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GEOCRES No. 30M5-189

DIST. 4 REGION

W.P. No. 410-85-00

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 403

LOCATION HWY 403 / CNR DETOUR

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ministry
of
Transportation
Ontario

**FILE No.** _____ **DATE** _____

**REMARKS** 9:00 am Thursday Hwy 5 – Tremaine Rd
Regional Rd
22
Northwest corner

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Ministry of
Transportation and
Communications

Ontario

# FOUNDATION DESIGN SECTION

# foundation investigation and design report

# ENGINEERING MATERIALS OFFICE
## FOUNDATION DESIGN SECTION

WP 410-85-00 DIST 4

HWY 403 STR SITE

C.N.R. Detour at Highway 403
(West of Proposed Hwy. 403/C.N.R. Subway)

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GEOCRES 30M5-189

DATE JUL 0 2 1992

FOUNDATION INVESTIGATION REPORT

for

C.N.R. Detour at Highway 403

(West of Proposed Hwy. 403/C.N.R. Subway)

W.P. 410-85-00

District 4, Burlington

## INTRODUCTION

This report summarizes the results of a foundation investigation conducted in conjunction with the proposed C.N.R. detour. The C.N.R. detour is bounded by the limits defined by Stations 8+947.097 (East Track), 8+946.801 (West Track) to the north and Station 10+000 to the south and is located west of the existing tracks at varying offsets ranging up to approximately 45 metres west of centreline of the existing tracks. The C.N.R. detour will be advanced in a shallow temporary cut approximately 3 m to 4 m deep in order to maintain acceptable railroad track grades.

The purpose of the detour is to facilitate the construction of the proposed Hwy. 403/C.N.R. Subway (W.P. 408-85-01, Site 10-478). This report contains factual soils information retrieved at two (2) boreholes at locations specified and pre-defined by the C.N.R. along the detour alignment (centreline at stations 9+400 and 9+550). Relevant physical and mechanical soil properties that enables the design of the sub-ballast and subgrade for the diversion track are contained in this report.

## SITE DESCRIPTION AND GEOLOGY

The site is located immediately west of the existing C.N.R. double line tracks approximately 1.5 km south of No. 1 Side Road in the City of Burlington, Regional Municipality of Halton. A level crossing exists at the intersection of the C.N.R. tracks which trends in a northeast-southwest direction in the site area and No. 1 Side Road, a two lane asphaltic roadway that commences at Regional Rd. 22 (Tremaine Rd.) and dead ends approximately 0.5 m west of the crossing. Bronte Creek, a meandering creek is located approximately 1 km west of the existing

tracks at the site location. An existing bridge structure carries the tracks over the Bronte Creek approximately 1 km south of the site.

Immediately north and northwest of the site, residential farm houses and horse stables are present.

The terrain surrounding the site is generally flat beyond the existing C.N.R. line excavation cut and the ground surface elevation ranges from approximately 163.0 m to 164.5 m. The flat fields on either side of the C.N.R. tracks are covered with tall grasses.

The double-track C.N.R. line is located in a cut approximately 3 to 4 m deep with side slopes approximately 1.5H:1V. The slopes are either covered with low lying shrubs, bush and grassland or are barren and exposed without any surficial cover.

Physiographically, the site is located within the geological domain known as the "South Slope". The South Slope is the southern slope of the Oak Ridges Moraine and also includes a strip south of the Peel Plain. The South Slope is predominantly a moraine till plain having been formed following the retreat of the Wisconsinan ice sheet which covered the area during the Pleistocene epoch (over 12,000 years ago). Overburden, therefore, consists of unsorted, unstratified heterogeneous mixtures of clayey silt to silt, sands and gravels of glacial till origin. At the site, the overburden has a thickness of approximately 14 to 17 metres.

The overburden is underlain by shale bedrock of the Queenston Shale Formation of the Upper Ordovician Period.

## INVESTIGATION PROCEDURE

Physical and mechanical soil properties were obtained by in situ and laboratory testing. The field and laboratory investigation and testing programs are summarized below.

