

REMARKS: _____

FOUNDATION INVESTIGATION REPORT

77-410
CONTRACT NO ~~76~~-

W/P 44-71-14



Ontario

Ministry of
Transportation and
Communications

Geo. No 30M14-146

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NOTE For purposes of this contract this report supercedes all other Foundation Investigation and Design Reports prepared by or for the Ministry in connection with the above mentioned project.

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

N - STANDARD PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

| <u>CONSISTENCY</u> | <u>c LB/SQ FT</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT</u> |
|--------------------|-------------------|------------------|-----------------------|
| VERY SOFT | 0 - 250 | VERY LOOSE | 0 - 4 |
| SOFT | 250 - 500 | LOOSE | 4 - 10 |
| FIRM | 500 - 1000 | COMPACT | 10 - 30 |
| STIFF | 1000 - 2000 | DENSE | 30 - 50 |
| VERY STIFF | 2000 - 4000 | VERY DENSE | > 50 |
| HARD | > 4000 | | |

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC

TYPE OF SAMPLE

| | | | |
|-----|---------------------|-----|-------------------|
| S.S | SPLIT SPOON | T W | THINWALL OPEN |
| WS | WASHED SAMPLE | T P | THINWALL PISTON |
| S T | SLOTTED TUBE SAMPLE | O S | OESTERBERG SAMPLE |
| A S | AUGER SAMPLE | F S | FOIL SAMPLE |
| C S | CHUNK SAMPLE | R C | ROCK CORE |

P H SAMPLE ADVANCED HYDRAULICALLY

P M SAMPLE ADVANCED MANUALLY

SOIL TESTS

| | | | |
|-----|---|-----|-----------------|
| U | UNCONFINED COMPRESSION | L V | LABORATORY VANE |
| UU | UNCONSOLIDATED UNDRAINED TRIAXIAL | F V | FIELD VANE |
| CU | CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| CID | " " DRAINED " | S | SENSITIVITY |
| CAU | " " ANISOTROPIC UNDRAINED " | | |
| CAD | " " DRAINED " | | |

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

| | |
|------------|--|
| γ | UNIT WEIGHT OF SOIL (BULK DENSITY) |
| γ_s | UNIT WEIGHT OF SOLID PARTICLES |
| γ_w | UNIT WEIGHT OF WATER |
| γ_d | UNIT DRY WEIGHT OF SOIL (DRY DENSITY) |
| γ' | UNIT WEIGHT OF SUBMERGED SOIL |
| G | SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$ |
| e | VOID RATIO |
| n | POROSITY |
| w | WATER CONTENT |
| S_r | DEGREE OF SATURATION |
| w_L | LIQUID LIMIT |
| w_p | PLASTIC LIMIT |
| I_p | PLASTICITY INDEX |
| w_s | SHRINKAGE LIMIT |
| I_L | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ |
| I_c | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ |
| e_{max} | VOID RATIO IN LOOSEST STATE |
| e_{min} | VOID RATIO IN DENSEST STATE |
| I_D | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| | RELATIVE DENSITY D_r IS ALSO USED |
| h | HYDRAULIC HEAD OR POTENTIAL |
| q | RATE OF DISCHARGE |
| v | VELOCITY OF FLOW |
| i | HYDRAULIC GRADIENT |
| k | COEFFICIENT OF PERMEABILITY |
| j | SEEPAGE FORCE PER UNIT VOLUME |
| m_v | COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$ |
| c_v | COEFFICIENT OF CONSOLIDATION |
| C_c | COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$ |
| T_v | TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH) |
| U | DEGREE OF CONSOLIDATION |
| τ_f | SHEAR STRENGTH |
| c' | EFFECTIVE COHESION INTERCEPT |
| ϕ' | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| c_u | APPARENT COHESION |
| ϕ_u | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| μ | COEFFICIENT OF FRICTION |
| S_i | SENSITIVITY |

GENERAL

| | |
|-------------------------------------|-----------------------------------|
| π | = 3.1416 |
| e | BASE OF NATURAL LOGARITHMS 2.7183 |
| $\log_e \sigma$ OR $\ln \sigma$ | NATURAL LOGARITHM OF σ |
| $\log_{10} \sigma$ OR $\log \sigma$ | LOGARITHM OF σ TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

STRESS AND STRAIN

| | |
|----------------|--|
| u | PORE PRESSURE |
| σ | NORMAL STRESS |
| $\bar{\sigma}$ | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| τ | SHEAR STRESS |
| ϵ | LINEAR STRAIN |
| γ | SHEAR STRAIN |
| ν | POISSON'S RATIO (μ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| η | COEFFICIENT OF VISCOSITY |

EARTH PRESSURE

| | |
|----------|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| δ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| K_0 | COEFFICIENT OF EARTH PRESSURE AT REST |

FOUNDATIONS

| | |
|-------|--|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| k_s | MODULUS OF SUBGRADE REACTION |

SLOPES

| | |
|---------|--|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| β | ANGLE OF SLOPE TO HORIZONTAL |

FOUNDATION INVESTIGATION REPORT

For

Patrol Yard Near the Brock Road
and Hwy. 401 Interchange
W.P. 44-71-14, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned project site. Fieldwork was carried out during the period of November 1 to November 2, 1976 utilizing a continuous flight auger equipped with 3¼" I.D. hollow stem augers.

DESCRIPTION OF SITE

The site is located in the Town of Pickering, near the crossing of Brock Road and Hwy. 401. The area south of the site is used for commercial purposes, while to the east of the site it is used for agricultural purposes. Brock Road runs in the north/south direction and is located several hundred feet to the west of the proposed site. The C.N.R. tracks and Hwy. 401 run parallel to each other in an east/west direction and are situated just north of the site.

