

GEOCRES No. 30MIS-75

DIST. _____ REGION _____

W.P. No. _____

CONT. No. GGE-332

W. O. No. _____

STR. SITE No. _____

HWY. No. GO-ALRT

LOCATION Brock St. Realignment

Water main and Sanitary Sewer Relocation

Service Road to Byron Street

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____



Ontario

Ministry of
Transportation and
Communications

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GO-ALRT P.O. #M0090

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NOTE: NO FND REPORT
WAS ISSUED FOR
THIS. JUST A MEMO
(84-07-04) AND A
CONTRACT REPORT

NOTE: For purposes of the contract, this report supersedes all other foundation reports prepared for or by the Ministry in connection with the above-mentioned projects.

GEOCRES No 30M15-75

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_α | 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'_{vo} | 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 |
| ρ | 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 | | | | | | |

3

FOUNDATION INVESTIGATION REPORT
for
- Site 'A' -
Brock Street Realignment
GO-ALRT Contract No. GGE-332
Watermain Relocation
Victoria and Brock Streets

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 05 29 and 84 05 31. The investigation consisted of 8 sampled boreholes (BH 1 to BH 8) advanced by means of hollow stem augers to depths ranging from 4.0 to 7.0 m below the existing ground surface. Two of the boreholes were also accompanied by cone penetration tests.

SITE DESCRIPTION AND GEOLOGY

The site is located in the Town of Whitby, Regional Municipality of Durham, approximately 400 m south of Hwy. 401 and 1 km north of Lake Ontario. Eight holes were bored along the north side of Victoria St., 5 west and 3 east of Brock St.

The site is situated in the physiographical region known as the Iroquois Plain which is generally characterized by a combination of till plains, drumlins, and lacustrine deposits. The overburden of this plain is typically underlain by a black shale of the Whitby Formation. Topography in the vicinity of the site is flat to gently rolling.

SUBSURFACE CONDITIONS

The predominant deposit across the site is a glacial till. Two distinct till deposits have been identified. In the upper zone the till is cohesive. Underlying the upper till is a second glacial till deposit which becomes less cohesive with depth to a point where it becomes cohesionless. Overlying the till deposit is between 1 and 3 m of fill. The proposed municipal service relocation will primarily lie within the cohesive till or the cohesive fill.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The locations and elevations of the borings along with a profile showing an estimated stratigraphical section based on borehole data are shown on Drawing Site 'A' - 1 in the Appendix.

The various soil types encountered are briefly described in the following paragraphs.

Fill (Gravelly Sand)

Gravelly sand fill was encountered in BH #2, 4, 6, 7 and 8. The thickness of this fill varies from 0.9 to 1.3 m and is found as the surficial material in all cases. Generally, this gravelly sand fill was encountered at the shoulder area of Victoria St. or at areas of driveways.

Grain size distribution tests were not conducted on samples of this non-cohesive material, however, based on visual observation of samples recovered, it appears that this fill is composed of approximately 70% sand and gravel size particles.

Interpretation of Standard Penetration test 'N' values indicate that this fill is in a very loose to compact state.

Fill (Silty Clay)

Silty clay fill was found in BH #1, 2, 3, and 5. The thickness of this fill varies in thickness from 1.2 to 2.7 m and is found as the surficial material or immediately underlying the gravelly sand fill. This light brown fill appears to have a 'corky' texture when a sample is opened up.

Atterberg Limits tests were carried out on two samples of this cohesive material. Results, plotted on Fig. 1, indicate that this fill exhibits the behaviour of clay of high plasticity (CH group). Natural water content of this material varied between 23% and 30% in the two samples tested.

The results of grain size distribution tests carried out on the same two samples are shown on Fig. 2 and can be summarized as follows:

| | Range % | Average % |
|--------|---------|-----------|
| Gravel | 0 | 0 |
| Sand | 2 - 6 | 4 |
| Silt | 43 - 52 | 48 |
| Clay | 46 - 51 | 49 |

Based on these results, the fill can be described as a silty clay, trace sand.

Interpretation of Standard Penetration test 'N' values ranging from 10 to 23 blows/0.3 m indicates that the fill has a stiff to very stiff consistency.

Silty Clay with Sand (Glacial Till)

This is the upper of two distinct glacial deposits encountered at this site. This till was found in BH 1-5, west of Brock St. This material was not found east of Brock St. This light brown deposit varies in thickness from 1.1 to 1.9 m and is found underlying either the silty clay fill or the gravelly sand fill.

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Atterberg Limits tests were carried out on 3 samples of this material and the results are plotted on Fig. 3. Results indicate that the till matrix is generally a silty clay of low plasticity (CL group). One sample, however, did plot in the CL-ML group (silt of slight plasticity to silty clay of low plasticity). Natural water content of this till ranged from 12.5 to 15.5% with an average of 14%.

The results of grain size distribution tests carried out on 3 samples of this material are shown on Fig. 4 and can be summarized as follows:

| | Range % | Average % |
|--------|---------|-----------|
| Gravel | 5 - 9 | 5 |
| Sand | 26 - 35 | 32 |
| Silt | 40 - 43 | 41 |
| Clay | 18 - 25 | 21 |

Based on this information this cohesive glacial till can be described as a silty clay, with sand, trace gravel.

Interpretation of Standard Penetration test 'N' values ranging from 8 to 22 blows/0.3 m indicate that this till has a stiff to very stiff consistency. Three vane tests carried out on this till indicate the material to be very stiff.

Heterogeneous Mixture Silty Clay, Sand, Gravel (Glacial Till)

This dark brown till was the lower of the two tills found at this site and was encountered in all boreholes with the exception of BH 2. West of Brock St. this material underlies the upper glacial till deposit previously described. East of Brock St., this till underlies the fill.

It should be noted that this till deposit is cohesive in the upper zones but becomes less cohesive with depth. In BH 1, 3, 7, and 8, augering was advanced to a depth where this till became non-cohesive. The approximate boundary is indicated on the appropriate log sheets in the Appendix. If the slightly cohesive or non-cohesive zones of this till are subjected to an unbalanced hydrostatic pressure, boiling may possibly result.

Atterberg Limits tests were carried out on 5 samples of this material and results are plotted on Fig. 5. The limits indicate that the fines of this till primarily plot in the CL-ML zone (sandy silt of slight plasticity to silty clay of low plasticity), with one sample plotting in the ML zone (silt of slight plasticity). Natural water content of this till stratum ranged from 7 to 9.5% with an average of 8.5%.

Grain size distribution tests carried out on the same 5 samples of this material are shown on Fig. 6 in envelope form, and can be summarized as follows:

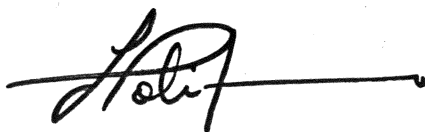
| | |
|--------|----------|
| Gravel | 8 - 30% |
| Sand | 38 - 60% |
| Silt | 19 - 27% |
| Clay | 7 - 12% |

The variation in sand and gravel contents can be attributed to the fact that the stratum generally appears to decrease in fines content with depth.

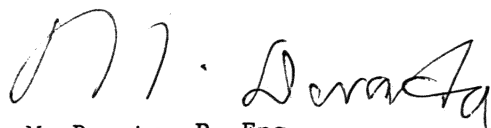
Interpretation of Standard Penetration 'N' values in the cohesive zones of this till indicates that the material has a stiff to hard consistency. In the non-cohesive zones, the till is generally in a very dense state.

Groundwater Conditions

Stabilized groundwater conditions were established when possible by measuring in open boreholes. The measurements indicate that the groundwater level varied from 1.5 to 2.8 m below the ground surface. It should be noted that in BH #7 and 8, no groundwater was evident in the boreholes 1 hr after the borehole was opened.



L. Politano
Project Foundation Engineer



M. Devata, P. Eng.
Chief Foundation Engineer (East)

A P P E N D I X

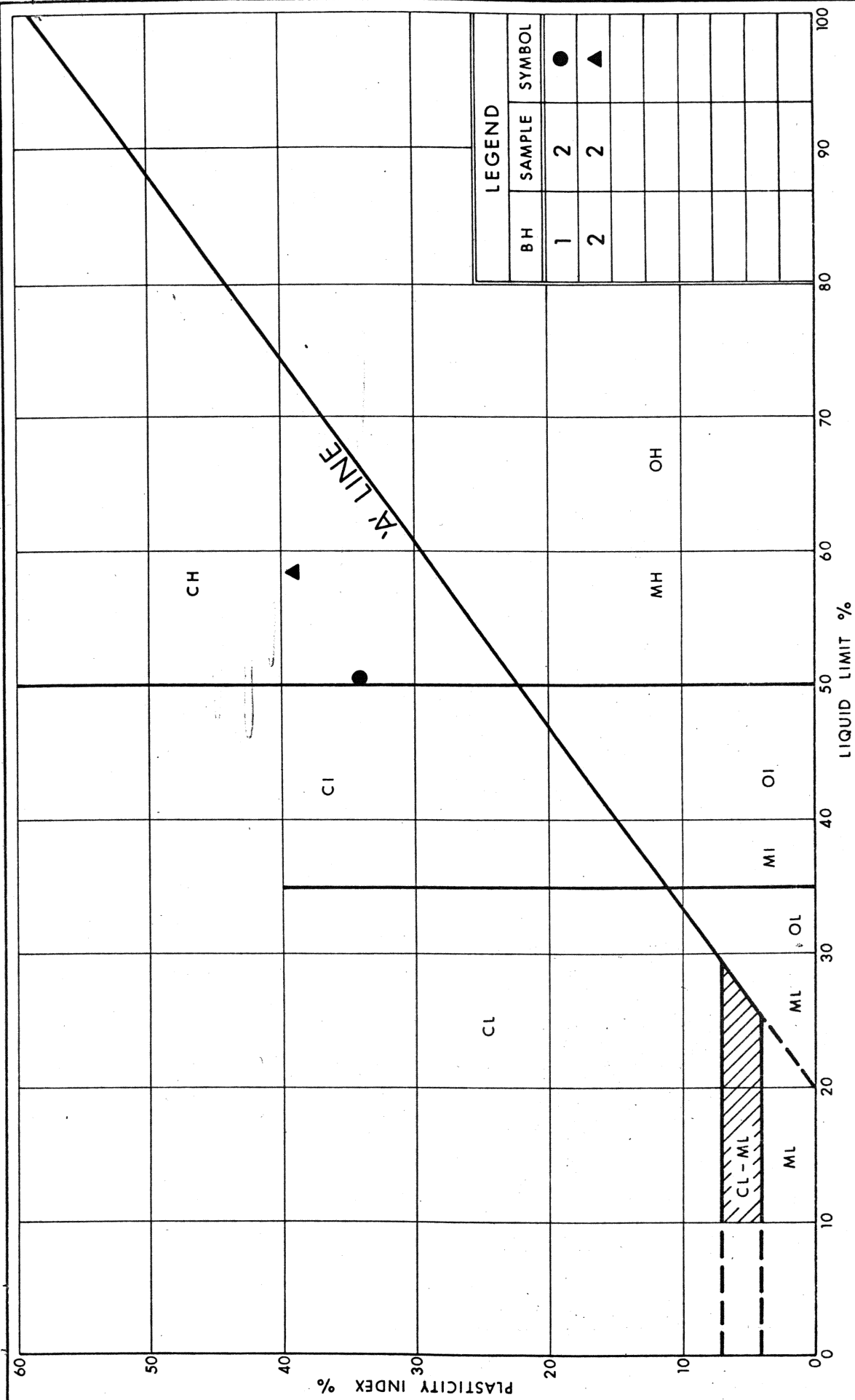


FIG No 1

PLASTICITY CHART
FILL (SILTY CLAY)

P. O. M0090

SITE 'A'

