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# **FOUNDATION INVESTIGATION REPORT**

W.P. 545-93-00  
HIGHWAY 60 –  
CLARKE CREEK  
BRIDGE REPLACEMENT

McCormick Rankin Corporation

PROJECT NO. 1023332  
SITE NO. 43-149  
GEOCRES NO. 31F-274

---

# **PROJECT NO. 1023332**

## **FOUNDATION INVESTIGATION REPORT**

**TO** McCormick Rankin Corporation  
2655 North Sheridan Way  
Mississauga, Ontario  
L5K 2P8

**ON** W.P. 545-93-00  
Highway 60 – Clarke Creek Bridge  
Replacement  
County of Nipissing  
District 43, Bancroft  
Ministry of Transportation  
Ontario  
Site No. 43-149  
Geocres No. 31F-274

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**October 2007**

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# FOUNDATION INVESTIGATION REPORT

for

W.P. 545-93-00

Highway 60 – Clarke Creek Bridge

Township of Airy

District 43, Bancroft

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## 1.0 INTRODUCTION

This report was prepared as part of the Total Project Management (TPM) assignment for the Detailed Design of Clarke Creek and Kearney Creek Bridge Replacements, Highway 60, G.W.P. 545-93-00.

This report presents the results of a foundation investigation carried out for the proposed replacement of the existing Clarke Creek Bridge on Highway 60 in Algonquin Park (Site No. 43-149).

The foundation investigation was carried out in general accordance with our proposal number 1019534 dated December 5, 2006. Authorization to proceed was provided by the Ministry of Transportation of Ontario (MTO) under Agreement Number 4006-E-0018 with McCormick Rankin Corporation (MRC), the Detailed Design Consultant for this project.

This report has been prepared specifically and solely for the project described herein. It contains factual information pertaining to the subsurface conditions which was obtained as part of this investigation.

It is noted that a Preliminary Foundation Investigation of this site was carried out by Jacques Whitford Limited. The relevant results from Report No. ONO11685 dated June 2006 have been included in the present report.

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## 2.0 SITE DESCRIPTION AND GEOLOGY

The subject site is within the limits of MTO project W.P. 545-93-00 (Highway 60). The site location is shown on the Key Plan inset to Drawings No. 1 and No. 2 provided in Appendix A. It is noted that for project orientation purposes, Highway 60 will be assumed to run north-south at the Clarke Creek Bridge, with chainage increasing from north to south.

Physiographically, the Clarke Creek Crossing is located within the Algonquin Highlands. This region is characterized by rough rounded knobs and ridges with frequent outcrops of bare rock. The bedrock is generally shallow, however, the depth to bedrock varies greatly over short distances.



Many of the valleys are floored with outwash sand and gravel. There are frequent swamps and bogs.

Clarke Creek flows from east to west and is approximately 13 m in width at the centreline of Highway 60. Water depths were estimated to be less than 1 m at the time of the investigation.

The existing roadway embankments are approximately 3.8 m and 5.0 m high at the north and south abutments, respectively. The water level in Clarke Creek was approximately 6 m below the top of pavement on the existing bridge deck at the time of the investigation. The banks of the creek are steeply sloped for approximately 1 m above water level and then very gradually slope upwards away from the creek. No indications of significant erosion were noted at the time of the site inspection. The ground surface within the highway right-of-way is vegetated with grass. Mature trees are present beyond the edges of the cleared right-of-way. Drainage in the area consists of overland flow directed towards the creek.

A plan view and profile are shown on each of Drawings No. 1 and No. 2, provided in Appendix A.

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## 3.0 PROCEDURE

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### 3.1 Field Investigation

The preliminary investigation consisted of eight (8) boreholes designated as 05-9 through 05-16. The details concerning the field procedures for those boreholes is documented in the June 2006 Preliminary Foundation Investigation Report.

The site soil conditions were further investigated in 2007 with a borehole drilling investigation, piezocone (CPTu) investigation and laboratory testing program. The borehole drilling and CPTu testing was carried out using a combination of a truck-mounted CME-75 drill rig and a track-mounted CME-55 drill rig between April 18 and May 24, 2007.

A total of three (3) boreholes, designated as 07-2, 07-4 and 07-5 were put down during the field investigation. Borehole 07-2 was advanced at the south abutment location for the temporary bridge structure along the proposed detour alignment. Boreholes 07-4 and 07-5 were advanced at the north and south abutment locations, respectively, on the permanent alignment. Borehole 07-1, which was to have been drilled at the north abutment along the proposed detour alignment was cancelled after discussions with MTO due to the depth to bedrock in Borehole 07-2 and the fact that a borehole (05-10) had been drilled at this abutment location during the preliminary investigation in 2005.

The boreholes were advanced through the overburden using casing and drilling mud in order to balance the pressure within the borehole and minimize sand coming up the augers. Despite the use of casing and thick drilling mud, frequent problems were encountered with sand/silt coming up inside the casing.

The subsurface conditions were identified in the field by Jacques Whitford Limited (JW) personnel from samples obtained while carrying out Standard Penetration Tests (SPT) (ASTM D1586) at regular intervals. The boreholes at the abutment locations on the permanent alignment were advanced to at least 3 m beyond SPT refusal in accordance with the Terms of Reference for this project. SPT refusal is defined as 100 or more blows for 300 mm of penetration. This required coring through boulders in Borehole 07-5 and into bedrock at Borehole 07-4. The casing became jammed at a depth of 47.2 m in Borehole 07-2. Beyond this depth the hole was advanced by driving a cone to refusal (defined as greater than 100 blows per 300 mm of penetration). Refusal to the cone penetration was reached at a depth of 51.9 m below ground surface. The recovered soil samples were stored in moisture proof containers and returned to our laboratory. The subsurface conditions encountered are described in detail in the Borehole Records presented in Appendix B.

Standpipes were installed in Boreholes 07-2 and 07-4. The standpipes consisted of slotted flexible poly-pipe tube with a diameter of 25 mm. The slotted section was backfilled with native sand material. Above the slotted section, the annular space around the pipe was backfilled with a cement-bentonite mixture. Groundwater levels were measured upon completion of the drilling.

Two CPTu test holes, designated as CPT 07-3 and CPT 07-6, were put down on the permanent alignment approximately 10 m behind the north and south abutments, respectively. These test holes were started by drilling through the existing pavement and coarse embankment fill using hollow stem augers. The piezocone was then pushed through the native silt and sand materials using the hydraulic system on the drill rig until refusal (ASTM D3441). In this case, refusal was reached when the piezocone tip resistance was sufficient to cause the drill rig to start to lift up from the ground.

Prior to completing the investigation, the boreholes were grouted with a cement/bentonite mix. Asphalt surfaces were reinstated with a minimum of 100 mm of cold patch asphalt.

---

### 3.2 Survey

Borehole locations were established in the field by measurement by JW personnel relative to existing site features such as the existing bridge structure. The locations for Boreholes 05-9, 05-10, 05-11 and 05-12 were referenced to the centerline of the proposed detour. All other holes are referenced to the permanent alignment of Highway 60. The ground surface elevations at the borehole locations were surveyed relative to the top of asphalt on the deck of the existing Clarke Creek bridge structure. The top of pavement at this location has been identified as having a geodetic elevation of 397.8 m based on a profile included in the Structural Design Report.

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### 3.3 Laboratory Testing

All samples returned to the laboratory were subjected to detailed visual classification by a geotechnical engineer. Routine testing, consisting of moisture content testing and grain size distribution analysis, was carried out on representative samples. One soil sample was submitted for pH, sulphate and resistivity testing to assess the potential for corrosion of buried steel and the potential for sulphate attack on buried concrete. Two samples had previously been analyzed as part of the preliminary investigation.

No complex testing was deemed to be necessary based on the soil conditions.

All soil samples will be stored for a period of one year after issuance of the final version of the foundation investigation report. Unless otherwise directed, the stored samples will be disposed of after this period.

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## 4.0 SUBSURFACE CONDITIONS

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### 4.1 Subsurface Profile

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix B. An explanation of the symbols and terms used to describe the Borehole Records is also provided. The results of the CPTu testing are also presented in Appendix B along with an explanation of terminology used on CPTu/SCPTu Records.

Borehole Records from the preliminary foundation investigation report for this project have been included in this report for completeness.

In general, the subsurface profile beneath the proposed detour alignment (Boreholes 05-9 to 05-12 and 07-2) consists of a fill or a thin topsoil layer, overlying sand on top of silty sand, over silt with some sand over glacial till.

Bedrock was not proven within the maximum depth of investigation (51.9 m) along this alignment.

Within the existing roadway platform (Boreholes 05-13 to 05-16, 07-4, 07-5 and CPT 07-3 and 07-6), the subsurface profile consists of the pavement structure overlying the existing bridge approach fill, over native soils with significant particle size variations in the shallower zones, ranging from silty sand to sandy gravel, overlying silty sand and silt layers, over glacial till over bedrock at a depth of more than 58 m below ground surface.

Borehole location plans and stratigraphic sections of the soils encountered within the boreholes are provided on Drawings No. 1 and No. 2 in Appendix A.

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#### 4.1.1 Fill: Silty Sand to Gravelly Sand with Silt

Granular fill was encountered beneath the asphalt in all of the boreholes located along the existing Highway 60 alignment. The composition of the fill ranged from sand, trace silt, trace gravel to gravelly sand, with silt. The thickness of the fill varied from 1.0 m in Borehole 05-13 to 4.9 m in Borehole 07-4. The base of the fill ranged from elevation 392.9 m (borehole closest to the creek) to 396.7 m (borehole further from the creek). The upper portion of the fill was frozen to a depth of approximately 1.2 m at the time of the preliminary investigation in 2005. The moisture content of the 7 samples of fill tested ranged from 3% to 16% and averaged 7%. The SPT 'N' values ranged from 3 to 41 (excluding the results within the upper frozen zone) with an average value of 14 indicating that the fill was generally compact. The asphalt surface overlying the fill was observed to be 90 mm to 200 mm thick at the borehole locations. Borehole 07-4 encountered a 180 mm thick concrete slab (likely the approach slab) directly beneath the asphalt.

