

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30115-167

DIST. 4 REGION

W.P. No. 409-85-02

CONT. No.

W. O. No.

STR. SITE No. 10-479

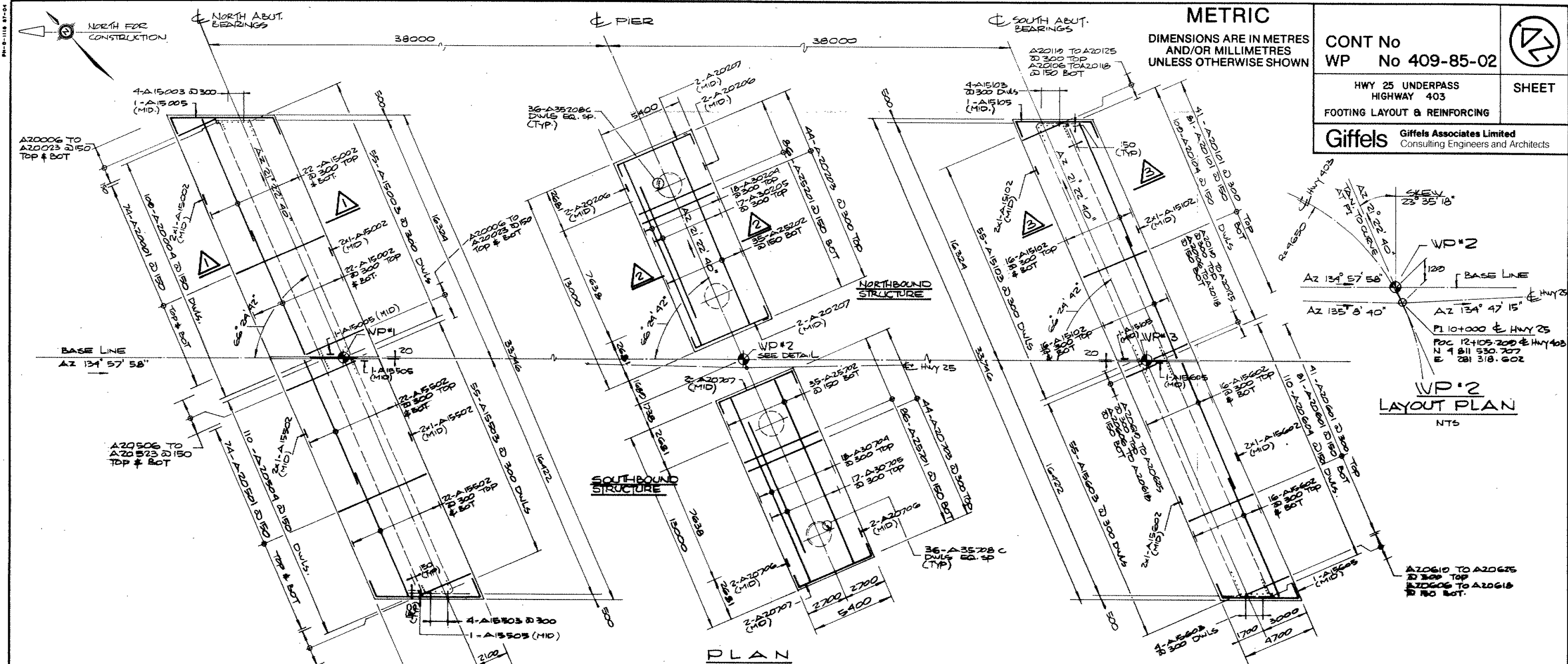
HWY. No. 403

LOCATION HWY 403 & HWY 25
UNDERPASS

=====
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

		APPLICABLE STANDARD DRAWINGS: DD-3503 MINIMUM GRANULAR BACKFILL REQUIREMENTS																																		
<p>DRAWING NOT TO BE SCALED 100 mm ON ORIGINAL DRAWING</p>																																				
REVISIONS		<table border="1"> <thead> <tr> <th>DATE</th> <th>BY</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		DATE	BY	DESCRIPTION																														
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DESIGN		BBB CHK KMN CODE OHBDC-83 LOAD CLASS A DATE OCT 90																																		
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METRIC

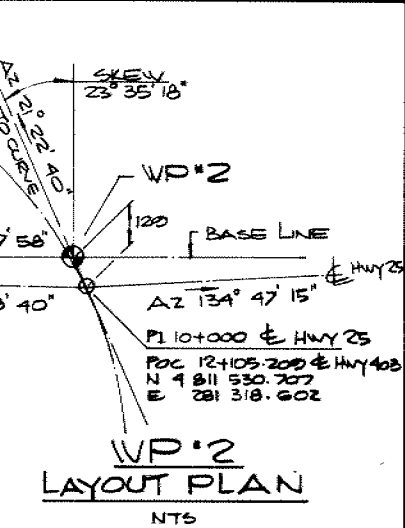
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No 409-85-02

HWY 25 UNDERPASS
HIGHWAY 403

FOOTING LAYOUT & REINFORCING

Giffels Giffels Associates Limited
Consulting Engineers and Architects

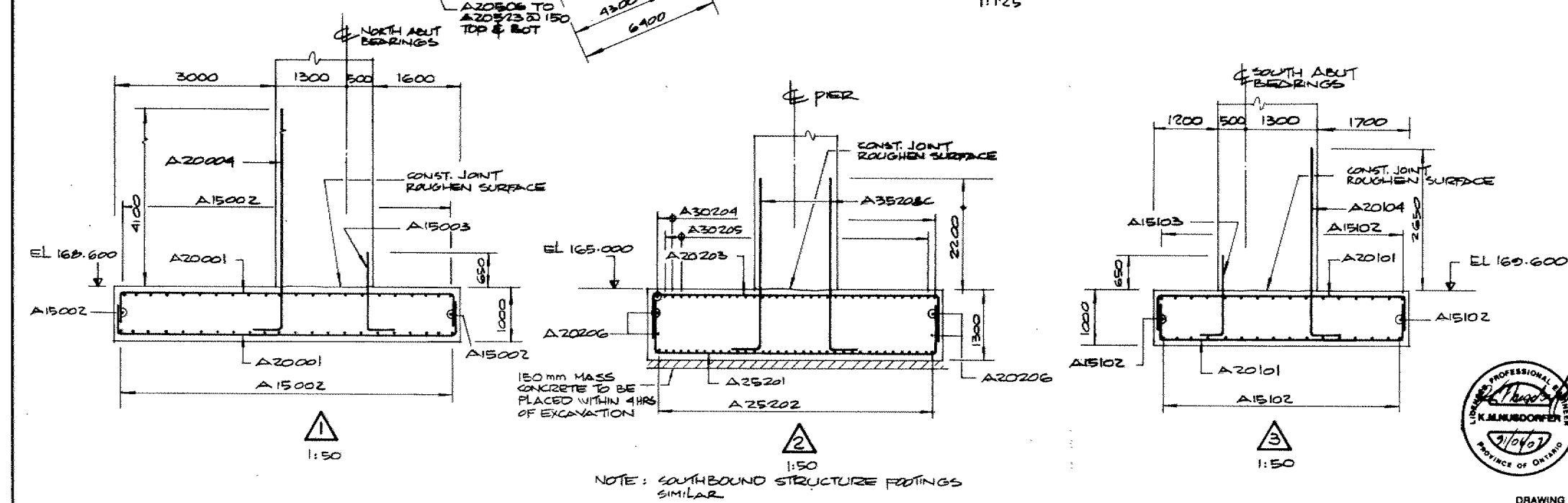


PLAN
1:125

WORKING POINT DATA

WP	STATION	COORDINATES	
		NORTH	EAST
1	0+061.048	4 811 557.681	281 201.768
2	0+099.048	4 811 530.826	281 318.640
3	10+037.048	4 811 503.072	281 345.535
4	0+060.847	4 811 560.224	281 202.750
5	0+028.800	4 811 533.250	281 319.598
6	10+036.866	4 811 506.509	281 346.528
7	0+063.048	4 811 555.137	281 200.767
8	10+001.085	4 811 528.162	281 317.606
9	10+039.030	4 811 501.436	281 344.542