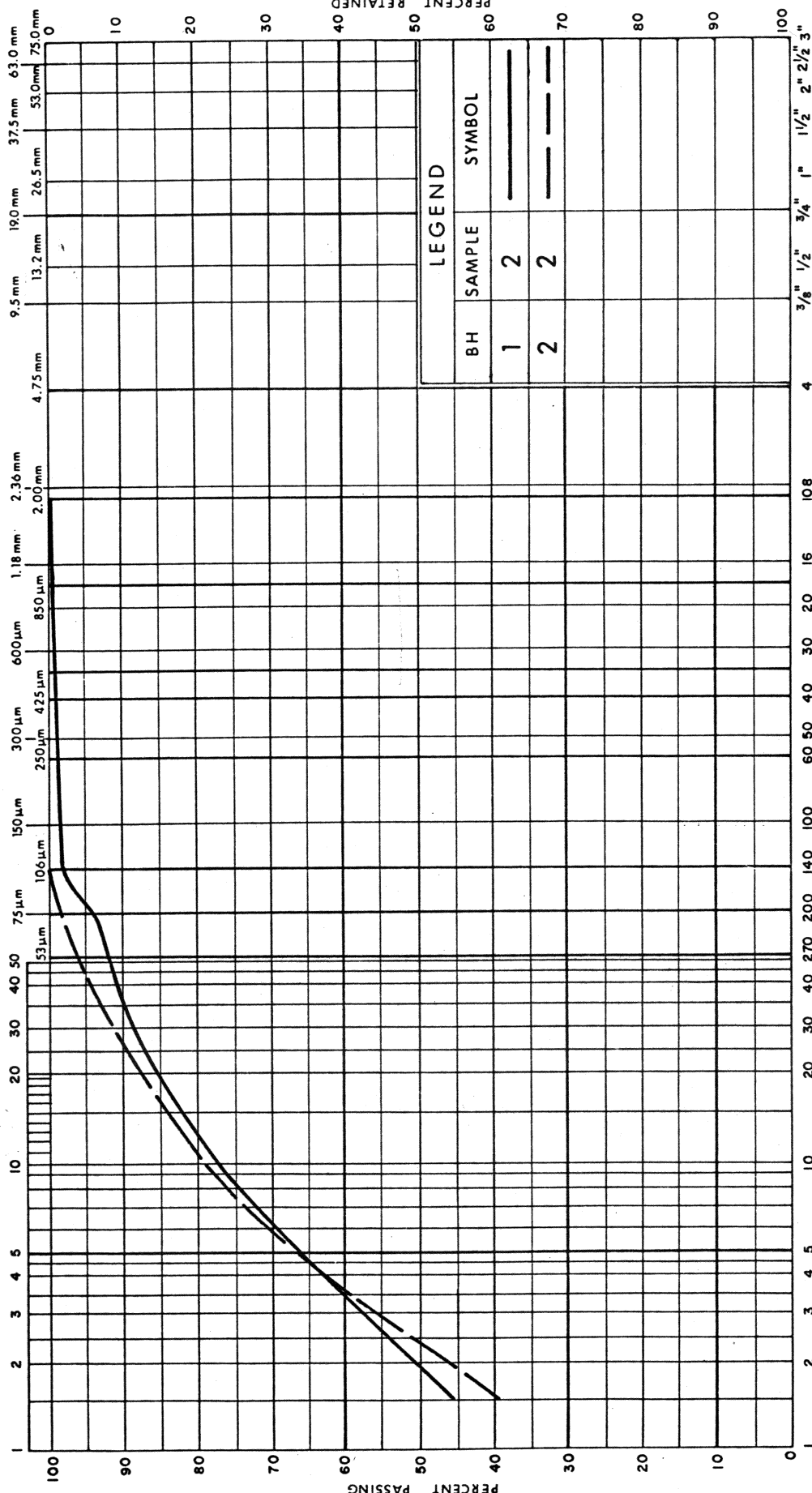
8

78 12 M

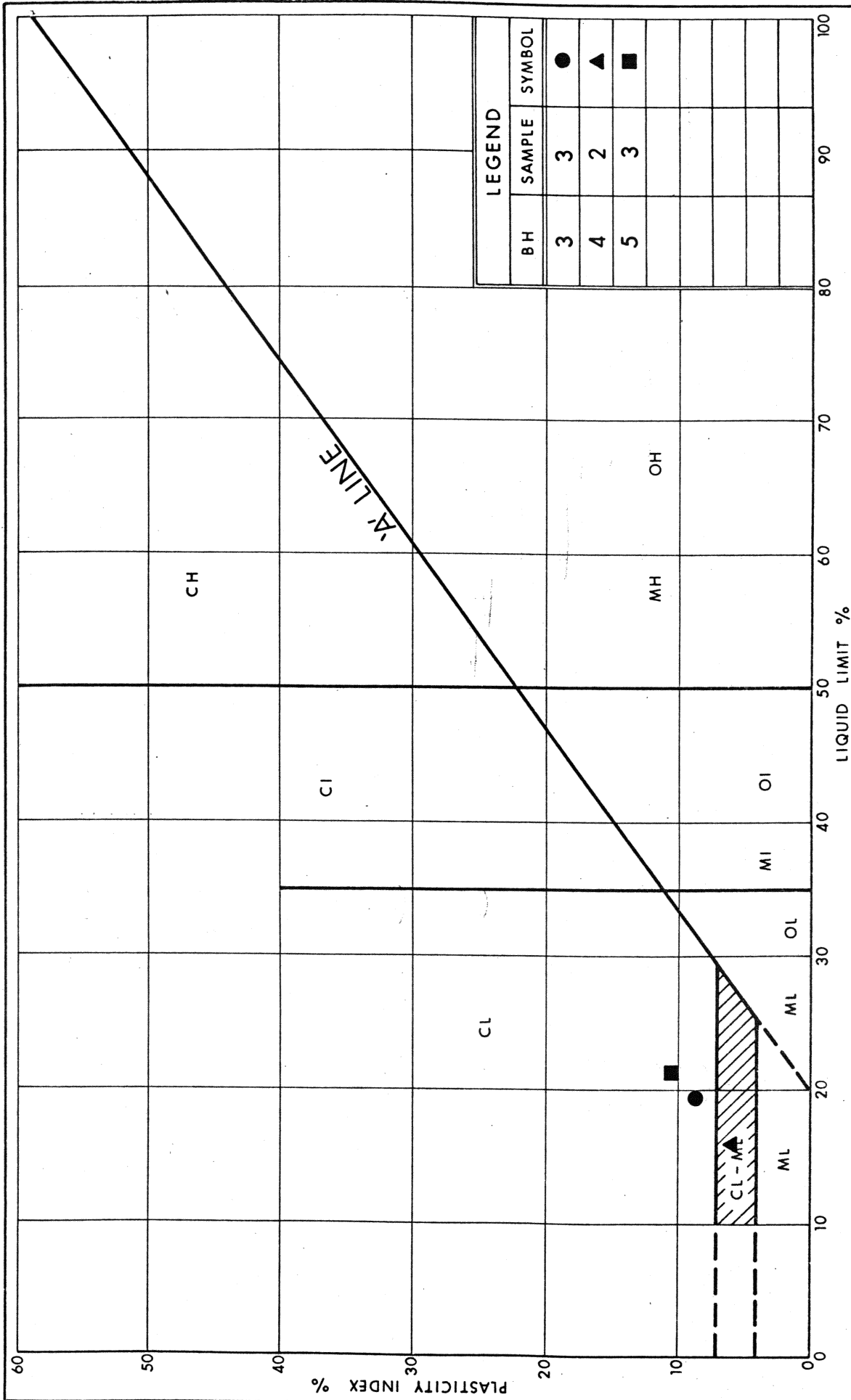
UNIFIED SOIL CLASSIFICATION SYSTEM

| | | | | | |
|-------------|--|--------|--|--------|--|
| CLAY & SILT | | SAND | | GRAVEL | |
| Fine | | Medium | | Coarse | |

MINISTRY SIEVE DESIGNATION (Metric)



Oct 75, FF-S-21

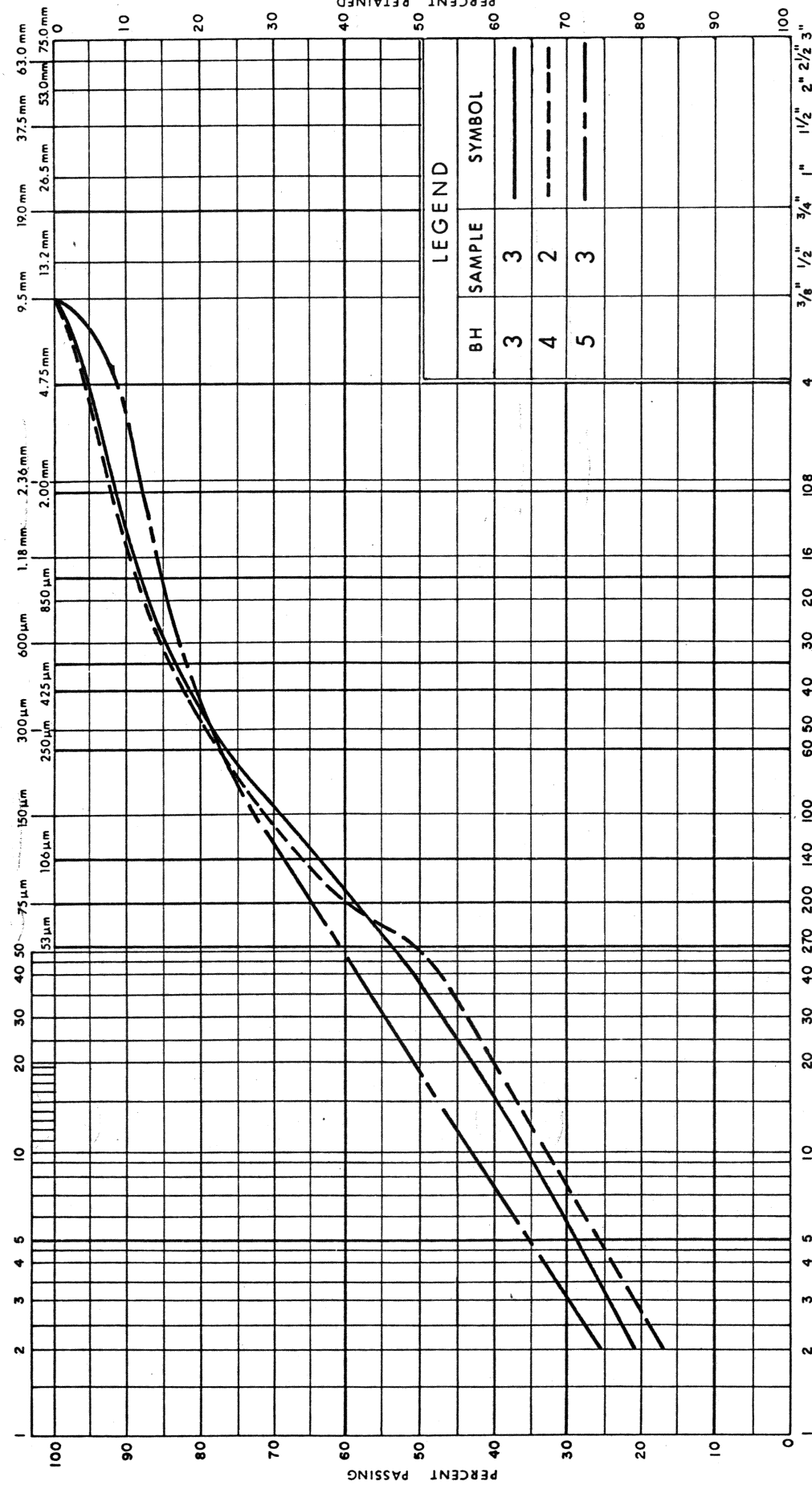


UNIFIED SOIL CLASSIFICATION SYSTEM

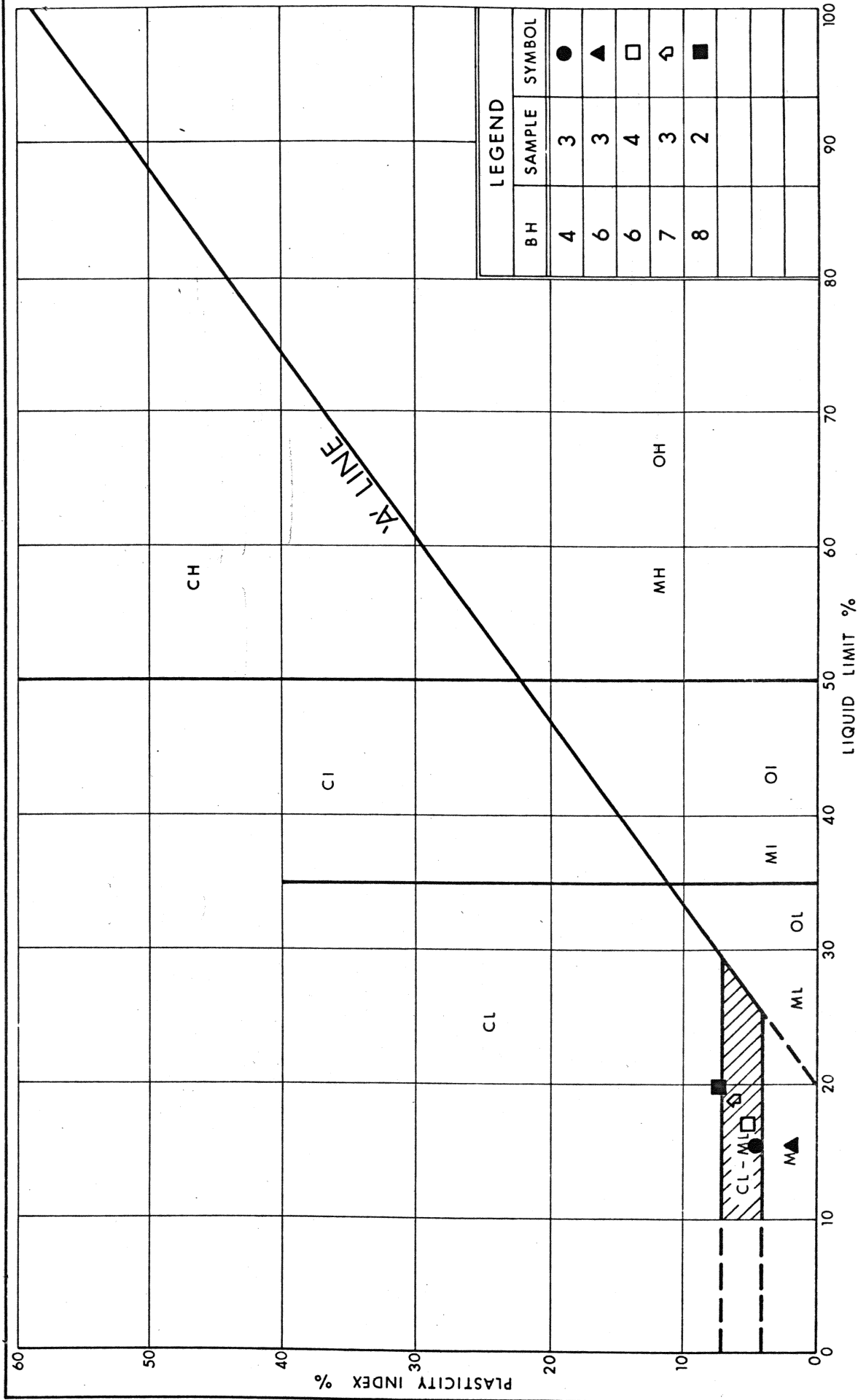
| CLAY & SILT | | SAND | | | GRAVEL | | |
|-------------|--|------|--------|--------|--------|--------|--|
| | | Fine | Medium | Coarse | Fine | Coarse | |