The results of two grain size analyses indicate that the tested samples of fill contained 6% and 16% gravel, 81% sand and 3% to 13% fines. The gradation results are provided on Figure 1 in Appendix B.

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#### 4.1.2 Poorly-Graded Sand (SP)/Poorly-Graded Sand with Silt (SP-SM)

A deposit of poorly-graded sand to poorly-graded sand with silt was observed directly beneath the fill or vegetation in all boreholes. The deposit contained gravel in Borehole 05-10 and 05-13 and occasional cobbles in 05-10, 05-11 and 05-13. The thickness of this deposit ranged from 2.9 m in Borehole 05-12 to 9.1 m in Borehole 05-14. The base of the unit varied from elevation 383.7 m to 390.2 m (geodetic). SPT 'N' values ranged from 1 to 45 and averaged 19, indicating that the deposit varies from a very loose to dense state but is on average, compact. The results of nine grain size analyses indicate that the deposit contained between 0 and 28 % gravel, 34 to 96% sand and 2 to 9% fines. The gradation results are provided on



Figures 2 and 3 in Appendix B. This material ranges from an SP to SP-SM soil using the MTO Soil Classification System.

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#### 4.1.3 Silty Sand (SM)

A layer of silty sand was observed beneath the poorly-graded sand deposit in all boreholes that fully penetrated the poorly-graded sand deposit. In some cases, the silty sand deposit was interrupted by layers of silt or sandy silt (ML). Where fully penetrated, the silty sand deposit ranged from 6.8 m thick to 38.7 m thick. The base of the unit varied from elevation 348.4 m to 383.1 m (geodetic). SPT 'N' values ranged from 4 to 100 and averaged 29, suggesting a generally compact state. The moisture content of the 32 samples tested ranged from 17% to 25% with an average of 21%. Grain size analysis of nine samples indicated that this deposit contained 0% to 1% gravel, 51% to 80% sand and 20% to 49% silt and clay sized particles. The results of the grain size distribution testing are shown on Figure 4 in Appendix B. This material corresponds to SM soil using the MTO Soil Classification System.

---

#### 4.1.4 Silt / Silt with Sand / Sandy Silt (ML)

A layer of silt, silt with sand or sandy silt was encountered within seven of the eleven boreholes at this site. Three of the boreholes were terminated within these silt deposits.

Where this deposit was fully penetrated, the thickness ranged from 3.0 m to 23.5 m and the base of the unit varied from elevation 343.2 m to 368.8 m (geodetic). SPT 'N' values ranged from 5 to 116 and averaged 28, suggesting a generally compact state. The moisture content of the 9 samples tested ranged from 18% to 28% with an average of 22%. Grain size analysis of the six samples tested indicated that they contained 0% gravel, 11% to 50% sand and 50% to 89% silt and clay sized particles. The results of the grain size distribution testing are shown on Figure 5 in Appendix B. These materials correspond to an ML soil using the MTO Soil Classification System.

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#### 4.1.5 Silty Sand with Gravel, Cobbles and Boulders (TILL)

A glacial till deposit was encountered beneath the silt and sand deposits in Boreholes 07-4 and 07-5. The upper surface of the till deposit ranged from 54.6 m below ground surface (elev. 343.2 m) in Borehole 07-4 to 50.0 m below ground surface (elev. 347.7 m) in Borehole 07-5. The thickness of the till in Borehole 07-4 was 3.8 m. Borehole 07-5 was terminated upon SPT refusal (100 blows for <300 mm of penetration) on four occasions and after penetrating 12.2 m into the till deposit.

Split spoon sample recovery was very limited within the till deposit due to the coarse nature of the material. Five of the six standard penetration tests

carried out within this deposit were terminated after 100 blows, typically for only 30 mm of penetration. Rock coring techniques were used to advance the holes through boulders within the till. Based on the limited sample recovery, the till deposit is inferred to consist of silty sand with gravel cobbles and boulders.

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#### 4.1.6 Bedrock

Bedrock was encountered in Borehole 07-4 at a depth of 58.4 m below ground surface (elev. 339.4 m). The bedrock was penetrated 2.9 m by coring with NQ-size coring equipment. The core recovery was between 98 and 100 %. The rock quality designation (RQD) ranged from 63 % to 100%, indicating fair to excellent rock mass quality. The recovered rock core consisted of grey, black and pink biotite gneiss. The rock generally had a fair to excellent rock mass quality and was moderately to slightly weathered with close to moderately spaced fractures and dip angles ranging from 0 to 40 degrees from horizontal. The unconfined compressive strength of two samples of the recovered rock core were 40 MPa and 155 MPa, indicating medium strong to very strong rock.

A detailed description of the rock cores is provided in the Rock Core Summary Table in Appendix B.

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#### 4.2 Groundwater

Groundwater levels were measured in the standpipes installed during the preliminary investigation on February 10, 2005. The water levels ranged from 1.2 m to 6.0 m below ground surface (elevation 391.5 m to 392.2 m). Groundwater levels were observed in the open boreholes at the time of drilling during the 2007 investigation. The water levels ranged from 1.2 m to 6.0 m below ground surface (elevation 391.4 m to 391.8 m).

The water level in Clarke Creek was surveyed to be at elevation 392.2 m and 391.7 m on January 20, 2005, and May 17, 2007, respectively. The groundwater levels measured in the boreholes are very close to the water level in the creek, as would be expected considering the permeable nature of the upper sandy deposits.

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

## 5.0 CLOSURE

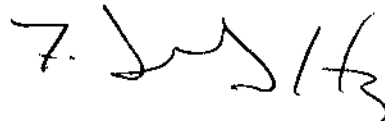
A subsurface investigation is a limited sampling of a site. The subsurface conditions given herein are based on information gathered at the specific borehole locations. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

Yours very truly,

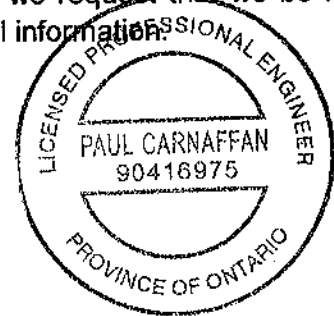
**JACQUES WHITFORD LIMITED**



Paul Carnaffan, M.Eng., P.Eng.



Fred J. Griffiths, Ph.D., P.Eng.  
Designated Principal MTO Foundation Contact



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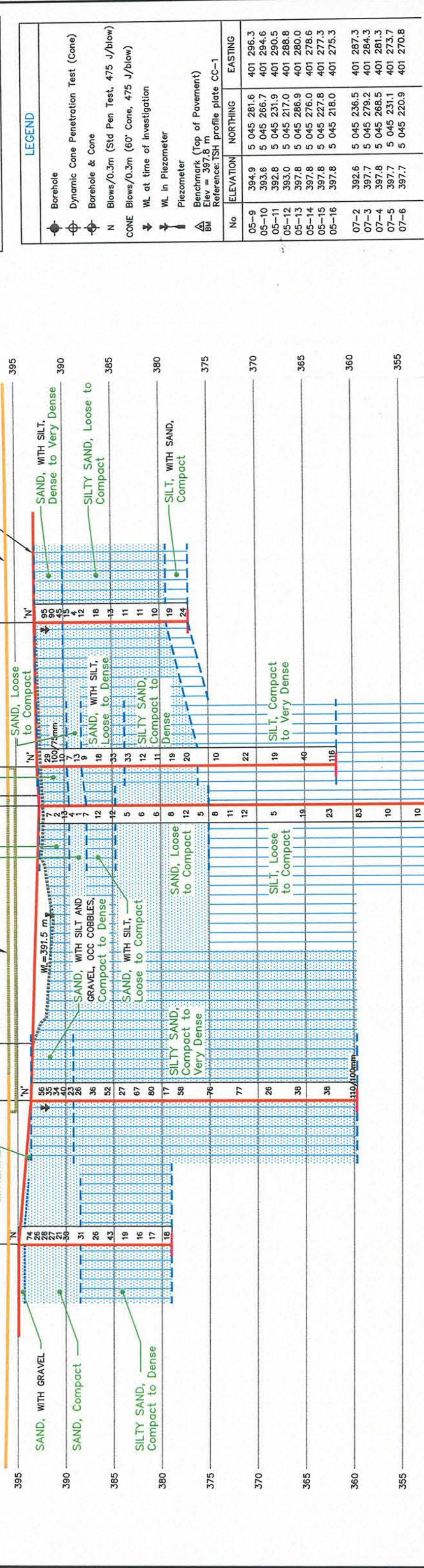
# **APPENDIX A**

## **Borehole Location Plans and Profile Plots**









<p align="center"><u>==NOTE==</u></p> <p>The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.</p>	
<p>NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the project office. The related documents is specifically included in accordance with the conditions of Section 102-2 of Form 100.</p>	
SECTIONS	DATE BY
---	---
<p align="center">GEORES No 31F-148</p>	
HWY No 60	DIST 43
SUBMITD PC	DATE 2007-10-25 SITE --
DRAWN GBB	CHECKED APPROVED <i>AC</i> DWG 2



## **APPENDIX B**

Symbols and Terms Used on Borehole Records

Borehole Records

Terminology Used on SCPTu Records

SCPTu Records

Grain Size Distribution Test Results

Rock Core Summary Table

# SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

## SOIL DESCRIPTION

### Terminology describing common soil genesis:

<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

### Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

### Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

### Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

### Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

### Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

Consistency	Undrained Shear Strength	
	kips/sq.ft.	kPa
<i>Very Soft</i>	<0.25	<12.5
<i>Soft</i>	0.25 - 0.5	12.5 - 25
<i>Firm</i>	0.5 - 1.0	25 - 50
<i>Stiff</i>	1.0 - 2.0	50 - 100
<i>Very Stiff</i>	2.0 - 4.0	100 - 200
<i>Hard</i>	>4.0	>200