NOTES: 1. FOR LOCATION AND ELEVATION OF WP*4 TO WP*9 SEE DWG. #1
2. FOR DETAILS OF COMPACTED GRANULAR 'A' FILL UNDER ABUTMENT FOOTINGS SEE DWG. #23



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN: KMN/CHK JJW CODE: OHBDC-83 LOAD CLASS: A DATE: APR 97
DRAWN: HY/CHK KMN SITE: 10-479 STRUCT: SCHEME: DWG. 3

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 409-85-02

DIST 4

HWY 403

STR SITE 10-479

Bridge Structure
Hwy. 403 - Hwy. 25 Underpass

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FOUNDATION INVESTIGATION REPORT
For
Bridge Structure
Hwy. 403 - Hwy. 25 Underpass
W.P. 409-85-02, Site No. 10-479
District 4, Burlington

INTRODUCTION

This report summarizes the information obtained from a foundation investigation carried out at the above mentioned site where a twin two span structure is proposed to carry the existing Hwy. 25 over the proposed Hwy. 403.

The fieldwork was carried out between 90 04 30 and 90 05 02. Seven boreholes (BH 1 to BH 7) were advanced and sampled as part of this project by means of hollow stem augers with a conventional diamond drill (NW casing and NQ core barrel) adopted for rock sampling purposes. These boreholes extended down to depths of 4.6 and 6.2 m below the existing ground surface.

This report contains factual information obtained from this investigation pertaining to structure foundations, approach embankments and related earthworks for the bridge structure as shown on Dwg. No. 4098502-A.

SITE DESCRIPTION AND GEOLOGY

The site is located on the proposed alignment of Hwy. 403 where it crosses the existing Hwy. 25 in the City of Oakville, Regional Municipality of Halton. The proposed structure is located approximately 2.0 km north of the existing Hwy. 5. The topography in the area is generally flat to gently undulating with ground surface sloping to the southeast. Land use in the vicinity of the site is primarily agricultural and dairy farming.

Physiographically, the site is located in the "Peel Plain" region (Ref. Chapman and Putnam, 1984) which is characterized by a glacial till containing large amount of paleozoic shale. Underlying the glacial deposit are the red Queenston shale from which the till's reddish colour is derived.

SUBSURFACE CONDITIONS

The subsoil conditions are generally uniform across the site. The overburden consists of a thin deposit of cohesive glacial till composed of a heterogeneous mixture of clayey silt, sand and gravel underlain by shale and siltstone bedrock. The maximum thickness of this deposit was found to be about 2.3 m at BH 2.

The upper portion of the shale was found to be weathered down to approximate El. 160.5 m with a maximum thickness of about 2.8 m at BH 7.

A thin layer of road fill materials was encountered at four borehole locations. However, it should be noted that at BH's 1, 3, 4, 5, 6 and 7 a thin layer of clayey silt topsoil was found from the ground surface or immediately underneath the fill material with the maximum thickness of 1.7 m at BH 4.

The boundaries between the various soil types, in situ and laboratory test results are shown on the attached Record of Borehole sheets in the Appendix. The locations and elevations of the boreholes, along with a profile and two sections showing soil stratigraphy based on borehole data, are shown on Dwg. No. 4098502-A.

A detailed description of the subsurface conditions encountered is given below.

Fill Material

Four boreholes encountered some 0.8 m of fill material whose composition ranged from a brown reworked clayey silt to sand and gravel. Through visual observation, it is apparent that the fill material can be classified as a clayey silt to sand and gravel.

Topsoil was encountered at six borehole locations. The maximum thickness of this layer is about 1.7 m at BH 4. Through the visual observation, the material can be classified as a clayey silt.

Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till)

This stratum encountered underneath the fill material or topsoil. This deposit consists of a heterogeneous mixture of clayey silt of low plasticity with varying amounts of sand and gravel. The thickness of this layer was found to be the maximum 2.3 m at BH 2.

Atterberg Limit tests were performed on these samples and the results are plotted on Figure 1 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	10.5-20.5	14.6
Liquid Limit (w_L)	22.0-40.5	29.0
Plastic Limit (w_p)	14.0-19.0	15.6
Plasticity Index (I_p)	7.5-21.5	13.4

From the plasticity chart, it is evident that the layer can be classified as a heterogeneous mixture of clayey silt, sand and gravel with low plasticity (CL).

Grain Size Distribution tests were carried out on this cohesive glacial till material. Figure 2 in the Appendix shows the results. An increasing frequency of fragments of weathered shale was encountered within the lower portion of this till.

In this stratum, the 'N' value ranges from 10 to over 100 blows/0.3 m indicating the consistency of this deposit described as stiff to hard.

Bedrock

In each of the borings, split spoon samples of the weathered portion of the bedrock were recovered before augering was terminated. Sound bedrock was proven in three boreholes by obtaining up to 1.6 m of NQ rock cores at BH's 1, 3 and 5. The top of the bedrock ranged from El. 162.6 to 164.2 m which are corresponded to 2.7 m and 2.4 m below the existing ground surface. The upper 1.5 m to 2.8 m is in a highly weathered state, with layers of broken shale and red clayey silt.

Atterberg Limit tests were performed on this weathered shale and the results are plotted on Figure 3 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	7.0-12.5	10.0
Liquid Limit (w_L)	22.5-29.0	26.2
Plastic Limit (w_p)	13.0-17.0	15.4
Plasticity Index (I_p)	8.0-14.5	10.8

From the plasticity chart, it is evident that the weathered shale can be classified as a clayey silt with trace of sand with low plasticity (CL).

Grain Size Distribution tests were carried out on this material. Figure 4 in the Appendix shows the results. In this stratum, the 'N' values ranges from 26 to over 100 blows/0.3 m indicating the consistency of this deposit as very stiff to hard.

The bedrock is a red shale with interbedded green siltstone (approximately 80% shale, 20% siltstone) of the Queenston formation. Detailed description of the rock are attached in the Appendix entitled "Rock Core Description".

The Core Recovery (CR) and Rock Quality Designation (RQD) values were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Core Recoveries (RC) range between 81 and 100 percent and Rock Quality Designation (RQD) values range from 10 to 59 percent. Based on these results, the rock can be classified as weak to very weak and slightly to unweathered.

GROUNDWATER CONDITIONS

Groundwater levels was encountered in three boreholes during the site investigation (BH's 2, 6 and 7). Four boreholes were dry during the site investigation (BH's 1, 3, 4 and 5). Two boreholes were charged with surface water later at BH's 1 and 4. Groundwater level in open boreholes was found to be approximate elevation between 161.6 m at BH 4 and 163.3 m at BH 2 which

correspond to depths of 3.8 m and 3.0 m below the existing ground surface. Upon completion of rock coring, the induced drill water remained perched within the borehole, indicating a low permeability both for the till and shale strata.

DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the bridge structure and related approaches.