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



Oct 75, FF-S-21



PLASTICITY CHART
HET MIXTURE OF
SILTY CLAY, SAND, GRAVEL (Glacial Till)

FIG No 5

P. O. M0090

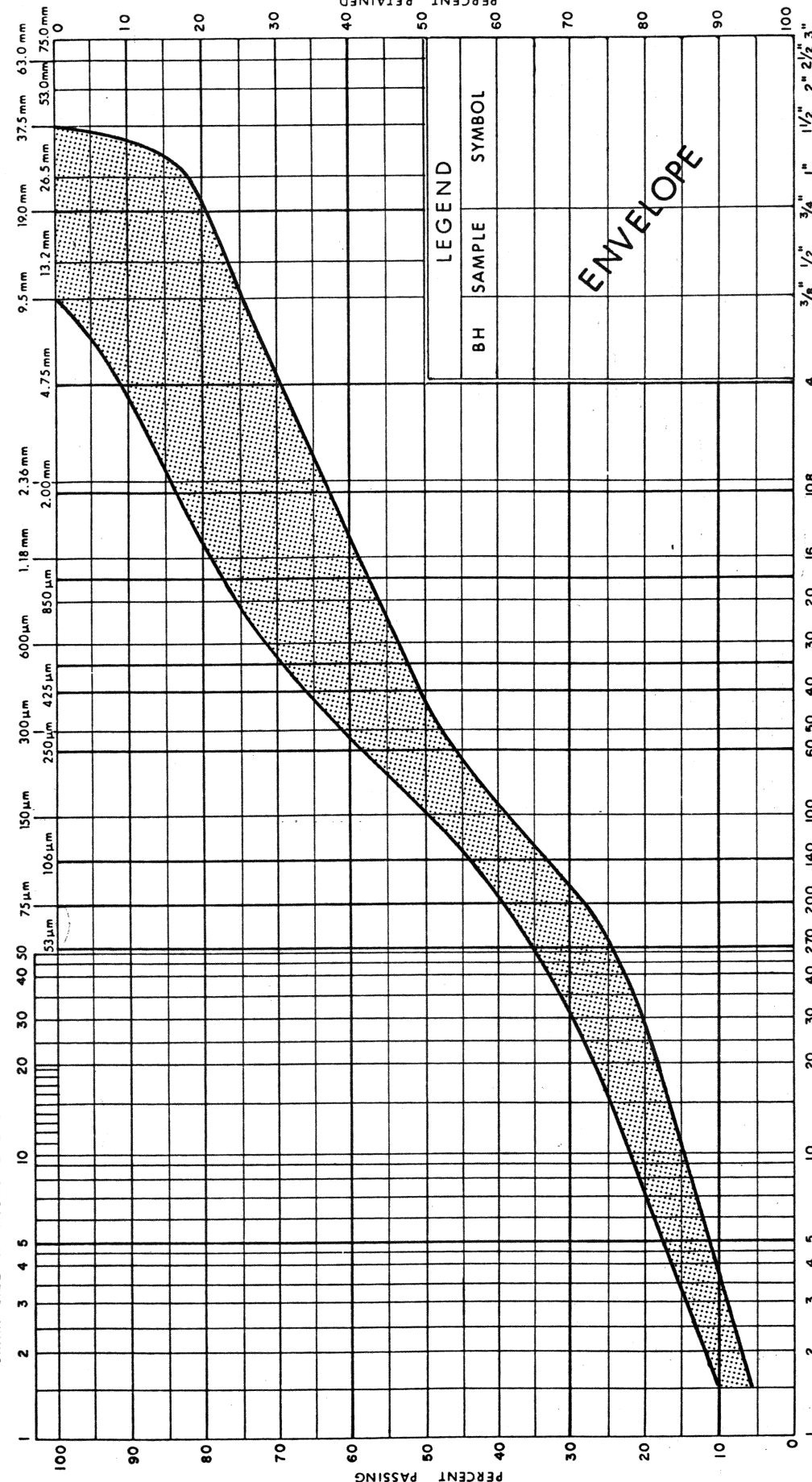
SITE 'A'

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UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | | |
|-------------|--|------|--------|--------|--------|--------|--|
| | | Fine | Medium | Coarse | Fine | Coarse | |

GRAIN SIZE IN MICROMETERS



LEGEND

BH SAMPLE SYMBOL

ENVELOPE

MINISTRY SIEVE DESIGNATION (Imperial)

Ministry of
Transportation and
Communications



GRAIN SIZE DISTRIBUTION

HET MIXTURE OF

SILTY CLAY, SAND, GRAVEL (Glacial Till)

FIG No 6

P.O. M0090

SITE 'A'

| RECORD OF BOREHOLE No 1 | | | | | | | | | | METRIC | | | | | |
|-------------------------|--|------------|---|------|------------|-------------------------|-----------------|--|--|--------|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| P.O. M0090 | | | LOCATION Co-ords. N 4 857 925.0; E 350 058.0 | | | ORIGINATED BY IR | | | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger and Cone Test | | | COMPILED BY IR | | | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 29 | | | CHECKED BY <i>CP</i> | | | | | | | | | |
| 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 (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| 79.2 | Ground Surface | | | | | | | | | | | | | | |
| 0.0 | Fill | X | | | | | | | | | | | | | |
| | Silty Clay | | | | | | | | | | | | | | |
| | trace sand | | | | | | | | | | | | | | |
| | Stiff to Very Stiff | | | | | | | | | | | | | | |
| | trace organics | | 1 | SS | 11 | | | | | | | | | | |
| | | | 2 | SS | 23 | | | | | | | | | | |
| 76.5 | | | 3 | SS | 10 | | | | | | | | | | |
| 2.7 | Silty Clay with sand trace gravel (Glacial Till) | X | 4 | SS | 8 | | | | | | | | | | |
| | | | 5 | SS | 12 | | | | | | | | | | |
| | | | 6 | SS | 9 | | | | | | | | | | |
| 75.1 | Stiff | | 7 | SS | 10 | | | | | | | | | | |
| 4.1 | Heterogeneous Mixture | X | 8 | SS | 8 | | | | | | | | | | |
| | Silty Clay and sand, some gravel (Glacial Till) | | 9 | SS | 9 | | | | | | | | | | |
| | Becoming less cohesive with depth | | 10 | SS | 6 | | | | | | | | | | |
| | stiff non-cohesive | | 11 | SS | 39 | | | | | | | | | | |
| | Dense to Very Dense | | 12 | SS | 72 | | | | | | | | | | |
| 72.2 | | | | | | | | | | | | | | | |
| 7.0 | End of Borehole | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 933.7; E 350 084.6 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY IR
DATUM Geodetic DATE 84 05 30 CHECKED BY *IR*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|---------------------------------|-------------------------------------|--------------------------------|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | | |
| 79.7 | Ground Surface | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | |
| 78.6 | Gravelly Sand some silt trace clay Very Loose | | 1 | SS | 4 | | | | | | | | |
| 1.1 | Fill | | | | | | | | | | | | |
| | Silty Clay trace sand | | 2 | SS | 16 | | | | | | | | |
| 76.8 | Stiff to Very Stiff | | 3 | SS | 14 | | | | | | | | |
| 2.9 | Silty Clay with sand, trace gravel (Glacial Till) Stiff | | 4 | SS | 12 | | | | | | | | |
| 75.7 | End of Borehole | | | | | | | | | | | | |
| 4.0 | End of Cone Test | | | | | | | | | | | | |
| 75.1 | | | | | | | | | | | | | |
| 4.6 | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 946.3; E 350 123.0 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 05 30 CHECKED BY *CP*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---|------------|---------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---|---|----------------|----------------------|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | Wp | W | W _L | | |
| 81.0 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | | |
| | Silty Clay | | 1 | SS | 16 | | | | | | | | | | | | |
| 79.8 | trace sand | | | | | | | | | | | | | | | | |
| 1.2 | Very Stiff | | | | | | | | | | | | | | | | |
| | Silty Clay with sand, trace gravel (Glacial Till) | | 2 | SS | 10 | | | | | | | | | | | | |
| | Stiff | | 3 | SS | 10 | | | | | | | | | | | | |
| 78.1 | Het. Mixture, Silty Clay and Sand, some gravel (Glacial Till) | | | | | | | | | | | | | | | | |
| 2.9 | Becoming less cohesive with depth | | 4 | SS | 14 | | | | | | | | | | | | |
| | non-cohesive | | 5 | SS | 10 | | | | | | | | | | | | |
| 76.9 | Compact | | | | | | | | | | | | | | | | |
| 4.1 | End of Borehole | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 960.3; E 350 166.0 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 05 30 CHECKED BY *EP*

| 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|-----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | | | | | |
| 82.3 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | |
| 81.4 | Gravelly Sand, some silt, trace clay | | 1 | SS | 10 | | | | | | | | | |
| 0.9 | Loose to Compact | | | | | | | | | | | | | |
| | Silty Clay, with sand, trace gravel (Glacial Till) | | 2 | SS | 10 | | | | | | | | | 5 34 43 18 |
| 80.2 | Stiff | | | | | | | | | | | | | |
| 2.1 | Heterogeneous Mixture | | | | | | | | | | | | | |
| | Silty Clay, and sand, some gravel (Glacial Till) | | 3 | SS | 16 | | | | | | | | | 28 38 27 7 |
| | Becoming less cohesive with depth | | 4 | SS | 8 | | | | | | | | | |
| 78.2 | Stiff to Very Stiff | | 5 | SS | 14 | | | | | | | | | |
| 4.1 | End of Borehole | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

P.O. M0090 LOCATION Co-ords. N 4 857 966.8; E 350 189.3 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 05 30 CHECKED BY *JP*

| 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 Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|----------------------------|-----------------|---|-----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | 20 40 60 80 100 | | | | | |
| 83.3 | Ground Surface | | | | | | | | | | | | |
| 0.0 | Fill | | 1 | SS | 10 | | | | | | | | |
| | Silty Clay trace sand | | | | | | | | | | | | |
| | Stiff | | 2 | SS | 14 | | | | | | | | |
| 81.7 | | | | | | | | | | | | | |
| 1.6 | Silty Clay, with sand, trace gravel (Glacial Till) | | 3 | SS | 22 | | | | | | | | |
| | Very Stiff | | | | | | | | | | | | |
| 79.8 | Het. Mixture, Silty Clay, and sand, some gravel (Glacial Till) | | | | | | | | | | | | |
| 3.5 | | | | | | | | | | | | | |
| 79.2 | Very Stiff | | | | | | | | | | | | |
| 4.1 | End of Borehole | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 6 | | | | | | | | | | METRIC | | | | | |
|-------------------------|--|------------|--|------|------------|-------------------------|-----------------|--|----|--------|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| P.O. M0090 | | | LOCATION Co-ords. N 4 857 984.5; E 350 249.7 | | | ORIGINATED BY IR | | | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger | | | COMPILED BY IR | | | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 30 | | | CHECKED BY <i>EP</i> | | | | | | | | | |
| 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 (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | | | | | |
| 85.6 | Ground Surface | X | 1 | SS | 17 | * | | | | | | | | | |
| 0.0 | Fill Gravelly Sand, some silt, trace clay Compact | X | | | | | | | | | | | | | |
| 84.5 | | X | 2 | SS | 13 | | | | | | | | | | |
| 1.1 | Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till) | X | 3 | SS | 27 | | | | | | | | | 8 61 24 7 | |
| | Becoming less cohesive with depth | X | 4 | SS | 69 | | | | | | | | | 23 48 20 9 | |
| | | X | 5 | SS | 60 | | | | | | | | | | |
| | Stiff to Hard | X | | | | | | | | | | | | | |
| 80.7 | | X | 6 | SS | 60 | | | | | | | | | | |
| 4.9 | End of Borehole | X | | | | | | | | | | | | | |
| | * Note: Water Table not established | | | | | | | | | | | | | | |