The topography of the terrain is fairly flat. The site is covered with weed growth up to 5 feet high. The drainage is generally poor in the vicinity of Toy Avenue turnaround and the eastern limits of the proposed parking lot.

The area is located within the South Slope physiographic region in which the glacial till overburden is underlain by shale bedrock of the Billings Formation, Ordovician Period.

SUBSURFACE CONDITIONS

Beneath a thin veneer of topsoil (8 to 12 inches) is a deposit of stiff to hard clayey silt to silty clay. The thickness of this cohesive stratum varies from 5.5 to 13 feet. The clayey silt to silty clay stratum is underlain by a glacial till deposit comprised of stiff to hard clayey silt with varying amounts of sand and gravel. The sampling of the boreholes were terminated within the glacial till deposit.

A description of the various soil types encountered in borings are shown on the Record of Borehole Sheets, together with a summary of field and laboratory tests performed. The inferred subsoil stratigraphy, together with the locations and elevations of all borings are shown on Drawing No. 447114-A. A description of the soil types encountered in the boreholes is presented below.

Clayey Silt to Silty Clay, Traces of Sand

Beneath a thin cover of topsoil (8 to 12 inches) is a deposit of brown to brown-grey clayey silt to silty clay with traces of sand and occasional thin seams of silt or sand. Traces of gravel were also observed within this deposit at certain locations. The thickness of this cohesive deposit varies from 5.5 to 13 feet.

The engineering properties of the cohesive subsoil as determined by the field and laboratory testing are plotted on the Record of Borehole Sheets and summarized in the following tables.

| <u>Index Properties</u> | <u>Range</u> | <u>Average</u> |
|----------------------------------|--------------|----------------|
| Natural Moisture Content W (%) | 19-37 | 26 |
| Liquid Limit W_L (%) | 16-46 | 35 |
| Plastic Limit W_p (%) | 11-21 | 17 |
| Liquidity Index | 0.3-0.8 | 0.5 |
| Bulk Unit Weight (pcf) | 114-138 | 125 |

Undrained Shear Strength (C_u) psf

| | |
|------------------------------|---------------|
| In Situ Vane Tests | 1,120 - 2,240 |
| Unconfined Compression Tests | 1,070 - 4,730 |

Standard Penetration 'N' Values - Blows per foot - 7-22

The Atterberg Limit Test results given in the Table are also summarized on the Plasticity Chart, Figure 1. The testing indicates that the cohesive stratum is inorganic of low to intermediate plasticity.

The natural moisture content is generally below the liquid limit as indicated by the liquidity indices which are less than unity.

From the undrained shear strength values and the Standard Penetration 'N' values, it is estimated that the consistency of the stratum varies randomly from stiff to very stiff with occasional hard layers.

Clayey Silt, Varying Amounts of Sand and Gravel (Glacial Till)

The clayey silt to silty clay stratum is underlain by a gray glacial till deposit consisting of clayey silt, with varying amounts of sand and gravel. The total thickness of this glacial till was not proven but extends at least to a depth of 17 feet. The glacial till is generally cohesive in nature, however, in one borehole the lower portion of the glacial till is non-cohesive and this zone is at least 2 feet thick. In addition, at one location (B.H. #4) a non-cohesive layer of sand was observed between elevations 278.5 and 279.5.

The engineering properties of the cohesive glacial till as determined by the field and laboratory testing are summarized in the following tables.

| <u>Index Properties</u> | <u>Range</u> | <u>Average</u> |
|----------------------------------|--------------|----------------|
| Natural Moisture Content W (%) | 7-17 | 9 |
| Liquid Limit W_L (%) | 13-21 | 16 |
| Plastic Limit W_p (%) | 9-12 | 10 |

The Atterberg Limit Test results given in the Table are also summarized on the Plasticity Chart, Figure 2. The testing indicates that the stratum is of low plasticity.

Standard Penetration Tests of the overall glacial till stratum gave 'N' values ranging from 26 blows per foot to 57 blows per foot. From these tests, together with one undrained shear strength measurement (shear strength = 1,790 psf), the consistency of the cohesive portion of this material is estimated to be stiff to hard and the relative density of the granular zones may be described as dense.

Grain-size distribution testing was carried out on samples obtained from this deposit. The results are plotted in an envelope form on Figure 3.

GROUNDWATER CONDITIONS

Groundwater levels were established during the period of the investigation by taking readings in two of the open boreholes. The observations indicate that the groundwater level is located at about elevation 282 which corresponds to some 5.5 feet below the existing ground surface.