## ROCK DESCRIPTION

### Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	<i>Very Poor</i>
25-50	<i>Poor</i>
50-75	<i>Fair</i>
75-90	<i>Good</i>
90-100	<i>Excellent</i>

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

### Terminology describing rock mass:

Spacing (mm)	Joint Classification	Bedding, Laminations, Bands
> 6000	<i>Extremely Wide</i>	-
2000-6000	<i>Very Wide</i>	<i>Very Thick</i>
600-2000	<i>Wide</i>	<i>Thick</i>
200-600	<i>Moderate</i>	<i>Medium</i>
60-200	<i>Close</i>	<i>Thin</i>
20-60	<i>Very Close</i>	<i>Very Thin</i>
<20	<i>Extremely Close</i>	<i>Laminated</i>
<6	-	<i>Thinly Laminated</i>

### Terminology describing rock strength:

Strength Classification	Unconfined Compressive Strength (MPa)
<i>Extremely Weak</i>	< 1
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

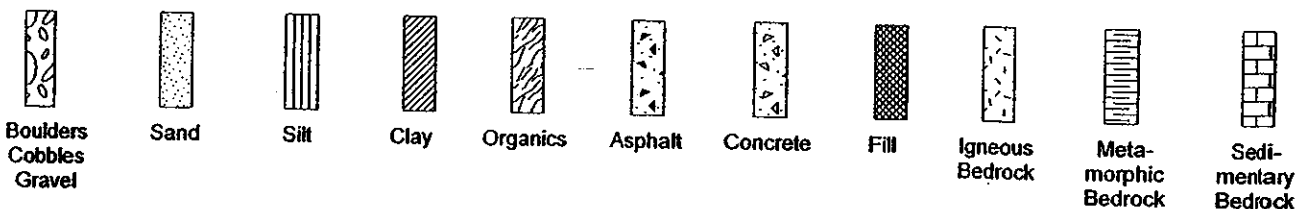
### Terminology describing rock weathering:

Term	Description
<i>Fresh</i>	No visible signs of rock weathering. Slight discolouration along major discontinuities
<i>Slightly Weathered</i>	Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured.
<i>Moderately Weathered</i>	Less than half the rock is decomposed and/or disintegrated into soil.
<i>Highly Weathered</i>	More than half the rock is decomposed and/or disintegrated into soil.
<i>Completely Weathered</i>	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.



## STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



## SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

## WATER LEVEL MEASUREMENT



## RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

## N-VALUE/RQD

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log. RQD is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery.

## DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability. Soil type may be inferred from adjacent boreholes and test pits.

## OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
$\gamma$	Unit weight
$G_s$	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
$Q_u$	Unconfined compression
$I_p$	Point Load Index ( $I_p$ on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer



RECORD OF BOREHOLE No 05-9

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045281.6 E401296.3 ORIGINATED BY AB  
DIST Bancroft HWY 80 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.04 - 05.02.04 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kNm <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
394.9	Sand with gravel																
0.0	Poorly-graded SAND with gravel, brown (SP)																
394.3																	
0.6	Poorly-graded SAND, compact, brown (SP)		1	SS	74	394											
			2	SS	26												
			3	SS	28	392											4 92 4
		4	SS	27													
		5	SS	21													
		6	SS	30	390												
386.5																	
6.4	SILTY SAND, compact to dense, brown to grey (SM)		7	SS	31	388											
			8	SS	26												
			9	SS	43	386											
			10	SS	19	384											
		11	SS	16	382												
		12	SS	17												0 59 41	
		13	SS	18	380												
379.1																	
15.9	End of Borehole																

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-10

1 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045266.7 E401294.6 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.04 - 05.02.04 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	× FIELD VANE	● QUICK TRIAXIAL						× LAB VANE	WATER CONTENT (%)
393.6	Grass						20	40	60	80	100	10	20	30	GR SA SI CL		
392.9	Organic material																
	Poorly-graded SAND with silt and gravel, occasional cobbles, compact to dense, brown (SP)		1	SS	56										28 64 9		
			2	SS	35												
			3	SS	34												
			4	SS	40												
389.2			5	SS	23												
4.4	SILTY SAND, compact to very dense, brown to grey (SM)		6	SS	28												
			7	SS	36												
			8	SS	52												
			9	SS	27												
			10	SS	67												
			11	SS	80												
			12	SS	17										0 77 23		
			13	SS	58												
			14	SS	76												
			15	SS	77												
			16	SS	26												

Continued Next Page

×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-10

2 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045266.7 E401294.6 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.04 - 05.02.04 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	SILTY SAND, compact to very dense, brown to grey (SM) (continued)																
			17	SS	38		368										
							366										
							364										
			18	SS	38		362										
							360										
359.7 33.9	End of Borehole Standpipe Installed (25 mm diameter flexible poly-tube)		19	SS	110/ 100mm												

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-11

1 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.9 E401290.5 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.08 - 05.02.08 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
392.8	Grass							20 40 60 80 100						
389.9	150 mm organic material							20 40 60 80 100						
389.8	Poorly-graded SAND with silt, occasional cobbles, compact to dense, brown (SP-SM)		1	SS	29		392							
			2	SS	100/ 75mm									
			3	SS	10									
389.8	Poorly-graded SAND, loose to compact, grey (SP)		4	SS	7		390							
388.2			5	SS	13									
4.6	Poorly-graded SAND with silt, loose to dense, brown (SP-SM)		6	SS	9		388							
			7	SS	18		386							
			8	SS	33									
383.7	SILTY SAND, compact to dense, grey to brown (SM)		9	SS	33		384							
9.1			10	SS	12		382							
			11	SS	11		380							
			12	SS	19		378							
			13	SS	20									
376.1	SILT, compact to very dense, grey (ML)		14	SS	10		376							
16.7			15	SS	22		374							
			16	SS	19		372							
							370							
							368							

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

\* 3, x 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-11

2 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.9 E401290.5 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.08 - 05.02.08 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
361.7	SILT, compact to very dense, grey (ML) (continued)		17	SS	40												
362			18	SS	116												
31.1	End of Borehole																

ONTARIO MTO. UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-12

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045217.0 E401288.8 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with SplitSpoons COMPILED BY JF  
DATUM Geodetic DATE 05.02.09 - 05.02.09 CHECKED BY PC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
393.0	Grass												
390.9	Organic material Poorly-graded SAND with silt, dense to very dense, brown (SP-SM)		1	SS	95								
			2	SS	90								
390.1			3	SS	45								
2.9	Silty SAND, loose to compact, grey to brown (SM)		4	SS	15								
			5	SS	4								
			6	SS	12								
			7	SS	18								
			8	SS	13								
			9	SS	11								
382.3			10	SS	11								
10.7	SILT with sand, compact, grey (ML)		11	SS	10								
			12	SS	19								
377.2			13	SS	24								
15.9	End of Borehole Standpipe installed (25 mm diameter flexible poly-tube)												

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25



# RECORD OF BOREHOLE No 05-13

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045286.9 E401280.0 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.01.23 - 05.01.23 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
397.8	Asphalt							20	40	60	80	100					
396.9	90 mm Asphalt		1	GS													
396.7	Sand, some gravel, trace silt, compact, brown (FILL)		2	SS	50/ 100mm												
1.1	Poorly-graded SAND with gravel, occasional cobbles, compact to dense, brown (SP)		3	SS	34		396										18 79 3
			4	SS	33												
			5	SS	30												
			6	SS	29		394										
392.3																	
5.5	Poorly-graded SAND, compact, brown (SP)		7	SS	18		392										9 89 2
390.2			8	SS	17												
7.6	End of Borehole																
	Standpipe Installed																
	(25 mm diameter flexible poly-tube)																

ONTARIO MTO UPDATE 11685.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-14

1 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045276.0 E401278.6 ORIGINATED BY AB  
 DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
 DATUM Geodetic DATE 05.01.23 - 05.01.23 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	× FIELD VANE							● QUICK TRIAXIAL	× LAB VANE	
							20	40	60	80	100							
397.8	Asphalt																	
396.9	100 mm Asphalt		1	GS														
0.9	Sand, trace silt, trace gravel, occasional cobbles, compact, brown (FILL)		2	SS	50/ 80mm													
	Silty sand, trace gravel, compact, brown (FILL)		3	SS	16													
			4	SS	29													
			5	SS	25													
394.1	Poorly-graded SAND with silt, loose to compact, brown to grey (SP)		6	SS	14													
3.7																		
			7	SS	26													
			8	SS	5													
			9	SS	8													
			10	SS	6													
			11	SS	31													
385.0	Silty SAND, compact to dense, brown to grey (SM)																	
12.8			12	SS	27													
			13	SS	53													
			14	SS	40													
			15	SS	32													
			16	SS	27													

ONTARIO MTO UPDATE 11665.GPJ, ONTARIO.MOT.GDT 07/10/25

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×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

**METRIC**

W.P.	545-93-00	LOCATION	Highway 60, Clarke Creek Bridge, N5045276.0 E401278.6	ORIGINATED BY	AB
DIST	Bancroft	HWY	60	BOREHOLE TYPE	Hollow Stem Augers/Casing with Split Spoons
DATUM	Geodetic	DATE	05.01.23 - 05.01.23	COMPILED BY	JF
				CHECKED BY	PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED		✕ FIELD VANE		● QUICK TRIAXIAL						✕ LAB VANE		
							20	40	60	80	100									
371.8	Silty SAND, compact to dense, brown to grey (SM) (continued)																			
26.0	SILT with sand, compact to dense, grey (ML)		17	SS	52											0 26 74				
368.8																				
29.0	Silty SAND, compact to very dense, grey (SM)		18	SS	10															
363.7			19	SS	100															
34.1	End of Borehole																			

