered or weathered.

Moderately Weathered (W3): less than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Highly Weathered (W4): more than 50% of the rock mass is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.

Completely Weathered (W5): 100% of the rock mass is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

Residual Soil (W6): all rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, as measured along the centerline axis of the core, relative to the length of the total core run. RQD varies from 0% for completely broken core to 100% for core in solid segments.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole, a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

AXJ Axial Joint	KV Karstic Void
BD Bedding	K Slickensided
BC Broken Core	LC Lost Core
CC Continuous Core	MB Mechanical Break
CL Closed	PL Planar
CO Contact	PO Polished
CU Curved	RO Rough
CT Coated	SA Slightly Altered
FLT Fault	SH Shear
FOL Foliation	SM Smooth
FR Fracture	SR Slightly Rough
GO Gouge	SY Stylolite
IN Infilled	UN Undulating
IR Irregular	VN Vein
JN Joint	VR Very Rough

ISRM Intact Rock Material Strength Classification

Grade	Description	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak rock	0.25 – 1.0
R1	Very weak rock	1.0 – 5.0
R2	Weak rock	5.0 – 25
R3	Medium strong rock	25 – 50
R4	Strong rock	50 -100
R5	Very strong rock	100 -250
R6	Extremely strong rock	>250



PROJECT		20148061B		RECORD OF BOREHOLE No H62-01		SHEET 1 OF 1		METRIC								
G.W.P.		4053-18-00		LOCATION		N 4895045.7; E 233000.8 MTM NAD 83 ZONE 9 (LAT. 44.191880; LONG. -77.398170)		ORIGINATED BY		BW						
DIST		Eastern HWY 401		BOREHOLE TYPE		Power Auger, 200 mm Dia. (Hollow Stem)		COMPILED BY		RS						
DATUM		Geodetic		DATE		September 8, 2022		CHECKED BY		KCP						
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
102.4	GROUND SURFACE															
0.0	ASPHALTIC CONCRETE															
0.2	CLAYEY SAND-SILTY SAND (SC-SM), and gravel, contains cobbles (FILL) Dense Brown to dark brown and white sections Moist		1	GS	-											
			2	SS	32											37 43 (20)
100.9																
1.5	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), contains cobbles and boulders (FILL) Very loose to compact Brown to dark brown and white spots Moist		3	SS	4											
			4	SS	3											17 39 31 13
			5	SS	7											
			6	SS	26											
97.8																
4.6	Sandy CLAYEY GRAVEL-SILTY GRAVEL (GC-GM), contains cobbles and boulders (FILL) Dense to compact Brown to dark brown and white spots Moist		7	SS	44											48 33 (19)
			8	SS	25											
			9	SS	15											
95.7																
6.7	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), contains cobbles and boulders (TILL) Compact Brown Moist to wet		10	SS	26											33 33 (34)
			11	SS	18											
92.9			12	SS	46/0.18											22 34 33 11
9.5	END OF BOREHOLE															
	NOTE: 1. Groundwater level measured at a depth of 8.8 m below ground surface (Elev. 93.6 m) upon completion of drilling.															



PROJECT		RECORD OF BOREHOLE		No H62-02		SHEET 1 OF 2		METRIC							
G.W.P. 4053-18-00		LOCATION		N 4895070.5; E 232981.1 MTM NAD 83 ZONE 9 (LAT. 44.192000; LONG. -77.398420)		ORIGINATED BY		BW							
DIST Eastern HWY 401		BOREHOLE TYPE		Power Auger, 200 mm Dia. (Hollow Stem), NQ Coring		COMPILED BY		RS							
DATUM Geodetic		DATE		October 21, 2022		CHECKED BY		KCP							
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
95.5	GROUND SURFACE														
0.0	ASPHALTIC CONCRETE														
0.2	Gravelly SILTY SAND (SM) to SILTY GRAVEL (GW), and sand (FILL) Compact Brown and grey Moist		1	AS	-										
			2	SS	25										
94.0															
1.5	Sandy SILTY CLAY (CI), some gravel (TILL) Stiff to very stiff Brown to dark brown Wet		3	SS	11										18 26 33 23
			4	SS	19										
92.3			5	SS	100/0.03										
3.2	LIMESTONE (BEDROCK)														
	Bedrock cored from 3.2 m to 7.4 m For rock coring details see Record of Drillhole H62-02		1	RC	REC 100%										RQD = 83%
			2	RC	REC 100%										RQD = 10%
			3	RC	REC 100%										RQD = 81%
88.1															
7.4	END OF BOREHOLE														
	NOTE: 1. Groundwater level measured at a depth of 1.7 m below ground surface (Elev. 93.8 m) prior to rock coring.														

PROJECT: 20148061B

RECORD OF DRILLHOLE: H62-02

SHEET 2 OF 2

LOCATION: N 4895070.50 ;E 232981.10

DRILLING DATE: October 21, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES	PIEZOMETER
						RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS	DISCONTINUITY DATA				WEATH- ERING INDEX	Diametral Point Load Index (MPa)					
						TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jzon							
						88.88	88.88	88.88	88.88	88.88					W1						
						88.88	88.88	88.88	88.88	88.88					W2						
						88.88	88.88	88.88	88.88	88.88					W3						
						88.88	88.88	88.88	88.88	88.88					W4						
						88.88	88.88	88.88	88.88	88.88					W5						
						88.88	88.88	88.88	88.88	88.88					W6						
						88.88	88.88	88.88	88.88	88.88					W7						
						88.88	88.88	88.88	88.88	88.88					W8						
						88.88	88.88	88.88	88.88	88.88					W9						
						88.88	88.88	88.88	88.88	88.88					W10						
						88.88	88.88	88.88	88.88	88.88					W11						
						88.88	88.88	88.88	88.88	88.88					W12						
						88.88	88.88	88.88	88.88	88.88					W13						
						88.88	88.88	88.88	88.88	88.88					W14						
						88.88	88.88	88.88	88.88	88.88					W15						
						88.88	88.88	88.88	88.88	88.88					W16						
						88.88	88.88	88.88	88.88	88.88					W17						
						88.88	88.88	88.88	88.88	88.88					W18						
						88.88	88.88	88.88	88.88	88.88					W19						
						88.88	88.88	88.88	88.88	88.88					W20						
						88.88	88.88	88.88	88.88	88.88					W21						
						88.88	88.88	88.88	88.88	88.88					W22						
						88.88	88.88	88.88	88.88	88.88					W23						
						88.88	88.88	88.88	88.88	88.88					W24						
						88.88	88.88	88.88	88.88	88.88					W25						
						88.88	88.88	88.88	88.88	88.88					W26						
						88.88	88.88	88.88	88.88	88.88					W27						
						88.88	88.88	88.88	88.88	88.88					W28						
						88.88	88.88	88.88	88.88	88.88					W29						
						88.88	88.88	88.88	88.88	88.88					W30						
						88.88	88.88	88.88	88.88	88.88					W31						
						88.88	88.88	88.88	88.88	88.88					W32						
						88.88	88.88	88.88	88.88	88.88					W33						
						88.88	88.88	88.88	88.88	88.88					W34						
						88.88	88.88	88.88	88.88	88.88					W35						
						88.88	88.88	88.88	88.88	88.88					W36						
						88.88	88.88	88.88	88.88	88.88					W37						
						88.88	88.88	88.88	88.88	88.88					W38						
						88.88	88.88	88.88	88.88	88.88					W39						
						88.88	88.88	88.88	88.88	88.88					W40						
						88.88	88.88	88.88	88.88	88.88					W41						
						88.88	88.88	88.88	88.88	88.88					W42						
						88.88	88.88	88.88	88.88	88.88					W43						
						88.88	88.88	88.88	88.88	88.88					W44						
						88.88	88.88	88.88	88.88	88.88					W45						
						88.88	88.88	88.88	88.88	88.88					W46						
						88.88	88.88	88.88	88.88	88.88					W47						
						88.88	88.88	88.88	88.88	88.88					W48						
						88.88	88.88	88.88	88.88	88.88					W49						
						88.88	88.88	88.88	88.88	88.88					W50						
						88.88	88.88	88.88	88.88	88.88					W51						
						88.88	88.88	88.88	88.88	88.88					W52						
						88.88	88.88	88.88	88.88	88.88					W53						
						88.88	88.88	88.88	88.88	88.88					W54						
						88.88	88.88	88.88	88.88	88.88					W55						
						88.88	88.88	88.88	88.88	88.88					W56						
						88.88	88.88	88.88	88.88	88.88					W57						
						88.88	88.88	88.88	88.88	88.88					W58						
						88.88	88.88	88.88	88.88	88.88					W59						
						88.88	88.88	88.88	88.88	88.88					W60						
						88.88	88.88	88.88	88.88	88.88					W61						
						88.88	88.88	88.88	88.88	88.88					W62						
						88.88	88.88	88.88	88.88	88.88					W63						
						88.88	88.88	88.88	88.88	88.88					W64						
						88.88	88.88	88.88	88.88	88.88					W65						
						88.88	88.88	88.88	88.88	88.88					W66						
						88.88	88.88	88.88	88.88	88.88					W67						
						88.88	88.88	88.88	88.88	88.88					W68						
						88.88	88.88	88.88	88.88	88.88					W69						
						88.88	88.88	88.88	88.88	88.88					W70						
						88.88	88.88	88.88	88.88	88.88					W71						
						88.88	88.88	88.88	88.88	88.88					W72						
						88.88	88.88	88.88	88.88	88.88					W73						
						88.88	88.88	88.88	88.88	88.88					W74						
						88.88	88.88	88.88	88.88	88.88					W75						
						88.88	88.88	88.88	88.88	88.88					W76						
						88.88	88.88	88.88	88.88	88.88					W77						
						88.88	88.88	88.88	88.88	88.88					W78						
						88.88	88.88	88.88	88.88	88.88					W79						
						88.88	88.88	88.88	88.88	88.88					W80						
						88.88	88.88	88.88	88.88	88.88					W81						
						88.88	88.88	88.88	88.88	88.88					W82						
						88.88	88.88	88.88	88.88	88.88					W83						
						88.88	88.88	88.88	88.88	88.88					W84						
						88.88	88.88	88.88	88.88	88.88					W85						



PROJECT		RECORD OF BOREHOLE		No H62-03		SHEET 1 OF 2		METRIC													
G.W.P.		LOCATION		N 4895103.3; E 232959.9 MTM NAD 83 ZONE 9 (LAT. 44.192390; LONG. -77.398690)		ORIGINATED BY		BW													
DIST		HWY		BOREHOLE TYPE		COMPILED BY		RS													
DATUM		DATE		September 12, 2022		CHECKED BY		KCP													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20	40	60	80	100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	GR	SA	SI	CL
94.9	0.0	GROUND SURFACE																			
94.9	0.1	Gravelly SILTY SAND (SM), contains rootlets (TOPSOIL) Compact Brown Moist		1	SS	16															
94.9	0.2	Sandy CLAYEY GRAVEL-SILTY GRAVEL (GC-GM) (TILL) Compact Brown Wet		2	SS	16															
94.9	0.3			3	SS	17															
92.8	2.1	LIMESTONE (BEDROCK)																			
92.8	2.1	Bedrock cored from 2.1 m to 5.9 m		1	RC	REC 56%															
92.8	2.1	For rock coring details see Record of Drillhole H62-03		2	RC	REC 100%															
92.8	2.1			3	RC	REC 100%															
89.0	5.9	END OF BOREHOLE																			
89.0	5.9	NOTE: 1. Water level measured in monitoring well: Date Depth (m) Elev. (m) 21-Sep-22 0.9 94.0 14-Dec-22 0.9 94.0 16-Feb-24 0.8 94.1																			