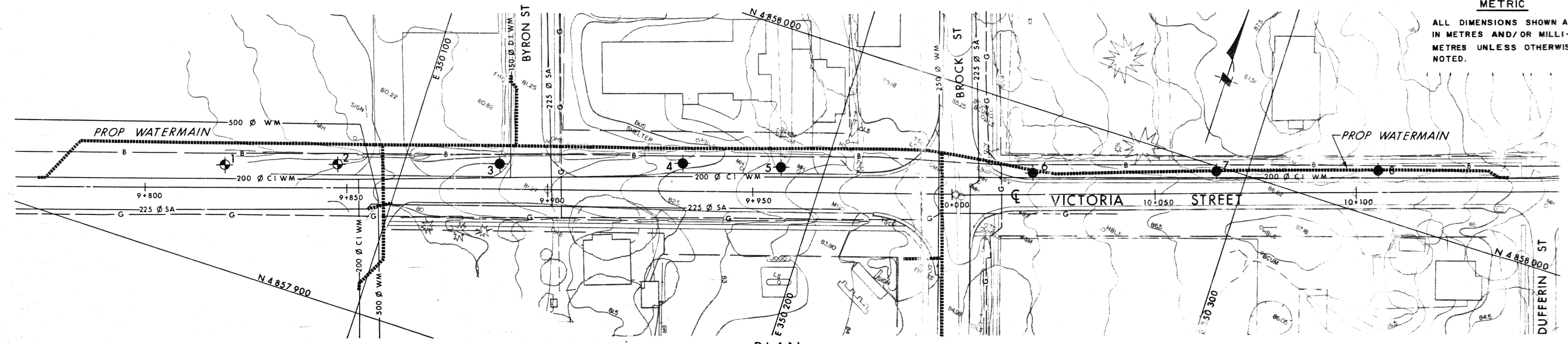
OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 8 | | | | | | | | | | METRIC | | | | |
|-------------------------|---|------------|--|------|------------|----------------------------|----------------------|---|----------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| P.O. M0090 | | | LOCATION Co-ords. N 4 858 011.0; E 350 331.0 | | | | ORIGINATED BY IR | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger | | | | COMPILED BY IR | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 31 | | | | CHECKED BY <i>EP</i> | | | | | | | |
| ELEV DEPTH | SOIL PROFILE DESCRIPTION | STRAT PLOT | 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 (%) GR SA SI CL |
| | | | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 10 20 30 | | | | | |
| 86.5 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill Gravelly Sand, some silt, trace clay | | | | | | 86 | | | | | | | |
| 85.5 | Compact | | 1 | SS | 24 | * | | | | | | | | |
| 1.0 | Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till) | | 2 | SS | 36 | | 85 | | | | | | | 15 46 28 11 |
| | Becoming less cohesive with depth | | 3 | SS | 57 | | 84 | | | | | | | |
| | Very Stiff to Hard | | 4 | SS | 93 | | 83 | | | | | | | |
| | Non-Cohesive | | | | | | | | | | | | | |
| 81.8 | Very Dense | | 5 | SS | 103 | | 82 | | | | | | | |
| 4.7 | End of Borehole | | | | | | | | | | | | | |
| | * Note: No water in hole after 1½ hour | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

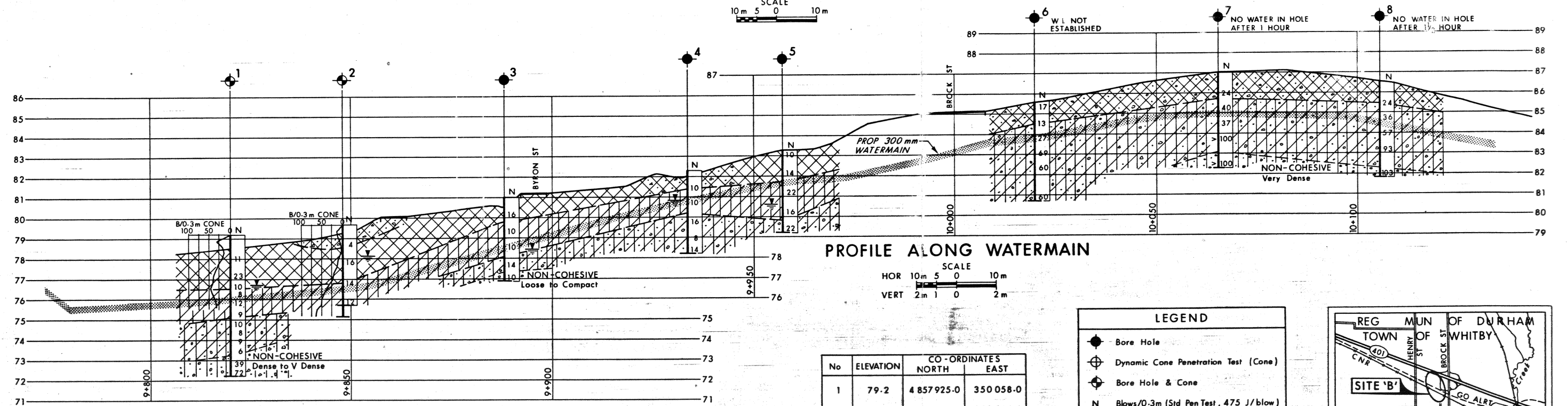
METRIC

ALL DIMENSIONS SHOWN ARE IN METRES AND/OR MILLI-METRES UNLESS OTHERWISE NOTED.



PLAN

SCALE
10m 5 0 10m



PROFILE ALONG WATERMAIN

SCALE
HOR 10m 5 0 10m
VERT 2m 1 0 2m

SOIL STRATIGRAPHY LEGEND

- | | |
|--|--|
| FILL GRAVELLY SAND SOME SILT, TRACE OF CLAY Loose to Compact | SILTY CLAY WITH SAND, TRACE OF GRAVEL (Glacial Till) Stiff to Very Stiff |
| FILL SILTY CLAY, TRACE OF SAND Stiff to Very Stiff | HET MIXTURE OF SILTY CLAY AND SAND SOME GRAVEL (Glacial Till) Stiff to Hard BECOMING LESS COHESIVE WITH DEPTH |

| No | ELEVATION | CO-ORDINATES | |
|----|-----------|--------------|-----------|
| | | NORTH | EAST |
| 1 | 79.2 | 4 857 925.0 | 350 058.0 |
| 2 | 79.7 | 4 857 933.7 | 350 084.6 |
| 3 | 81.0 | 4 857 946.3 | 350 123.0 |
| 4 | 82.3 | 4 857 960.3 | 350 166.0 |
| 5 | 83.3 | 4 857 966.8 | 350 189.3 |
| 6 | 85.6 | 4 857 984.5 | 350 249.7 |
| 7 | 87.0 | 4 857 998.5 | 350 292.8 |
| 8 | 86.5 | 4 858 011.0 | 350 331.0 |

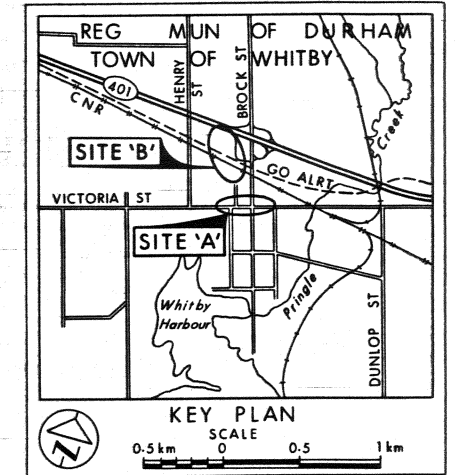
Geocres No 30M15-75

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 84 05

—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.



GO-ALRT REF

| | | | | | | | | | | | | |
|------------------------------|--------------------------------|------------------|--|-------------------------|----------------------------|---|---|--|-------------------------------|-----------------------------|------------|--------------|
| REFERENCE DRAWINGS | | REVISIONS | | DRAWN BY: G P | DESIGNED BY: L P | ENGINEERING MATERIALS OFFICE FOUNDATION DESIGN SECTION | Ministry of Transportation and Communications | DURHAM REGION BROCK ST (RR 46) REALIGNMENT VICTORIA & BROCK STREETS WATERMAIN RELOCATION BOREHOLE LOCATIONS & SOIL STRATA | | | | |
| 84 04 06 | U-003 Sheet 60 | | | 84 07 17 | | | | | CONTRACT NO GGE-332 | DWG NO SITE 'A'-1 | REV | SHEET |
| | Totten sims hubicki associates | | | CHK'D BY: | APPROVED BY: | | | | | | | |
| SCALE: FULL SIZE ONLY | | | | | | | | PROJECT MANAGER | | | | |
| AS NOTED | | | | | | | | | | | | |

23

FOUNDATION INVESTIGATION REPORT
for
- Site 'B' -
Brock Street Realignment
GO-ALRT Contract No. GGE-332
Watermain and Sanitary Sewer Relocation
Service Road to Byron St.

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above-mentioned site between 84 05 31 and 84 06 01. The investigation consisted of 8 sampled boreholes (BH 9 to BH 16) advanced by means of hollow stem augers to depths ranging from 4.1 to 6.6 m below the existing ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located along the Service Rd. and Byron St. some 100 m south of Hwy. 401, just west of Brock St., and approximately 1 km north of Lake Ontario. The site is situated in the Town of Whitby, Regional Municipality of Durham.

The site lies in the physiographical region known as the Iroquois Plain which is generally characterized by a combination of till plains, drumlins, and lacustrine deposits. The overburden of this plain is typically underlain by a black shale of the Whitby Formation. Topography in the vicinity of the site is flat to gently rolling.

SUBSURFACE CONDITIONS

The predominant deposit across the site is a glacial till. Two distinct till deposits have been identified. In the upper till, the soil matrix is composed of a greater percentage of fine particles than that of the lower till. Overlying the till is between 2 and 3 m of fill. The proposed services relocation will primarily lie within the till strata.

The boundaries between the various soil types, insitu and laboratory test results, as well as stabilized groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The locations and elevations of the borings along with a profile showing estimated stratigraphical sections based on borehole data are shown on Drawing Site 'B' - 1 in the Appendix.

The various soil types encountered are briefly described in the following paragraphs.

Fill (Gravelly Sand)

This fill material was encountered in BH #12, 14, and 16. Thickness of the fill varied from 0.6 to 2.5 m. In BH 14 and 16 the material was found to immediately overlie the natural glacial deposit. In BH 12, this gravelly sand fill was underlain by the silty clay fill.

Results of grain size distribution tests conducted on 2 samples of this material are shown on Fig. 1 and can be summarized as follows:

| | |
|--------|----------|
| Gravel | 37 - 43% |
| Sand | 34 - 43% |
| Silt | 9 - 19% |
| Clay | 5 - 10% |

Based on this information this non-cohesive fill material is described as a gravelly sand, some silt, trace clay.

Interpretation of Standard Penetration test 'N' values indicate that this material is in a compact state.

Fill (Silty Clay)

Silty clay fill was encountered in 6 boreholes (BH 9-13, 15) and ranged in thickness from 1.3 to 3.2 m. This fill was found as the surficial material or immediately underlying the gravelly sand fill (BH 12).

The results of Atterberg Limits testing carried out on 1 sample of this cohesive material are illustrated on Fig. 2 and show that the fill matrix is a silty clay of intermediate plasticity (CI group). Natural water content in the 1 sample was measured to be 23%.

The results of grain size distribution testing carried out on 1 sample of this material are shown on Fig. 3 and can be summarized as follows:

| | |
|--------|-----|
| Clay | 35% |
| Silt | 45% |
| Sand | 16% |
| Gravel | 4% |

Based on its distribution, this material can be described as a silty clay, trace to some sand, trace gravel.

Interpretation of Standard Penetration test 'N' values ranging from 10 to 30 blows/0.3 m reveals that the fill has a generally stiff to very stiff consistency.

Silty Clay with Sand (Glacial Till)

This is the upper of two distinct glacial deposits encountered at this site and was found in BH9-12, 14, 15. The thickness of this stratum ranged from 0.6 m in BH 11 to 2.0 m in BH 10. In all boreholes, this material was found to directly underlie the fill.

Results of Atterberg Limits tests carried out on 7 samples of this material indicate that the till matrix is a silty clay of low plasticity (CL-group). The natural water content of this material varied from 13.5 to 20% in the 7 samples tested, with an average value of 15%. Results of the Atterberg Limits tests are shown on Fig. 4.

Results of grain size distribution testing conducted on the same 7 samples are shown on Fig. 5 in envelope form, and can be summarized as follows:

| | Range % | Average % |
|--------|---------|-----------|
| Gravel | 2 - 10 | 7 |
| Sand | 22 - 38 | 31 |
| Silt | 35 - 40 | 38 |
| Clay | 15 - 35 | 24 |

Based on this distribution, this till can be described as a silty clay with sand, trace gravel.

Interpretation of Standard Penetration test 'N' values indicates that this cohesive material has a consistency of firm to very stiff.

Heterogeneous Mixture Silty Clay, Sand, Gravel (Glacial Till)

This is the lower of the two till deposits at this site and was encountered in all boreholes with the exception of BH 16. This layer was proven to its full depth in BH 9, 10, 11 where the thickness was in the order of 0.5 m. It appears that the till layer became thicker in the remainder of the boreholes, however, its extent was not proven.

Results of Atterberg Limits tests were carried out on 4 samples of this cohesive material and show that the till matrix is a sandy silt of slight plasticity to a silty clay of low plasticity (CL-ML group). Natural water content in this material was constant at about 8%. Fig. 6 shows the results of the Atterberg Limits tests.

Grain size distribution tests were conducted on 5 samples of this till material are shown on Fig. 7 in envelope form, and can be summarized as follows:

| | Range % | Average % |
|--------|---------|-----------|
| Gravel | 22 - 28 | 25 |
| Sand | 40 - 44 | 42 |
| Silt | 18 - 28 | 24 |
| Clay | 6 - 12 | 9 |

Interpretation of Standard Penetration test 'N' values indicate that this material has a consistency of firm to hard, but generally very stiff.