M. Devata
M. Devata, P. Eng.
Supervising Engineer

APPENDIX

RECORD OF BOREHOLE NO 1

WP 44-71-14 LOCATION As shown on drawing ORIGINATED BY H.S.
 DIST 6 HWY 401 BORING DATE Nov. 1, 1976 COMPILED BY H.S.
 DATUM Geodetic BOREHOLE TYPE H. S. Augers, Cone Test CHECKED BY A.J.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ PCF | REMARKS |
|---------------|--|-------------|---------|------|------------|----------------------|--|----|----|----|-----|--|-----|-------|-----------------------------------|------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 287.5 | Ground Level | | | | | | SHEAR STRENGTH PSF | | | | | WATER CONTENT % | | | | |
| | | | | | | | O UNCONFINED + FIELD VANE • QUICK TRIAXIAL X LAB VANE | | | | | 10 20 30 | | | | |
| | | | | | | | 400 800 1200 1600 2000 | | | | | | | | | |
| 0.0 | Topsoil | | 1 | ss | 9 | | | | | | | | | | | |
| | Clayey Silt to Silty Clay, trace of sand, occasional seams of silt or sand. Stiff to v. stiff. | | 2 | ss | 22 | 285 | | | | | | | | | | 0 3 49 48 |
| | | | 3 | TW | PH | | | | | | | | | | | |
| 281.7 | | | 4 | AS | - | | | | | | | | | | | |
| 5.8 | Clayey silt, varying amounts of sand, gravel. (Glacial Till) Very stiff to hard. | | 5 | ss | 34 | 280 | | | | | | | | | | 18 48 28 6 |
| | | | 6 | ss | 57 | | | | | | | | | | | 15 38 42 5 |
| | | | 7 | ss | 42 | | | | | | | | | | | |
| | | | 8 | ss | 36 | 275 | | | | | | | | | | |
| | | | 9 | ss | 30 | | | | | | | | | | | |
| | | | 10 | ss | 27 | 270 | | | | | | | | | | 8 34 41 17 |
| 266.0 | silty sand, some gravel--Dense | | 11 | ss | 41 | | | | | | | | | | | 11 58 29 2 |
| 21.5 | End of Borehole | | | | | 265 | | | | | | | | | | |

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 44-71-14LOCATION As shown on drawingORIGINATED BY H.S.DIST 6 HWY 401BORING DATE Nov. 1, 1976COMPILED BY H.S.DATUM GeodeticBOREHOLE TYPE H. S. Augers, Cone TestCHECKED BY Chad

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|---|-------------|---------|------|-----------|----------------------|---|----|----|----|-----|--|-----|-------|-----------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | W_P | W | W_L | | |
| 287.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | 2 | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, trace of sand, occasional seams of silt or sand. Stiff to very stiff | | 1 | TW | PH | 285 | | | | | | | | | 128 | $E_o=0.58$ $C_c=0.124$ |
| | | | 2 | SS | 14 | 280 | | | | | | | | | | |
| | traces of gravel | | 3 | SS | 10 | | | | | | | | | | | 0 5 53 42 |
| 275.5 | | | 4 | SS | 7 | | | | | | | | | | | |
| 12.0 | Clayey silt, varying amounts of sand, gravel (Glacial Till) | | 5 | SS | 27 | 275 | | | | | | | | | | 13 40 38 9 |
| 271.0 | Very stiff to hard | | 6 | SS | 39 | | | | | | | | | | | 9 41 14 9 |
| 16.5 | End of Borehole | | | | | 270 | | | | | | | | | | |

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

| | | | | | |
|-------|-----------|---------------|-------------------------|---------------|------|
| WP | 44-71-14 | LOCATION | As shown on drawing | ORIGINATED BY | H.S. |
| DIST | 6 HWY 401 | BORING DATE | Nov. 2, 1976 | COMPILED BY | H.S. |
| DATUM | Geodetic | BOREHOLE TYPE | H. S. Augers, Cone Test | CHECKED BY | V.J. |

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|--|-------------|---------|------|------------|----------------------|--|------|------|------|-----|--|----|--|--------------------------------|---------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p ——— w ——— w_L | | | | |
| | | | | | | | SHEAR STRENGTH PSF | | | | | WATER CONTENT % | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | |
| | | | | | | 400 | 800 | 1200 | 1600 | 2000 | 10 | 20 | 30 | | | |
| 287.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | 2/2 | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, traces of sand, gravel, occasional seams of silt or sand. | | 1 | SS | 10 | 285 | | | | | | | | | | |
| | Stiff to Hard | | 2 | TW | PH | 280 | | | | | | | | | 129 | |
| | | | 3 | TW | PH | 275 | | | | | | | | | 118 | |
| 274.5 | | | 4 | TW | PH | 270 | | | | | | | | | | |
| 13.0 | Clayey silt, varying amounts of sand, gravel (Glacial Till) Very stiff to hard. | | 5 | SS | 34 | | | | | | | | | | | |
| | | | 6 | SS | 52 | | | | | | | | | | | |
| | | | 7 | SS | 49 | | | | | | | | | | | |
| 266.0 | End of Borehole | | | | | 265 | | | | | | | | | | |
| 21.5 | NOTE: W. L. not established | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