PROJECT: 20148061B

RECORD OF DRILLHOLE: H62-03

SHEET 2 OF 2

LOCATION: N 4895103.29 ;E 232959.90

DRILLING DATE: September 12, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY																		FEATURES	PIEZOMETER																																																																																																																																																																																																																																																																																																																																																																																																																																												
						FLUSH RETURN	RECOVERY		R.Q.D. %	FRACT. INDEX PER	DISCONTINUITY DATA					WEATH- ERING INDEX			Diametral Point Load Index (MPa)																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							TOTAL CORE %	SOLID CORE %			DIP W/L CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jzon	W1	W2	W3		W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																															
																							000000			000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000

DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP



PROJECT 20148061B			RECORD OF BOREHOLE No H62-04			SHEET 1 OF 2			METRIC																										
G.W.P. 4053-18-00			LOCATION N 4895050.3; E 232980.4 MTM NAD 83 ZONE 9 (LAT. 44.191920; LONG. -77.398430)			ORIGINATED BY BW																													
DIST Eastern HWY 401			BOREHOLE TYPE Power Auger, 200 mm Dia. (Hollow Stem), NQ Coring			COMPILED BY RS																													
DATUM Geodetic			DATE September 9, 2022			CHECKED BY KCP																													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			ELEVATION SCALE			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)														
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																													
94.6	0.0	GROUND SURFACE																																	
94.3	0.3	TOPSOIL - SILTY CLAYEY SAND (SC), contains rootlets Brown to dark brown Moist		1	SS	6																													
		CLAYEY GRAVEL-SILTY GRAVEL (GC-GM), some sand, contains cobbles and boulders (TILL) Compact Brown Wet		2	SS	20																													
93.0	1.6	LIMESTONE (BEDROCK)		3	SS	100/0.0																													
		Bedrock cored from 1.6 m to 4.7 m For rock coring details see Record of Drillhole H62-04		1	RC	REC 97%																													
				2	RC	REC 100%																													
89.9	4.7	END OF BOREHOLE																																	
<p>NOTE:</p> <p>1. Water level measured in monitoring well:</p> <table><thead><tr><th>Date</th><th>Depth (m)</th><th>Elev. (m)</th></tr></thead><tbody><tr><td>23-Sep-22</td><td>0.6</td><td>94.0</td></tr><tr><td>14-Dec-22</td><td>0.5</td><td>94.1</td></tr><tr><td>16-Feb-24</td><td>0.9</td><td>93.7</td></tr></tbody></table>																								Date	Depth (m)	Elev. (m)	23-Sep-22	0.6	94.0	14-Dec-22	0.5	94.1	16-Feb-24	0.9	93.7
Date	Depth (m)	Elev. (m)																																	
23-Sep-22	0.6	94.0																																	
14-Dec-22	0.5	94.1																																	
16-Feb-24	0.9	93.7																																	

GTA-MTO 001 S:\CLIENTS\MTOWHY_401_BELLEVILLE\02_DATA\GINT\HWY_401_BELLEVILLE.GPJ GAL-GTA.GDT 9/19/24

PROJECT: 20148061B

RECORD OF DRILLHOLE: H62-04

SHEET 2 OF 2

LOCATION: N 4895050.31 ;E 232980.37

DRILLING DATE: September 9, 2022

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 55

DRILLING CONTRACTOR: CCC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	FLUSH RETURN	NOTE: For abbreviations, symbols and descriptions refer to LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY														FEATURES	PIEZOMETER
							RECOVERY		R.Q.D. %	FRACT. INDEX PER	DIP w.r.t CORE AXIS °/°	DISCONTINUITY DATA				WEATH- ERING INDEX	Diametral Point Load Index (MPa)					
							TOTAL CORE %	SOLID CORE %				TYPE AND SURFACE DESCRIPTION	Jr	Ja	Jzon							
																		80 60 40 20	80 60 40 20	80 60 40 20		
2	Rotary Drill NQ Coring	Continued from Record of Borehole H62-04 Fresh to slightly weathered, light to dark grey banded black in areas, fine grained, non to slightly porous, fair to excellent quality, strong LIMESTONE with shale beds interbedded <																				

DEPTH SCALE

1 : 50



LOGGED: BW

CHECKED: KCP



PROJECT		RECORD OF BOREHOLE		No H62-05		SHEET 1 OF 1		METRIC																	
G.W.P.		LOCATION		N 4895128.7; E 232972.5 MTM NAD 83 ZONE 9 (LAT. 44.192620; LONG. -77.398540)		ORIGINATED BY		BW																	
DIST		HWY		BOREHOLE TYPE		COMPILED BY		RS																	
DATUM		DATE		September 6, 2022		CHECKED BY		KCP																	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	20	40	60	80	100	20	40	60	80	100	W _p	W	W _L	γ	GR	SA	SI	CL
103.2	0.0	GROUND SURFACE																							
0.0	0.2	ASPHALTIC CONCRETE																							
		Sandy CLAYEY GRAVEL-SILTY GRAVEL (GC-GM) (FILL)		1	GS	-	103																		
		Very dense																							
		Brown and grey																							
		Moist		2	SS	53	102																		
101.7	1.5	CLAYEY GRAVEL-SILTY GRAVEL (GC-GM), and sand, contains cobbles and boulders (FILL)		3	SS	12	101																		
		Compact to very dense																							
		Brown																							
		Moist		4	SS	48	100																		
				5	SS	32	99																		
				6	SS	34	98																		
				7	SS	61	97																		
98.0	5.2	CLAYEY SAND-SILTY SAND (SC-SM), some gravel, trace wood pieces, contains cobbles and boulders (TILL)		8	SS	38	96																		
		Compact to dense																							
		Brown																							
		Moist		9	SS	20	95																		
				10	SS	34	94																		
95.5	7.7	Gravelly CLAYEY SAND-SILTY SAND (SC-SM), contains cobbles and boulders (TILL)		11	SS	100/0.08	93																		
		Very dense																							
		Brown																							
		Wet		12	SS	85	92																		
94.0	9.2	END OF BOREHOLE																							
		NOTE:																							
		1. Groundwater level measured at a depth of 8.2 m below ground surface (Elev. 95.0 m) prior to running casing.																							

BH H62-02 (Dry)
Core Box 1 & 2 of 2

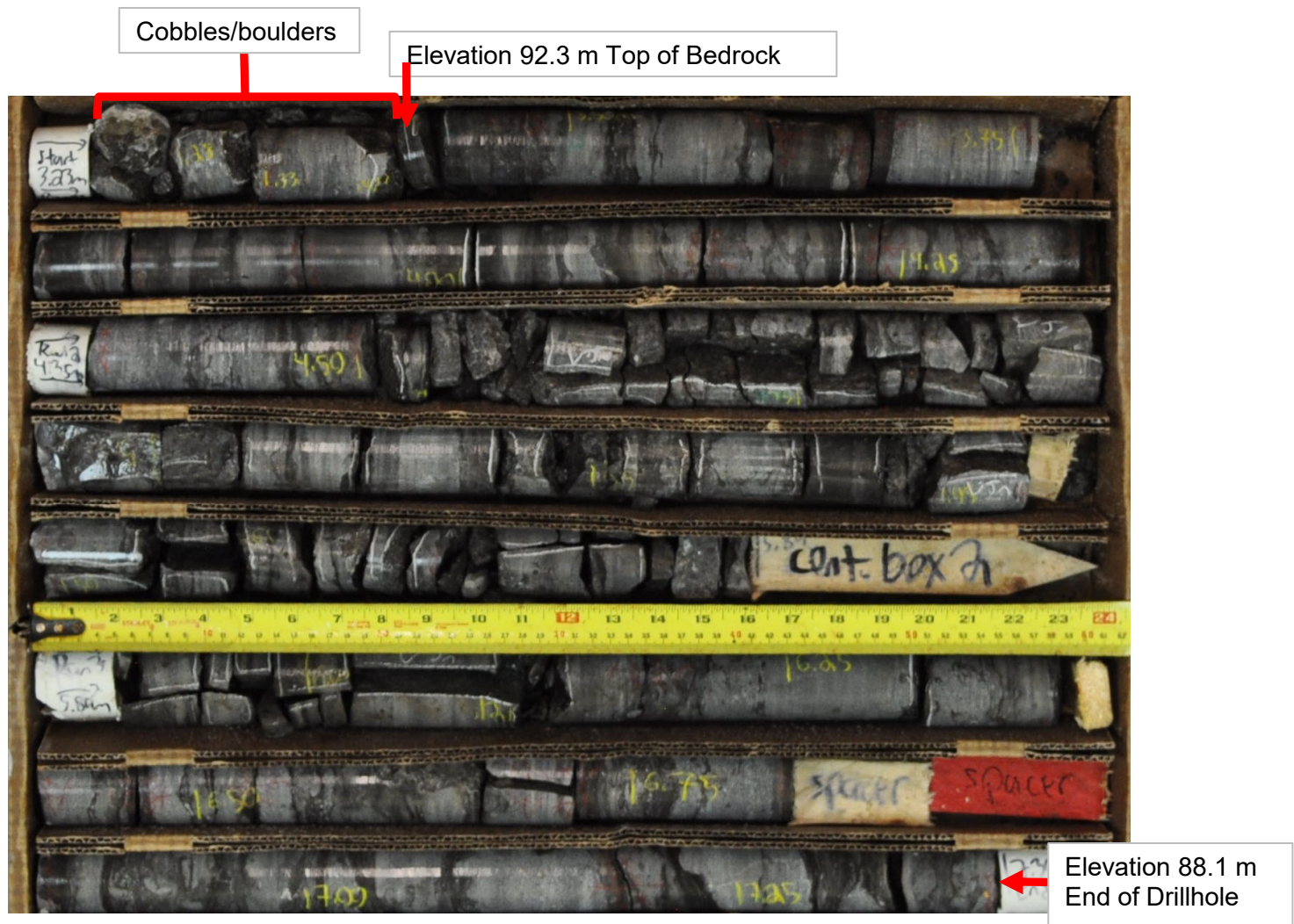


Replacement of Underpass Structure No. 11X-0160/B0
GWP 4053-18-00 WP 4075-18-01
Highway 401/ Highway 62 Interchange
Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A1

BH H62-02 (Wet)
Core Box 1 & 2 of 2



Replacement of Underpass Structure No. 11X-0160/B0
GWP 4053-18-00 WP 4075-18-01
Highway 401/ Highway 62 Interchange
Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A2

BH H62-03 (Dry)
Core Box 1 & 2 of 2



Note:

1. Clay and crushed rock seam from Elevations 90.15 to 90.13 m



Replacement of Underpass Structure No. 11X-0160/B0

GWP 4053-18-00 WP 4075-18-01

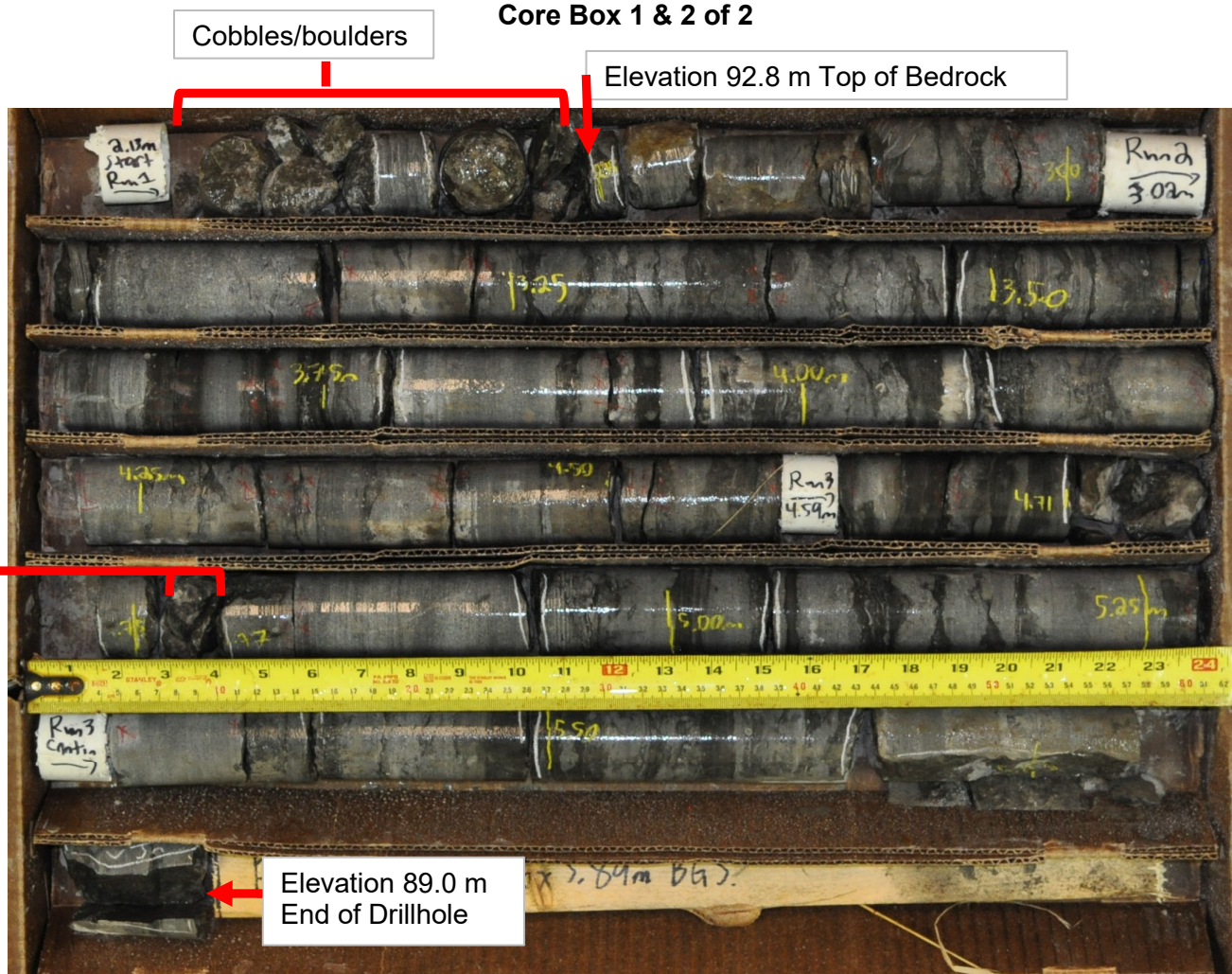
Highway 401/ Highway 62 Interchange

Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A3

BH H62-03 (Wet)
Core Box 1 & 2 of 2



Note:
 1. Clay and crushed rock seam from Elevations 90.15 to 90.13 m

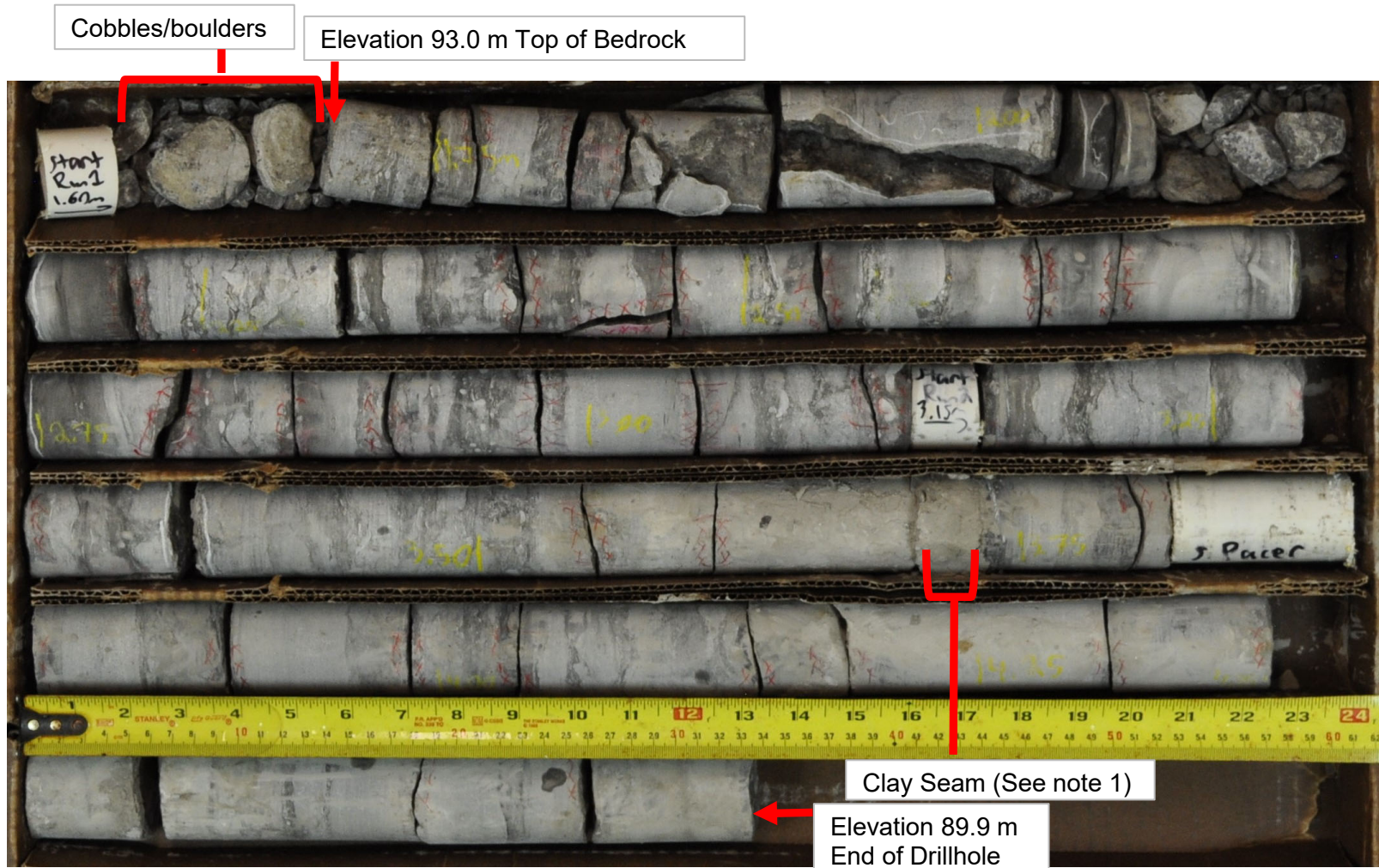


Replacement of Underpass Structure No. 11X-0160/B0
GWP 4053-18-00 WP 4075-18-01
Highway 401/ Highway 62 Interchange
Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A4

BH H62-04 (Dry)
Core Box 1 & 2 of 2



Note:
1. Clay seam from Elevations 90.90 to 90.87 m



Replacement of Underpass Structure No. 11X-0160/B0
GWP 4053-18-00 WP 4075-18-01
Highway 401/ Highway 62 Interchange
Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A5

BH H62-04 (Wet)
Core Box 1 & 2 of 2



Note:

1. Clay seam from Elevations 90.90 to 90.87 m



Replacement of Underpass Structure No. 11X-0160/B0

GWP 4053-18-00 WP 4075-18-01

Highway 401/ Highway 62 Interchange

Belleville, Ontario

Project No.	20148061B
Drawn:	BW/ KG
Date:	2024-09-20
Checked:	KCP
Review:	DS

Figure A6

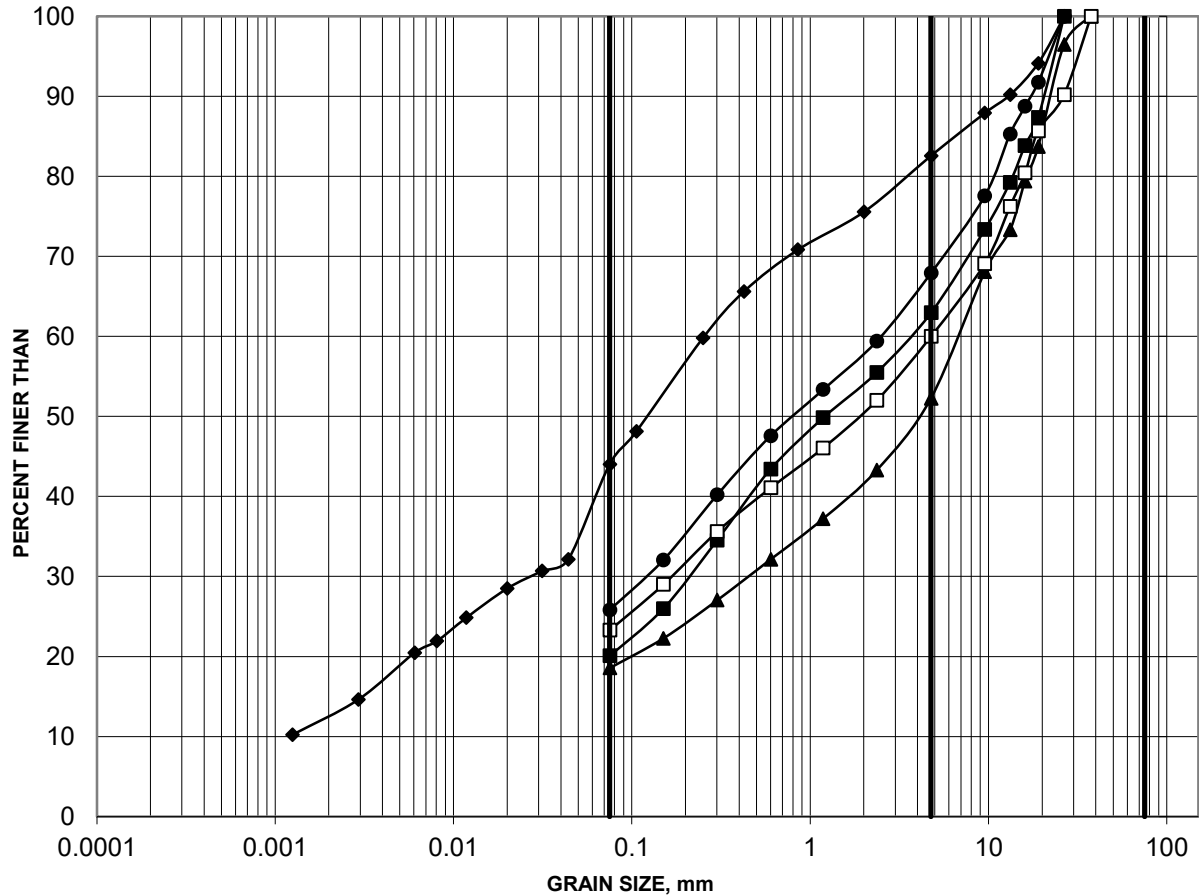
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

FIGURE B1

Sandy CLAYEY GRAVEL-SILTY GRAVEL (GC-GM) to Gravelly CLAYEY SAND-SILTY SAND (SC-SM) (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	H62-01	2	0.76-1.37	37	43	20	
◆	H62-01	4	2.29-2.90	17	39	31	13
▲	H62-01	7	4.57-5.18	48	33	19	
●	H62-05	2	0.76-1.37	32	42	26	
□	H62-05	4	2.29-2.90	40	37	23	