## Field Investigation

The fieldwork for the investigation was carried out on 92 05 19 and consisted of two (2) sampled boreholes advanced to depths of 7.9 m and 8 m below the existing ground surface. A gas powered track mounted Central Mining Equipment (CME) 55 drilling unit was used to advance the boreholes employing conventional solid stem augering techniques.

As requested by the C.N.R., continuous subsoil sampling was provided from the proposed track level to a depth of 3 metres below the track level. Above the track level elevation, subsoil samples were retrieved at 0.7 m intervals and below the 3 metre continuous sampling, subsoil samples were retrieved at 0.7 metre intervals up to a total depth of 6 metres and at 1.5 metre intervals thereafter.

Disturbed subsoil samples were retrieved employing a standard split spoon sampler in accordance with the Standard Penetration Test (ASTM D1585). All subsoil samples were identified in the field and then placed in sealed plastic jars to ensure the preservation of the natural moisture contents. Samples were subsequently transported to the laboratory and then classified employing both visual and laboratory methods as described below.

Groundwater levels were determined by monitoring the levels in the open boreholes throughout the duration of the field investigation. All boreholes were backfilled upon completion of the fieldwork.

The survey related to the location and elevation of the individual boreholes was provided by Central Region Surveys and Plans.

## Laboratory Analyses

As mentioned above, all subsoil samples were visually examined in the laboratory using procedures described in the MTO Soil Classification Manual. These procedures consist of estimating the particle size distribution of the material

and conducting manual physical index property tests.

The visual examinations of the samples were combined with some laboratory testing on selected representative samples. Laboratory tests were carried out to define the behaviour, gradation and other physical properties of the soil and included:

1) Atterberg Limits
2) Grain Size Distributions
3) Natural Moisture Contents
4) Bulk Unit Weights

Laboratory tests were conducted in accordance with the respective procedures outlined in the MTO Laboratory Testing Manual and as described in Chapter 3 of the MTO Soil Classification Manual.

Laboratory test results have been summarized below in the subsequent section of this report entitled "Subsurface Conditions", and are illustrated on the corresponding boreholes and figures included in the Appendix of this report.

## SUBSURFACE CONDITIONS

### General

The subsurface conditions described in this report are a summary of the information retrieved at two (2) borehole locations as discussed earlier in this report. This information is contained in the individual Record of Borehole sheets attached in the Appendix to this report. These borehole logs illustrate the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of investigation. Information pertaining to the locations and elevations/depths of the boreholes are also illustrated on the Record of Borehole Sheets.

The subsurface conditions as determined at the two (2) borehole locations are generally uniform and consist of a surficial native deposit of a cohesive heterogeneous mixture of clayey silt, sand and gravel. This deposit is of a

glacial till origin and has a hard consistency. It's thickness varied from 3.8 metres at BH1 to 7.1 metres at BH2.

The surficial cohesive deposit of glacial till origin is underlain by a second deposit of glacial till origin consisting of a heterogeneous mixture of silt, sand and gravel. Unlike the surficial cohesive deposit, this deposit exhibits a cohesionless behaviour. The thickness of this lower cohesionless deposit was not explored during the investigation and was investigated for a maximum depth of 4.2 metres. This cohesionless deposit has a very dense denseness.

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

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

The surficial native material at the site location consists of a deposit comprised of a heterogeneous mixture of clayey silt, sand and gravel. This deposit of glacial till origin also contains boulders and cobbles as inferred by auger grinding during the borehole advancement and sampler bouncing during sample retrieval. In addition, cohesionless sand seams up to 100 mm in thickness are also present randomly within the deposit. The thickness of the deposit ranges from 3.8 metres at BH1 to 7.1 metres at BH2.

The upper 3 to 4 metres of the deposit has been oxidized and hence is brown in colour. Beneath the oxidized depth, the material is unoxidized and grey in colour.