**x<sup>3</sup>, x<sup>3</sup>:** Numbers refer to Sensitivity      **○<sup>3</sup>%** STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-15

1 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045227.8 E401277.3 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.01.24 - 05.01.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED	× FIELD VANE							● QUICK TRIAXIAL	× LAB VANE	
397.8	Asphalt		1	GS			20	40	60	80	100							
396.7	90 mm Asphalt Gravelly sand, with silt, compact, brown (FILL)		2	SS	50/80mm													
			3	SS	10													
394.8																		
3.1	Poorly-graded SAND with silt, very loose to compact, brown to greyish-brown (SP-SM)		4	SS	13													
			5	SS	2													
			6	SS	14											0 91 9		
			7	SS	25													
			8	SS	19											0 92 9		
388.7																		
9.1	Silty SAND, loose to dense, brown to grey (SM)		9	SS	8													
			10	SS	34													
			11	SS	26													
			12	SS	29													
			13	SS	13													
382.0																		
15.9	SILT with sand, compact to very dense, grey (ML)		14	SS	22													
			15	SS	52											0 14 86		
			16	SS	31													

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×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 05-15

2 OF 2

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045227.8 E401277.3 ORIGINATED BY AB  
 DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers/Casing with Split Spoons COMPILED BY JF  
 DATUM Geodetic DATE 05.01.24 - 05.01.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kNm <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	SILT with sand, compact to very dense, grey (ML) (continued)																
			17	SS	83												
			18	SS	22												
363.9			19	SS	100/100mm												
33.9	End of Borehole Standpipe installed (25 mm diameter flexible poly-tube)																

ONTARIO MTO UPDATE 11885.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 05-16

1 OF 1

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045218.0 E401275.3 ORIGINATED BY AB  
DIST Bancroft HWY 60 BOREHOLE TYPE Hollow Stem Augers with Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 05.01.22 - 05.01.21 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED      × FIELD VANE ● QUICK TRIAXIAL    × LAB VANE												
397.8	Asphalt						20	40	60	80	100	10	20	30	kN/m <sup>3</sup>	GR SA SI CL				
398.7	100 mm Asphalt		1	GS																
	Gravelly sand, with silt, very dense, brown (FILL)		2	SS	50/60mm															
398.3																				
1.5	Gravelly sand, with silt, occasional cobbles, loose to dense, brown (FILL)		3	SS	12															
			4	SS	6															
			5	SS	41															
394.1																				
3.7	Poorly-graded SAND with silt, loose to compact, brown (SP-SM)		6	SS	13															
			7	SS	10															
			8	SS	7															
390.2																				
7.6	Silty SAND, trace organics, compact, grey (SM)		9	SS	16															
389.6																				
8.2	End of Borehole																			

×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 07-2

1 OF 6

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045236.5 E401267.3 ORIGINATED BY JF  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 07.04.18 - 07.04.25 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
392.6	Grass													
0.0	Poorly-graded SAND with silt, occasional cobbles, trace woody organic (SP-SM)													
			1	SS	7		392							
			2	SS	2		391							3 85 (12)
			3	SS	13		390							
389.6														
3.1	Poorly-graded SAND, very loose, grey (SP)		4	SS	4		389							
			5	SS	1		388							1 96 (3)
387.7			6	SS	7		387							
4.9	Poorly-graded SAND with silt, loose to compact, brown (SP-SM)		7	SS	12		386							3 88 (9)
			8	SS	12		385							
384.7							384							
7.9	Silty SAND, loose to compact, grey (SM)		9	SS	5		383							1 76 (23)

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$\times^3, \times^3$ : Numbers refer to Sensitivity  $\circ$  3% STRAIN AT FAILURE

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

RECORD OF BOREHOLE No 07-2

2 OF 6

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045236.5 E401287.3 ORIGINATED BY JF  
 DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons COMPILED BY JF  
 DATUM Geodetic DATE 07.04.18 - 07.04.25 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Silty SAND, loose to compact, grey (SM) (continued)		10	SS	8		382							
							381							
			11	SS	6		380							
							379							
			12	SS	8		378							
							377							
			13	SS	12		376							
							375							
			14	SS	5		374							
							373							
375.0 17.6	SILT, loose to compact, grey (ML)		15	SS	8									
			16	SS	11									

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$\times^3, \times^3$ : Numbers refer to Sensitivity  $\bigcirc$  3% STRAIN AT FAILURE



RECORD OF BOREHOLE No 07-2

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METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045236.5 E401287.3 ORIGINATED BY JF  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons COMPILED BY JF  
DATUM Geodetic DATE 07.04.18 - 07.04.25 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	SILT, loose to compact, grey (ML) (continued)																
			17	SS	12												
			18	SS	5												
			19	SS	19												

ONTARIO MTO 1023392.GPJ ONTARIO MOT.GDT 07/10/25

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$\times^3, \times^3$ : Numbers refer to Sensitivity  $\circ$  3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 07-2

4 OF 6

METRIC

W.P. 545-93-00 LOCATION Highway 80, Clarke Creek Bridge, N5045236.5 E401287.3 ORIGINATED BY JF  
 DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons COMPILED BY JF  
 DATUM Geodetic DATE 07.04.18 - 07.04.25 CHECKED BY PC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	SILT, loose to compact, grey (ML) (continued)		20	SS	23											
						362										
						361										
						360										
	- very dense		21	SS	83											
						359										
						358										
						357										
			22	SS	10											
						356										
						355										
						354										
			23	SS	10											
						353										

Continued Next Page

x<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity  
 O 3% STRAIN AT FAILURE

**METRIC**

**DATUM** Geodetic **DATE** 07.04.18 - 07.04.25 **CHECKED BY** PC

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

**×<sup>3</sup>, ×<sup>3</sup>:** Numbers refer to Sensitivity      **○<sup>3%</sup>:** STRAIN AT FAILURE

# RECORD OF BOREHOLE No 07-2

6 OF 6

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045236.5 E401287.3 ORIGINATED BY JF  
 DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons COMPILED BY JF  
 DATUM Geodetic DATE 07.04.18 - 07.04.25 CHECKED BY PC

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
	- dynamic cone penetration test (continued)													
340.7														
51.9	End of Borehole Standpipe Installed													

ONTARIO MTO 1023332.GPJ ONTARIO MTO.GDT 07/10/25

RECORD OF BOREHOLE No 07-4

1 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045268.5 E401281.3 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons, NQ Core COMPILED BY JF  
DATUM Geodetic DATE 07.05.14 - 07.05.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	○ UNCONFINED      × FIELD VANE						
							20 40 60 80 100	● QUICK TRIAXIAL      × LAB VANE						
397.8	Asphalt													
397.8	130 mm ASPHALT													
397.4	180 mm CONCRETE													
0.3	Sand, with gravel and silt, compact, brown (FILL)		1	GS										
396.9							397							
0.9	Silty sand, trace gravel, very loose to compact, brown (FILL)		2	SS	15									
			3	SS	12		396							
			4	SS	3		395							
			5	SS	4		394							
			6	SS	14		393							
			7	SS	10		392							
392.9			8	SS	14		391							
4.9	Poorly-graded SAND with silt, compact, brown (SP)		9	SS	15		390							
			10	SS	4		389							
			11	SS	18		388							

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

$\times^3, \times^3$ : Numbers refer to Sensitivity  $\circ$  3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-4

2 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045288.5 E401281.3 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons, NQ Core COMPILED BY JF  
DATUM Geodetic DATE 07.05.14 - 07.05.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	20 40 60 80 100						
387.1	Poorly-graded SAND with silt, compact, brown (SP) (continued)													
10.7	Silty SAND, loose to compact, grey (SM)		12	SS	7		387							0 69 31 0
							386							
			13	SS	24		385							
							384							
			14	SS	20		383							
							382							
			15	SS	18		381							
							380							
							379							
							378							

Continued Next Page

x<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 07-4

3 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045268.5 E401281.3 ORIGINATED BY AO  
 DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons, NQ Core COMPILED BY JF  
 DATUM Geodetic DATE 07.05.14 - 07.05.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
	Silty SAND, loose to compact, grey (SM) (continued)		16	SS	24									
							377							
							376							
							375							
							374							
			17	SS	14		373							0 51 47 2
							372							
							371							
							370							
							369							
			18	SS	14		368							

Continued Next Page

\*<sup>3</sup>, X<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

## METRIC

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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
								○ UNCONFINED      × FIELD VANE ● QUICK TRIAXIAL    × LAB VANE					
	Silty SAND, loose to compact, grey (SM) (continued)												
							367						
							366						
							365						
			19	SS	42								
							364						
							363						
							362						
			20	SS	40								
							361						
							360						
							359						
			21	SS	57								
							358						

**Continued Next Page**

✕<sup>3</sup>, ✕<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE



RECORD OF BOREHOLE No 07-4

5 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045268.5 E401281.3 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons, NQ Core COMPILED BY JF  
DATUM Geodetic DATE 07.05.14 - 07.05.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Silty SAND, loose to compact, grey (SM) (continued)													
			22	SS	80		357							
							356							
							355							
							354							
							353							
			23	SS	20		352							0 65 (35)
							351							
							350							
			24	SS	48		349							
							348							
348.4 49.4	Sandy SILT, dense, grey (ML)													

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

## METRIC

CHECKED BY PC

**×<sup>3</sup>, ×<sup>3</sup>:** Numbers refer to Sensitivity      **○<sup>3%</sup>:** STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-4