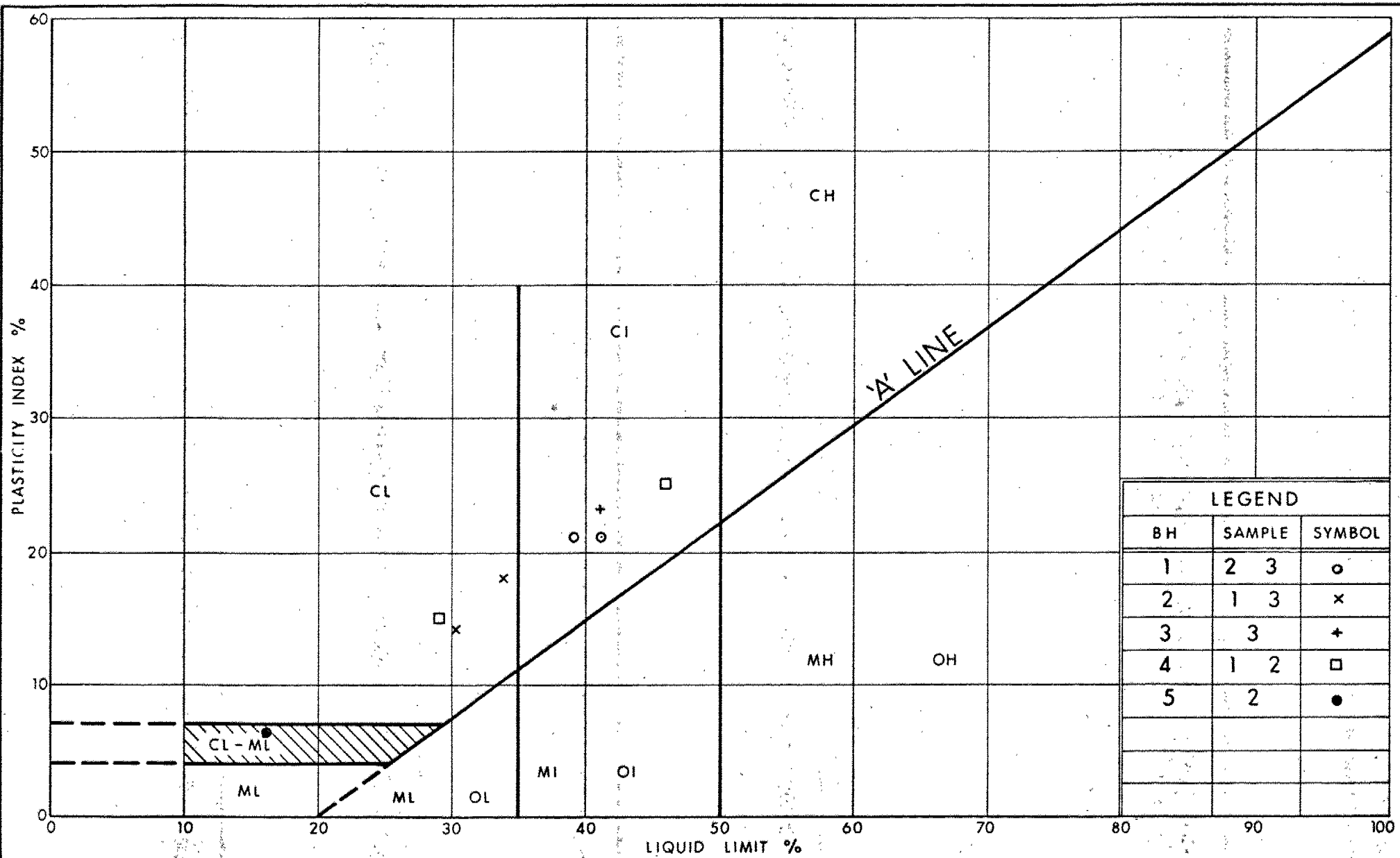
WP 44-71-14 LOCATION As shown on drawing ORIGINATED BY H.S.
 DIST 6 HWY 401 BORING DATE Nov. 2, 1976 COMPILED BY H.S.
 DATUM Geodetic BOREHOLE TYPE H. S. Augers, Cone Test CHECKED BY V.J.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u> | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|--|-------------|---------|------|------------|----------------------|---|----|----|----|-----|---|---|----------------|--------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | W _P | W | W _L | | |
| 287.0 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, traces of sand, gravel, occasional seams of silt or sand. | | 1 | SS | 7 | 285 | | | | | | | | | | 0 2 57 41 |
| 260.6 | Stiff to very stiff. | | 2 | TW | PH | | | | | | | | | | 138 | |
| 6.4 | Clayey sand silt, varying amts. of sand, gravel. (Glacial Till) | | 3 | SS | 26 | 280 | | | | | | | | | | 16 36 40 8 |
| 275.5 | Very stiff to hard. | | 4 | SS | 54 | | | | | | | | | | | 15 33 41 11 |
| 11.5 | End of borehole | | | | | 275 | | | | | | | | | | |
| 272.0 | | | | | | | | | | | | | | | | |
| 15.0 | End of cone test | | | | | | | | | | | | | | | |
| | NOTE: W.L. not established. | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE NO 5

WP 44-71-14LOCATION As shown on drawingORIGINATED BY H.S.DIST 6 HWY 401BORING DATE Nov. 2, 1976COMPILED BY H.S.DATUM GeodeticBOREHOLE TYPE H.S. AugersCHECKED BY So

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT — w | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|---|-------------|---------|------|-----------|----------------------|--|------|------|------|-----|--|----|--|-----------------------------------|---------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | | | | | |
| | | | | | | | SHEAR STRENGTH PSF | | | | | w_p ——— w ——— w_L | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | WATER CONTENT % | | | | |
| | | | | | | 400 | 800 | 1200 | 1600 | 2000 | 10 | 20 | 30 | | | |
| 287.0 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | 1 | SS | 5 | 285 | | | | | | | | | | |
| | Clayey silt to silty clay, trace of sand, occasional seams of silt or sand. | | 2 | TW | PH | | | | | | | | | | | |
| 281.5 | Stiff to very stiff | | | | | | | | | | | | | | | |
| 5.5 | Clayey silt, varying amts. of sand, gravel. (Glacial Till) | | 3 | TW | PH | 280 | | | | | | | | | | |
| 278.0 | Stiff to hard. | | 4 | SS | 28 | | | | | | | | | | | |
| 9.0 | End of Borehole | | | | | 275 | | | | | | | | | | |
| | NOTE: W.L. not Established. | | | | | | | | | | | | | | | |