The main component of this unsorted, unstratified deposit is the clayey silt material. This material matrix essentially binds the coarser sands and gravels within the deposit. A grain size distribution envelope for the deposit as determined by mechanical sieve and hydrometer analyses is given in Figure 1 in the Appendix. The envelope includes particle sizes up to 75 mm (coarse gravel) and hence excludes the boulder and cobble sizes. The envelope reveals that the

fine grained portions (less than 75 micrometre) contribute approximately 57% to 78% of this deposit.

Atterberg Limit Tests were carried out to define the behaviour and plasticity of the fine grained portion of the soil and the results are plotted on Figure 2. A summary of the indices is provided in Table 1 below. Bulk unit weights and natural moisture contents are also included in the table.

Table 1 - Heterogeneous Mixture of Clayey Silt
Sand and Gravel (Glacial Till)

| | Range | No. of Tests |
|---|---|---|
| Natural Moisture Content (W%) | 7-13 | 6 |
| Liquid Limit ($W_L$%) | 20-34 | 6 |
| Plasticity Index ($I_p$%) | 6-16 | 6 |
| Unit Weight (kN/m$^3$) $\gamma$ | 20.0-22.1 | 4 |

The test results reveal that the fine grained portion of the deposit is of low plasticity and hence is classified as clayey silt. Natural moisture contents are generally close to the plastic limit of the soil indicating that the soil is in a plastic to semi-solid state.

Standard Penetration Tests (SPT) carried out in this deposit revealed "N" values ranging from 34 blows/0.3 m to 126 blows/0.3 m. These "N" values are representative of an overconsolidated material of hard consistency.

Heterogeneous Mixture of Silt, Sand and Gravel
(Glacial Till)

The cohesive heterogeneous mixture of clayey silt, sand and gravel is underlain by a greyish red cohesionless heterogenous mixture of silt, sand and gravel at a depth ranging from 3.8 m to 7.1 m below the natural ground surface (Elevation 160.8 m to 156.8 m). Boulders and cobbles as inferred by auger grinding and

sampler bouncing are also present within this deposit. The thickness of this deposit was not explored during the investigation.

Grain size distribution curves determined by mechanical sieve and hydrometer analyses are given in Figure 3 in the Appendix. Boulder and cobble sizes are not illustrated on the figure.

Standard Penetration Tests carried out in this deposit revealed "N" values ranging from 80 blows/0.3 m to 100 blows/0.1 m. These high values and the fact that the SPT's met refusal in some instances, are indicative of the very dense state of denseness inherent of this deposit.

## GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open boreholes at the time of the field investigation. Groundwater levels ranged from 1.5 m to 2.0 m below the ground surface (Elevation 163.1 to 162.6 m).

Groundwater levels, in general, are subject to seasonal fluctuations and hence can vary from the values given in this report.