7 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045268.5 E401281.3 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE Hollow stem augers, NW casing, Split Spoons, NQ Core COMPILED BY JF  
DATUM Geodetic DATE 07.05.14 - 07.05.18 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
336.5	Biotite GNEISS, grey, black and pink, fair to excellent, moderate to slightly weathered, close to moderately spaced fractures, thin bedding, 0 to 40 degree dip (continued)		30	NQ												TCR = 100% RQD = 90%	
61.3	End of Borehole  Standpipe Installed to 7.62 m																

RECORD OF BOREHOLE No 07-5

1 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE NQ casing, split casing, NQ Core COMPILED BY JD  
DATUM Geodetic DATE 07.05.22 - 07.05.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	× FIELD VANE	● QUICK TRIAXIAL							× LAB VANE	
397.7	Asphalt						20	40	60	80	100							
0.0	200 mm ASPHALT																	
397.5																		
397.4	Sand, with gravel and silt, compact, brown: FILL		1	GS														
0.4	Well-graded sand with gravel, very loose to compact, brown: FILL		2	SS	22													
			3	SS	10													
			4	SS	8													
			5	SS	14													
			6	SS	3													
393.2																		
4.6	Poorly-graded SAND with silt, loose to compact, brown (SP)		7	SS	11													
			8	SS	9													
			9	SS	6													
			10	SS	22													
			11	SS	15													
388.0																		
9.7	Silty SAND, loose to compact, brown to grey (SM)																	

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-5

2 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE NQ casing, split casing, NQ Core COMPILED BY JD  
DATUM Geodetic DATE 07.05.22 - 07.05.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Silty SAND, loose to compact, brown to grey (SM) (continued)		12	SS	10		387							
			13	SS	9		386							0 80 (20)
			14	SS	10		384							
383.1							383							0 21 75 4
14.6	SILT with sand, loose to compact, grey (ML)		15	SS	8		382							
							381							
							380							
							379							
			16	SS	16		378							

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

$\times^3, \times^3$ : Numbers refer to Sensitivity  $\bigcirc$  3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 07-5

3 OF 7

### METRIC

W.P. 545-93-00

**LOCATION** Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7

ORIGINATED BY AO

DIST 43 HWY 60BOREHOLE TYPE NQ casing, split casing, NQ Core

COMPILED BY JD

**DATUM** Geodetic

DATE 07.05.22 - 07.05.24

CHECKED BY PC

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$\times^3, \times^3$ : Numbers refer to Sensitivity
 
 $\bigcirc^{3\%}$  STRAIN AT FAILURE

RECORD OF BOREHOLE No 07-5

4 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE NQ casing, split casing, NQ Core COMPILED BY JD  
DATUM Geodetic DATE 07.05.22 - 07.05.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	SILT with sand, compact to dense, grey (ML) (continued)							○ UNCONFINED    ✕ FIELD VANE ● QUICK TRIAXIAL    ✕ LAB VANE						
			19	SS	34		367							
							366							
							365							
							364							
							363							
							362							
			20	SS	44		361							
							360							
359.6 38.1	Silty SAND, dense to very dense, grey (SM)						359							
			21	SS	56		358							0 53 45 2

Continued Next Page

✕<sup>3</sup>, ✕<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 1023332.GPJ ONTARIO MTO.GDT 07/10/25

RECORD OF BOREHOLE No 07-5

5 OF 7

METRIC

W.P. 545-93-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7 ORIGINATED BY AO  
 DIST 43 HWY 60 BOREHOLE TYPE NQ casing, split casing, NQ Core COMPILED BY JD  
 DATUM Geodetic DATE 07.05.22 - 07.05.24 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
	Silty SAND, dense to very dense, grey (SM) (continued)													
			22	SS	37		357							
							356							
							355							
							354							
							353							
			23	SS	76		352							
							351							
							350							
			24	SS	39		349							
							348							
347.7														

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

Continued Next Page

×<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE





RECORD OF BOREHOLE No 07-5

7 OF 7

METRIC

W.P. 545-83-00 LOCATION Highway 60, Clarke Creek Bridge, N5045231.1 E401273.7 ORIGINATED BY AO  
DIST 43 HWY 60 BOREHOLE TYPE NQ casing, split casing, NQ Core COMPILED BY JD  
DATUM Geodetic DATE 07.05.22 - 07.05.24 CHECKED BY PC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									
						20	40	60	80	100							
						○ UNCONFINED    × FIELD VANE ● QUICK TRIAXIAL    × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	10	20	30				
	Silt and sand, with cobbles and boulders, very dense, grey: TILL (continued)																
335.5			31	SS	100/80 mm												
62.2	End of Borehole																

ONTARIO MTO 1023332.GPJ ONTARIO MOT.GDT 07/10/25

## Terminology Used on SCPTu Records

### Key Terminology and Principles

#### **SCPTu:**

- Seismic Piezocone (SCPTu);
- A piezocone (CPTu) is an enhanced cone penetration test (CPT) probe that is able to measure porewater pressure ( $u$ );
- A seismic piezocone (SCPTu) is further enhanced to measure surface generated compression and shear waves at depth; used to define the shear wave velocity of soils.

#### **Equipment Type and Governing Standard:**

- 10 cm<sup>2</sup> seismic piezocone;
- 150 cm<sup>2</sup> friction sleeve;
- manufactured by Applied Research Associates, Inc.;
- ASTM Specification D3441.

#### **PCPT Investigation Objectives:**

- evaluate soil type and soil stratigraphy;
- estimate the relative density of granular soils and in situ undrained shear strength of cohesive soils.

#### **Soil Behaviour Type (SBT):**

- The SBT is selected based on a soil's response to cone penetration, which is different from an explicit soil type defined by specified laboratory testing procedures, but is normally what the geotechnical engineer requires for design purposes.
- The SBT can be classified on the basis of the soil friction ratio,  $f_s$ ; ratio between the side shear on the friction sleeve and cone tip resistance.
- The SBT can also be classified on the basis of the normalized pore pressure,  $B_q$ ; a function of the pore water response and the cone tip resistance.
- The "CPT Soil Behaviour Type Legend" used for this project is attached.

#### **Canadian Foundation Engineering Manual (3<sup>rd</sup> Edition) Statement on the CPT**

- "The most significant advantage that the electric cone penetrometers offer is their repeatability and accuracy."
- "One of the most important applications of the cone penetration test is to accurately determine the soil profile."

#### Key References:

T. Lunne, P.K. Robertson, and J.J.M. Powell (1997). "Cone Penetration Testing in Geotechnical Practice"; Spon Press.

P.W. Mayne (1986). "CPT indexing of in situ OCR in Clays"; Proceedings of the ASCE Specialty Conference In Situ '86: Use of In Situ Tests in Geotechnical Engineering, Blacksburg, 780-93, ASCE.

P.K. Robertson and R.G. Campanella (1988). "Guidelines for geotechnical design using CPT and CPTU"; University of British Columbia, Vancouver, Department of Civil Engineering, Soil Mechanics Series 120.

### Terminology and Key Engineering Relationships

Parameter	Description	Symbol/Equation	Reference
Depth	Depth of the centroid of the sensor		
Elevation	Elevation of centroid of the sensor	Ground Surface – Depth	
Sleeve Stress	Sleeve Stress – interpolated to the depth of the tip	$f_s$	
Tip Stress, Uncorrected	Measured Tip Stress	$q_c$	
Tip Stress COR	Tip Stress, corrected for probe geometry	$q_t = q_c + u_2 x(1 - a)$	
Ratio COR	Friction Ratio	$R_f = \frac{f_s}{q_t} \times 100\%$	
Pore Pressure	Measured Pore Pressure	$u_2$	
Soil Behaviour Type	Soil Behaviour Type	$SBT'$	Lunne, Robertson and Powell, 1997
Overburden Stress		$\sigma_{vo} = \sum_{i=1}^n \gamma_i x h_i$	
Effective Overburden Stress		$\sigma'_{vo} = \sigma_{vo} - u_o$	
Normalized Tip Stress		$Q_t = \frac{q_t - \sigma_{vo}}{\sigma'_{vo}}$	Lunne, Robertson and Powell, 1997
Normalized Friction Ratio		$F_r = \frac{f_s}{q_t - \sigma_{vo}}$	Lunne, Robertson and Powell, 1997
Normalized Pore Pressure		$B_q = \frac{\Delta u}{q_t - \sigma_{vo}}$ where $\Delta u = u_2 - u_o$	Lunne, Robertson and Powell, 1997

K:\Divisions\GeoMaterials\CPT\CPT

Tools\Terminology

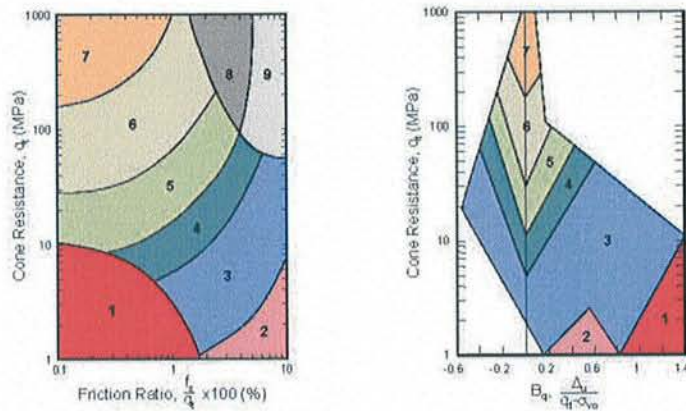
Used

on

SCPTu

Records.doc

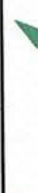
# **CPT Soil Behavior Type Legend (Robertson et al. 1990)**