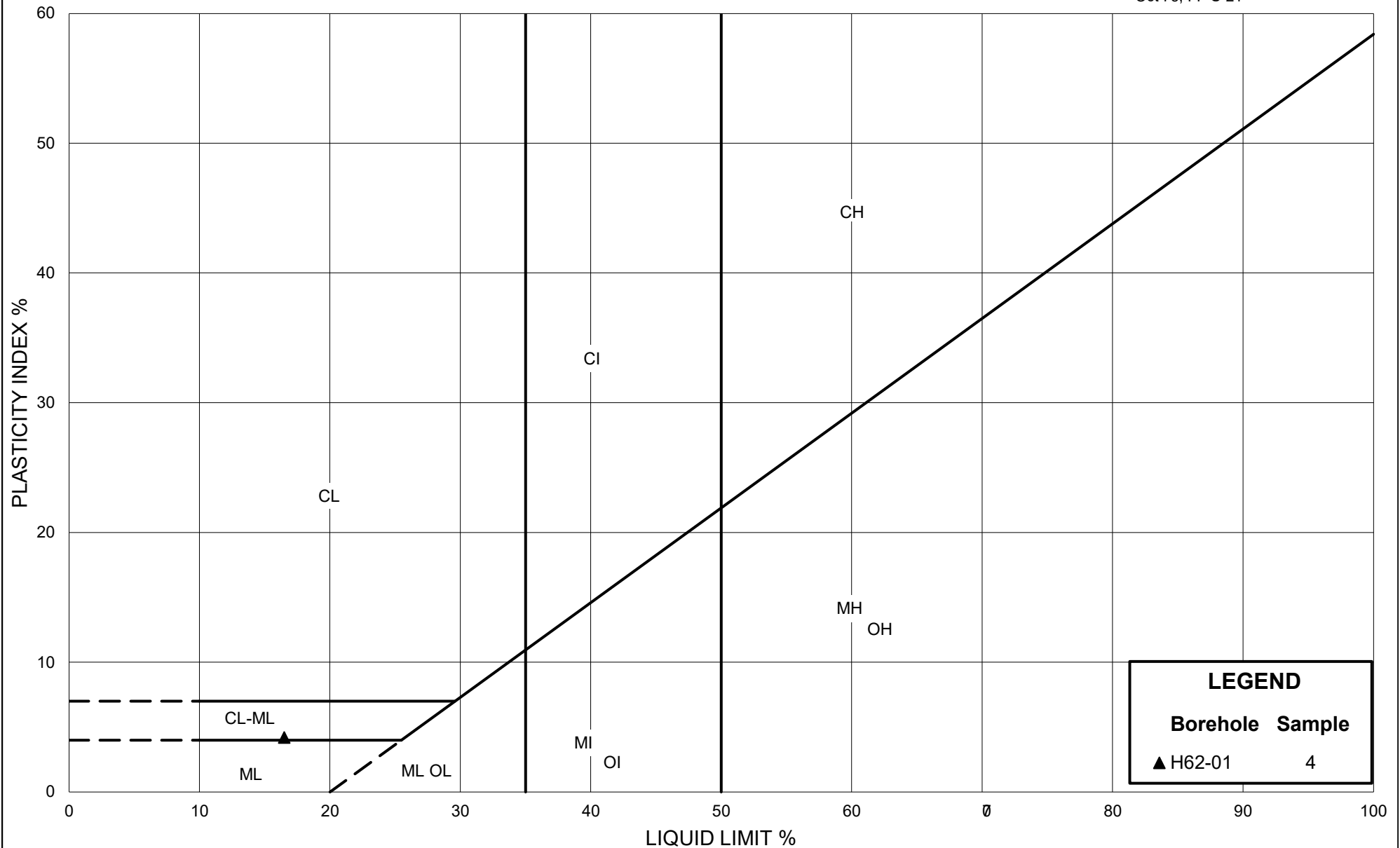


Project: 20148061B-2100 - GWP 4053-18-00

[https://goldeassociates.sharepoint.com/sites/152692/Project Files/5 Technical Work/lab/1-Figures/figures/4.Highway 62/](https://goldeassociates.sharepoint.com/sites/152692/Project%20Files/5%20Technical%20Work/lab/1-Figures/figures/4.Highway%2062/)

Created by: BW

Checked by: CW



Ontario

Ministry of Transportation

PLASTICITY CHART FILL

Figure: B2

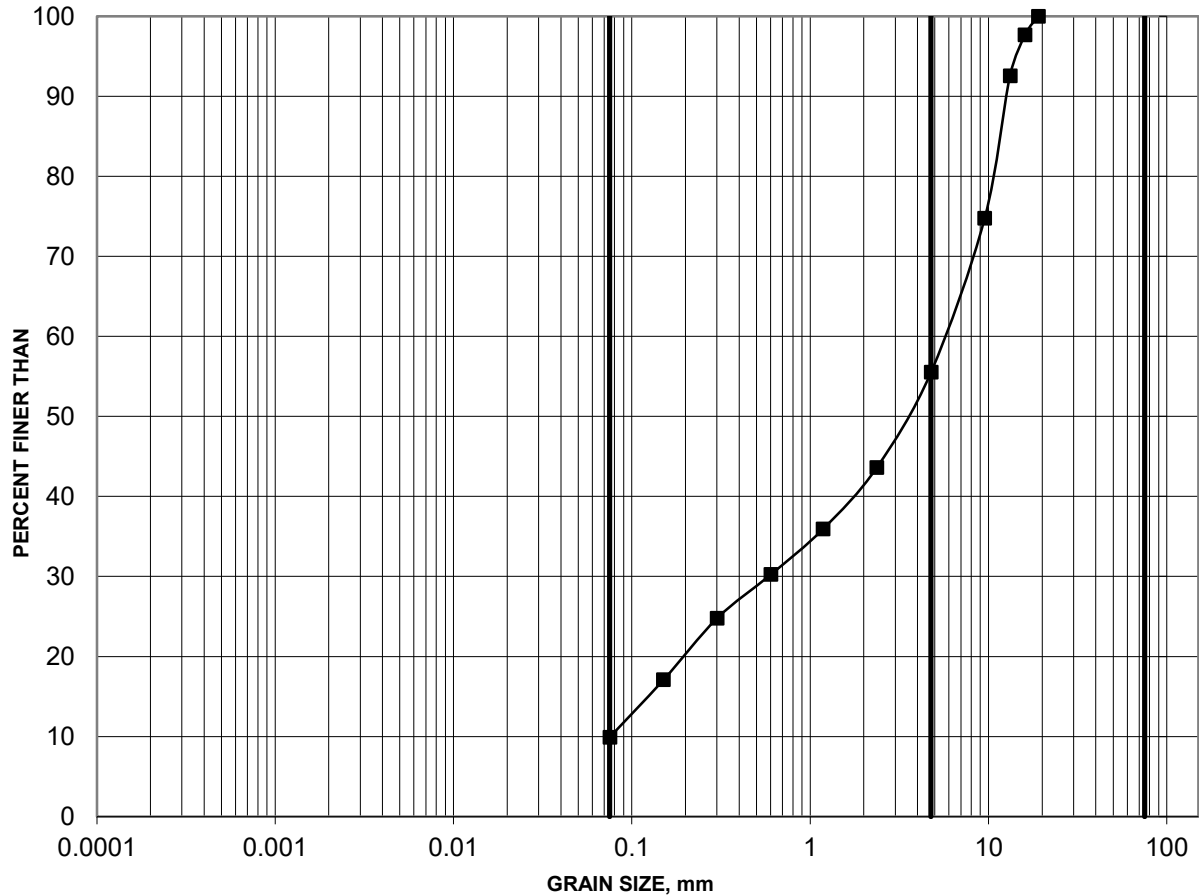
Project: 20148061B-2000 - GWP 4053-18-00

Created By: BW Checked By: CW

GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND (SW-SM), and gravel, some fines (FILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

Borehole	Sample	Depth (m)	Constituents (%)			
			Gravel	Sand	Silt	Clay
■ H62-02	1	0.00-0.76	44	46	10	

Project: 20148061B-2100 - GWP 4053-18-00

[https://golderassociates.sharepoint.com/sites/152692/Project Files/5 Technical Work/lab/1-Figures/figures/4.Highway 62/](https://golderassociates.sharepoint.com/sites/152692/Project%20Files/5%20Technical%20Work/lab/1-Figures/figures/4.Highway%2062/)

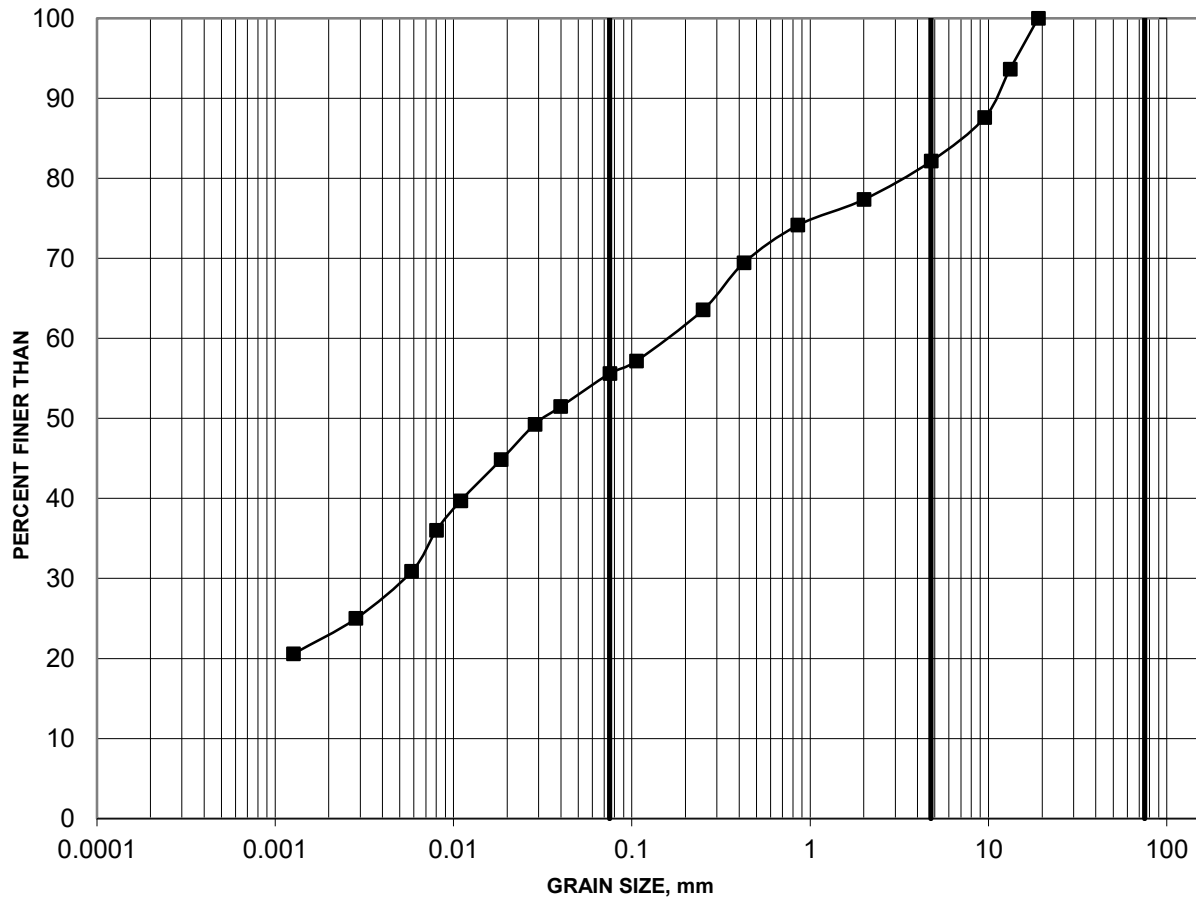
Created by: BW

Checked by: CW

GRAIN SIZE DISTRIBUTION

FIGURE B4

Sandy SILTY CLAY (CI), some gravel (TILL)



Borehole	SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
		SAND SIZE			GRAVEL SIZE		

				Constituents (%)			
	Sample	Depth (m)		Gravel	Sand	Silt	Clay
■	H62-02 0	3	1.52-2.13	18	26	33	23