## MISCELLANEOUS

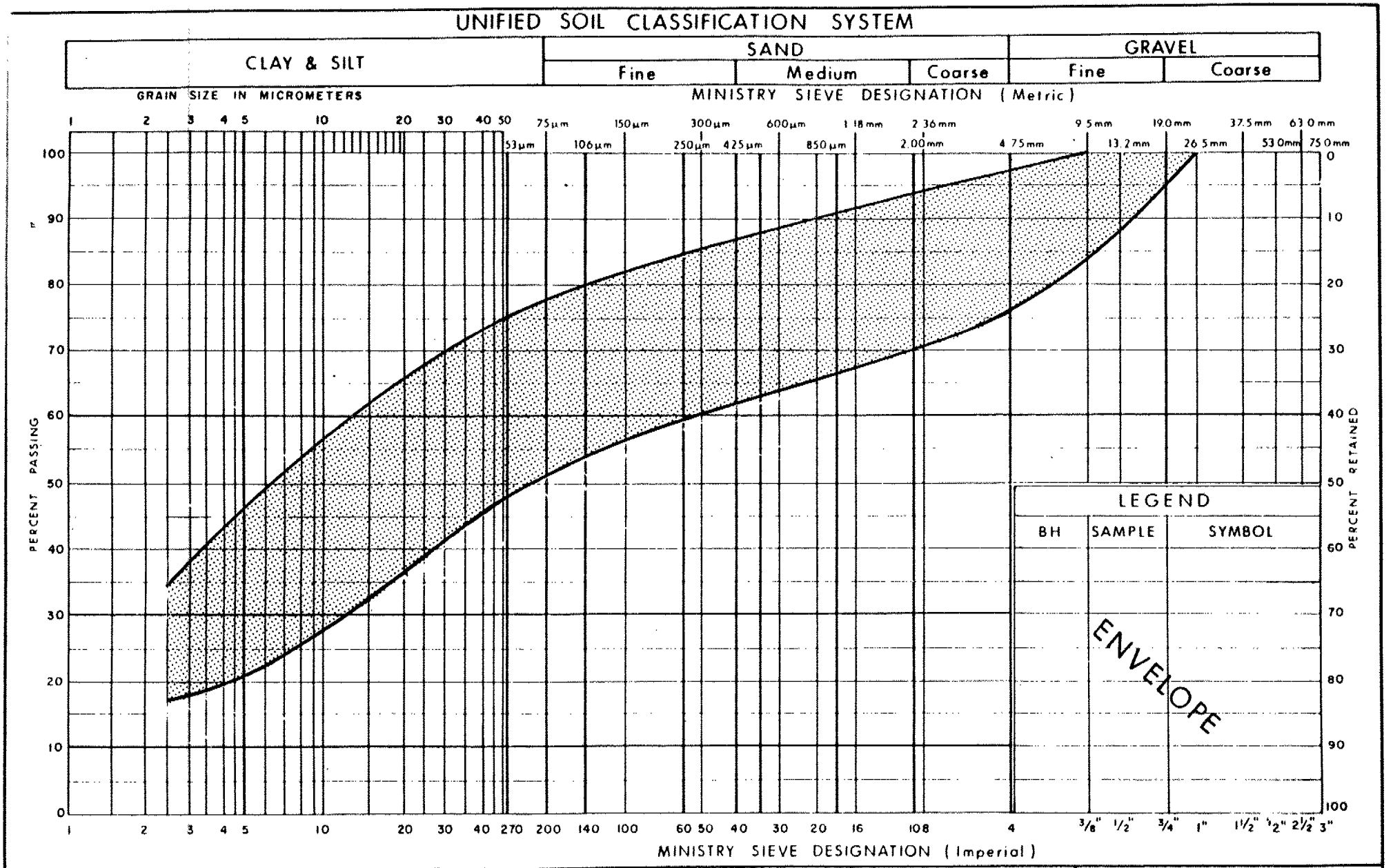
The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano, Foundation Engineer and L. Dametto, Student Engineer, utilizing equipment owned and operated by K & S Drilling Ltd.

The project was carried out by T. Sangiuliano under the general supervision of P. Payer, Senior Foundation Engineer. The report was written by T. Sangiuliano, reviewed by P. Payer and approved by Mr. M. Devata, Chief Foundation Engineer.