Ontario

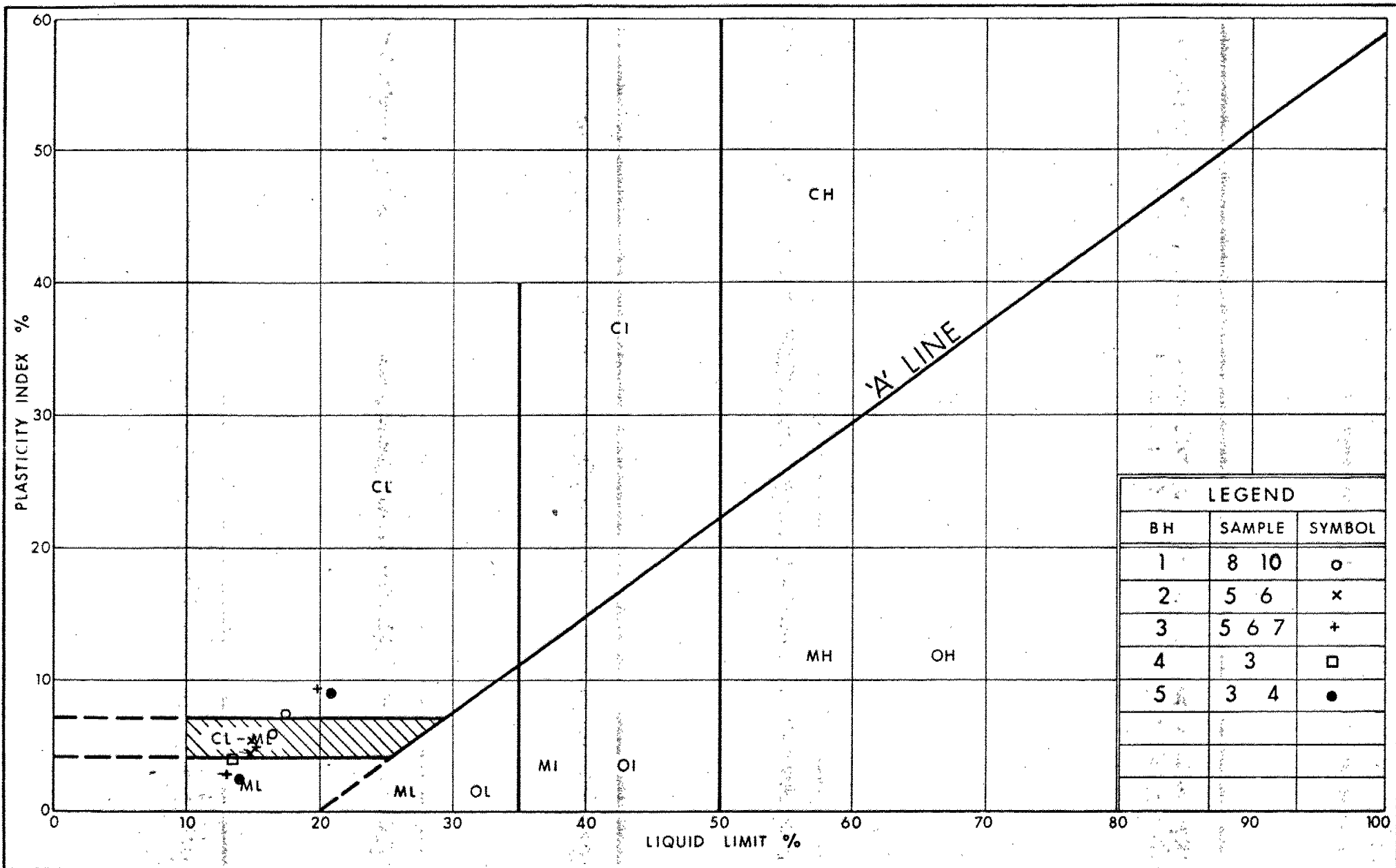
ENGINEERING SERVICES BRANCH

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Communications

PLASTICITY CHART CLAYEY SILT TO SILTY CLAY TRACE OF SAND

FIG No 1

W P 44-71-14



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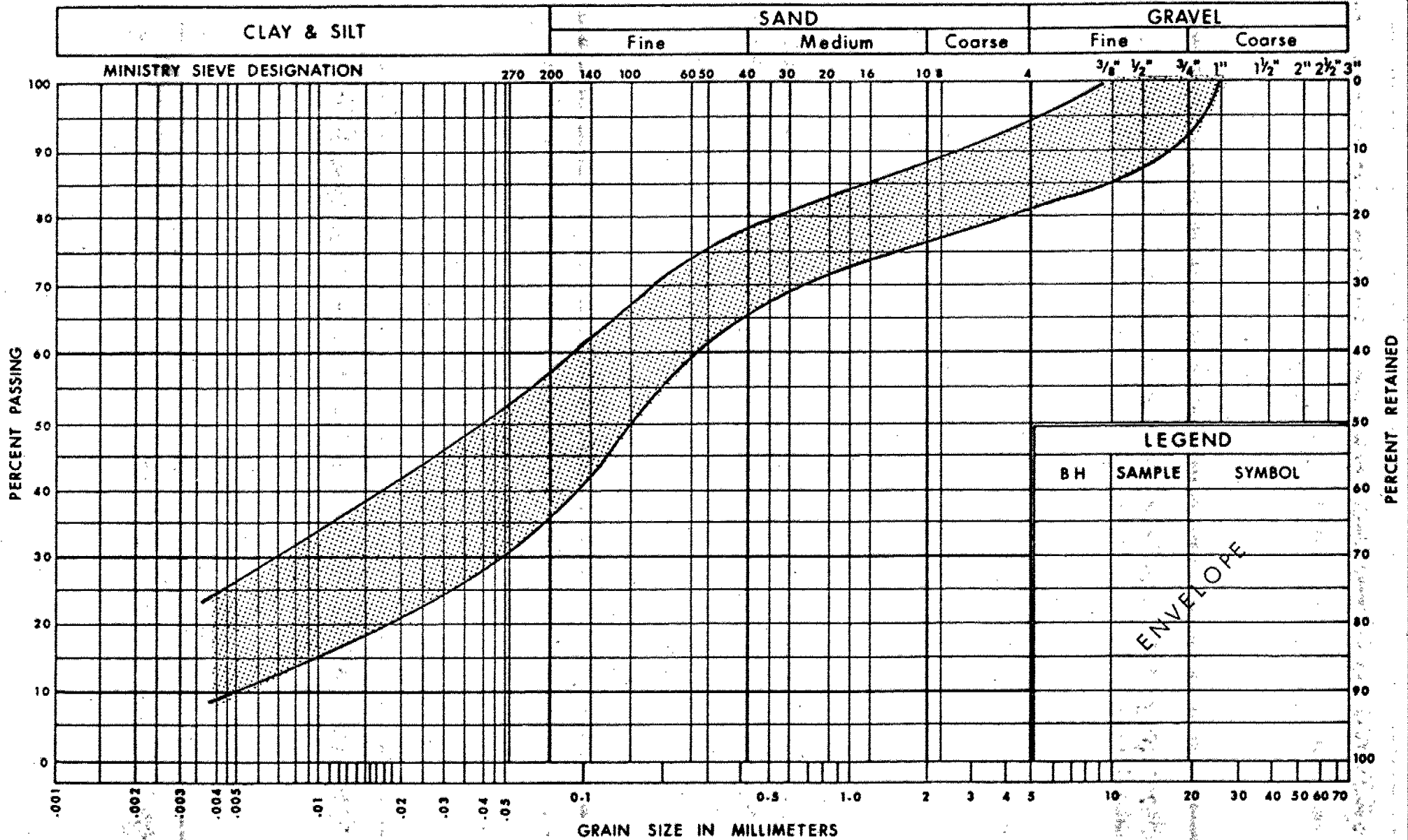
ENGINEERING SERVICES BRANCH