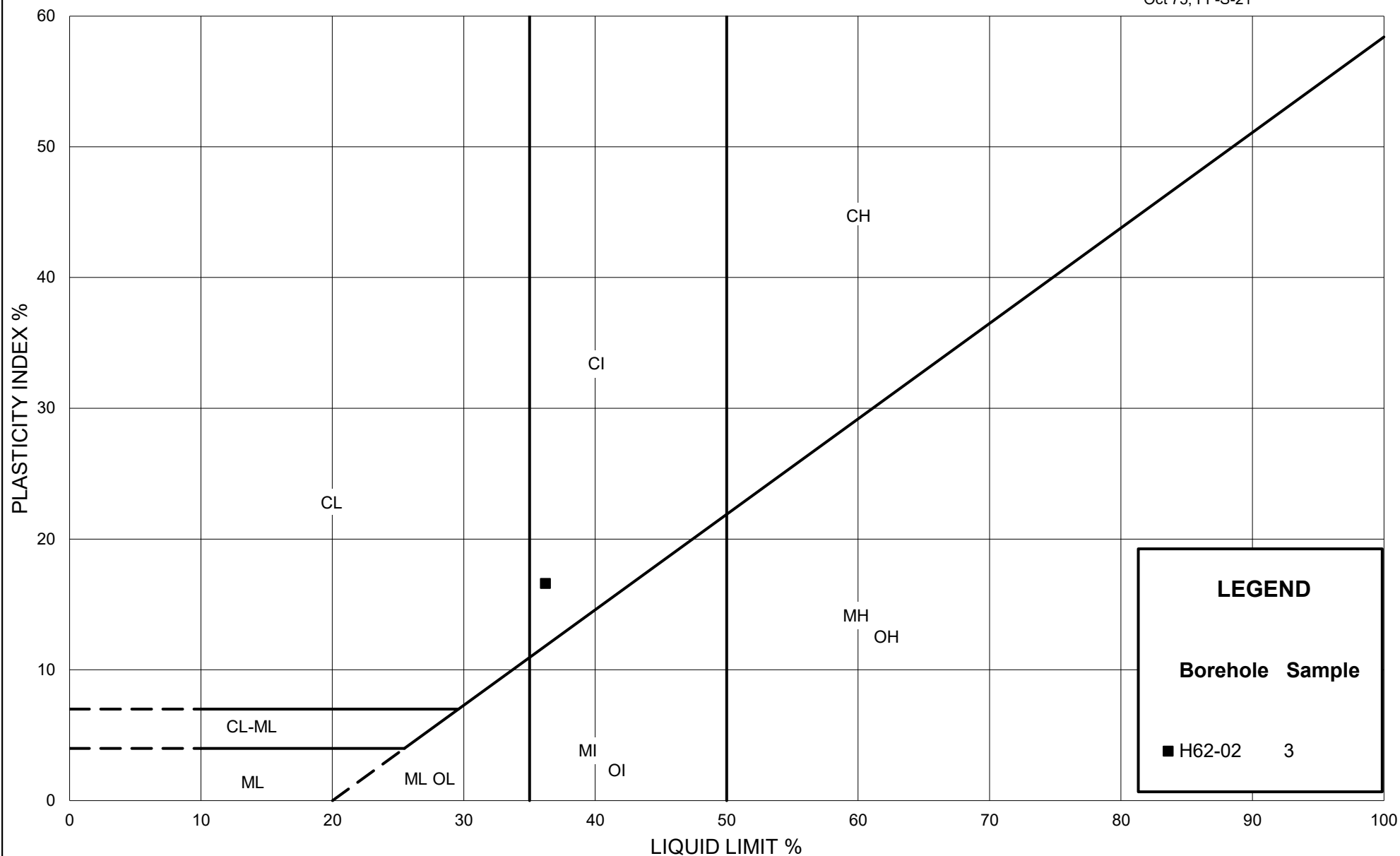


Project: 20148061B-2100 - GWP 4053-18-00

[https://golderassociates.sharepoint.com/sites/152692/Project Files/5 Technical Work/lab/1-Figures/figures/4.Highway 62/](https://golderassociates.sharepoint.com/sites/152692/Project%20Files/5%20Technical%20Work/lab/1-Figures/figures/4.Highway%2062/)

Created by: BW

Checked by: CW



Ministry of Transportation

PLASTICITY CHART

SANDY SILTY CLAY (CI), SOME GRAVEL

Figure: B5

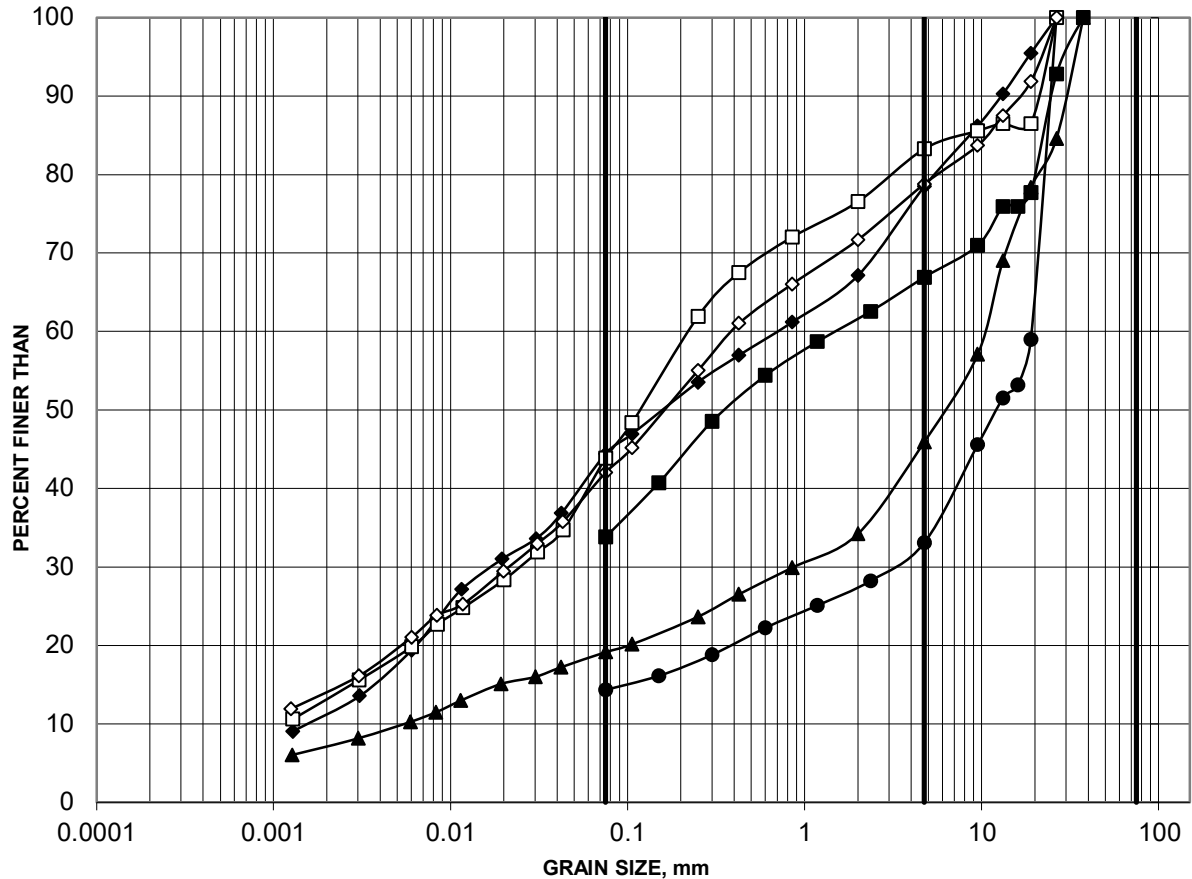
Project: 20148061B-2000 - GWP 4053-18-00

Created By: CW Checked By: BW

GRAIN SIZE DISTRIBUTION

FIGURE B6

Gravelly CLAYEY SAND-SILTY SAND (SC-SM) to Sandy CLAYEY GRAVEL-SILTY GRAVEL (GC-GM) (TILL)



SILT AND CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
	SAND SIZE			GRAVEL SIZE		

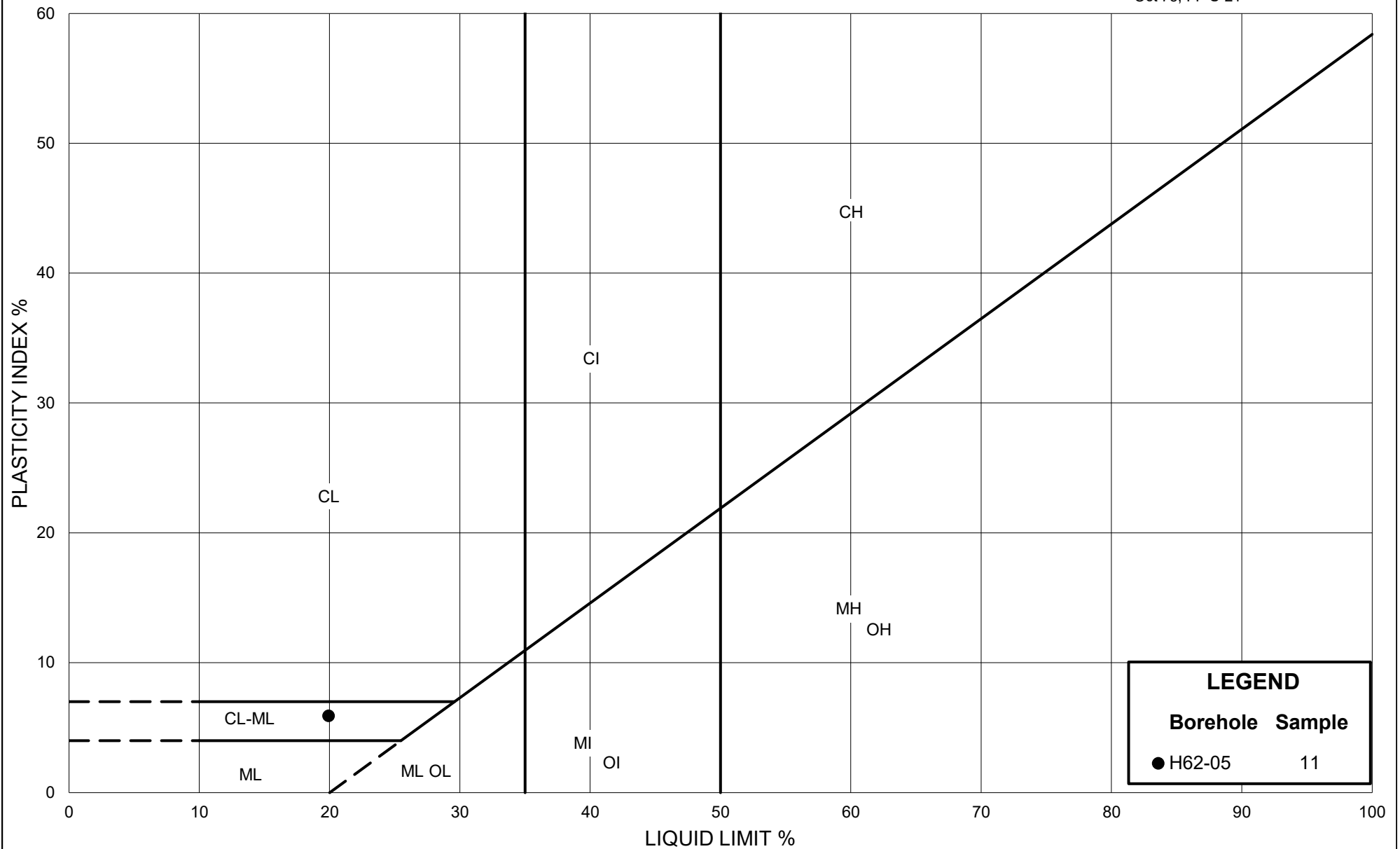
	Borehole	Sample	Depth (m)	Constituents (%)			
				Gravel	Sand	Silt	Clay
■	H62-01	10	6.86-7.47	33	33	34	
◆	H62-01	12	9.14-9.45	22	34	33	11
▲	H62-03	2	0.76-1.37	54	27	12	7
●	H62-04	2	0.76-1.37	67	19	14	
□	H62-05	9	6.10-6.71	17	39	31	13
◇	H62-05	11	7.62-8.08	21	37	28	14