T. Sangiuliano, P. Eng.
Foundation Engineer

M. Devata, P. Eng.
Chief Foundation Engineer

# APPENDIX

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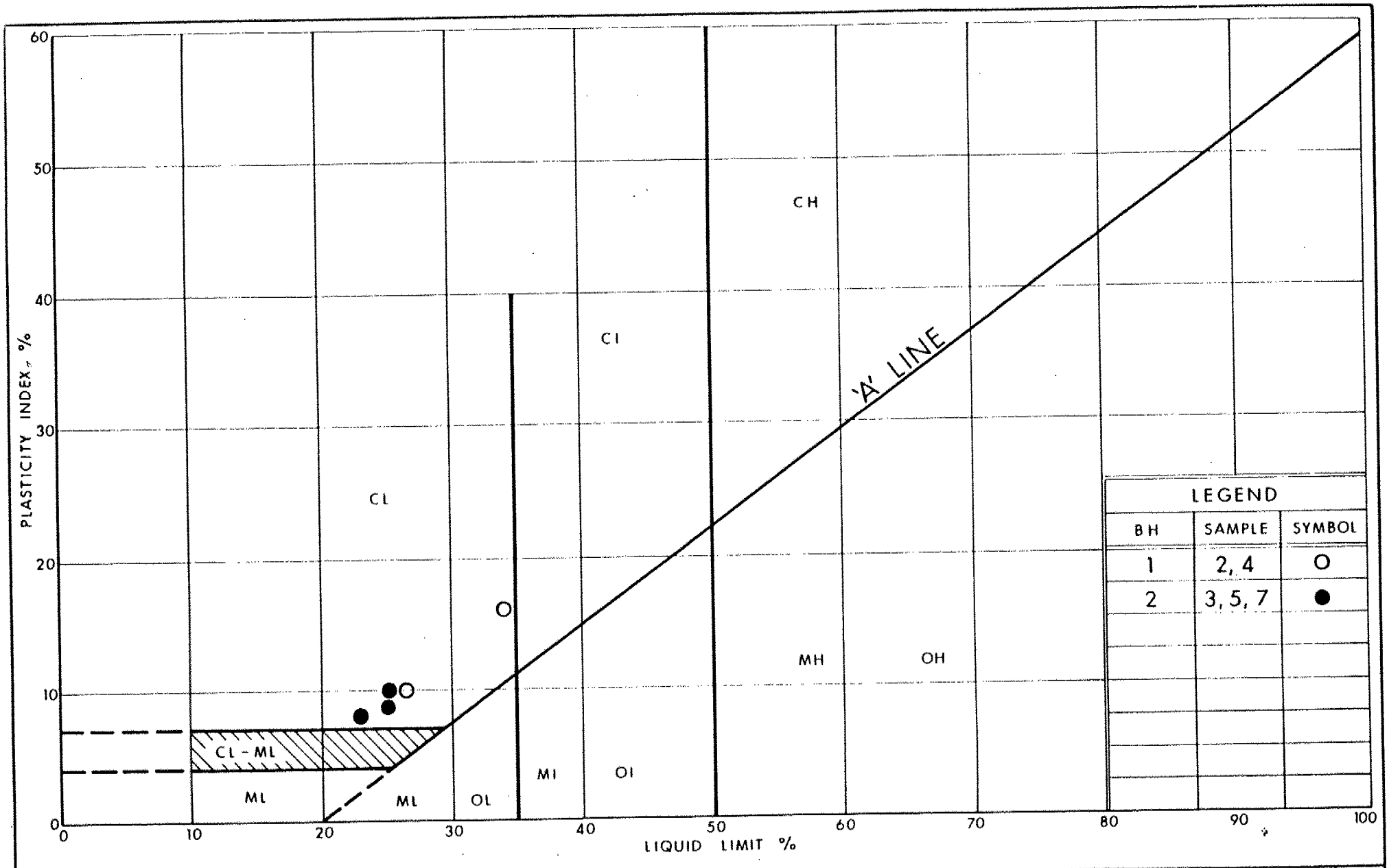
# GRAIN SIZE DISTRIBUTION
## HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
## ( Glacial Till )