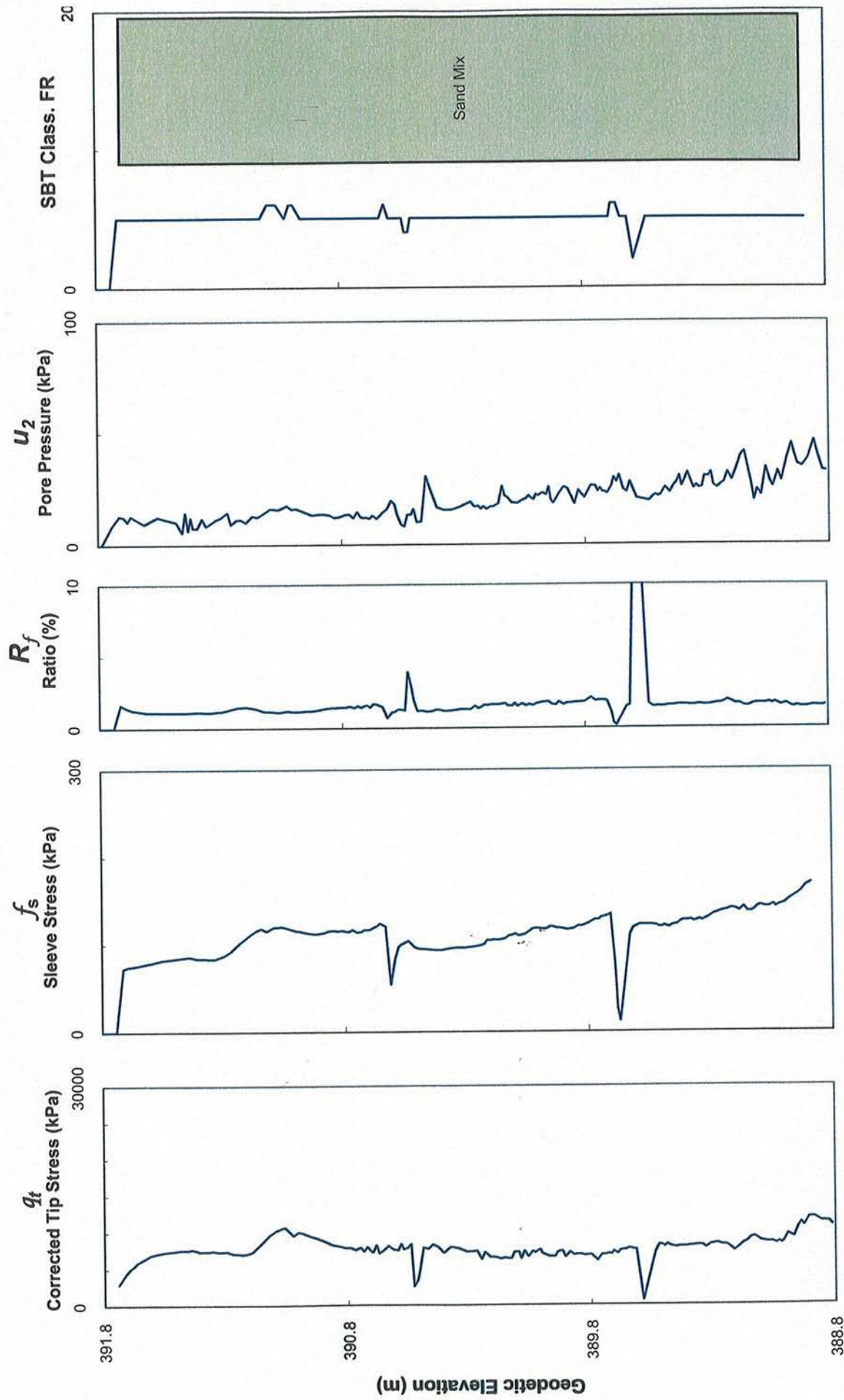


Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Soils-Peats
3	Clays; Clay to Silty Clay
4	Silt Mixtures; Clayey Silt to Silty Clay
5	Sand Mixtures; Silty Sand to Sandy Silt
6	Sands; Clean Sands to Silty Sands
7	Gravelly Sand to Sand
8	Very Stiff Sand to Clayey Sand*
9	Very Stiff Fine Grained*
*Overconsolidated or Cemented	



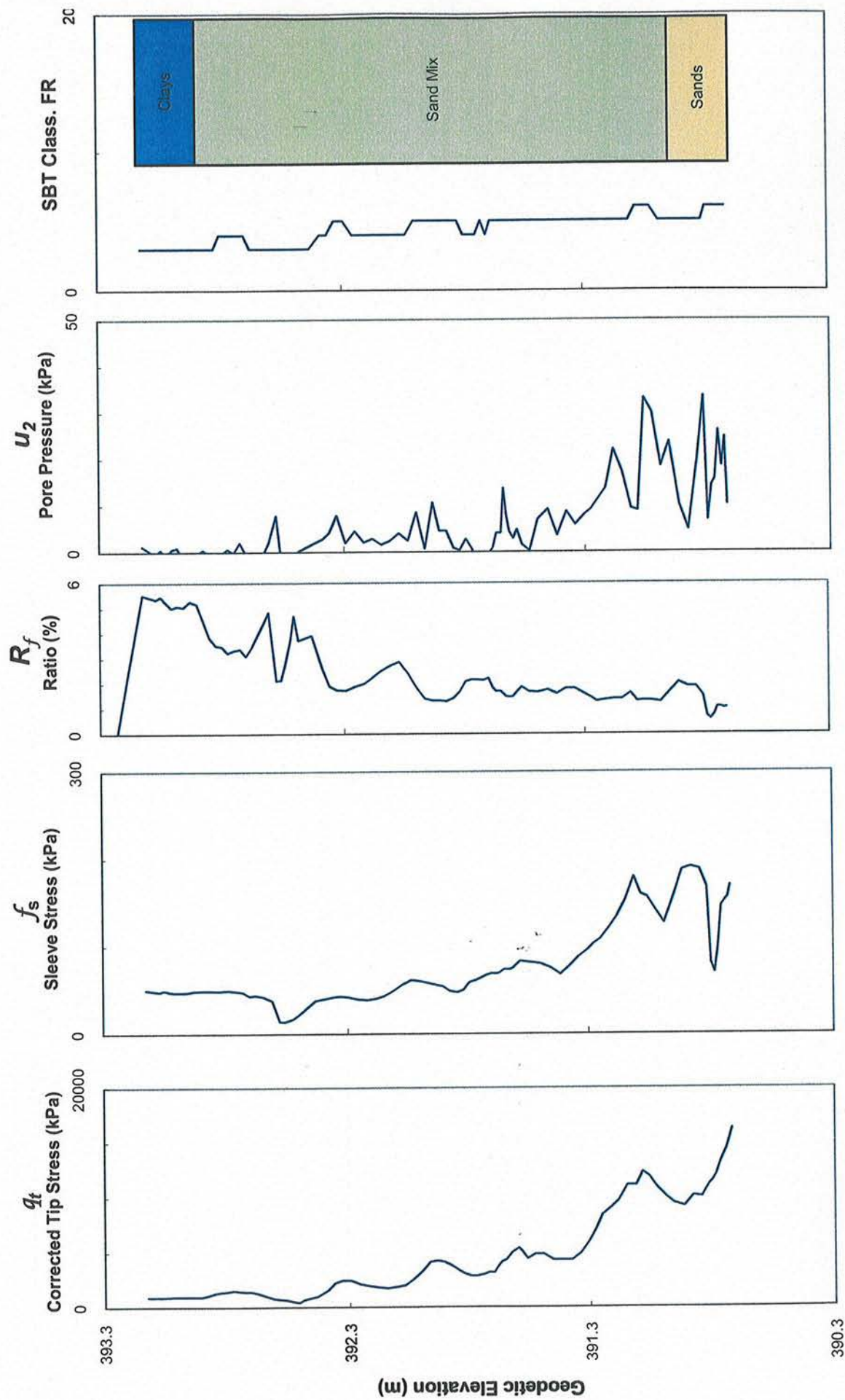


 <b>Jacques Whitford</b>	Ground Surface Elevation: 397.73 m			Test Date: April 26, 2006 Project No. 1023332 N5045279.2 E401284.3	CPT 07-3
	CPTu Start Elevation: 391.79 m				
	Groundwater Elevation: 391.66 m				
	Client: McCormick Rankin Corporation				
	Project: MTO WP 545-93-00, Clarke Creek Bridge Replacement				





Client: McCormick Rankin Corporation Project: MTO WP 545-93-00, Clarke Creek Bridge Replacement	Ground Surface Elevation: 397.68 m	Test Date: May 11, 2006	CPT 07-6
	CPTu Start Elevation: 393.24 m	Project No. 1023332	
	Groundwater Elevation: 391.66 m	N5045220.9 E401270.8	





UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	
MINISTRY SIEVE DESIGNATION (Metric)							
		150 µm	425 µm	2.00 mm	4.75 mm	9.5 mm	19.0 mm
		106 µm	250 µm	2.36 mm	4.75 mm	13.2 mm	26.5 mm
		75 µm	300 µm	2.00 mm	4.75 mm	9.5 mm	19.0 mm
		53 µm	425 µm	2.00 mm	4.75 mm	13.2 mm	26.5 mm