Silty Sand

Within the cohesive heterogeneous mixture of silty clay, sand, gravel as described above, an isolated pocket of non-cohesive silty sand was encountered in BH 14 at elev. 81.9 ±. The thickness of this pocket was interpreted to be approximately 0.4 m. Based on visual inspection of a sample of this material, this pocket consisted of approximately 60% sand and gravel, and 40% silt and clay size particles. Interpretation of the Standard Penetration test 'N' value of 24 blows/0.3 m indicates that the non-cohesive pocket is in a compact state.

Sand, Some Silt

Sand was encountered in BH 9, 10, 11 at an elevation of approximately 80, immediately below the heterogeneous mixture of silty clay, sand, gravel.

Two grain size distribution tests were conducted on samples of this material. The results are shown on Fig. 8 and can be summarized as follows:

| | |
|--------|----------|
| Gravel | 4 - 6% |
| Sand | 61 - 77% |
| Silt | 16 - 28% |
| Clay | 3 - 5% |

It is to be noted, however, that these two grain size distribution tests were conducted on samples obtained from the upper zone of this deposit in BH 10 and the results may not be representative of the material.

It appears that in this stratum the gravel and sand content increases with depth. Based on visual inspection, sample 9 of BH 11 was composed of approximately 30% gravel and 60% sand.

Interpretation of Standard Penetration test 'N' values indicate that this material is in a compact to dense state.

When subjected to an unbalanced hydrostatic pressure, this material may be susceptible to boiling.

Silty Clay

Immediately underlying the fill in BH 16, silty clay was encountered at elevation 82.1.

Results of Atterberg Limits testing conducted on two samples of this material are shown on Fig. 9 and indicate that this deposit can be classified as a silty clay of intermediate plasticity. Natural water content varied from 32.5 to 39.5%.

One grain size distribution test was conducted on this material and results indicate 33% clay, 61% silt, 6% sand, and zero % gravel sized particles. Results are shown on Fig. 10.


Interpretation of Standard Penetration test 'N' values, varying from 5 to 14 blows/0.3 m, indicate that this cohesive material has a firm to stiff consistency.

GROUNDWATER CONDITIONS

Stabilized groundwater conditions are established when possible measuring in open boreholes. The measurements indicate that the groundwater level varied from 1.9 to 2.7 m below the ground surface. It should be noted that in BH 13 no groundwater was evident in the borehole 1 hour after the borehole was opened.



L. Politano
Project Foundation Engineer



M. Devata, P. Eng.
Chief Foundation Engineer (East)

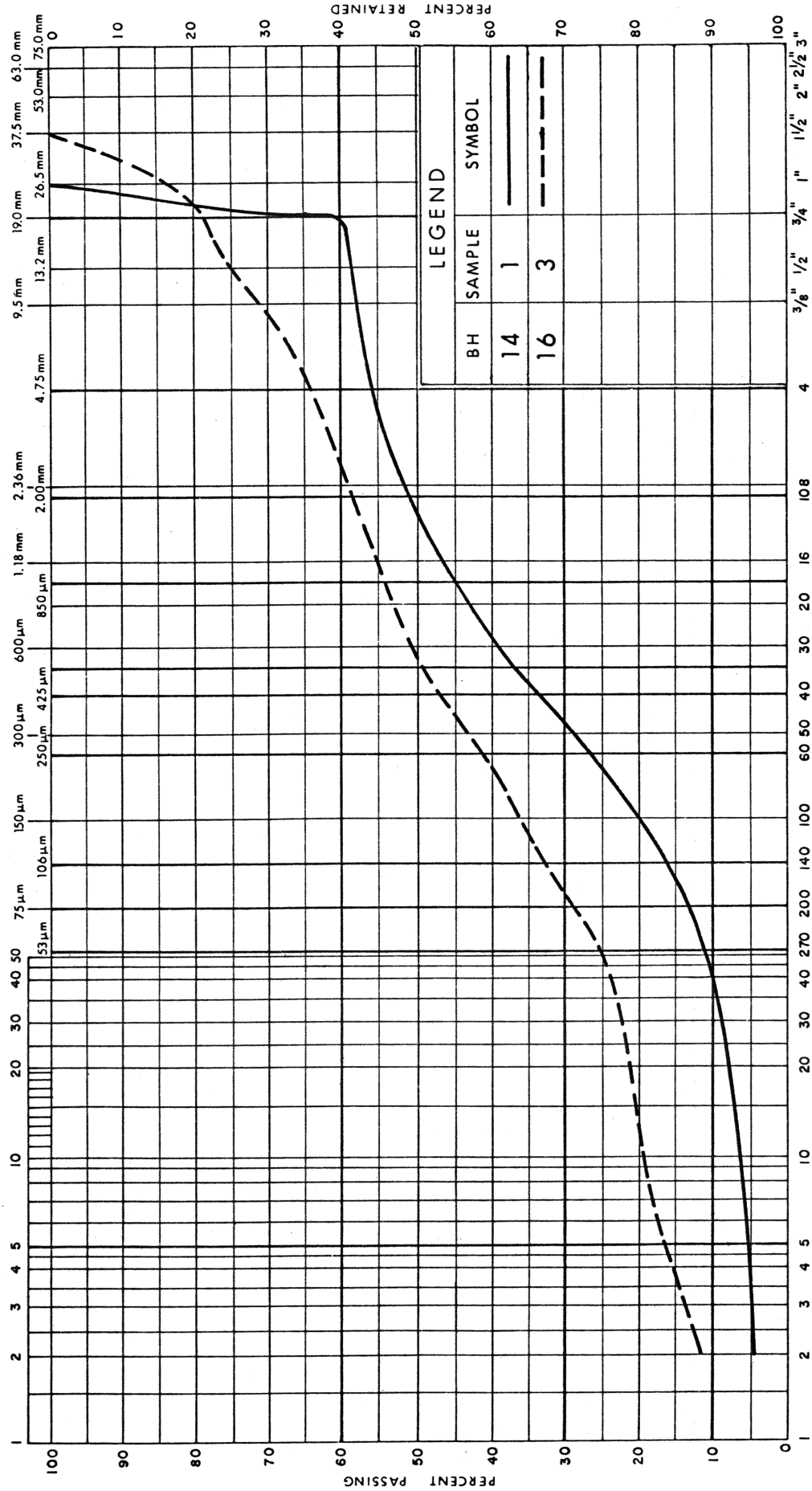
A P P E N D I X

UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | | | SAND | | | | GRAVEL | | | |
|-------------|--|--|--|------|--------|--------|--|--------|--------|--|--|
| | | | | Fine | Medium | Coarse | | Fine | Coarse | | |

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



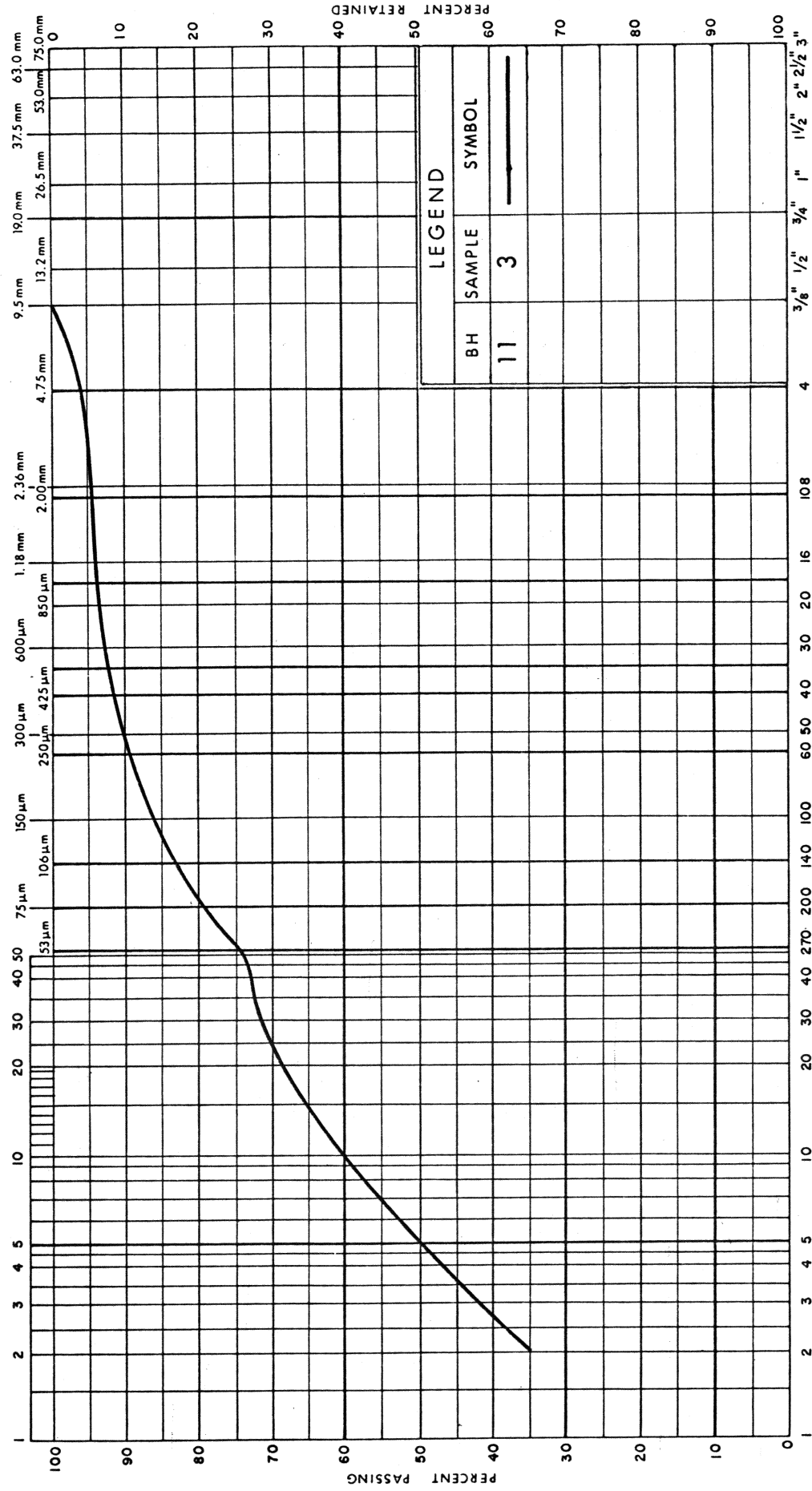
GRAIN SIZE DISTRIBUTION FILL (GRAVELLY SAND)

UNIFIED SOIL CLASSIFICATION SYSTEM

| | | | | | | |
|-------------|--|--------|--|--------|--------|--------|
| CLAY & SILT | | SAND | | | GRAVEL | |
| Fine | | Medium | | Coarse | | Coarse |

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



LEGEND

| BH | SAMPLE | SYMBOL |
|----|--------|--------|
| 11 | 3 | — |

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

FILL (SILTY CLAY)

FIG No 3

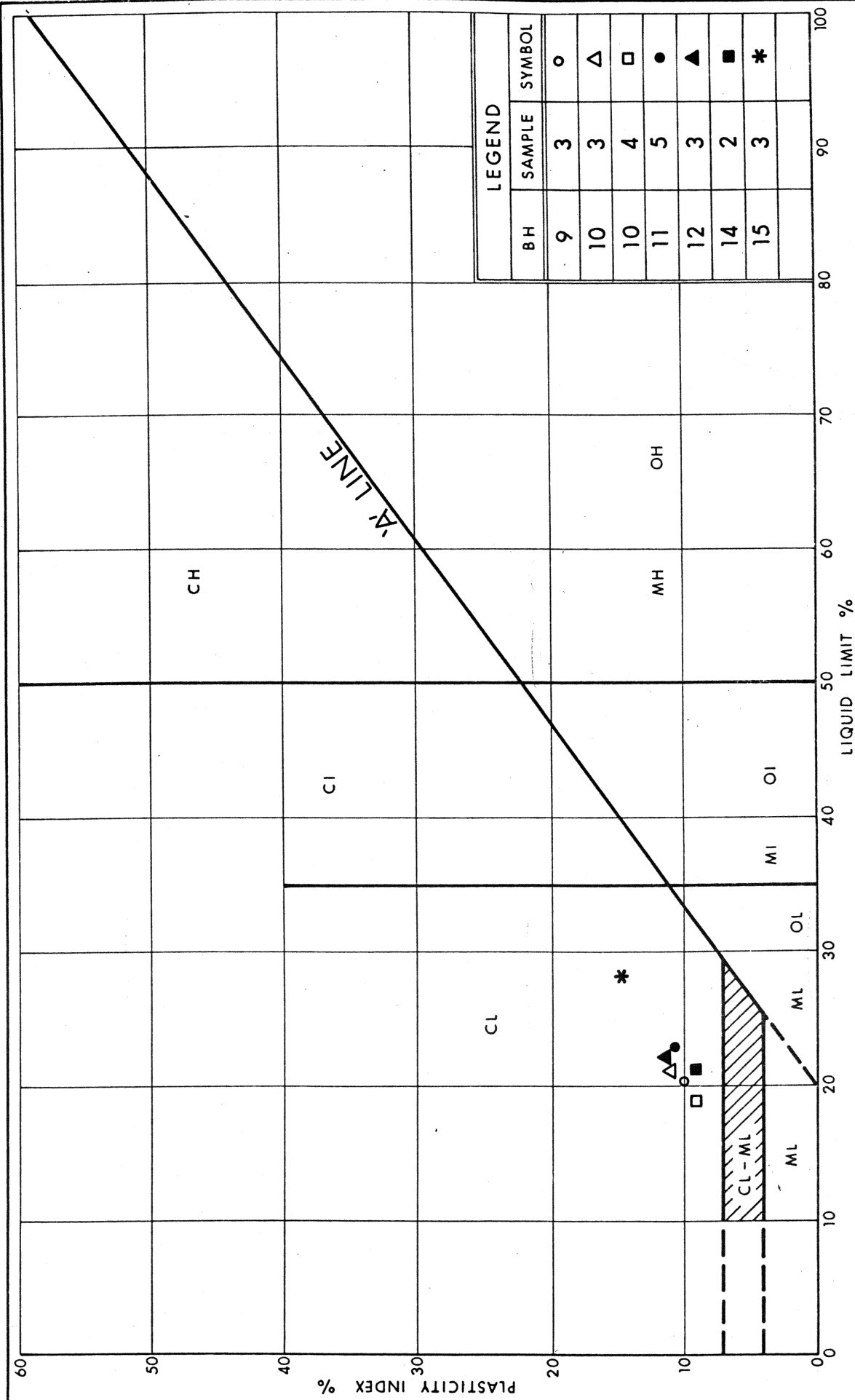
P.O. M0090

SITE 'B'