FIG No 1

W P 410 - 85 - 00

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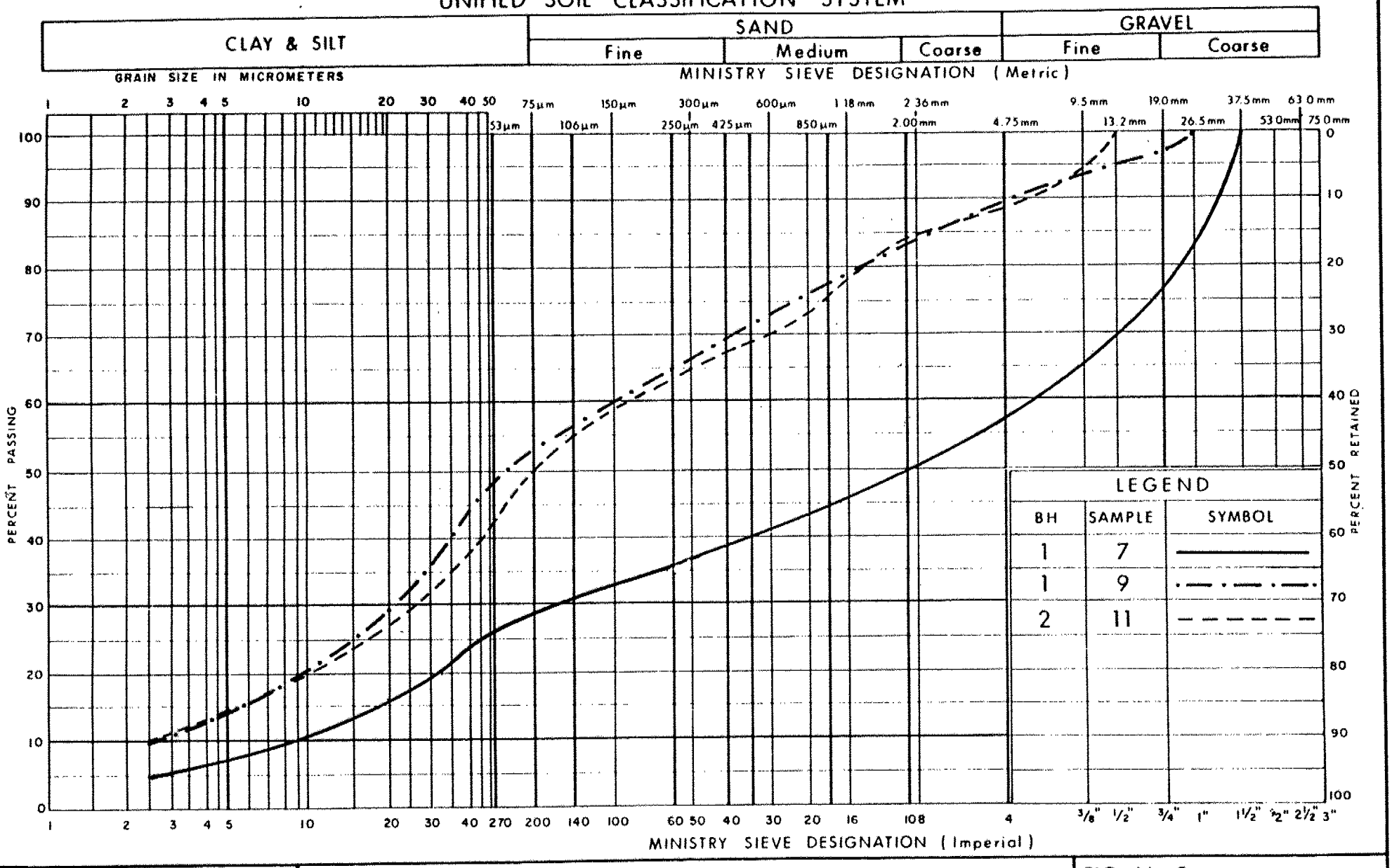
# PLASTICITY CHART
## HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
## ( Glacial Till )

FIG No 2

W P 410 - 85 - 00

# UNIFIED SOIL CLASSIFICATION SYSTEM

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## GRAIN SIZE DISTRIBUTION
HET MIXTURE OF SILT, SAND & GRAVEL
( Glacial Till )

FIG No 3
W P 410-85-00

# 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 (R Q D), FOR MODIFIED RECOVERY, IS:

| R Q D (%) | 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 |
| $\sigma$ | kPa | TOTAL NORMAL STRESS |
| $\sigma'$ | kPa | EFFECTIVE NORMAL STRESS |
| $\tau$ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| $\epsilon$ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| $\mu$ | 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 |
| $C_\alpha$ | 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 |
| $\sigma'_{vo}$ | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| $\sigma'_p$ | kPa | PRECONSOLIDATION PRESSURE |
| $\tau_f$ | kPa | SHEAR STRENGTH |
| $c'$ | kPa | EFFECTIVE COHESION INTERCEPT |
| $\phi'$ | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| $c_u$ | kPa | APPARENT COHESION INTERCEPT |
| $\phi_u$ | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| $\tau_R$ | kPa | RESIDUAL SHEAR STRENGTH |
| $\tau_r$ | kPa | REMOULDED SHEAR STRENGTH |
| $S_t$ | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