It is proposed to construct underpass structure that will carry the existing Hwy. 25 over the proposed Hwy. 403 eastbound and westbound lanes. The proposed structure is a twin two span bridge.

A proposed Hwy. 25 profile grade, ranging from 174.8 m at south abutment to 175.2 m at north abutment with a proposed Hwy. 403 profile grade of about 167.0 m, will necessitate minimum approach fill in the order of 9.5 m at south abutment and 9.0 m at north abutment above the existing ground surface.

Recommendations pertaining to the foundations of the new structure and related earth work are summarized as follows.

Structure Foundations

South Abutment

In consideration of the weak nature of the subsoil at this location, existing fill material, topsoil and weak cohesive glacial till should be excavated down to El. 163.5 m and the excavation can be backfilled with compacted Granular 'A' as high as possible as shown on Figure 5.

For the purposes of the O.H.B.D.C. the following values are recommended:

Factored Bearing Capacity at U.L.S. 900 kPa
Bearing Capacity at S.L.S. Type II 350 kPa

Alternatively, the closed-type of abutment can be supported on spread footings within very stiff to hard glacial till for the following recommended values:

Factored Bearing Capacity at U.L.S. (kPa)	Allowable Capacity at S.L.S. Type II (kPa)	Proposed Footing Elevation (m)
555	370	at or below 163.0

North Abutment

At this location, existing fill material, topsoil and weak cohesive glacial till should be also excavated down to El. 165.0 m and the excavation can be backfilled with compacted Granular 'A' as high as possible as shown on Figure 5.

For the purpose of the O.H.B.D.C. the following values are recommended:

Factored Bearing Capacity at U.L.S.	900 kPa
Bearing Capacity at S.L.S. Type II	350 kPa

Alternatively, the closed-type of abutment can be supported on spread footings within very stiff to hard glacial till for the following recommended values:

Factored Bearing Capacity at U.L.S. (kPa)	Allowable Capacity at S.L.S. Type II (kPa)	Proposed Footing Elevation (m)
675	450	at or below 165.0

Pier

In consideration of the competent nature of subsoils, spread footings can be founded on native glacial till with the following design parameters.

Factored Bearing Capacity at U.L.S. (kPa)	Allowable Capacity at S.L.S. Type II (kPa)	Proposed Footing Elevation (m)
675	450	at or below 164.5

A footing width of 2.5 m with an embedded depth of 1.2 m was used in the calculation of the above capacities. The magnitude of the differential

settlement of the footings is anticipated to be within 25 mm, provided the subsoil is not disturbed by construction activities.

Other Considerations

Sliding Resistance

Sliding resistance may be computed by assuming a coefficient of friction of 0.57 for cohesive till and 0.7 for Granular 'A' material to apply between the underside of footings and the founding soil.

Lateral Earth Pressures on Structures

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the abutments to prevent hydrostatic pressure build-up.

Design parameters of the soil are given below for purpose of the O.H.B.C.D.

	Granular 'A'	Granular 'B'
Angle of Internal Friction, ϕ	35°	30°
Unit Weight (kN/m ³), γ	22.8	21.2
Coefficient of Active Earth Pressure (Ka)	0.27	0.33
Coefficient of Earth Pressure at Rest (Ko)	0.43	0.50

The earth pressure coefficient at rest is to be used in design of the abutment walls are rigid and unyielding. Weep holes in the abutment walls should be designed to drain any accumulation of water in the backfill.

Dewatering

No major dewatering difficulties are anticipated for footing excavations in consideration of the relatively low permeability of the glacial

till. However, if localized seepage or surface water to accumulate in excavations, it can be controlled by perimeter ditches and pumping from corner sumps.

Frost Protection

The footings should be placed so as to have a minimum earth cover of 1.2 m to allow for frost protection.

Approaches and Excavations

The base of all footing excavations should be covered immediately upon exposure with a working slab of lean concrete to protect the exposed glacial till from disturbing and softening within 4 hours of exposure. All organic and softened material should be stripped from within the plan limits of the immediate approach embankments prior to placement of any fill.

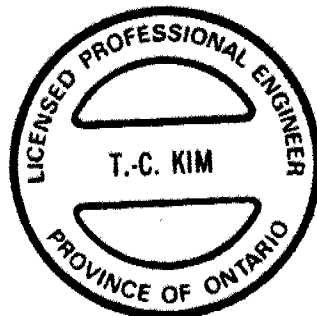
No stability problems are anticipated toward longitudinal direction at both abutments for permanent embankment constructed to a 2H:1V geometry.

However, due to the high fill height toward transverse direction at both abutments (9.5 m at south abutment, 9.0 m at north abutment), it is recommended that the approach embankment should be constructed with a 2.0 m wide berm to the midheight of the slope, incorporating side slopes with 2H:1V. Berm should be constructed as an integral part of the main embankment up to the berm height.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Tae C. Kim, Senior Foundation Engineer, and Frank Reynolds, Technician for Northwestern Region. The equipment was owned and operated by Marathon Drilling Co. Ltd. and Master Soil Investigation Co. Ltd., Toronto.

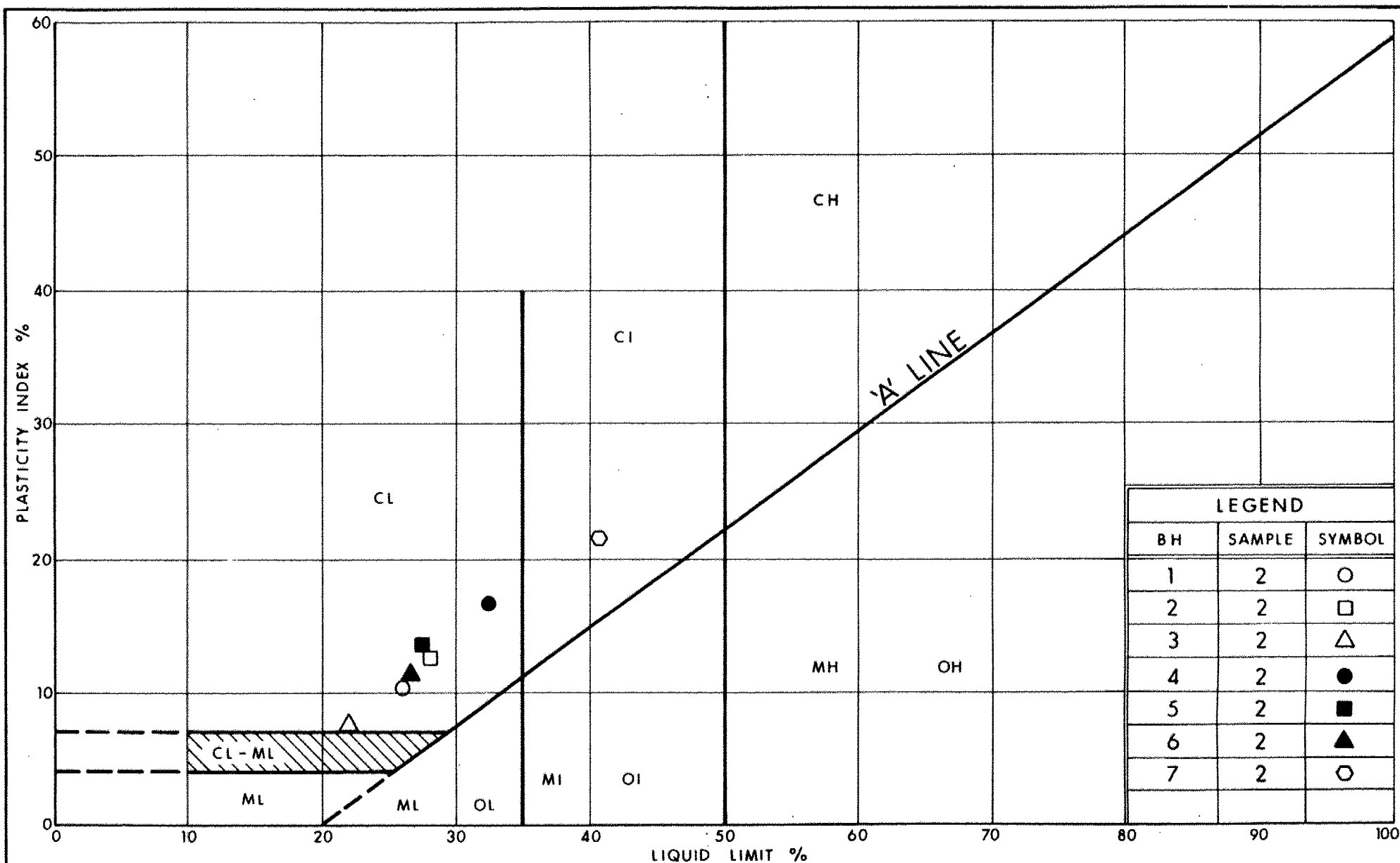
This report was written by Tae C. Kim and reviewed by P. Payer, Senior Foundation Engineer, and approved by M. Devata, Chief Foundation Engineer.