Project: 20148061B-2100 - GWP 4053-18-00

[https://goldeassociates.sharepoint.com/sites/152692/Project Files/5 Technical Work/lab/1-Figures/figures/4.Highway 62/](https://goldeassociates.sharepoint.com/sites/152692/Project%20Files/5%20Technical%20Work/lab/1-Figures/figures/4.Highway%2062/)

Created by: BW
Reviewed by: CW



Ontario

Ministry of Transportation

PLASTICITY CHART TILL

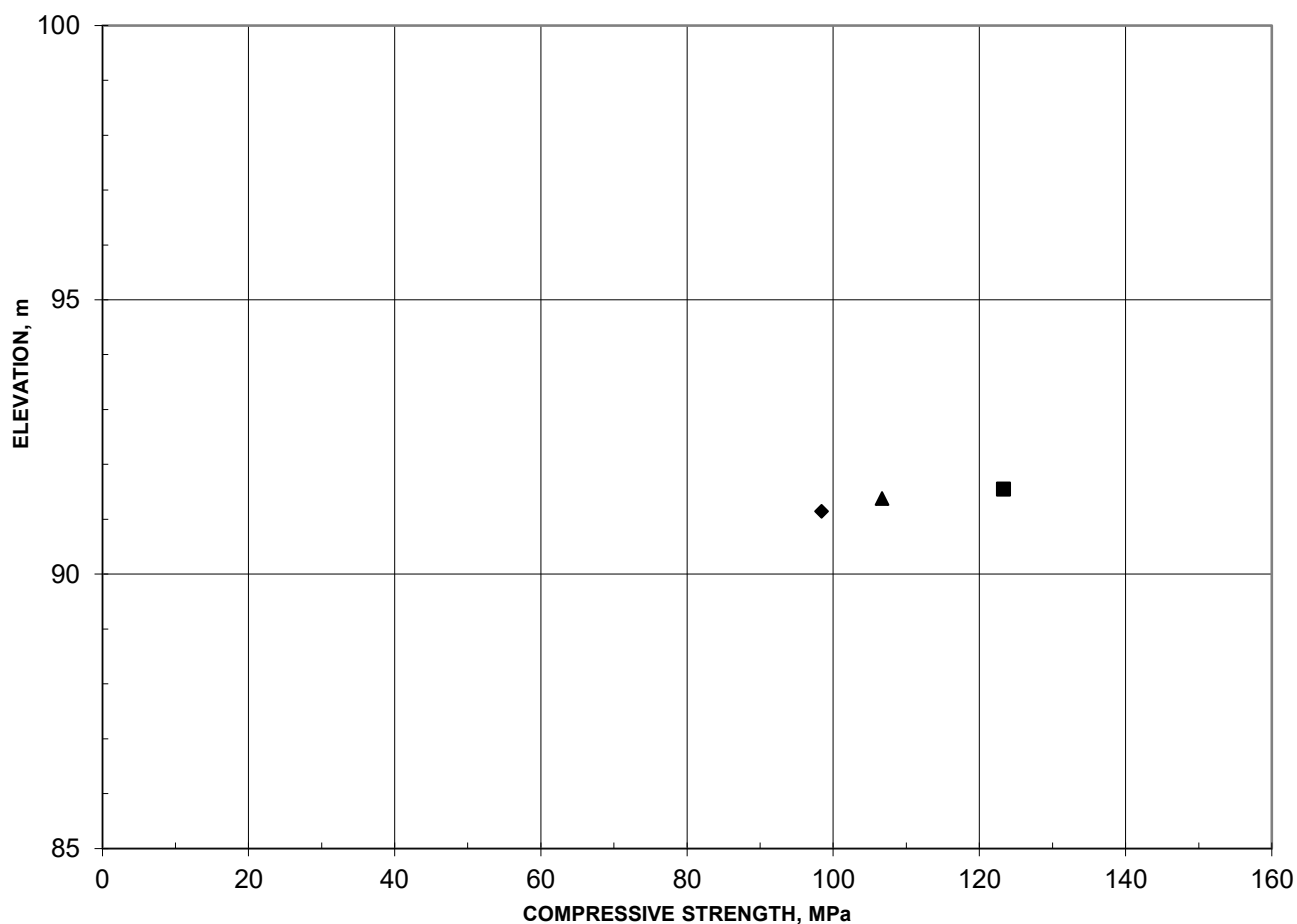
Figure: B7

Project: 20148061B-2000 - GWP 4053-18-00

Created By: BW Checked By: CW

ASTM D7012 - Method C
UNCONFINED COMPRESSIVE STRENGTH OF ROCK CORE
SUMMARY OF LABORATORY TEST RESULTS

FIGURE B8



	Borehole	Depth (m)	L/D	Bulk Density (kg/m ³)	Lithology	UCS (MPa)	Failure Type
■	BHH62-03 RC1	3.3	2.5	2675	Limestone	123	1
◆	BHH62-04 RC1	3.5	2.4	2677	Limestone	98	1
▲	BHH62-02 RC1	4.4	2.5	2658	Limestone	107	1

Notes:

Failure Types

1. Well formed cones on both ends
2. Well formed cones on one end, vertical cracks through cap
3. Columnar vertical cracking through both ends
4. Diagonal fracture with no cracking through ends
5. Side fractures at top or bottom
6. Side fractures at both sides of top or bottom

Remarks

- Cores tested in vertical direction.
- Cores tested in air-dry condition.
- Time to failure > 2 and < 15 minutes.



Project: 20148061B-2100 - GWP 4053-18-00

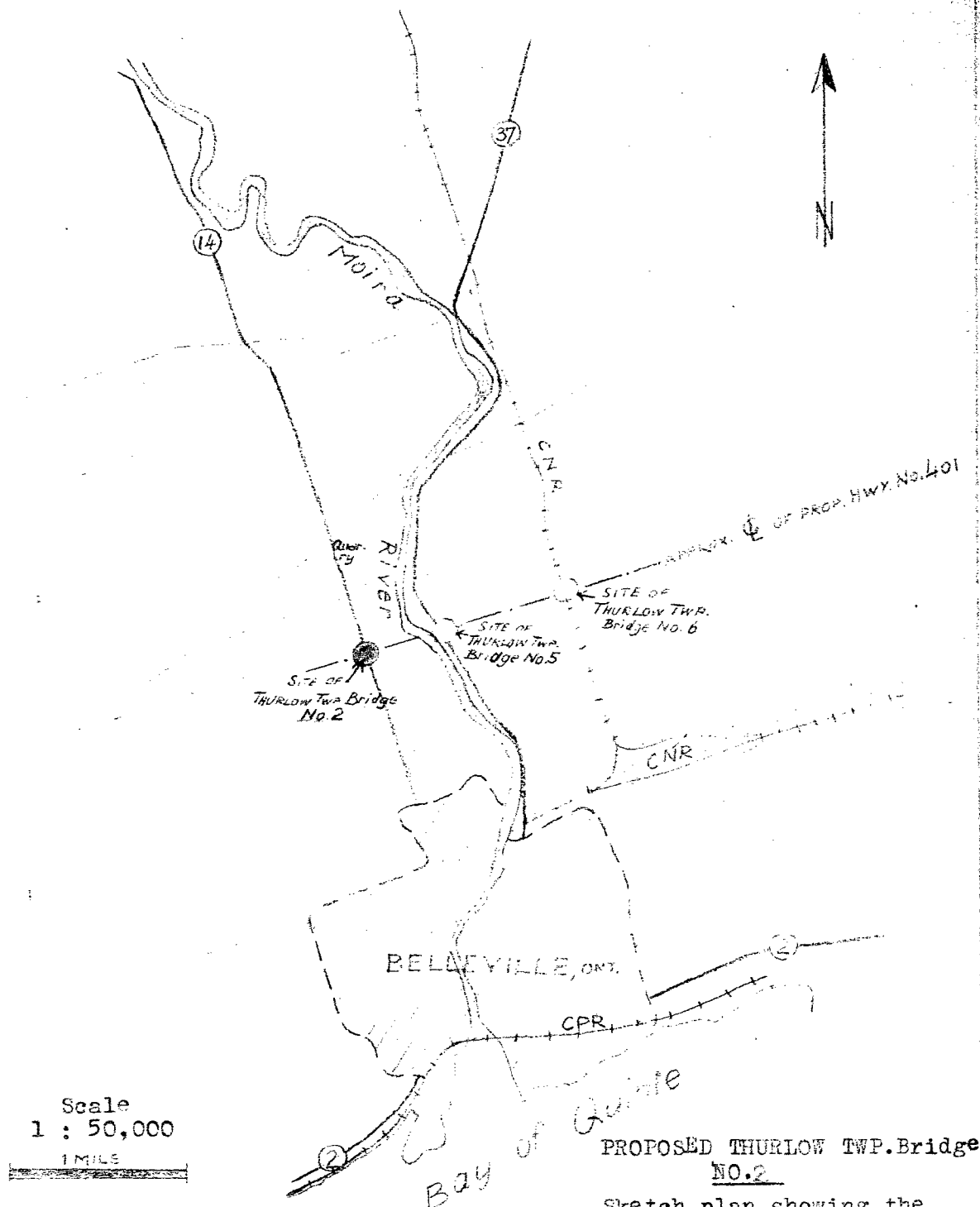
Created by: BW

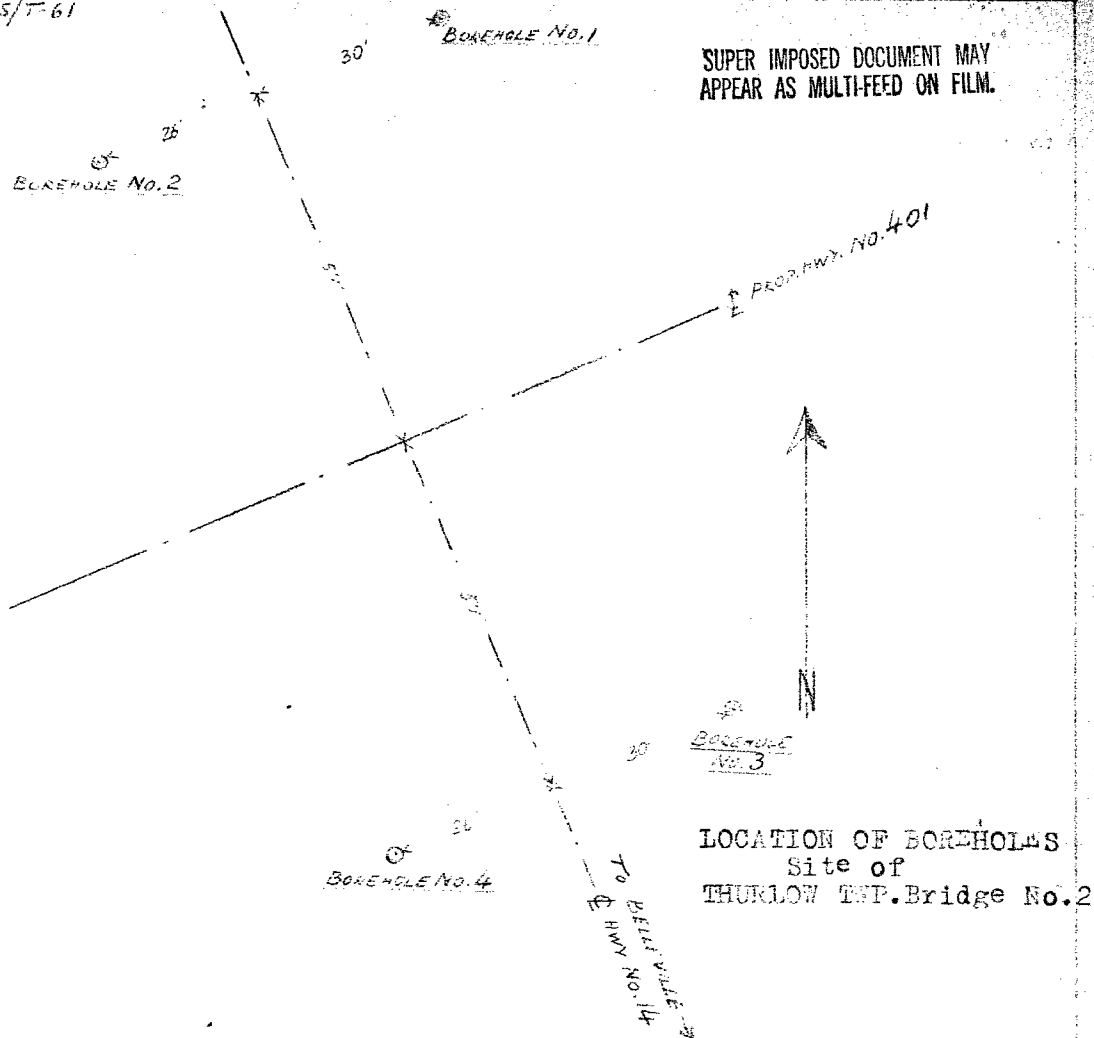
Checked by: CW

APPENDIX C

Previous Investigation Results

S-500-501/55/T-61
 PREP & DRAWING: K.T.