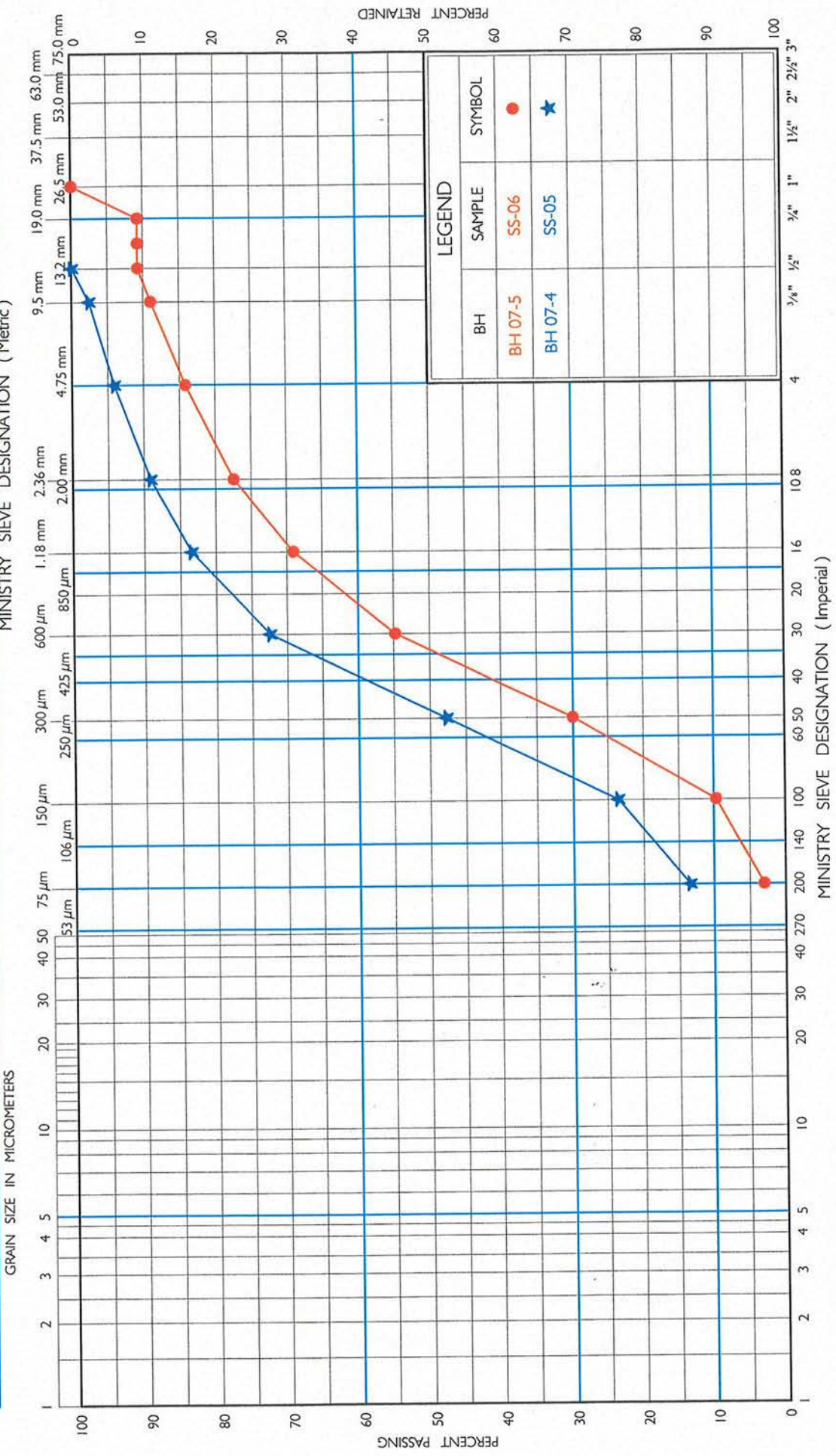


FIG No 1

GRAIN SIZE DISTRIBUTION

SILTY SAND TO WELL-GRADED SAND WITH GRAVEL (FILL)



# UNIFIED SOIL CLASSIFICATION SYSTEM

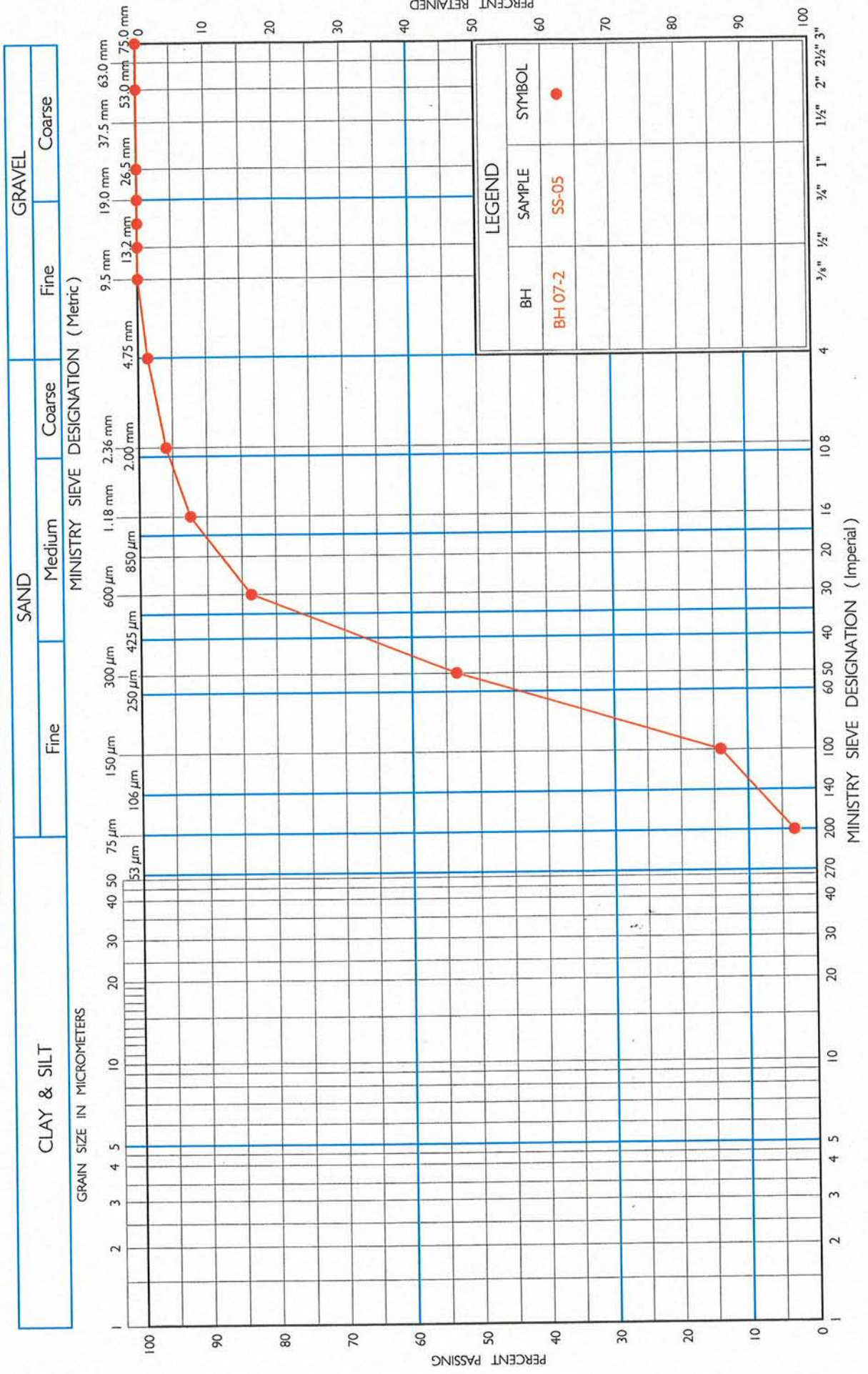


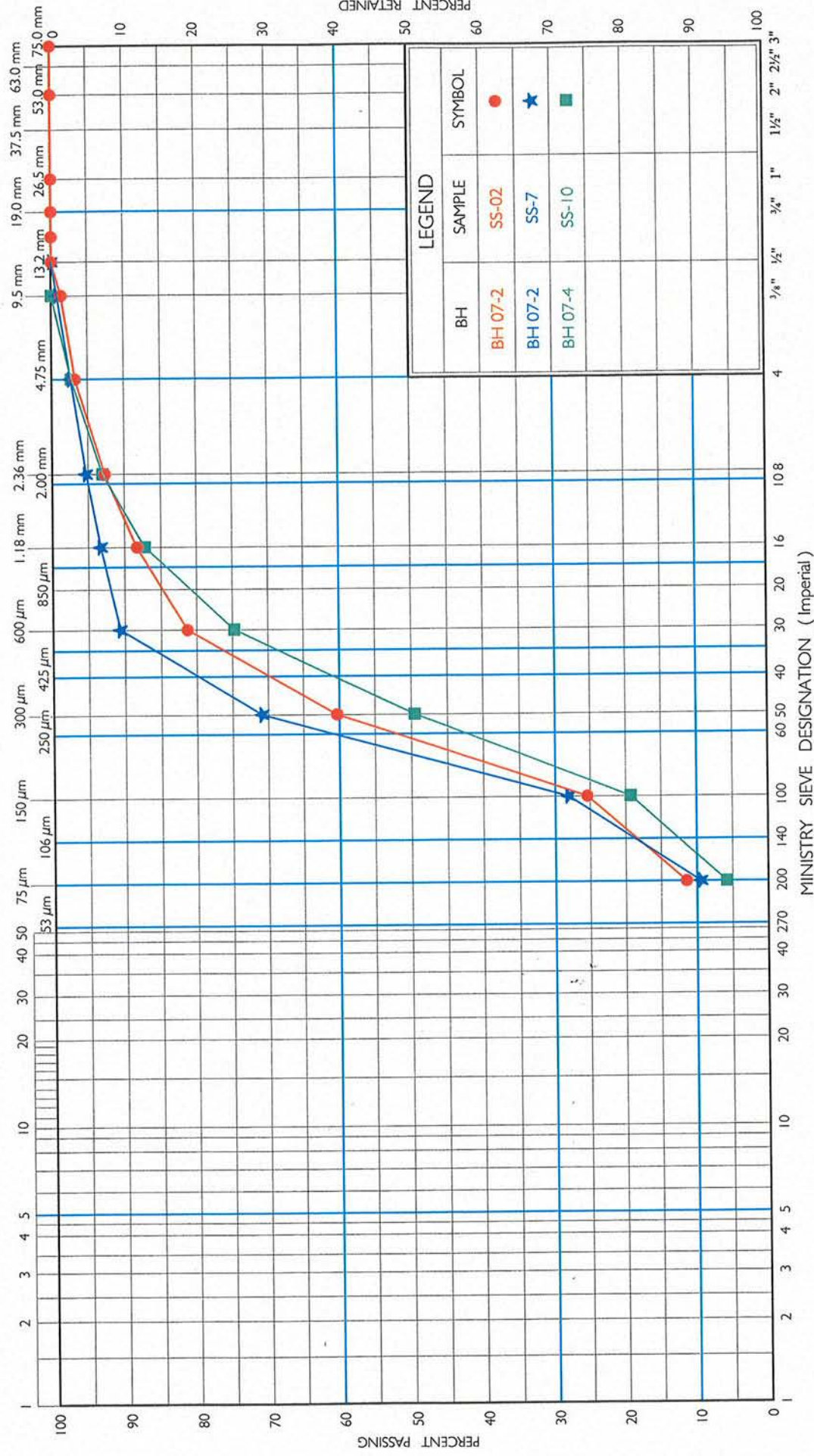
FIG No 2  
GRAIN SIZE DISTRIBUTION  
POORLY-GRADED SAND (SP)