Tae C. Kim
Tae C. Kim, P.Eng.
Senior Foundation Engineer

M. Devata
M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX



Ministry of
Transportation

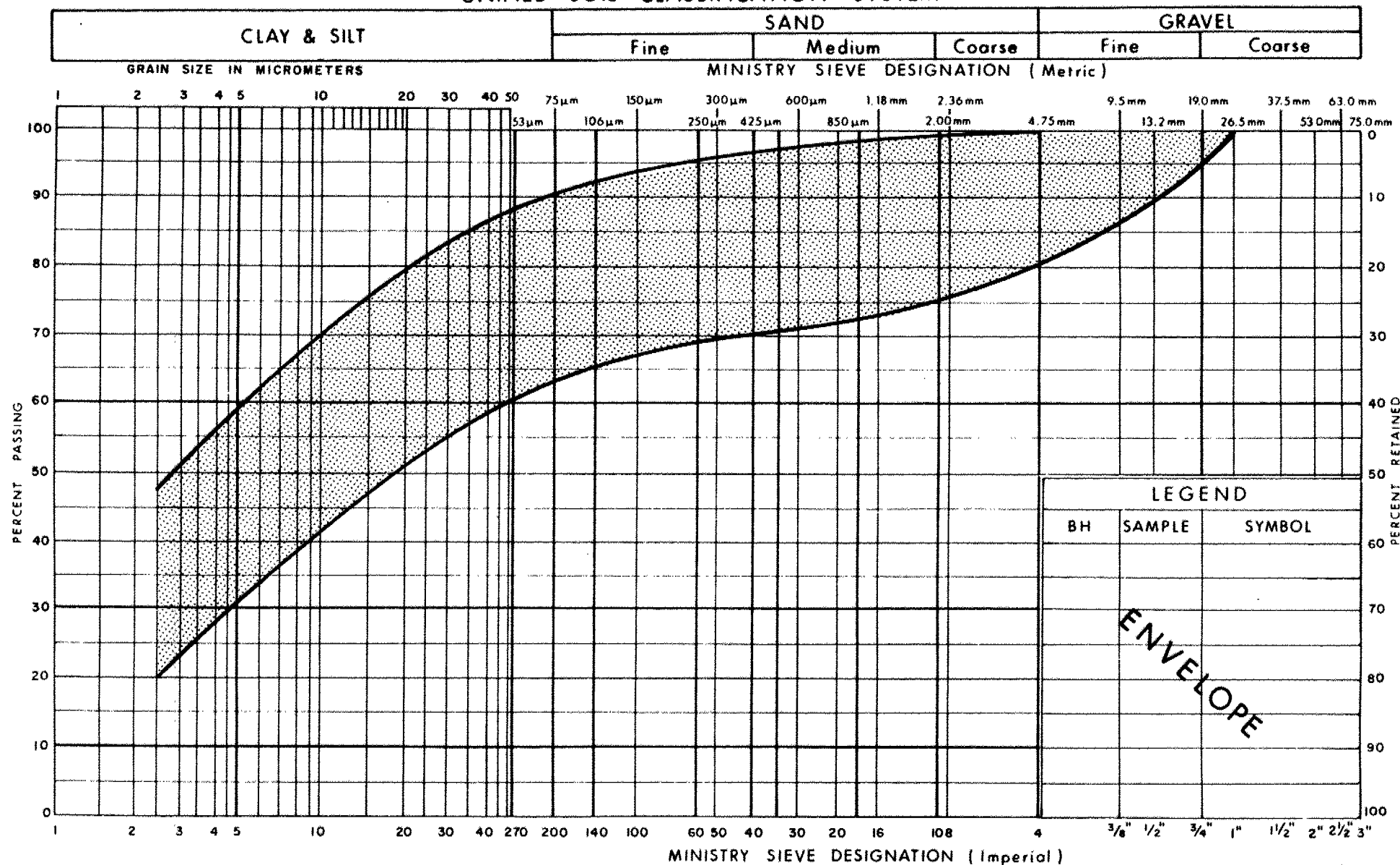
Ontario

PLASTICITY CHART HETEROGENEOUS MIXTURE OF CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 1

W P 409-85-02

UNIFIED SOIL CLASSIFICATION SYSTEM

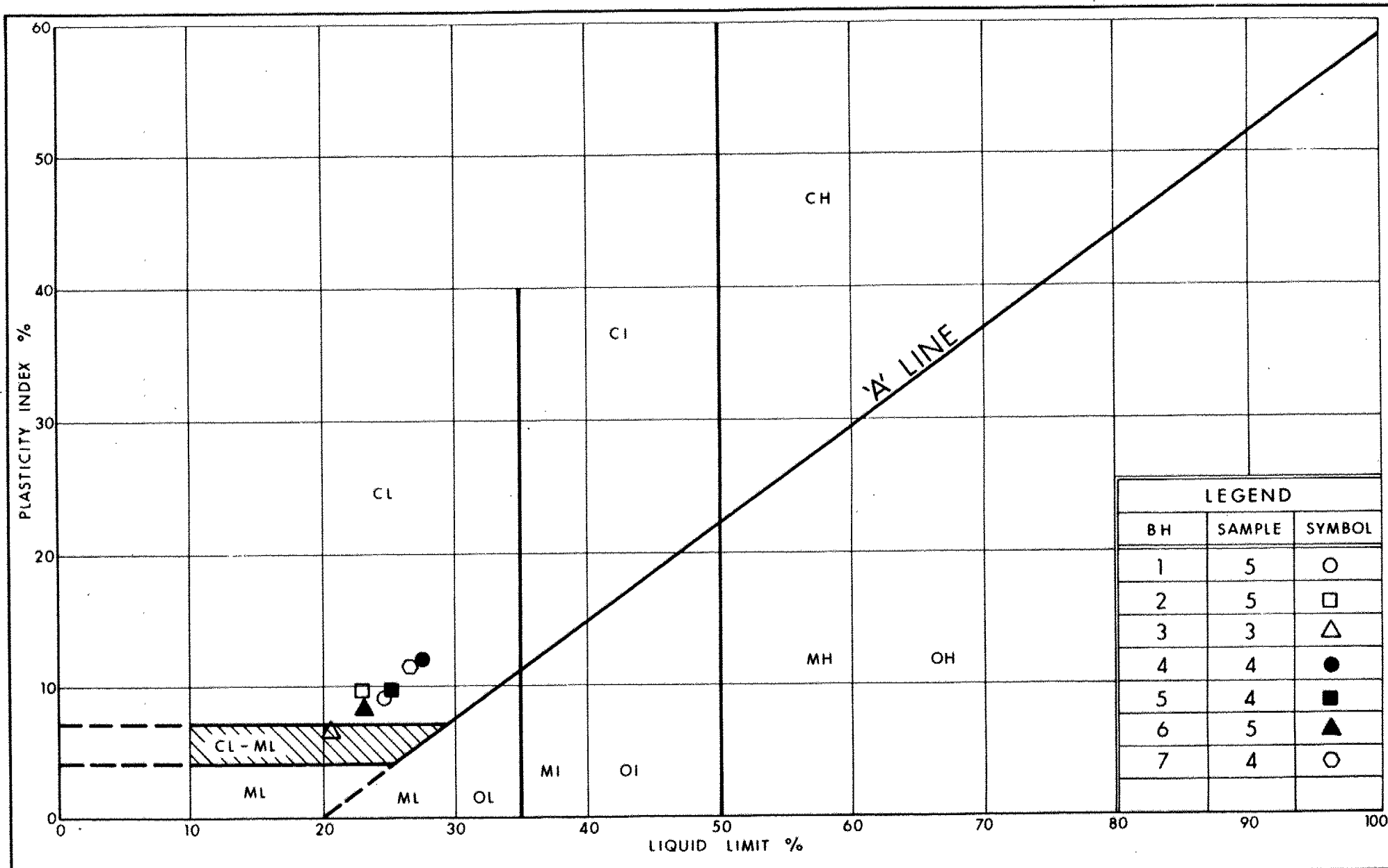


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
 HETEROGENEOUS MIXTURE OF
 CLAYEY SILT, SAND & GRAVEL (Glacial Till)