Bedding of Bedrock
shown in wall of an
abandoned quarry,
about 1/2 mile north
of the bridge site.

30°

Borehole No. 1

SUPER IMPOSED DOCUMENT MAY
APPEAR AS MULTI-FEED ON FILM.

Borehole No. 2

Borehole No. 401

N

Borehole No. 4

LOCATION OF BOREHOLES
Site of
THURLOW TWP. Bridge No. 2

TO HILLSVILLE



Bedding of bedrock
shown in wall of an
abandoned quarry,
about 1/2 mile north
of the bridge site.

Order No. S-500-504/55/T-61 TRACEY, MACCALLUM AND ASSOCIATES

A. McCadden

Dated

Limited

Driller

Day Month Year

Foundation Engineering Division

Hole Begun 7/2/55

D. McCurdy

Hole Ended 9/2/55

Engineering Data Sheet for Borehole: 1

Helper

Job Name: THURLOW BRIDGE NO. 2

K. TUBBESING

Job Located: INTERSECTION OF HWY. NO. 14 AND PROP. HWY. NO. 401, ~2 MILES

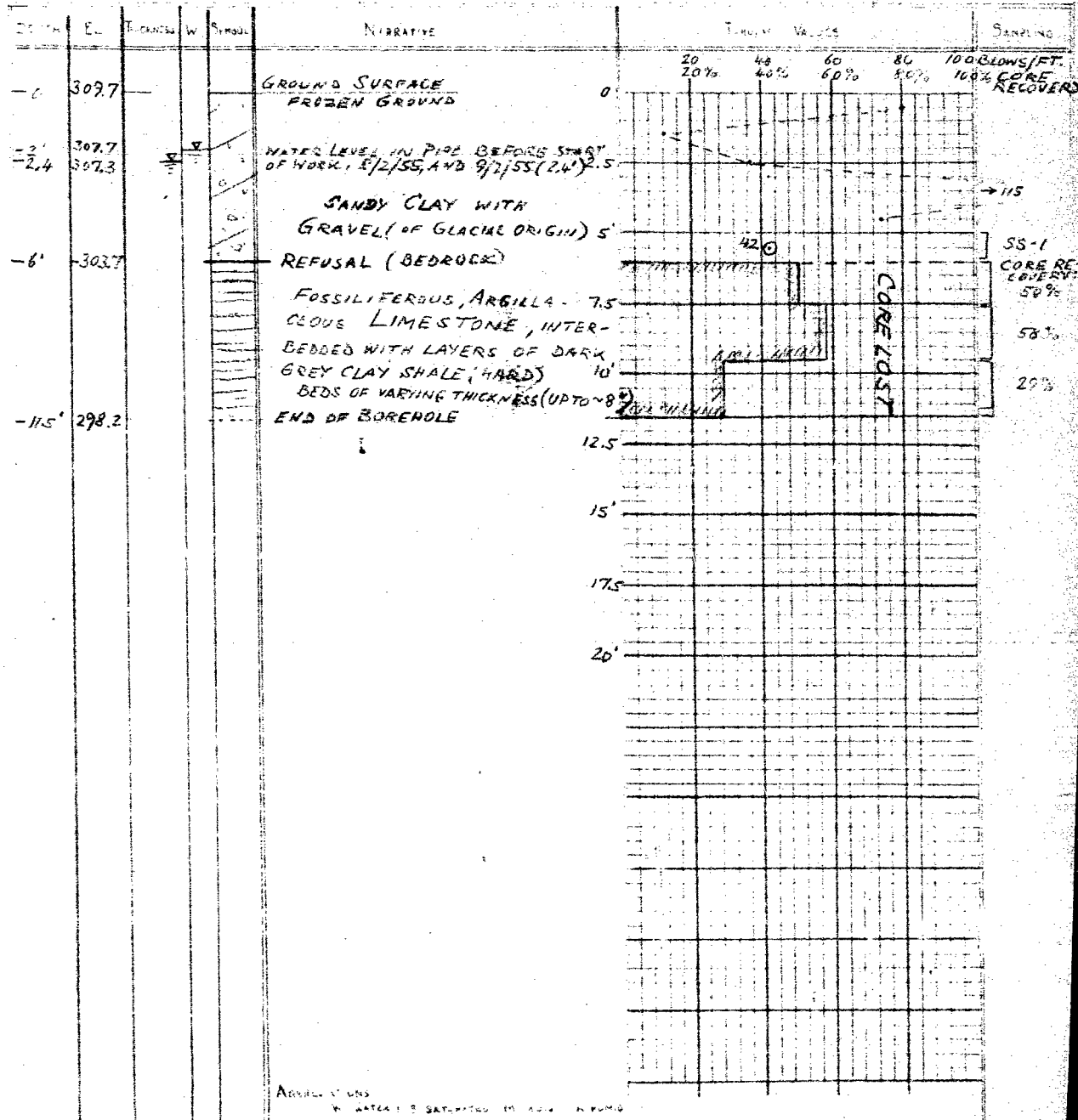
Checked by

Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN, NNN OF BELLEVILLE, ILL.

Hole Elevation: 309.7 Datum: M.S.L.

15/2/55

Day Month Year



Order No.: S-500-501/55/T-61 RACEY, MacCALLUM AND ASSOCIATES

Dated: Limited

A. McCadden

Driller

Day Month Year

Foundation Engineering Division

Hole Begun 10/2/55

D. McCurdy

Hole Ended 15/2/55

Engineering Data Sheet for Corehole: 2

Helper

Job Name: THURLOW BRIDGE NO. 2

K. TUBBESING

Job Location: INTERSECTION OF HWY. NO. 14 AND ROAD, HWY. NO. 401, ~2 MILES

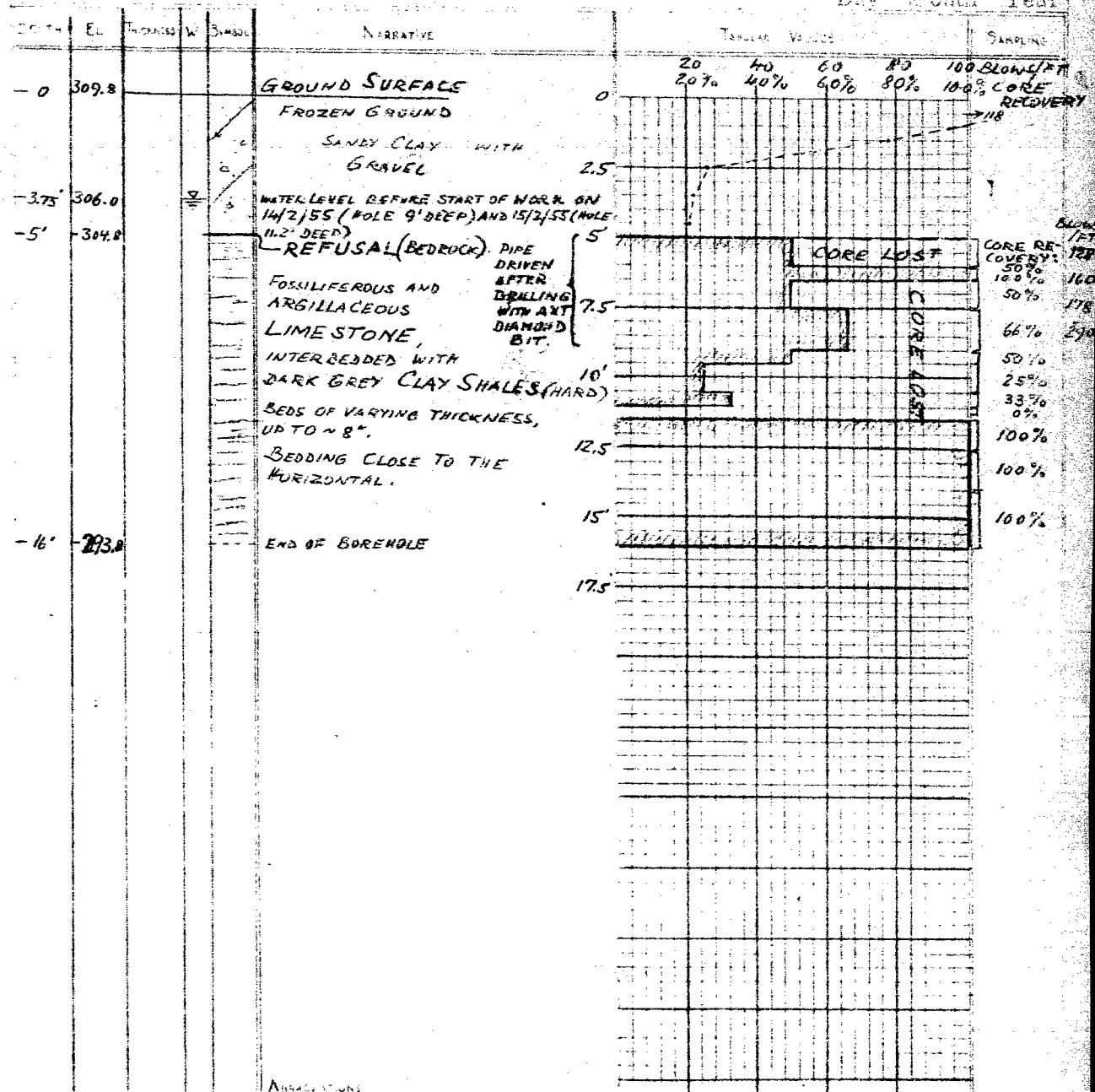
Checked by

Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN NNW OF BELLEVILLE, ILL.

Hole Elevation: 309.8 Datum: M.S.L.