PLASTICITY CHART CLAYEY SILT VARYING AMOUNTS OF SAND, GRAVEL (GLACIAL TILL)

FIG No 2

W P 44-71-14

UNIFIED SOIL CLASSIFICATION SYSTEM



**Ministry of
Transportation and
Communications**

ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

CLAYEY SILT VARYING AMOUNTS OF
SAND, GRAVEL (GLACIAL TILL)

FIG No. 3

W P 44-71-14

DOCUMENT MICROFILMING IDENTIFICATION

G.I-30 SEPT 1976

GEOCRES No. 30M14-146

DIST. 6 REGION Central

W.P. No. 44-71-14

CONT. No. 77-140

W. O. No. _____

STR. SITE No. _____

HWY. No. 401

LOCATION New Patrol Yard at the
Brock Road Interchange

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: ① documents to be unfolded
before microfilming
② to be added to existing microfilm

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 44-71-14

DIST. 6

HWY. 401

STR..SITE

New Patrol Yard at the
Brock Road Interchange

DISTRIBUTION

G.C.E. Burkhardt (3)

R.S. Pillar

C.S. Grebski

B.J. Giroux

G.A. Wrong

M.R. Ernesaks

R.D. Gunter

H. Greenland

R. Hore

J. Anderson)

R. Fitzgibbon) cover only

G. Sloan)

Files J

SAMPLE DISPOSITION NOTICE

| TYPE | DISCARD AFTER | RECOMM. BY |
|---------------|---------------|------------|
| JARS | Dec 21/76 | M.A. |
| TUBES | " | " |
| ROCK CORES | " | " |

30M14-146

GEOCREs

* GEOCREs No.

DATE

DEC 21 1976

INTRODUCTION

It is proposed to construct a patrol yard at the afore-mentioned location, consisting of a 14-bay masonry garage and three salt domes. This report contains the results of the subsurface investigation and recommendations pertaining to the design of foundations for the proposed structure.

SITE AND GEOLOGY

The site is located in the Town of Pickering, near the crossing of Brock Road and Hwy. 401. The area south of the site is used for commercial purposes, while to the east of the site, it is used for agricultural purposes. Brock Road runs in the north/south direction and is located several hundred feet to the west of the proposed site. The C.N.R. tracks and Hwy. 401 run parallel to each other in an east/west direction, and are situated just north of the site.

The topography of the terrain is fairly flat. The site is covered with weed growth up to 5 feet high. The drainage is generally poor in the vicinity of Toy Avenue turnaround and the eastern limits of the proposed parking lot.

The area is located within the South Slope physiographic region in which the glacial till overburden is underlain by shale bedrock of the Billings formation, Ordovician Period.

FIELD AND LABORATORY INVESTIGATION

The field investigation consisted of five boreholes, four of which were accompanied by dynamic cone penetration tests. Disturbed samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test. Undisturbed samples were obtained by using 2-inch I.D. Shelby tubes pushed manually into the soil. In addition, field vane tests were performed where possible. Bedrock was not proven in this investigation. The soil and

groundwater conditions encountered in the borings are presented on the Record of Borehole Sheets and on Drawing No. 447114-A.

All samples were subjected to a careful visual examination in the field and subsequently, in the laboratory. Following the examination, laboratory tests were carried out on representative samples to determine the following engineering properties of the overburden:

- Natural Moisture Contents
- Atterberg Limits
- Bulk Unit Weights
- Unconfined Compression Tests
- Grain Size Distributions
- Consolidation Characteristics

The results of the laboratory testing were plotted on the individual Record of Borehole Sheets which are appended to this report.

SUBSURFACE CONDITIONS

Beneath a thin veneer of topsoil (8 to 12 inches) is a deposit of stiff to hard clayey silt to silty clay. The thickness of this cohesive stratum varies from 5.5 to 13 feet. The clayey silt to silty clay stratum is underlain by a glacial till deposit comprised of stiff to hard clayey silt with varying amounts of sand, silt, and gravel. The sampling of the boreholes were terminated within the glacial till deposit, and proven to a maximum depth of 17 feet.