Ministry of
Transportation and
Communications



Oct 75, FF-S-21





Ministry of
Transportation and
Communications
Ontario

FIG No 4

P.O. M0090

SITE 'B'

PLASTICITY CHART

SILTY CLAY WITH SAND (Glacial Till)

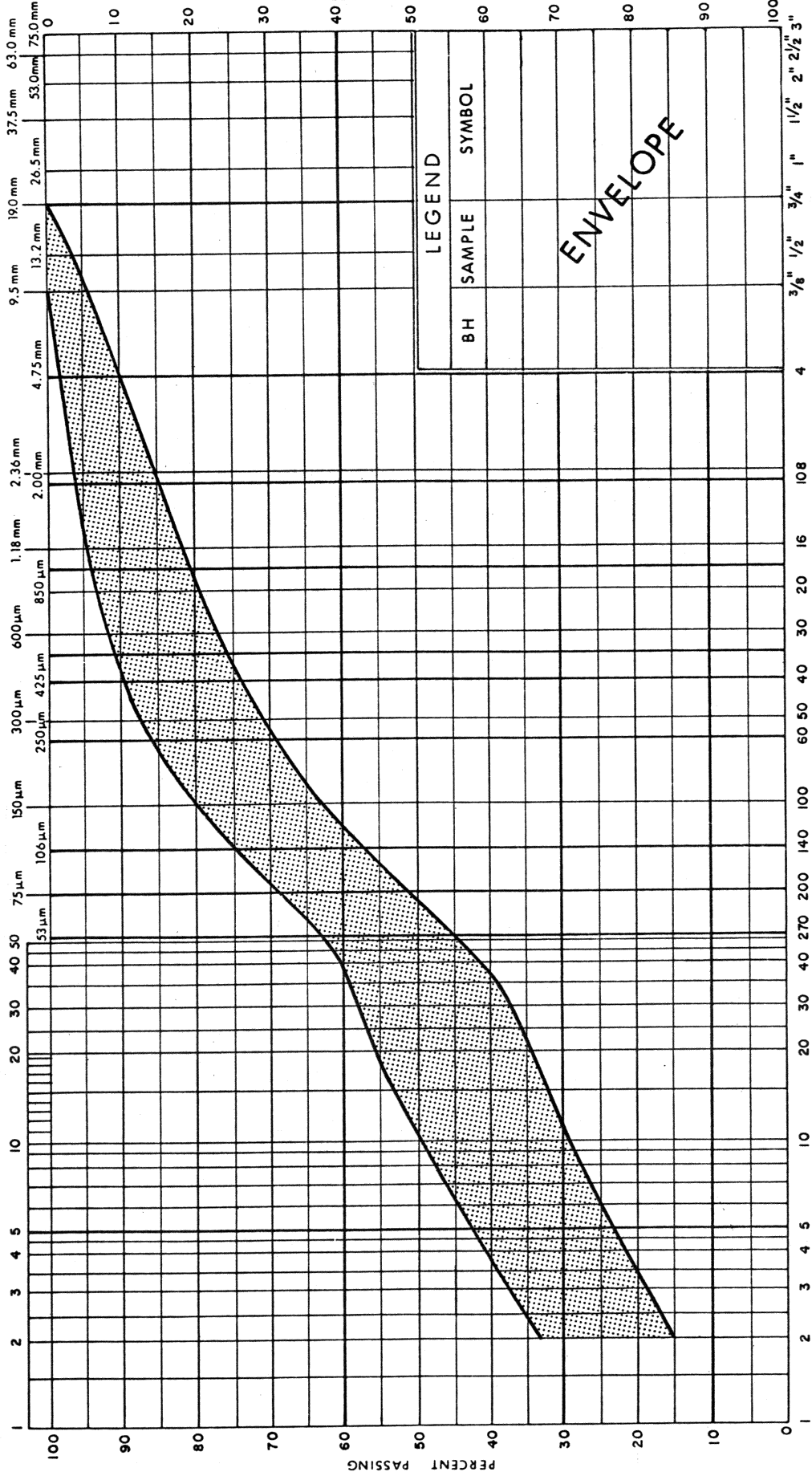
32

UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | SAND | | | GRAVEL | |
|-------------|--|------|--------|--------|--------|--------|
| | | Fine | Medium | Coarse | Fine | Coarse |

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SILTY CLAY WITH SAND (Glacial Till)

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FIG No 5

P.O. M0090

SITE 'B'

Oct 75, FF-S-21

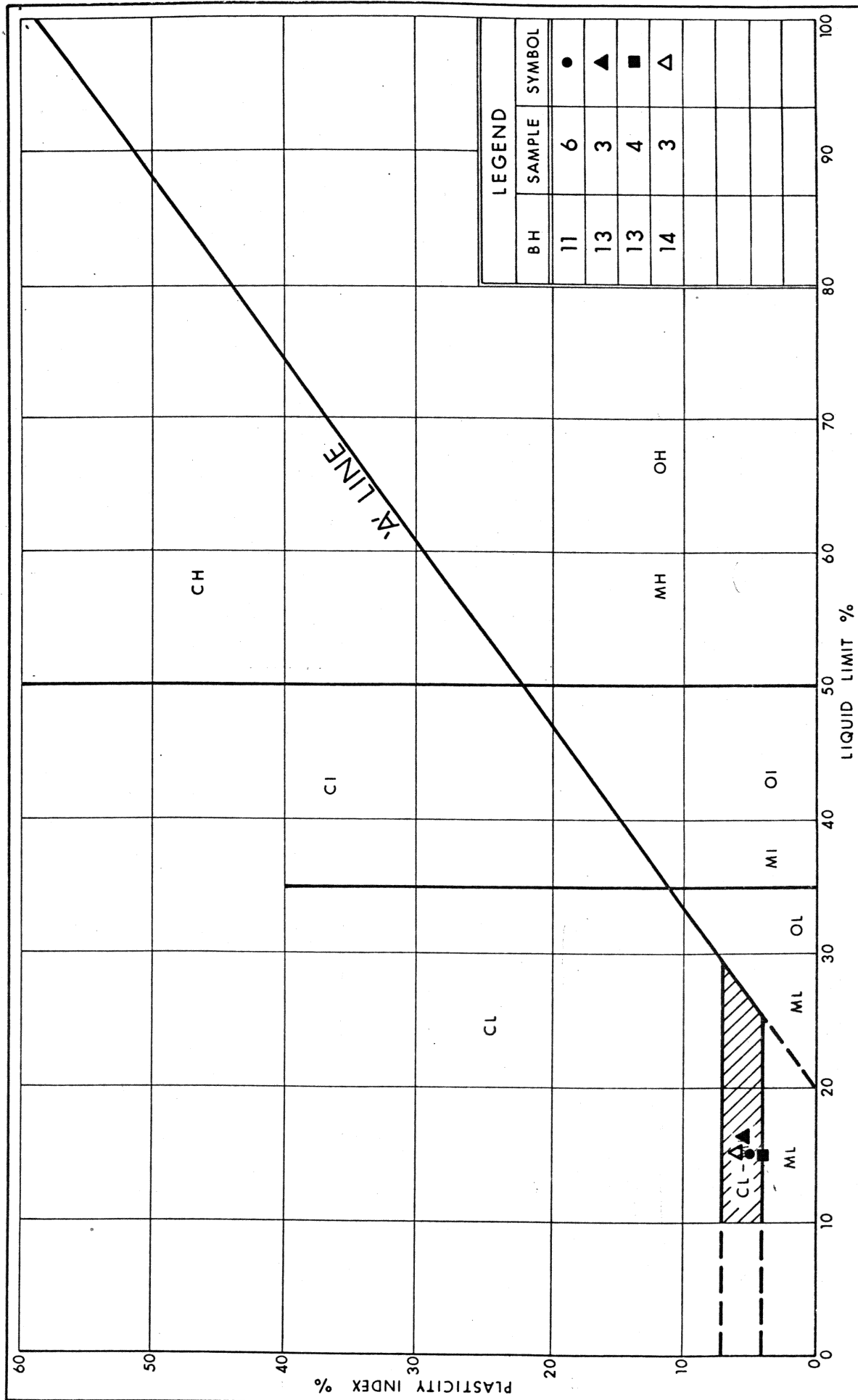


FIG No 6

P.O. M0090

SITE 'B'

PLASTICITY CHART

HET MIXTURE OF

SILTY CLAY, SAND, GRAVEL (Glacial Till)

Ministry of
Transportation and
Communications

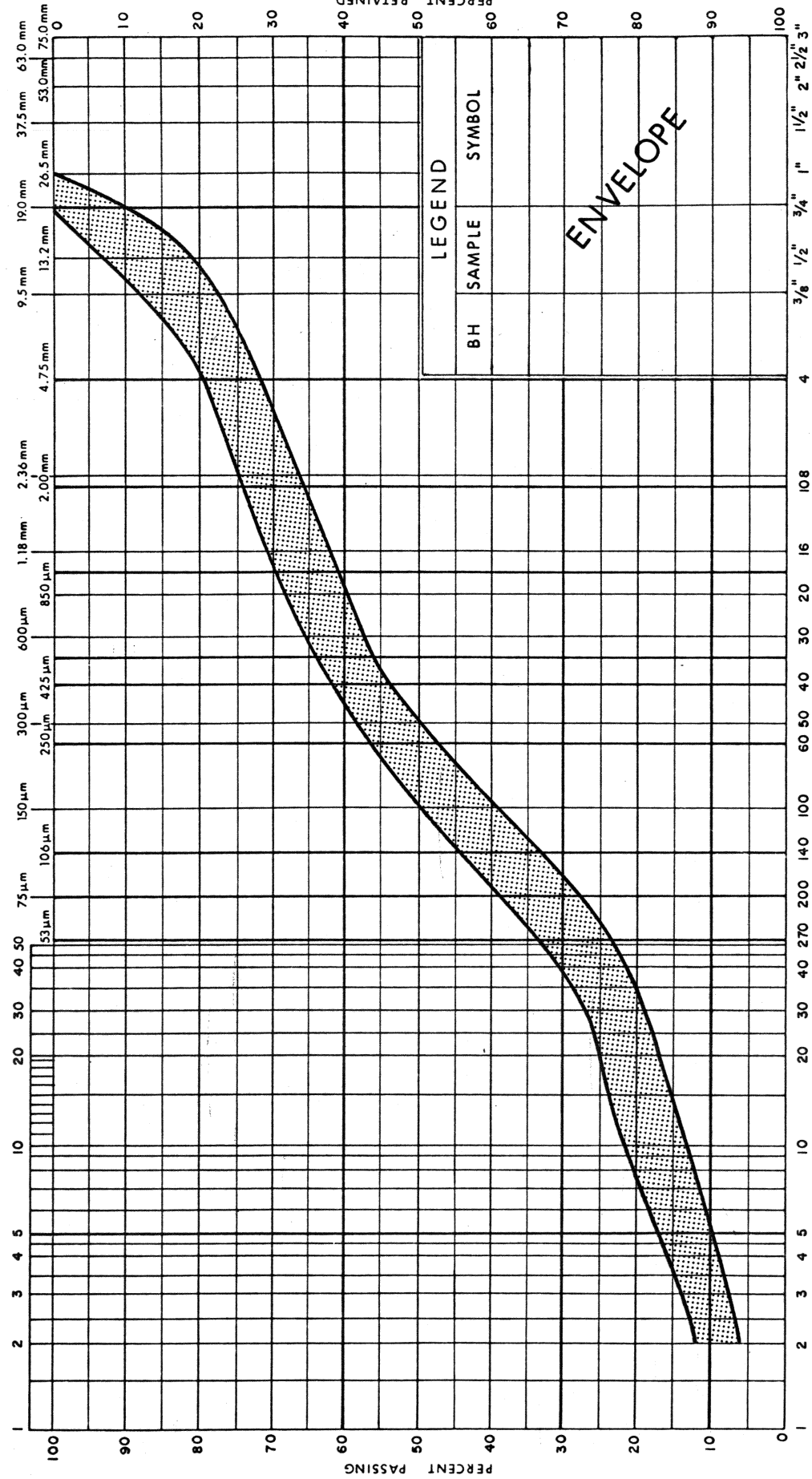
Ontario

UNIFIED SOIL CLASSIFICATION SYSTEM

| CLAY & SILT | | | SAND | | | GRAVEL | | |
|-------------|--|--|------|--------|--------|--------|--------|--|
| | | | Fine | Medium | Coarse | Fine | Coarse | |