## PHYSICAL PROPERTIES OF SOIL

| | | |
|---|---|---|
| $\rho_s$ | $kg/m^3$ | DENSITY OF SOLID PARTICLES |
| $\gamma_s$ | $kN/m^3$ | UNIT WEIGHT OF SOLID PARTICLES |
| $\rho_w$ | $kg/m^3$ | DENSITY OF WATER |
| $\gamma_w$ | $kN/m^3$ | UNIT WEIGHT OF WATER |
| $\rho$ | $kg/m^3$ | DENSITY OF SOIL |
| $\gamma$ | $kN/m^3$ | UNIT WEIGHT OF SOIL |
| $\rho_d$ | $kg/m^3$ | DENSITY OF DRY SOIL |
| $\gamma_d$ | $kN/m^3$ | UNIT WEIGHT OF DRY SOIL |
| $\rho_{sat}$ | $kg/m^3$ | DENSITY OF SATURATED SOIL |
| $\gamma_{sat}$ | $kN/m^3$ | UNIT WEIGHT OF SATURATED SOIL |
| $\rho'$ | $kg/m^3$ | DENSITY OF SUBMERGED SOIL |
| $\gamma'$ | $kN/m^3$ | UNIT WEIGHT OF SUBMERGED SOIL |

| | | |
|---|---|---|
| e | 1, % | VOID RATIO |
| n | 1, % | POROSITY |
| w | 1, % | WATER CONTENT |
| $S_r$ | % | DEGREE OF SATURATION |
| $w_L$ | % | LIQUID LIMIT |
| $w_p$ | % | PLASTIC LIMIT |
| $w_S$ | % | SHRINKAGE LIMIT |
| $I_p$ | % | PLASTICITY INDEX = $w_L - w_p$ |
| $I_L$ | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ |
| $I_C$ | 1 | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ |
| e | 1, % | VOID RATIO IN LOOSEST STATE |

| | | |
|---|---|---|
| $e_{min}$ | 1, % | VOID RATIO IN DENSEST STATE |
| $I_D$ | 1 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| D | mm | GRAIN DIAMETER |
| $D_n$ | mm | n PERCENT - DIAMETER |
| $C_U$ | 1 | UNIFORMITY COEFFICIENT |
| h | m | HYDRAULIC HEAD OR POTENTIAL |
| q | $m^3/s$ | RATE OF DISCHARGE |
| v | m/s | DISCHARGE VELOCITY |
| i | 1 | HYDRAULIC GRADIENT |
| k | m/s | HYDRAULIC CONDUCTIVITY |
| j | $kN/m^3$ | SEEPAGE FORCE |

# RECORD OF BOREHOLE No 1 1 OF 1 METRIC

W.P. 410-85-00 LOCATION Co-ords: N 4 809 231; E 279 294 (Sta. 9+400, ℄ of CNR Detour) ORIGINATED BY LD
DIST 4 HWY 403 BOREHOLE TYPE SS Auger COMPILED BY TS
DATUM Geodetic DATE 92 05 19 CHECKED BY PP

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES 'N' VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 20 40 60 80 100) | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ — WATER CONTENT (%) 10 20 30 | UNIT WEIGHT $\gamma$ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 164.6 | Ground Surface | | | | | | | | | | |
| 0.0 | Sand Seam | | 1 | SS | 35 | | 164 | | | | |
| | | | 2 | SS | 36 | ▼* | | | o ⊢ | 20.0 | 6 20 46 28 |
| | Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) | | 3 | SS | 41 | | | | | | |
| | | | 4 | SS | 126 | | | | o ⊢ | 21.7 | 3 20 45 32 |
| | Hard Brown | | 5 | SS | 69 | | 162 | | | | |
| | Grey | | 6 | SS | 84 | | | | | | |
| 160.8 | | | | | | | | | | | |
| 3.8 | | | 7 | SS | 91 | | | | o | | 43 28 24 5 |
| | Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) | | 8 | SS | 80 | | 160 | | | | |
| | | | 9 | SS | ** | | | | o | | 10 37 44 9 |
| | Greyish Red, Very Dense | | 10 | SS | 120 | /25cm | | | | | |
| | | | | | | | 158 | | | | |
| 156.6 | | | 12 | SS | 100 | /25cm | | | | | |
| 8.0 | End of Borehole | | | | | | | | | | |