Boundaries between different deposits are shown on the Record of Borehole Sheets which are appended to this report. The locations and elevations of the borings are shown on Drawing No. 447114-A, together with the subsoil encountered in each of the boreholes. A description of the soil types encountered in the boreholes is presented below.

Clayey Silt to Silty Clay, Traces of Sand

Beneath a thin cover of topsoil (8 to 12 inches) is a deposit of brown to brown-grey clayey silt to silty clay with traces of sand and occasional thin seams of silt or sand. Traces of gravel were also observed within this deposit at certain locations. The thickness of this cohesive deposit varies from 5.5 to 13 feet.

The engineering properties of the cohesive subsoil as determined by the field and laboratory testing are plotted on the Record of Borehole Sheets and summarized in the following tables.

| <u>Index Properties</u> | <u>Range</u> | <u>Average</u> |
|----------------------------------|--------------|----------------|
| Natural Moisture Content W (%) | 19-37 | 26 |
| Liquid Limit W_L (%) | 16-46 | 35 |
| Plastic Limit W_p (%) | 11-21 | 17 |
| Liquidity Index | 0.3-0.8 | 0.5 |
| Bulk Unit Weight (pcf) | 114-138 | 125 |

Undrained Shear Strength (C_u) psf

| | |
|------------------------------|----------------|
| In Situ Vane Tests | 1,120 - >2,240 |
| Unconfined Compression Tests | 1,070 - 4,730 |

Standard Penetration 'N' Values - Blows per foot - 7-22

Compressibility Characteristics

| | <u>Range</u> |
|--|--------------|
| Initial Void Ratio (e_0) | 0.58-0.72 |
| Compression Index (C_c) | 0.092-0.125 |
| Degree of Preconsolidation ($P_c - P_0$) psf | 7,300-13,680 |

The Atterberg Limit Test results given in the Table are also summarized on the Plasticity Chart, Figure 1. The testing indicates that the cohesive stratum is inorganic of low to intermediate plasticity.

The natural moisture content is generally below the liquid limit as indicated by the liquidity indices which are lesser than unity.

From the undrained shear strength values and the Standard Penetration 'N' values, it is estimated that the consistency of the stratum varies randomly from stiff to very stiff with occasional hard layers.

The consolidation characteristics of this stratum were determined by carrying out three laboratory oedometer tests, the results of which are shown as a Void Ratio v.s. Pressure Plots on Figure 5. The results indicate that the cohesive stratum is preconsolidated by about 3.6 to 6.8 tsf in excess of the existing overburden pressure.

Clayey Silt, Varying Amounts of Sand, Silt, and Gravel (Glacial Till)

The clayey silt to silty clay stratum is underlain by a grey glacial till deposit consisting of clayey silt, with varying amounts of sand, silt and gravel. The total thickness of this glacial till was not proven but extends at least to a depth of 17 feet. The glacial till is generally cohesive in nature, however, in one borehole, the lower portion of the glacial till is non-cohesive and this zone is at least 2 feet thick. In addition, at one location, a non-cohesive layer (sand) was observed between elevations 278.5 and 279.5 (B.H. 4).

The engineering properties of the cohesive glacial till as determined by the field and laboratory testing are summarized in the following tables.

| <u>Index Properties</u> | <u>Range</u> | <u>Average</u> |
|----------------------------------|--------------|----------------|
| Natural Moisture Content W (%) | 7 -17 | 9 |
| Liquid Limit W_L (%) | 13-21 | 16 |
| Plastic Limit W_p (%) | 9 -12 | 10 |

The Atterberg Limit Test results given in the Table are also summarized on the Plasticity Chart, Figure 2. The testing indicates that the stratum is of low plasticity.

Standard Penetration Tests of the overall glacial till stratum gave 'N' values ranging from 26 blows per foot to 57 blows per foot. From these tests, together with one undrained shear strength measurement (shear strengths=1,790 psf), the consistency of the cohesive portion of this material is estimated to be stiff to hard and the relative density of the granular zones may be described as dense.

Grain-size distribution testing was carried out on samples obtained from this deposit. The results are plotted in an envelope form on Figure 4.

GROUNDWATER CONDITIONS

Groundwater levels were established during the period of the investigation by taking readings in two of the open boreholes. The results of the readings are shown on the borelog sheets, as well as on Drawing No. 447114-A.

The observations indicate that the groundwater level is located at about elevation 282.0 which corresponds to some 5.5 feet below existing ground surface.

DISCUSSION AND RECOMMENDATIONS

General

The construction of a patrol yard consisting of 14-bay masonry garage and 3 salt domes has been proposed near the intersection of Hwy. 401 and Brock Road in Pickering.

The subsoil generally consists of 5.5 to 13 feet thick layer of stiff to hard clayey silt to silty clay, underlain by a relatively cohesive glacial till deposit comprised of stiff to hard clayey silt with varying amounts of sand, silt and gravel. The maximum thickness of the glacial till deposit was found to be least 17 feet.

Recommendations pertaining to the design of the foundations for the proposed structure are presented in the following.

Structure Foundations

The existing ground surface elevation is about 287-288. The finished floor of the garage will be at elevation 294. This indicates that the general area has to be raised by some 6 to 7 feet.

It has been ascertained from the Structural Office that a load of one tsf would be quite adequate for design purposes. Therefore, we recommend that the proposed garage be founded on spread footings located either in the natural subsoil or within the fill material provided a minimum distance of 4 feet to the underside of the foundations is maintained for frost protection purposes. If the footings are located within the fill, the material beneath the foundation should consist of well-compacted Granular 'A' and should extend a minimum horizontal distance of one foot on either side of the footing.