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



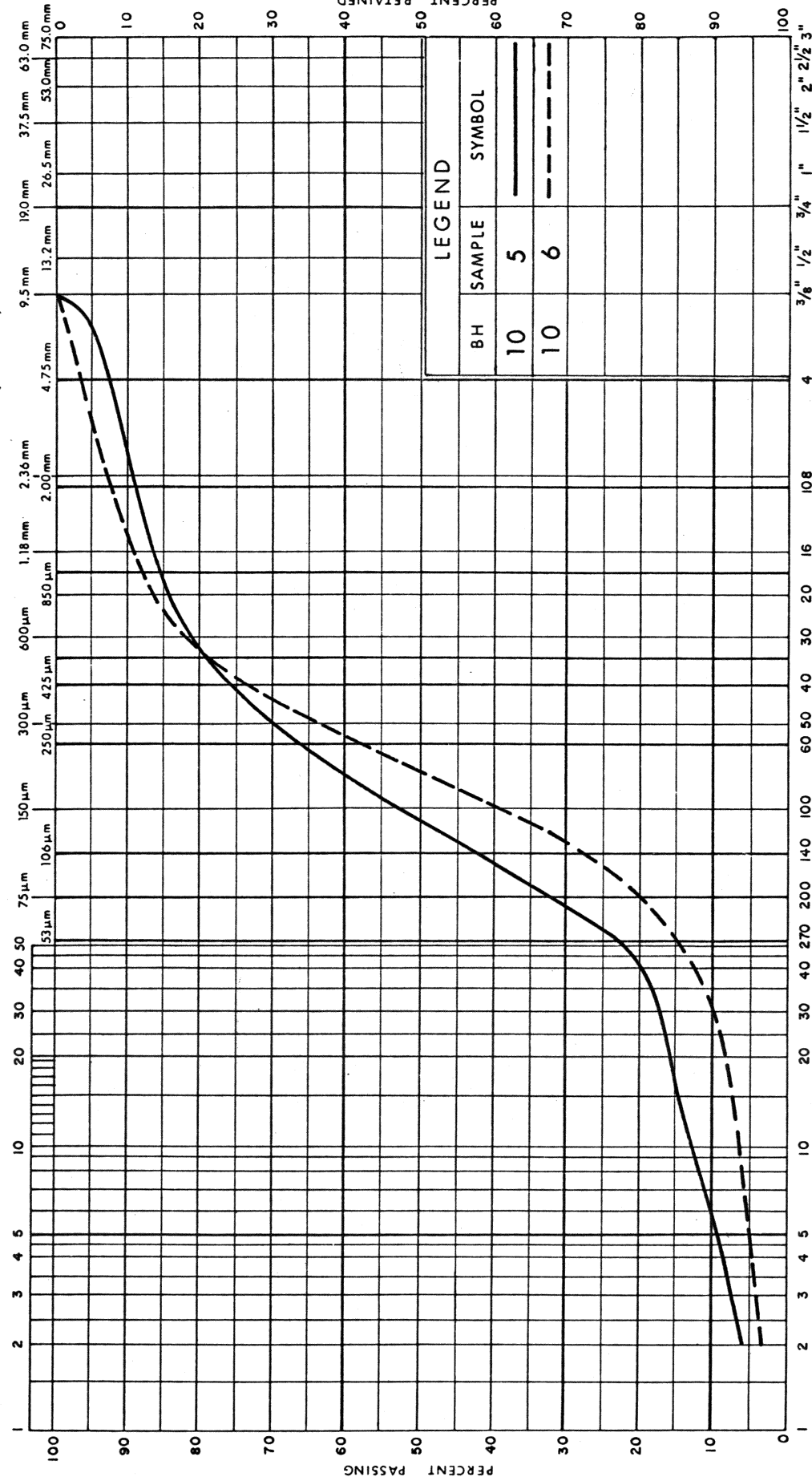
78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM

| | | | | | | |
|-------------|--|------|--------|--------|--------|--------|
| CLAY & SILT | | SAND | | | GRAVEL | |
| | | Fine | Medium | Coarse | Fine | Coarse |

MINISTRY SIEVE DESIGNATION (Metric)

GRAIN SIZE IN MICROMETERS



LEGEND

| BH | SAMPLE | SYMBOL |
|----|--------|--------|
| 10 | 5 | — |
| 10 | 6 | - - - |

MINISTRY SIEVE DESIGNATION (Imperial)

GRAIN SIZE DISTRIBUTION

SAND, SOME SILT

FIG No 8

P.O. M0090

SITE 'B'

Plasticity Chart showing Plasticity Index (%) versus Liquid Limit (%).

The chart is divided into regions for soil classification based on Plasticity Index (PI) and Liquid Limit (LL):

- CH (Clayey Hard)
- CI (Clayey Intermediate)
- CL (Clayey Low)
- MH (Medium High)
- OH (Organic High)
- MI (Medium Intermediate)
- OL (Organic Low)
- ML (Medium Low)
- CL-ML (Clayey Low-Medium Low)

The 'A' LINE is shown, separating the upper regions (CH, CI, MH, OH) from the lower regions (CL, MI, OL, ML, CL-ML).

Legend:

| BH | SAMPLE | SYMBOL |
|----|--------|--------|
| 16 | 4 | ● |
| 16 | 5 | ▲ |

PLASTICITY CHART SILTY CLAY

FIG No. 9

P. O. M0090

SITE 'B'

37

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

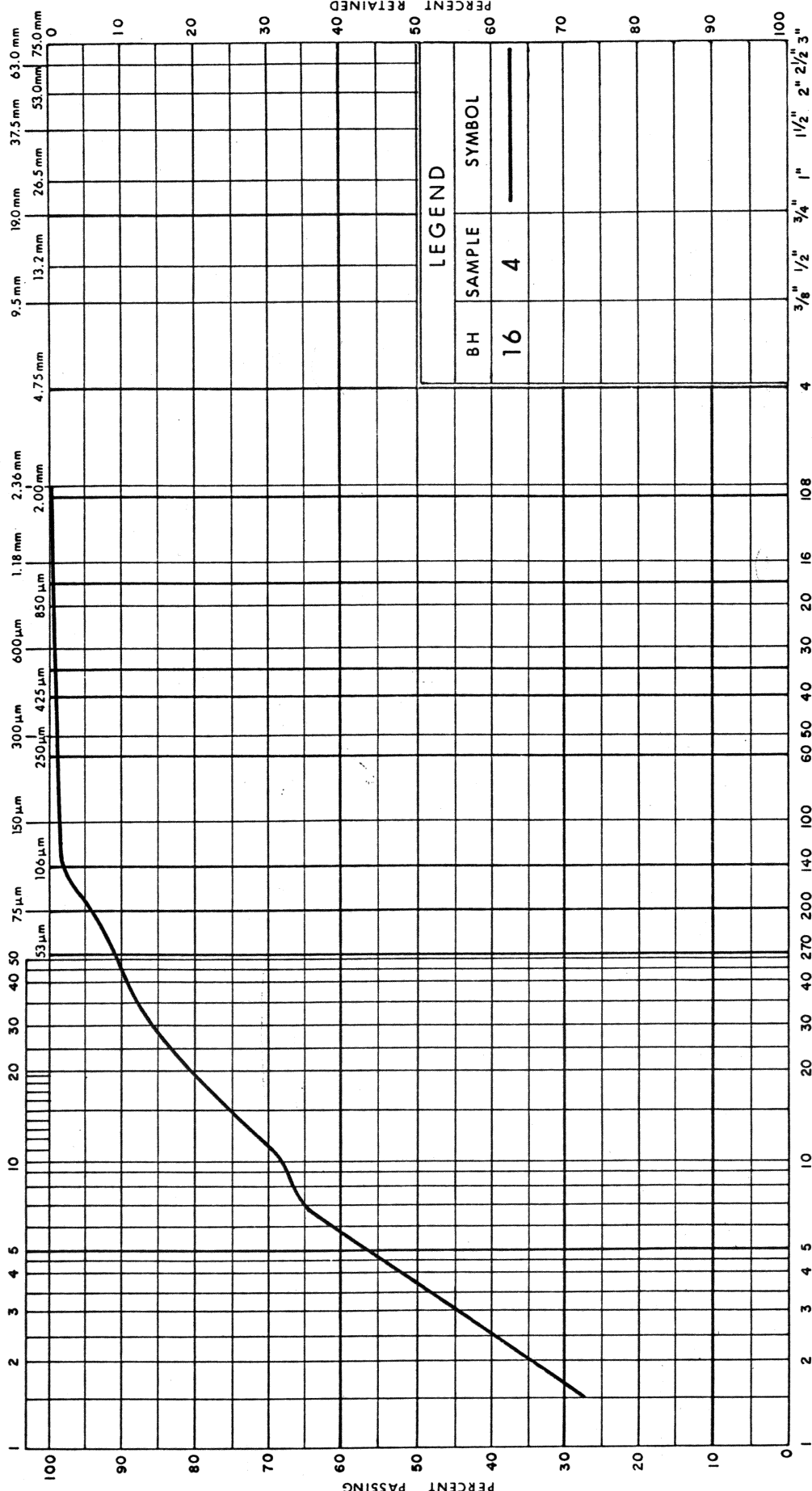
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



LEGEND

| BH | SAMPLE | SYMBOL |
|----|--------|--------|
| 16 | 4 | — |

Ministry of
Transportation and
Communications



GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No 10

P.O. M0090

SITE 'B'

| RECORD OF BOREHOLE No 9 | | | | | | | | | | METRIC | | | | | | |
|-------------------------|--|------------|--|------|------------|----------------------------|------------------|---|----|--------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|----|
| P.O. M0090 | | | LOCATION Co-ords. N 4 858 148.0; E 350 056.0 | | | | ORIGINATED BY IR | | | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger | | | | COMPILED BY IR | | | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 31 | | | | CHECKED BY | | | | | | | | | |
| 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 (%) GR SA SI CL | |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | | | | | | 80 |
| 83.3 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | 83 | | | | | | | | | |
| | Silty Clay | | | | | | | | | | | | | | | |
| | trace sand | | 1 | SS | 21 | | 82 | | | | | | | | | |
| | Very Stiff | | | | | | | | | | | | | | | |
| 82.0 | | | | | | | | | | | | | | | | |
| 1.3 | Silty Clay, with sand, trace gravel (Glacial Till) | | 2 | SS | 13 | | 81 | | | | | | | | | |
| | Stiff to Very Stiff | | | | | | | | | | | | | | | |
| | | | 3 | SS | 25 | | | | | | | | | | | |
| 80.5 | | | | | | | | | | | | | | | | |
| 2.8 | Het. Mixture Silty Clay, and sand, some gravel (Glacial Till) Hard | | 4 | SS | 41 | | 80 | | | | | | | | | |
| 79.9 | | | | | | | | | | | | | | | | |
| 3.4 | Sand, some silt trace gravel | | | | | | | | | | | | | | | |
| | Dense | | 5 | SS | 43 | | | | | | | | | | | |
| 79.0 | | | | | | | | | | | | | | | | |
| 4.3 | End of Borehole | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 190.0; E 350 049.0 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 05 31 CHECKED BY *dp*

| 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 | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 84.2 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | 84 | | | | | | | | | | |
| | Silty Clay trace sand | | 1 | SS | 17 | 83 | | | | | | | | | | |
| | Very Stiff | | 2 | SS | 20 | | | | | | | | | | | |
| 82.2 | | | | | | 82 | | | | | | | | | | |
| 2.0 | Silty Clay, with sand, trace gravel (Glacial Till) | | 3 | SS | 11 | | | | | | | | | | | |
| | Stiff | | | | | 81 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 80.2 | | | | | | | | | | | | | | | | |
| | Het. Mixture Silty Clay and sand, some gravel (Glacial Till) Stiff | | 4 | SS | 13 | 80 | | | | | | | | | | 10 38 37 15 |
| 4.0 | | | | | | | | | | | | | | | | |
| 79.7 | | | | | | | | | | | | | | | | |
| 4.5 | Sand, some silt trace gravel | | 5 | SS | 15 | | | | | | | | | | | 6 61 28 5 |
| | Increasing gravel content with depth | | 6 | SS | 13 | 79 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | Compact | | 7 | SS | 14 | 78 | | | | | | | | | | 4 77 16 3 |
| 77.7 | | | | | | | | | | | | | | | | |
| 6.5 | End of Borehole | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 11