FIG No 2

W P 409-85-02



Ministry of
Transportation

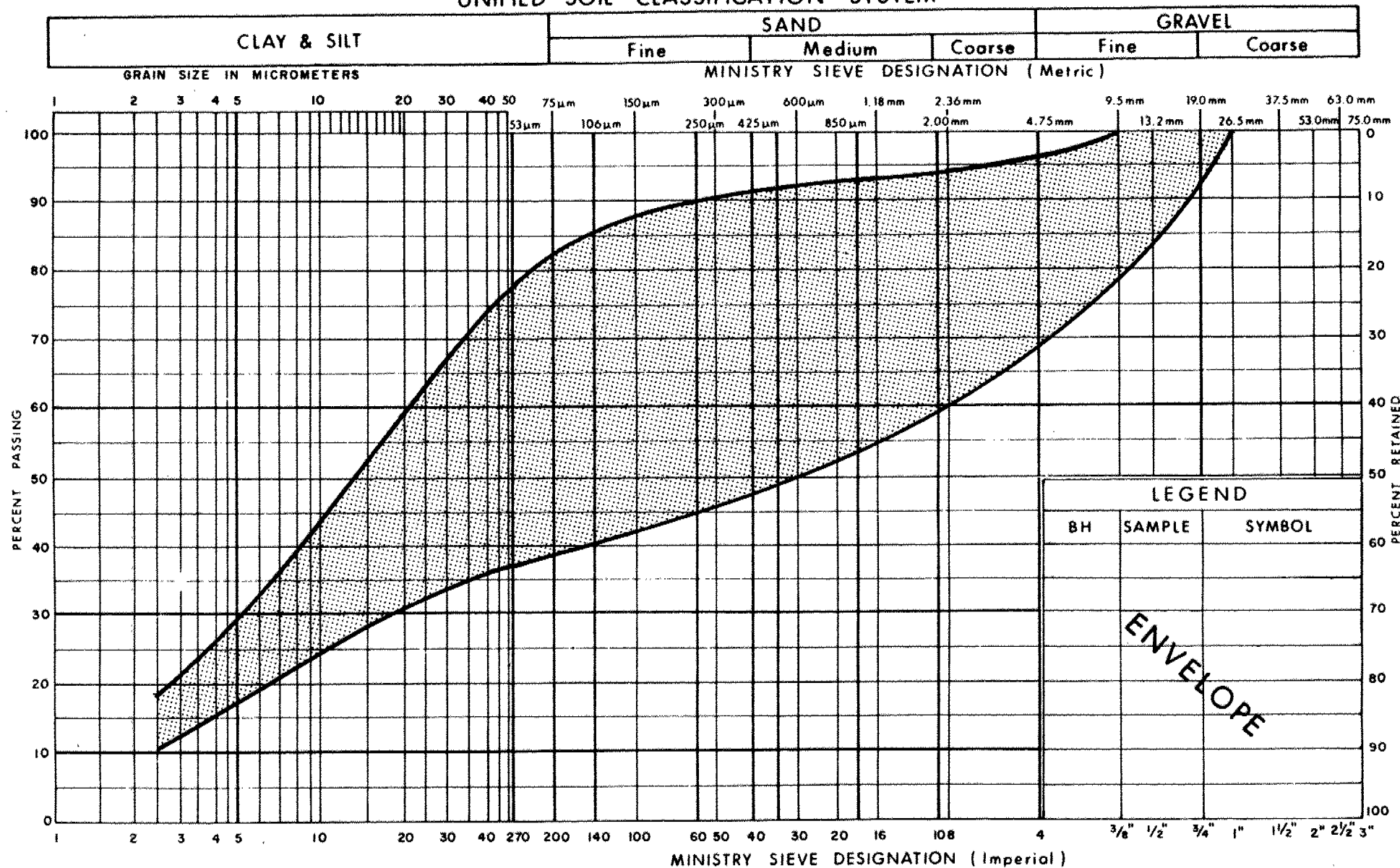
Ontario

PLASTICITY CHART QUEENSTON SHALE Weathered

FIG No 3

W P 409-85-02

UNIFIED SOIL CLASSIFICATION SYSTEM

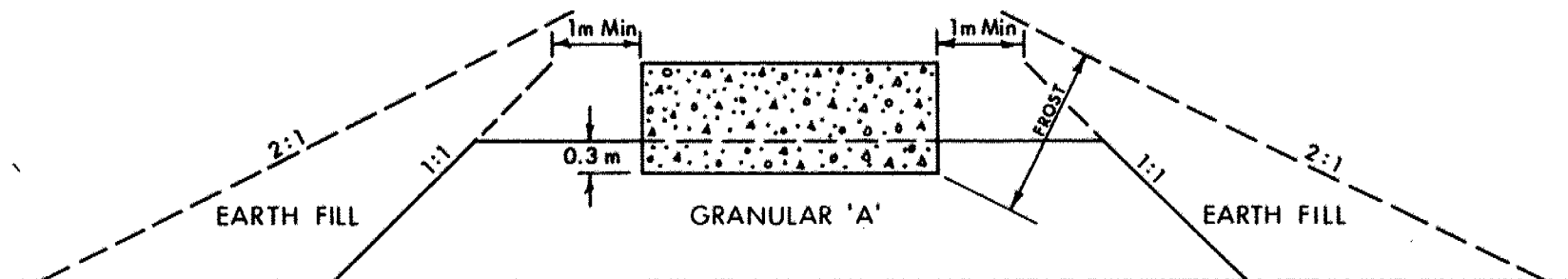


Ministry of
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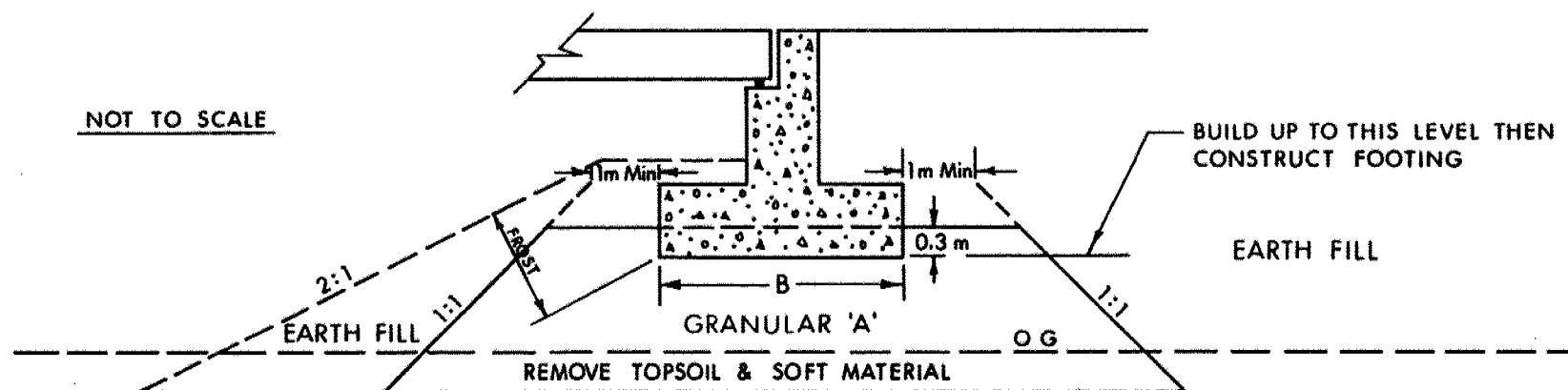
GRAIN SIZE DISTRIBUTION QUEENSTON SHALE Weathered

FIG No 4

W P 409-85-02



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
- 3 - CONSTRUCT CONCRETE FOOTING.
- 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.



Ministry of
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Ontario

ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 5

W P 409 - 85 - 02

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED AVERAGE N VALUE IS DENOTED THUS \bar{N}

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O D 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND /OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{v0}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
P	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kn/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m^3	SEEPAGE FORCE
γ'	kn/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 568.5 E 281 293.7 ORIGINATED BY T.K.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, and NQ Core COMPILED BY J.L.
 DATUM Geodetic DATE May 2, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
166.2	GROUND SURFACE													
0.0	Clayey Silt (Topsoil)						166							
165.2			1	SS	13		165							
1.0	Heterogeneous Mixture of Clayey Silt, Sand and Gravel Stiff to Hard (Glacial Till)		2	SS	37		164							5 24 55 16
	Brown													
	Reddish Brown													
163.5	Reddish Brown		3	SS	106		163							
2.7	Red													
	Bedrock		4	SS	59		162							
	Queenston Shale		5	SS	115	/23cm								31 12 45 12
	Weathered		6	SS	100	/5cm								
	Sound						161							RQD 33%
160.0			7	RC	REC	100%								
6.2	End of Borehole													
	* Borehole dry upon completion charged with water later													

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 549.4 E 281 287.3 ORIGINATED BY T.K.
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, and H.S. Auger COMPILED BY J.L.
DATUM Geodetic DATE May 1, 1990 CHECKED BY T.K.

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			20 40 60 80 100	20 40 60 80 100					
166.3	GROUND SURFACE													
0.0														
165.5	Sand and Gravel (Fill)													
0.8	Heterogeneous Mixture of Clayey Silt, Sand and Gravel Hard (Glacial Till)		1	SS	22									
	Brown		2	SS	83									
	Reddish Brown		3	SS	103	/25cm								16 21 43 20
163.2	Reddish Brown													
3.1	Bedrock		4	SS	104									
	Queenston Shale		5	SS	123	/25cm								25 37 24 14
161.7	Weathered		6	SS	105	/4cm								
4.6	End of Borehole													