15/2/55

Day Month Year

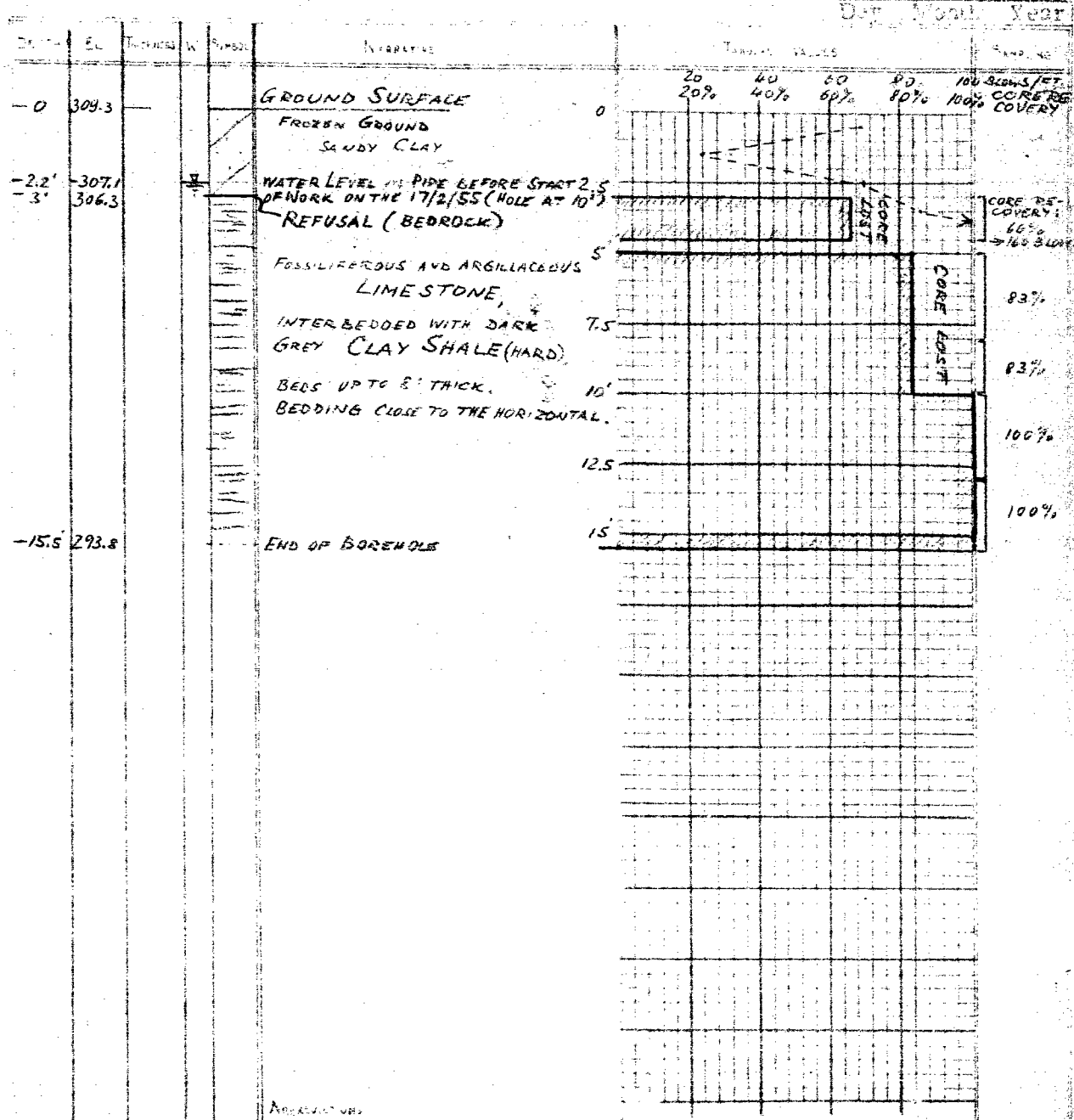


Abbreviations

WATER SATURATION IN SOIL DEPTH

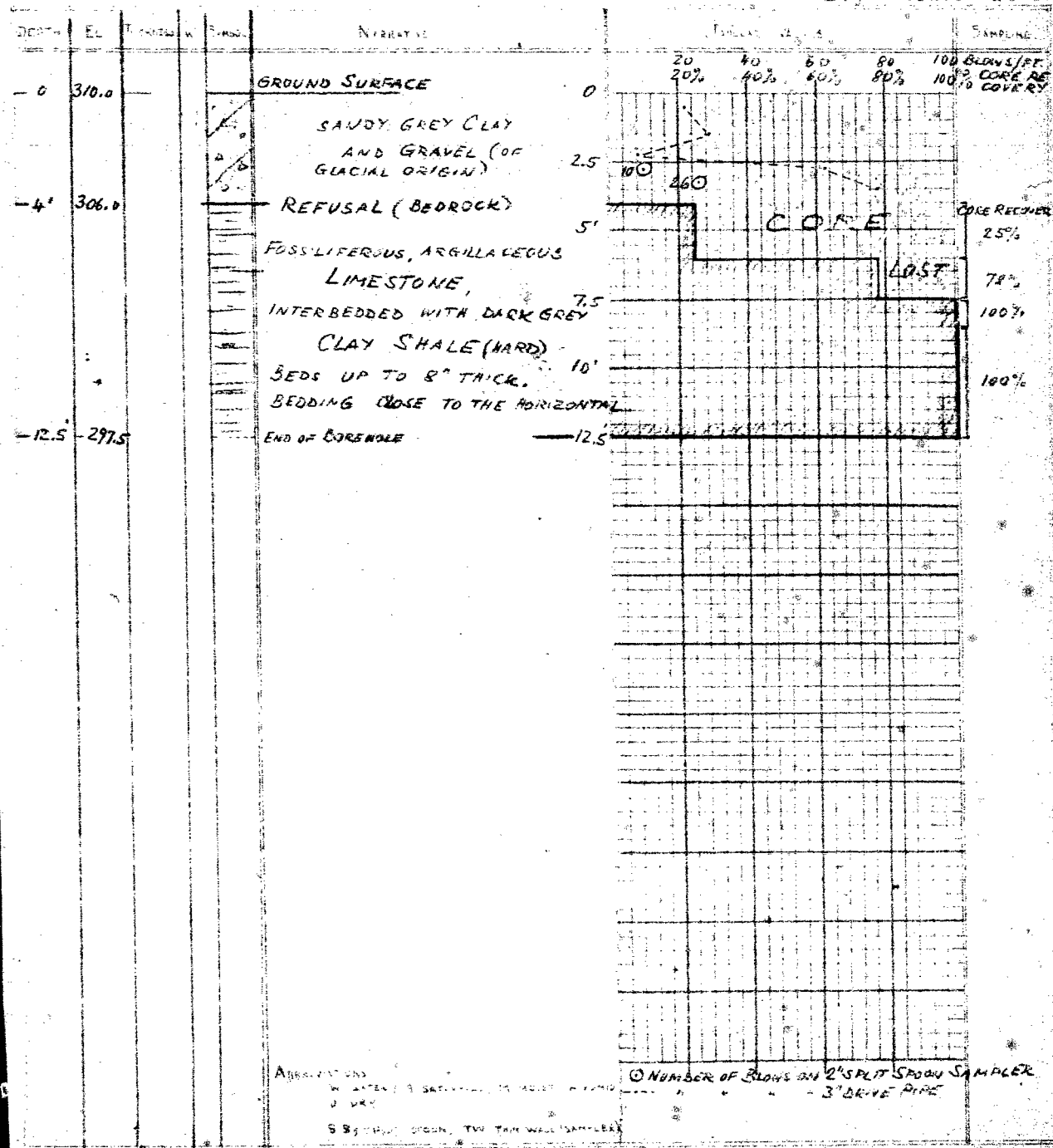
Dated: NOV 16 1955 FOUNDATION ENGINEERING DIVISION Driller
 Day: Month Year: 16/2/55 Foundation Engineering Division
 Hole Begun: 16/2/55 Engineering Data Sheet for Borehole: 3 D. MCCURDY
 Hole Ended: 17/2/55 OF BELLEVILLE, ONT. Helper

Job Name: THURLOW BRIDGE NO. 2 K. TUBGESING
 Job Located: INTERSECTION OF HWY. NO. 14 AND PROP. HWY. NO. 401, ~ 2 MILES NNW Checked by
 Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN.
 Hole Elevation: 309.3 Datator: M.S.L. 20/2/55



Order No. S-500-501/55/T-61 RACEY, MACCORMACK AND ASSOCIATES A. MACCORMACK
 Dated Limited Driller
 Day Month Year Foundation Engineering Division
 Hole begun 9/2/55 Hole Ended 10/2/55 Engineering Data Sheet for Borehole: 4 D. McCURDY
 Helper

Job Name: THURLOW BRIDGE NO. 2 K. TUBBESING
 Job Located: INTERSECTION OF HWY. NO. 14 AND PROP. HWY. NO. 401, ~ 2 MILES NNW Checked by
 Hole Located: AS SHOWN ON ATTACHED SKETCH PLAN. OF BELLEVILLE, ONT.
 Hole Elevation: 310.0 Datum: M.S.L. 20/2/55
 Day Month Year



APPENDIX D

Analytical Laboratory Test Results



Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario

Attention: Mr. Kenton Power

PO#:

Invoice to: Golder Associates Ltd

Report Number: 1986686
Date Submitted: 2022-09-22
Date Reported: 2022-09-29
Project: Belleville 20148061B-1-162
COC #: 900600

Page 1 of 3

Dear Kenton Power:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL:

Emma-Dawn Ferguson, Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <https://directory.cala.ca/>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario

Attention: Mr. Kenton Power

PO#:

Invoice to: Golder Associates Ltd

Report Number: 1986686
Date Submitted: 2022-09-22
Date Reported: 2022-09-29
Project: Belleville 20148061B-1-162
COC #: 900600

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1652793 Soil 2022-09-08 H62-01 SS6 12.5-14.5'	1652794 Soil 2022-09-08 H62-05 SS3 5-7'	1652795 Soil 2022-09-15 C-01 SS2 2.5-4.5'	1652796 Soil 2022-09-14 C-05 SS4 7.5-9.5'
Group	Analyte	MRL	Units	Guideline					
General Chemistry	Anions								
	Cl	0.002	%			0.135	0.083	0.093	0.009
	SO4	0.01	%			0.03	0.02	0.02	0.02
	Electrical Conductivity	0.05	mS/cm			2.93	2.03	0.22	0.30
	pH	2.00				8.33	8.89	8.36	8.50
	Resistivity	1	ohm-cm			341	493	4540	3330

					Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.	1652797 Soil 2022-08-31 C-09 SS3 5-7'	1652798 Soil 2022-09-07 C-10 SS3 5-6.75'	1652799 Soil 2022-09-13 H-37-02 SS2 2.5-4.5'	1652800 Soil 2022-09-13 H37-01 SS3 5-7'
Group	Analyte	MRL	Units	Guideline					
General Chemistry	Anions								
	Cl	0.002	%			0.005	0.002	0.002	0.014
	SO4	0.01	%			0.04	0.02	0.02	0.03
	Electrical Conductivity	0.05	mS/cm			0.44	0.17	0.17	0.47
	pH	2.00				7.87	8.23	8.20	7.56
	Resistivity	1	ohm-cm			2270	5880	5880	2130

Guideline = * = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Certificate of Analysis

Client: Golder Associates Ltd (Ottawa)
1931 Robertson Road,
Ottawa, Ontario

Attention: Mr. Kenton Power

PO#:

Invoice to: Golder Associates Ltd

Report Number: 1986686
Date Submitted: 2022-09-22
Date Reported: 2022-09-29
Project: Belleville 20148061B-1-162
COC #: 900600

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 430396 Analysis/Extraction Date 2022-09-27 Analyst IP Method Cond-Soil			
Electrical Conductivity	<0.05 mS/cm	101	90-110
pH	7.85	100	90-110
Resistivity			
Run No 430430 Analysis/Extraction Date 2022-09-28 Analyst AA Method C CSA A23.2-4B			
Chloride	<0.002 %		90-110
Run No 430473 Analysis/Extraction Date 2022-09-28 Analyst IP Method AG SOIL			
SO4	<0.01 %	98	70-130

Guideline = *** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX E

Site Photographs



Photograph 1: Looking north across the proposed Highway 62 alignment toward Borehole H62-02; July 7, 2024



Photograph 2: Looking north from Borehole H62-05 toward the northern approach to the Highway 62 underpass; July 7, 2024



Photograph 3: Looking northeast from Borehole H62-04 toward the existing Highway 62 underpass; July 7, 2024



Photograph 4: Looking southeast from Borehole H62-03 toward the Highway 62 underpass; July 7, 2024