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 223.0; E 350 040.6 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 05 31 CHECKED BY *CP*

| 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 | | | | | |
| 84.8 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | | |
| | Silty Clay trace sand | | 1 | SS | 11 | | 84 | | | | | | | | | | |
| | | | 2 | SS | 12 | | 83 | | | | | | | | | | |
| | Stiff | | 3 | SS | 10 | | 82 | | | | | | | | | | 4 16 45 35 |
| 81.6 | organic | | 4 | TW | PH | | 81 | | | | | | | | | | 8 32 39 21 |
| 3.2 | Silty Clay, with sand trace gravel | | 5 | SS | 11 | | 80 | | | | | | | | | | |
| 81.0 | (Glacial Till) Stiff | | | | | | 79 | | | | | | | | | | |
| 3.8 | Het. Mixture Silty Clay and sand, some gravel | | 6 | SS | 17 | | | | | | | | | | | | 23 42 28 7 |
| 80.4 | (Glacial Till) | | | | | | | | | | | | | | | | |
| 4.4 | Very Stiff | | 7 | SS | 25 | | | | | | | | | | | | |
| | Sand, some silt trace gravel | | 8 | SS | 25 | | | | | | | | | | | | |
| | Compact to Dense | | 9 | SS | 44 | | | | | | | | | | | | |
| 78.3 | End of Borehole | | | | | | | | | | | | | | | | |
| 6.5 | | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 12 | | | | | | | | | | METRIC | | | | | |
|--------------------------|---|------------|--|------|------------|-------------------------|----------------------|--|----|--------|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| P.O. M0090 | | | LOCATION Co-ords. N 4 858 287.5; E 350 012.0 | | | | ORIGINATED BY IR | | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger | | | | COMPILED BY IR | | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 31 | | | | CHECKED BY <i>JP</i> | | | | | | | | |
| 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 (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | | | | | |
| 85.2 | Ground Surface | | | | | | | | | | | | | | |
| 0.0 | Fill Gravelly Sand some silt, trace clay | | | | | | 85 | | | | | | | | |
| 84.6 | | | | | | | | | | | | | | | |
| 0.6 | Fill Silty Clay trace sand | | 1 | SS | 7 | | 84 | | | | | | | | |
| | Firm to Very Stiff | | 2 | SS | 20 | | | | | | | | | | |
| 83.1 | | | | | | | 83 | | | | | | | | |
| 2.1 | Silty Clay with sand, trace gravel (Glacial Till) | | 3 | SS | 30 | | | | | | | | | | |
| | Very Stiff | | 4 | SS | 15 | | 82 | | | | | | | | |
| 81.5 | | | | | | | | | | | | | | | |
| 3.7 | Het. Mixture Silty Clay and sand some gravel (Glacial Till) | | 5 | SS | 22 | | 81 | | | | | | | | |
| 80.9 | Very Stiff | | | | | | | | | | | | | | |
| 4.3 | End of Borehole | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 13 | | | | | | | | | | METRIC | | | | |
|--------------------------|--|------------|--|------|------------|----------------------------|--------------------|---|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| P.O. M0090 | | | LOCATION Co-ords. N 4 858 328.0; E 349 998.8 | | | ORIGINATED BY IR | | | | | | | | |
| DIST 6 HWY GO-ALRT | | | BOREHOLE TYPE Hollow Stem Auger | | | COMPILED BY IR | | | | | | | | |
| DATUM Geodetic | | | DATE 84 05 31 | | | CHECKED BY | | | | | | | | |
| 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 | | | | | |
| 85.4 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill Silty Clay trace sand Stiff to Very Stiff | | 1 | SS | 10 | * | | | | | | | | |
| 83.4 | | | 2 | SS | 16 | | | | | | | | | |
| 2.0 | Heterogeneous Mixture Silty Clay and sand, some gravel (Glacial Till) Stiff to Very Stiff | | 3 | SS | 29 | | | | | | | | | 28 42 18 12 |
| | | | 4 | SS | 29 | | | | | | | | | |
| 81.1 | | | 5 | SS | 13 | | | | | | | | | |
| 4.3 | End of Borehole | | | | | | | | | | | | | |
| | * No water in borehole after 1 hour | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

44

RECORD OF BOREHOLE No 14

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 374.0; E 349 999.7 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 06 01 CHECKED BY *[Signature]*

| 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 85.0 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | | |
| | Gravelly Sand some silt, trace clay | | 1 | SS | 11 | | 84 | | | | | | | | | | 43 43 9 5 |
| 83.8 | Compact | | | | | | | | | | | | | | | | |
| 1.2 | Silty Clay, with sand, trace gravel (Glacial Till) | | 2 | SS | 12 | | 83 | | | | | | | | | | 2 27 40 31 |
| 82.9 | Stiff | | | | | | | | | | | | | | | | |
| 2.1 | Het. Mixture, Silty clay, and sand, some gravel (Glacial Till) | | 3 | SS | 23 | | 82 | | | | | | | | | | 22 40 26 12 |
| | Very Stiff to Hard | | | | | | | | | | | | | | | | |
| | Silty Sand Pocket | | 4 | SS | 24 | | 81 | | | | | | | | | | |
| | Becoming less cohesive with depth | | 5 | SS | 53 | | | | | | | | | | | | |
| 80.7 | End of Borehole | | | | | | | | | | | | | | | | |
| 4.3 | * Note: Water table not stabilized, hole open 4 hours | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 15

METRIC

P.O. M0090 LOCATION Co-ords. N 4 858 376.0; E 349 941.0 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 06 01 CHECKED BY SP.

| 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 (%) GR SA SI CL | | | |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|-------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | | | | |
| 84.3 | Ground Surface | | | | | | | 20 | 40 | 60 | 80 | 100 | 10 | 20 | 30 | | | | | |
| 0.0 | Fill | | | | | | 84 | | | | | | | | | | 8 23 35 34 | | | |
| | Silty Clay trace sand | | 1 | SS | 12 | | | | | | | | | | | | | | | |
| | Stiff | 2 | SS | 11 | | | | | | | | | | | | | | | | |
| 82.2 | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Silty Clay with sand, trace gravel (Glacial Till) | 3 | SS | 14 | | | 82 | | | | | | | | | | | | | |
| | Firm to Stiff | 4 | SS | 7 | | 81 | | | | | | | | | | | | | | |
| 80.6 | | | | | | | | | | | | | | | | | | | | |
| 3.7 | Heterogeneous Mixture Silty Clay, and sand, some gravel (Glacial Till) | 5 | SS | 5 | | 80 | | | | | | | | | | | | | | |
| 79.6 | Firm | | | | | | | | | | | | | | | | | | | |
| 4.7 | End of Borehole | | | | | | | | | | | | | | | | | | | |
| | * Note: Water table not stabilized, hole open 3 hours | | | | | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 16

METRIC

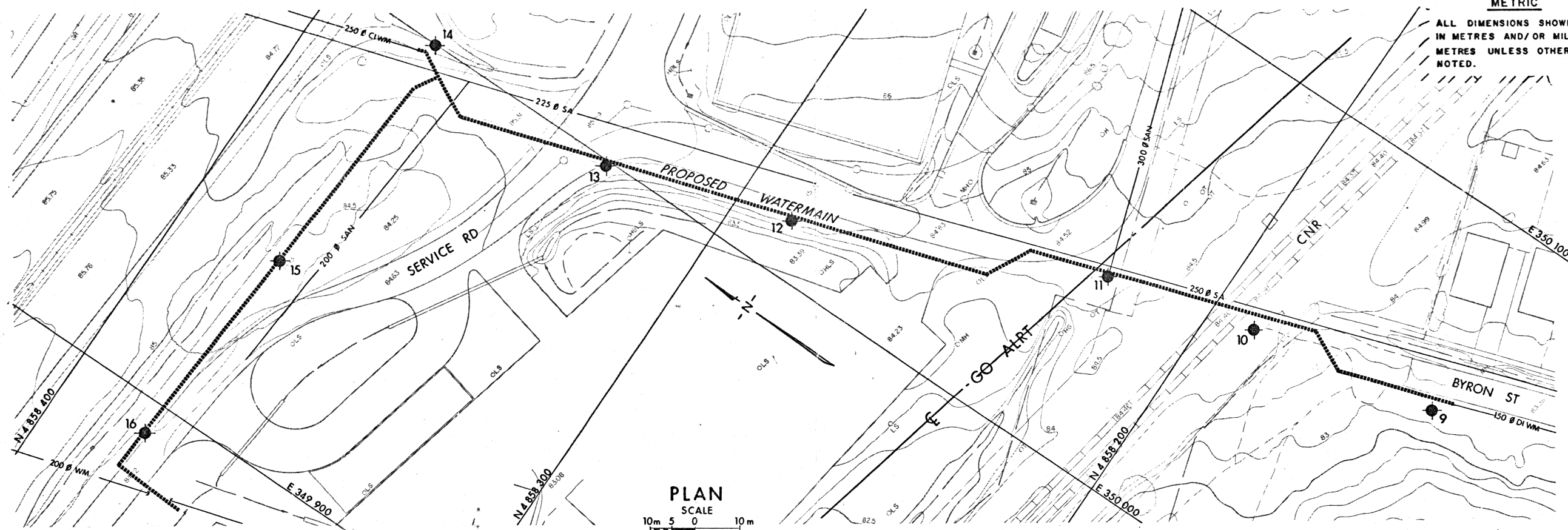
P.O. M0090 LOCATION Co-ords. N 4 858 379.0; E 349 893.2 ORIGINATED BY IR
DIST 6 HWY GO-ALRT BOREHOLE TYPE Hollow Stem Auger COMPILED BY IR
DATUM Geodetic DATE 84 06 01 CHECKED BY *JP*

| 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 | | | | | |
| 84.6 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | 84 | | | | | | | | | | |
| | Gravelly Sand some silt trace clay | | 1 | SS | 15 | | | | | | | | | | | | |
| | Compact | | 2 | SS | 24 | | 83 | | | | | | | | | | |
| 82.1 | | | 3 | SS | 5 | | 82 | | | | | | | | | | 36 34 19 11 |
| 2.5 | Silty Clay trace sand | | 4 | SS | 14 | | | | | | | | | | | | 0 6 61 33 |
| | Firm to Stiff | | 5 | SS | 10 | | 81 | | | | | | | | | | |
| 80.3 | | | | | | | | | | | | | | | | | |
| 4.3 | End of Borehole | | | | | | | | | | | | | | | | |
| | * Note: Water table not stabilized, hole open 2½ hours | | | | | | | | | | | | | | | | |

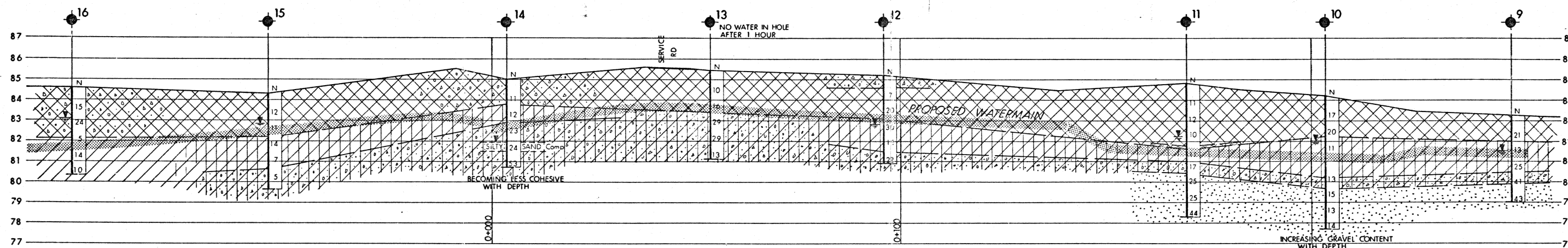
OFFICE REPORT ON SOIL EXPLORATION

METRIC

ALL DIMENSIONS SHOWN ARE
IN METRES AND/OR MILLI-
METRES UNLESS OTHERWISE
NOTED.



PLAN
SCALE
10m 5 0 10m



PROFILE ALONG WATERMAIN

SCALE
HOR 10m 5 0 10m
VERT 2m 1 0 2m

SOIL STRATIGRAPHY LEGEND

| | | | |
|--|--|--|---|
| | FILL GRAVELLY SAND SOME SILT, TRACE OF CLAY Compact | | SILTY CLAY WITH SAND, TRACE OF GRAVEL (Glacial Till) Firm to Very Stiff |
| | FILL SILTY CLAY TRACE OF SAND Firm to Very Stiff | | HET MIXTURE OF SILTY CLAY AND SAND SOME GRAVEL (Glacial Till) Firm to Hard |
| | SILTY CLAY TRACE OF SAND Firm to Stiff | | SAND SOME SILT, TRACE OF GRAVEL Compact to Dense |

—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.


SEE DWG NO - SITE 'A'-1
FOR KEY PLAN

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 84 05 & 06

Geocres No 30M15-75

GO-ALRT REF

| REFERENCE DRAWINGS | | | | REVISIONS | | DRAWN BY: | DESIGNED BY: | ENGINEERING MATERIALS OFFICE | |  Ministry of Transportation and Communications | DURHAM REGION | | |
|--------------------|--------------------------------|--|--|-----------|--|-----------------------|--------------|------------------------------|--|--|---|-----|-------|
| 84 04 06 | U-002 Sheet 59 | | | | | SO | | FOUNDATION DESIGN SECTION | | | BROCK ST (RR 46) REALIGNMENT | | |
| | Totten sims hubicki associates | | | | | 84 07 19 | | | | | SERVICE ROAD TO BYRON ST WATERMAIN RELOCATION | | |
| | | | | | | CHK'D BY: | APPROVED BY: | | | | BOREHOLE LOCATIONS & SOIL STRATA | | |
| | | | | | | SCALE: FULL SIZE ONLY | | | | PROJECT MANAGER | | | |
| | | | | | | AS SHOWN | | | | | | | |
| | | | | | | | | | | CONTRACT NO | DWG NO | REV | SHEET |
| | | | | | | | | | | GGE-332 | SITE 'B'-1 | | |