	Sound													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 521.0 E 281 315.6 ORIGINATED BY T.K.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, and NQ Core COMPILED BY J.L.
 DATUM Geodetic DATE May 1, 1990 CHECKED BY T.K.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
165.8	GROUND SURFACE													
0.0	Clayey Silt (Topsoil)					* DRY								
165.0	Brown													
0.8	Reddish Brown		1	SS	11		165							
	Heterogeneous Mixture of Clayey Silt, Sand and Gravel Stiff to Hard (Glacial Till)		2	SS	36		164							14 23 43 20
163.5	Reddish Brown													
2.3	Red		3	SS	160	/28cm	163							20 16 54 10
	Bedrock Queenston Shale		4	SS	69		162							
			5	SS	160	/25cm	161							
	Weathered Sound		6	SS	100	/6cm	160							
			7	RC	REC 81%									RQD 59%
159.6														
6.2	End of Borehole • Borehole dry during the site investigation.													

RECORD OF BOREHOLE No 4

1 OF 1 METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 512.0 E 281 350.3 ORIGINATED BY T.K.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, and H.S. Auger COMPILED BY J.L.
 DATUM Geodetic DATE May 2, 1990 CHECKED BY T.K.

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
165.4	GROUND SURFACE												
0.0	Clayey Silt (Topsoil)		1	SS	7								
163.7	Brown												
1.7	Reddish Brown		2	SS	10								0 11 57 32
163.1	** (Glacial Till)												
2.3	Reddish Brown		3	SS	34								
	Bedrock		4	SS	109								15 16 54 15
	Queenston Shale		5	SS	100								
160.7	Weathered		6	SS	100								
4.7	End of Borehole	Sound											
	• Borehole dry upon completion charged with water later ** Heterogeneous Mixture of Clayey Silt, Sand and Gravel Stiff to Hard												

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 492.8 E 281 344.0 ORIGINATED BY T.K.
 DIST 4 HWY 403 BOREHOLE TYPE Cone Test, H.S. Auger, and NQ Core COMPILED BY J.L.
 DATUM Geodetic DATE April 30, 1990 CHECKED BY T.K.

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 7 kN/m ³	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					
165.3	GROUND SURFACE													
0.0	Sand and Gravel (Fill)					* DRY	165							
164.5														
0.8	Clayey Silt (Topsoil)		1	SS	8									
163.9														
1.4	Heterogeneous Mixture of Clayey Silt Brown Sand and Gravel --- Reddish Brown		2	SS	11								3 23 49 25	
162.6	Stiff to Very Stiff (Glacial Till) Reddish Brown		3	SS	28									
2.7	Bedrock Queensston Shale Weathered Sound		4	SS	103								0 2 82 16	
			5	SS	100	/10cm								
			6	SS	120	/13cm								
			7	RC	REC 95%									RQD 10%
159.1														
6.2	End of Borehole * Borehole dry during the site investigation													

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 589.7 E 281 272.6 ORIGINATED BY T.K.
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, and H.S. Auger COMPILED BY J.L.
DATUM Geodetic DATE May 2, 1990 CHECKED BY T.K.