* 92 05 21

** Sampler Bouncing (Probable Boulder)

$+^3$, $\times^5$ : Numbers refer to Sensitivity

$15 \overset{20}{\diamond} 5$ (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 2 1 OF 1 METRIC

W.P. 410-85-00 LOCATION Co-ords: N 4 809 086; E 279 343 (Sta. 9+550, ℄ of CNR Detour) ORIGINATED BY LD
DIST 4 HWY 403 BOREHOLE TYPE SS Auger COMPILED BY TS
DATUM Geodetic DATE 92 05 19 CHECKED BY PP

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES 'N' VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT $w_P$ / NATURAL MOISTURE CONTENT $w$ / LIQUID LIMIT $w_L$ WATER CONTENT (%) 10 20 30 | UNIT WEIGHT γ kN/m³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 163.9 | Ground Surface | | | | | | | | | | |
| 0.0 | Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) Hard | | 1 | SS | 34 | | | | | | |
| | | | 2 | SS | 34 | ▼* | 162 | | | | |
| | | | 3 | SS | 46 | | | | | 22.1 | 3 26 45 26 |
| | | | 4 | SS | 37 | | | | | | |
| | | | 5 | SS | 39 | | | | | 21.7 | 6 25 45 24 |
| | | | 6 | SS | 49 | | | | | | |
| | Brown / Grey | | 7 | SS | 73 | | 160 | | | | 15 28 39 18 |
| | | | 8 | SS | ** | | | | | | |
| | | | 9 | SS | 81 | | | | | | |
| | | | 10 | SS | 100 | /25cm | 158 | | | | 23 25 36 16 |
| 156.8 | | | | | | | | | | | |
| 7.1 | Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till) | | | | | | | | | | |
| 156.0 | Greyish Red, Very Dense | | 11 | SS | 100 | /10cm | | | | | 12 37 43 8 |
| 7.9 | End of Borehole | | | | | | | | | | |

* 92 05 21

** Sampler Bouncing (Probable Boulder)

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE

# memorandum

Ontario

To: P. Payer, P. Eng.
Senior Foundation Engineer

Date: 93 07 16

From: T. Sangiuliano, P. Eng.
Foundation Engineer

Re: Final Engineering Drawings Review
Hwy 403 Advance Structure Approaches
Hwy 25 to Walkers Line
WP 410-85-00

Table 1 attached summarizes the comments derived from my review of a number of the structures included in the above mentioned package. Table 2 identifies the structures that are yet to be reviewed.

T. Sangiuliano, P. Eng.

## TABLE 1

| WP | Description | Comments |
|---|---|---|
| 409-85-02 | Hwy 25 | Midheight berm not required |
| 409-85-04 | Tremaine Rd | " |
| 411-85-02 | Appleby Line | No Compacted Granular 'A' pad standard detail |
| 411-85-04 | Walkers Line | -No reinforcing strip schedule<br>-No panel schedule<br>-No front face elevation |
| | Grading & Drainage | -Relief Well System Details-Sheet 85 must be revised<br>-Plan of relief well system outstanding |
| 410-85-00 | Drop Shaft & Tunnel | -Primary Liner Details should be shown and not left to the Contractor<br>-Rigid Foam should extend for full length of drop shaft in the rock<br>-Details of sheeted excavation require discussion |

## TABLE 2

| WP | Description | Comments |
|---|---|---|
| 408-85-01 | Bronte Ck | |
| 410-85-01/02 | CNR Subway | |