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine		Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS





# UNIFIED SOIL CLASSIFICATION SYSTEM

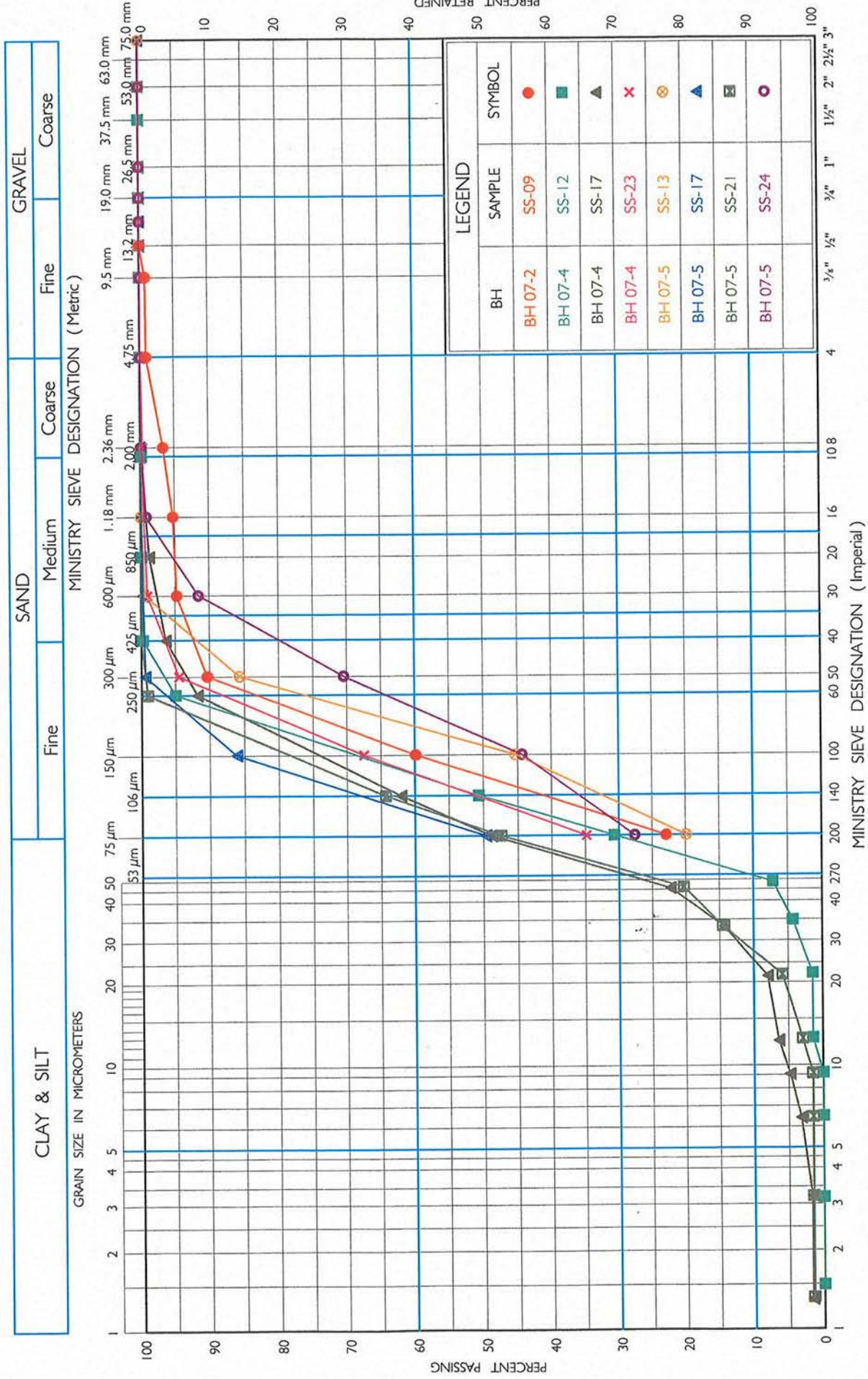


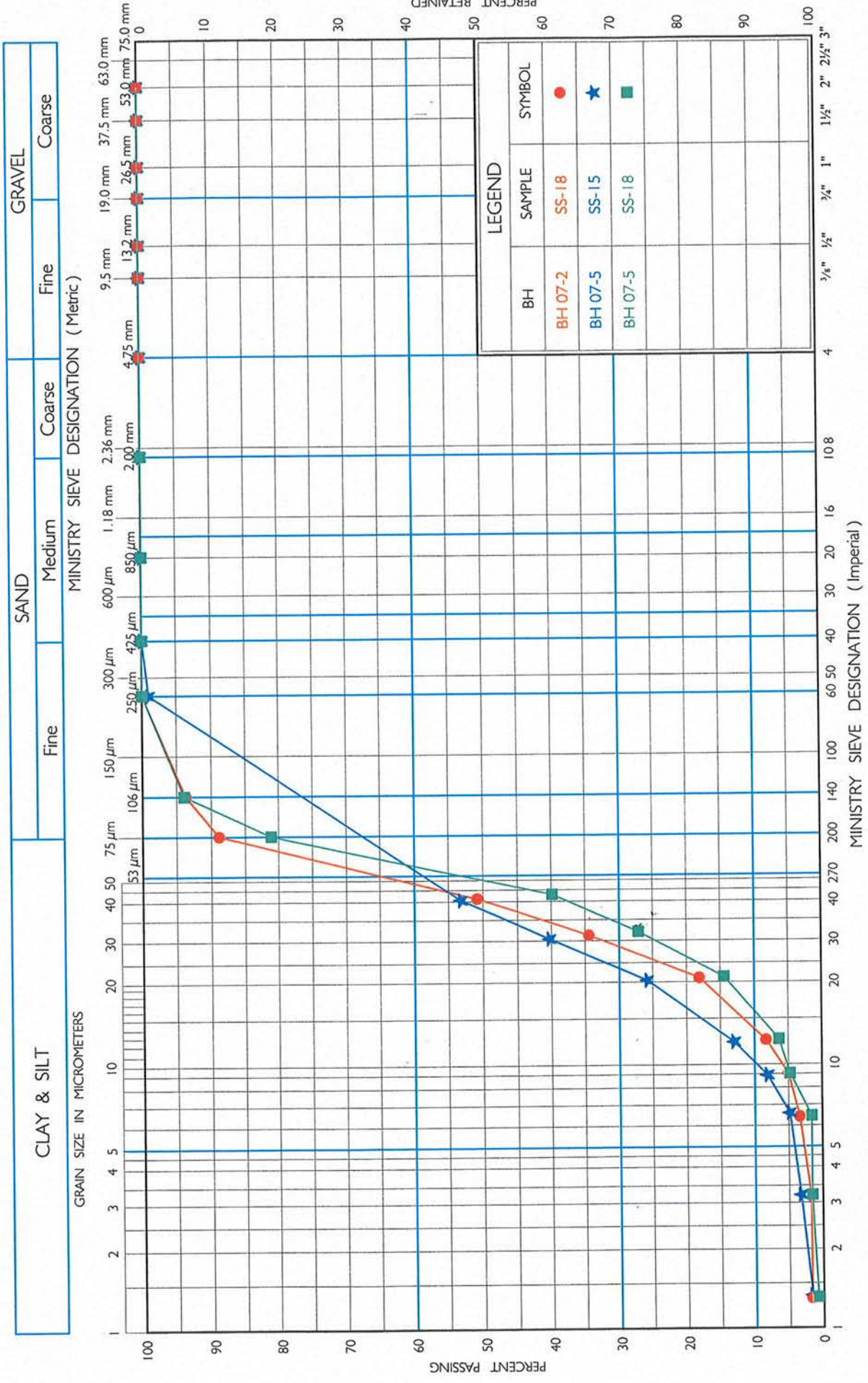
FIG No 4

GRAIN SIZE DISTRIBUTION

SILTY SAND (SM)

GWP 545-93-00

# UNIFIED SOIL CLASSIFICATION SYSTEM



**FIG No 5**

**GRAIN SIZE DISTRIBUTION**

**SILT / SILT WITH SAND (ML)**



**Rock Core Summary Table**  
**W.P. 302-89-00**

Borehole #	Sample #	Recovery (%)	R.Q.D. (%)	Unconfined Compressive Strength (MPa)	Description
07-4	28	100	63	-	Biotite GNEISS, grey, black and pink, fair to excellent, moderate to slightly weathered, close to moderately spaced fractures, 0 to 40 degree dip
	29	98	100	40, 155	
	30	100	90	-	