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 7 kN/m ³	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					
166.6	GROUND SURFACE													
0.0	Clayey Silt (Fill)													
165.2	Clayey Silt (Topsoil)		1	SS	8									
1.4	Heterogeneous Mixture of Clayey Silt, Sand and Gravel Very Stiff to Hard Brown		2	SS	27									11 21 47 21
164.2	(Glacial Till) Reddish Brown		3	SS	105									
2.4	Bedrock Queenston Shale		4	SS	100	/3cm								
			5	SS	102	/27cm								4 13 65 18
161.9	Weathered		6	SS	100	/10cm								
4.7	End of Borehole Sound													

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 409-85-02 LOCATION Co-ord: N 4811 471.7 E 281 365.3 ORIGINATED BY T.K.
DIST 4 HWY 403 BOREHOLE TYPE Cone Test, and H.S. Auger COMPILED BY J.L.
DATUM Geodetic DATE April 30, 1990 CHECKED BY T.K.

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			20	40	60	80	100					
165.2	GROUND SURFACE																
0.0	Sand and Gravel (Fill)						165										
164.4																	
0.8	Clayey Silt (Fill)		1	SS	9												
163.8	(Topsoil)																
1.4	** (Glacial Till)																
163.3	Reddish Brown		2	SS	11												1 8 46 45
1.9	Red																
	Bedrock																
	Queenston Shale		3	SS	26												
			4	SS	95												4 12 67 17
			5	SS	120	/28cm											
160.5	Weathered		6	SS	100	/13cm											
4.7	End of Borehole	Sound															
	* Borehole encountered water level at an elevation of 160.8 m during the site investigation and charged with water at an elevation of 163.1 m later																
	** Heterogeneous Mixture of Clayey Silt, Sand and Gravel Stiff																

ROCK CORE DESCRIPTION
WP 409-85-02

Page 1 of 1

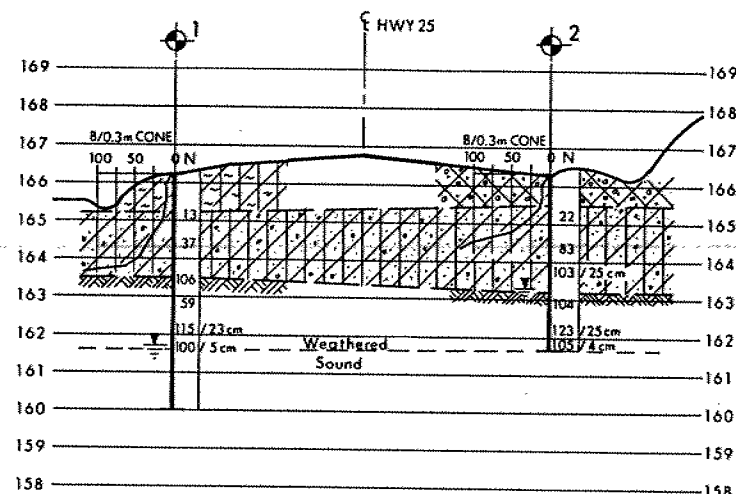
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	7	4.57-6.17	100	33	4.57-6.17	SHALE, dark reddish brown, interbedded with greyish green SILTSTONE (14%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to extremely close spaced fractures.
2						SHALE, expected as above (no core recovered).
3	7	4.65-6.17	81	59	4.65-6.17	SHALE, dark reddish brown, interbedded with greyish green SILTSTONE (5%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to extremely close spaced fractures.
4						SHALE, expected as above (no core recovered).
5	7	4.60-6.20	95	10	4.60-6.20	SHALE, dark reddish brown, interbedded with greyish green SILTSTONE (21%); very fine grained; weak to very weak rock; unweathered to slightly weathered; close to extremely close spaced fractures.
6						SHALE, expected as above (no core recovered).
7						SHALE, expected as above (no core recovered).

*CR = CORE RECOVERY

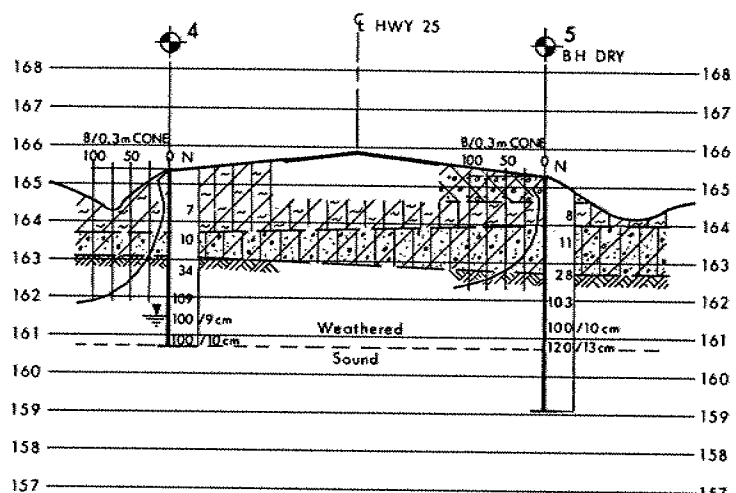
*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

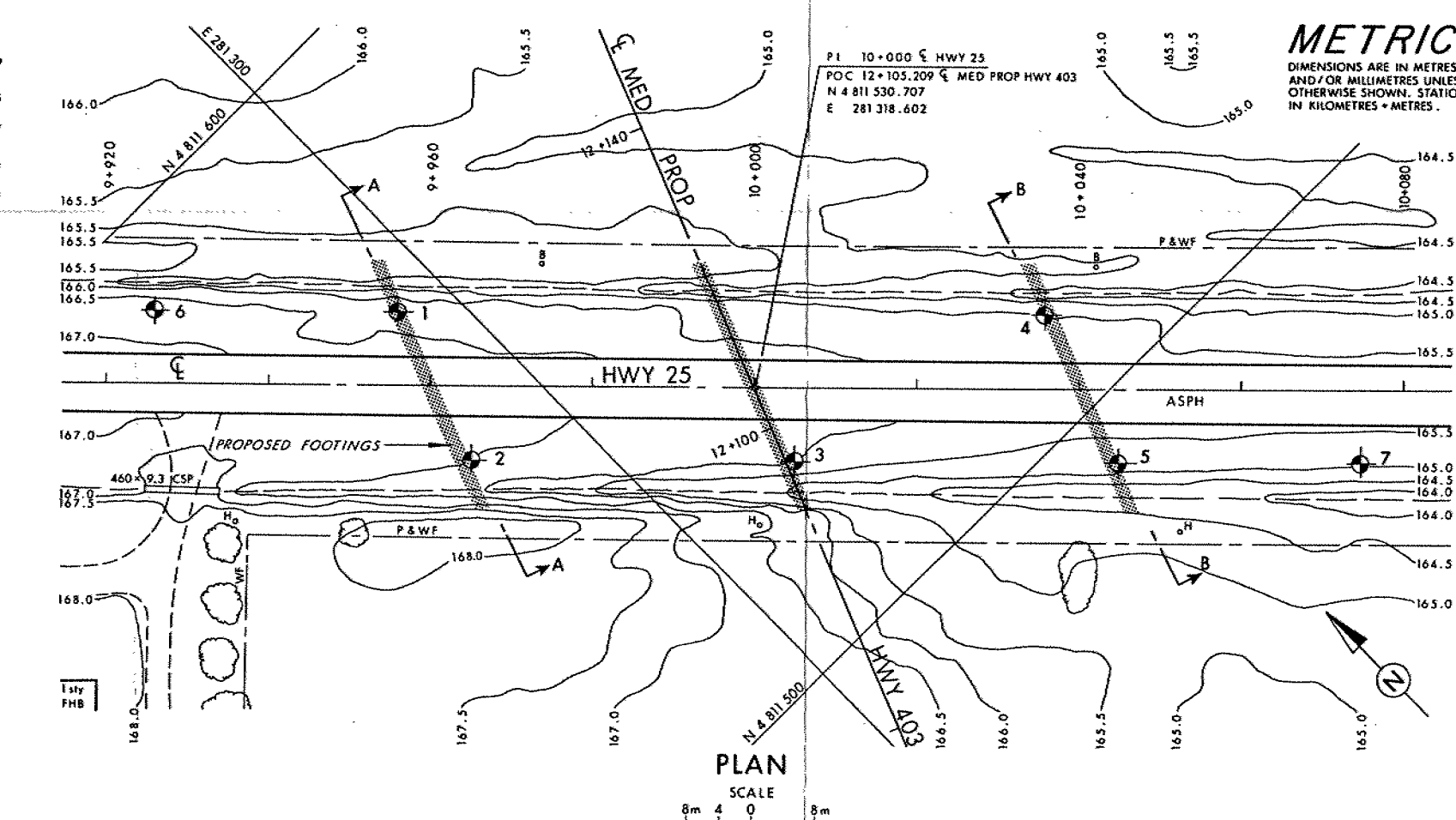
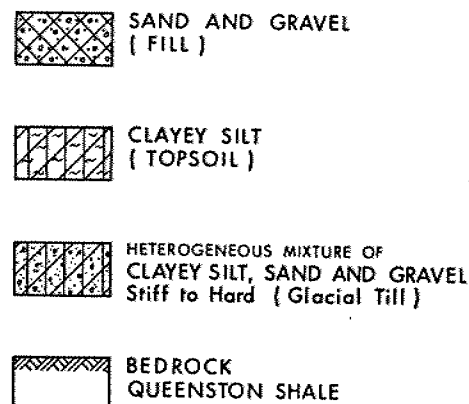


A - A



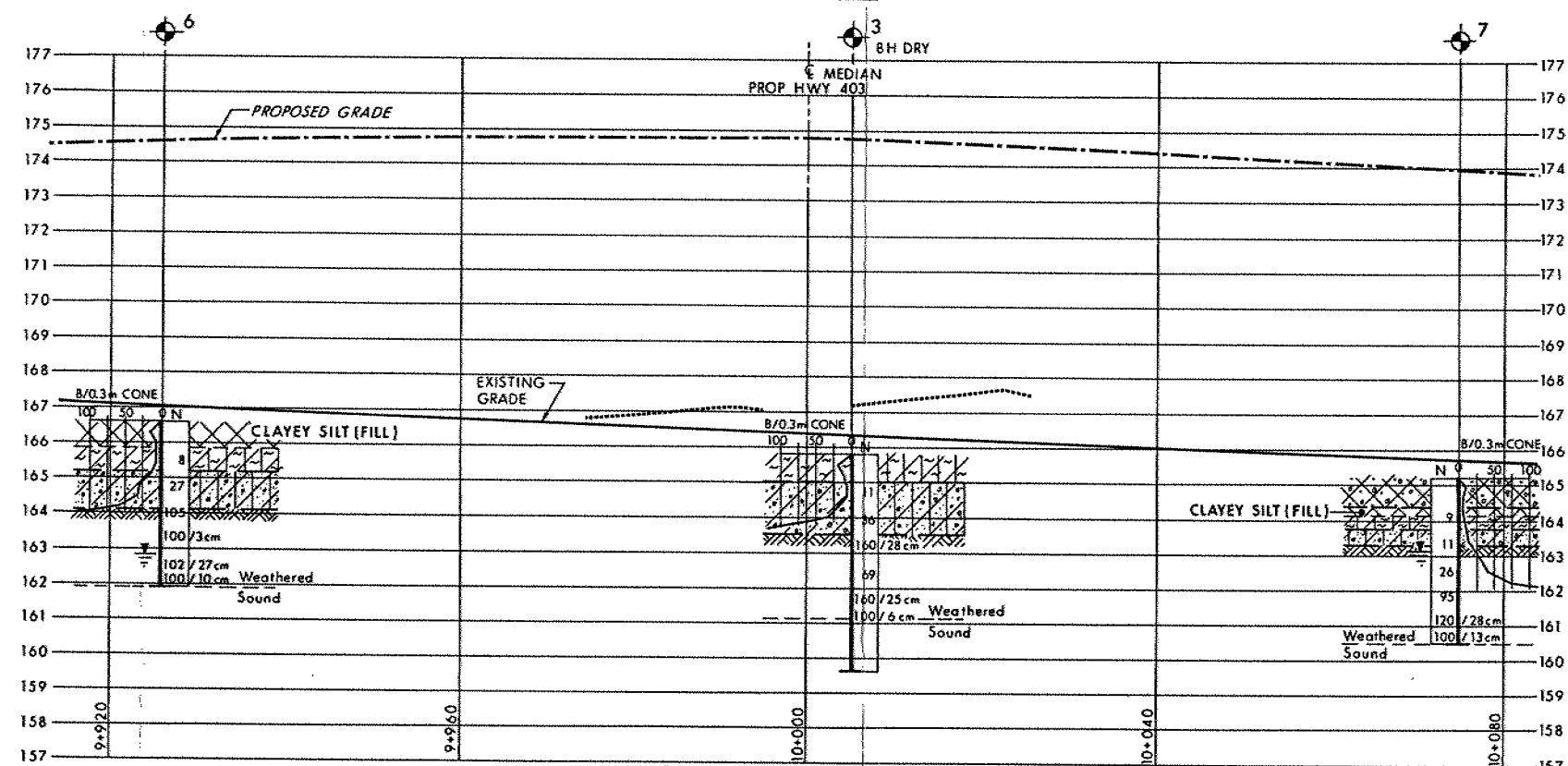
B - B
SECTIONS
SCALE
4m 2 0 4m HOR
2m 1 0 2m VERT

SOIL STRATIGRAPHY LEGEND



PLAN

SCALE
8m 4 0 8m



PROFILE - HWY 25

SCALE
8m 4 0 8m HOR
2m 1 0 2m VERT

METRIC

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

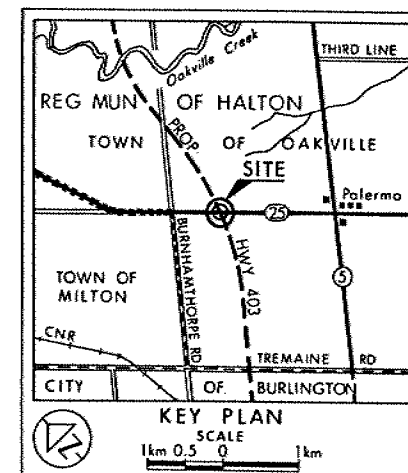
CONT No
WP No 409-85-02

HIGHWAY 25

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 1990 05

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	166.2	4 811 568.5	281 293.7
2	166.3	4 811 549.4	281 287.3
3	165.8	4 811 521.0	281 315.6
4	165.4	4 811 512.0	281 350.3
5	165.3	4 811 492.8	281 344.0
6	166.6	4 811 589.7	281 272.6
7	165.2	4 811 471.7	281 365.3

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
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Geocres No 30 M05-167

HWY No 403	SUBMD TK	CHECKED	DATE 1990 11 19	DIST 4
DRAWN R5	CHECKED	APPROVED		SITE 10-479
				DWG 4098502-A