The subsoil is highly overconsolidated and the settlement will be negligible and of a recompression nature. It is understood that several construction joints have been proposed for other reasons, and consequently, no problems are anticipated for any possible minor differential

settlements.

No major dewatering problems are anticipated for the construction of the footings. Any minor inflow or seepage due to surficial runoff could be controlled by conventional pumping methods.

The topsoil should be stripped from beneath the structure location (garage and sand piles), all roadway and parking aprons, and backfilled with suitable material as per recommendations by the Regional Geotechnical Section.

Sand Piles

No stability problems are anticipated at the proposed sand pile locations. Adequate measures should be taken to prevent any possible water contamination by surface runoff from the sand pile locations.

MISCELLANEOUS

The fieldwork was carried out during the period of November 1 to November 2, 1976 under the supervision of Mr. H. Shah, Project Engineer.

The equipment used for subsoil sampling was owned and operated by Site Investigation Services. This report was written by Mr. H. Shah and was reviewed by Mr. M. Devata, Supervising Engineer.

H. Shah

H. Shah, P. Eng.
Project Engineer



M. Devata

M. Devata, P. Eng.
Supervising Engineer

MD/HS/jf

December, 1976.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 44-71-14

LOCATION As shown on drawing

ORIGINATED BY H.S.

DIST 6 HWY 401

BORING DATE Nov. 1, 1976

COMPILED BY H.S.

DATUM Geodetic

BOREHOLE TYPE H. S. Augers, Cone Test

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | UNIT WEIGHT γ PCF | REMARKS |
|---------------|--|-------------|---------|------|-----------|----------------------|---|----|----|----|--|-------|-----|-----------------------------------|------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | |
| 287.5 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | 1 | ss | 9 | | | | | | | | | | 0 3 49 48 |
| | Clayey Silt to Silty Clay, trace of sand, occasional seams of silt or sand. Stiff to v. stiff. | | 2 | ss | 22 | 285 | | | | | | | | | 114 |
| 281.7 | | | 3 | TW | PH | | | | | | | | | | |
| 5.8 | | | 4 | AS | - | | | | | | | | | | |
| | Clayey silt, varying amounts of sand, silt, gravel. (Glacial Till) Very stiff to hard. | | 5 | ss | 34 | 280 | | | | | | | | | 18 48 28 6 |
| | | | 6 | ss | 57 | | | | | | | | | | 15 38 42 5 |
| | | | 7 | ss | 42 | | | | | | | | | | |
| | | | 8 | ss | 36 | 275 | | | | | | | | | |
| | | | 9 | ss | 30 | | | | | | | | | | |
| | | | 10 | ss | 27 | 270 | | | | | | | | | 8 34 41 17 |
| 266.0 | silty sand, some gravel--Dense | | 11 | ss | 41 | | | | | | | | | | 11 58 29 2 |
| 21.5 | End of Borehole | | | | | 265 | | | | | | | | | |

20
15 ϕ 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 44-71-14 LOCATION As shown on drawing ORIGINATED BY H.S.
 DIST 6 HWY 401 BORING DATE Nov. 1, 1976 COMPILED BY H.S.
 DATUM Geodetic BOREHOLE TYPE H. S. Augers, Cone Test CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ PCF | REMARKS |
|---------------|---|-------------|---------|------|------------|----------------------|---|----|----|----|-----|--|-----|-------|--------------------------------|---------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 287.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, trace of sand, occasional seams of silt or sand. Stiff to very stiff | | 1 | TW | PH | 285 | | | | | | | | | 128 | $E_o=0.58$ $C_c=0.124$ |
| | | | 2 | SS | 14 | | | | | | | | | | | |
| | | | 3 | SS | 10 | | | | | | | | | | | |
| | traces of gravel | | 4 | SS | 7 | | | | | | | | | | | |
| 275.5 | | | | | | | | | | | | | | | | |
| 12.0 | Clayey silt, varying amounts of sand, silt, gravel (Glacial Till) | | 5 | SS | 27 | 275 | | | | | | | | | | |
| 271.0 | Very stiff to hard | | 6 | SS | 39 | | | | | | | | | | | |
| 16.5 | End of Borehole | | | | | 270 | | | | | | | | | | |

20
15 ϕ 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 44-71-14 LOCATION As shown on drawing ORIGINATED BY H.S.
 DIST 6 HWY 401 BORING DATE Nov. 2, 1976 COMPILED BY H.S.
 DATUM Geodetic BOREHOLE TYPE H. S. Augers, Cone Test CHECKED BY V.J.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|-----------------------------|---|-------------|---------|------|------------|----------------------|---|----|----|----|-----|--|-----|-------|-----------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 287.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, traces of sand, gravel, occasional seams of silt or sand. | | 1 | SS | 10 | 285 | | | | | | | | | | |
| | Stiff to Hard | | 2 | TW | PH | 280 | | | | | | | | | | |
| | | | 3 | TW | PH | 275 | | | | | | | | | | |
| 274.5 | | | 4 | TW | PH | 270 | | | | | | | | | | |
| -13.0 | Clayey silt, varying amounts of sand, silt, gravel (Glacial Till) Very stiff to hard. | | 5 | SS | 34 | | | | | | | | | | | |
| | | | 6 | SS | 52 | | | | | | | | | | | |
| 266.0 | | | 7 | SS | 49 | | | | | | | | | | | |
| 21.5 | End of Borehole | | | | | 265 | | | | | | | | | | |
| NOTE: W. L. not established | | | | | | | | | | | | | | | | |

20
15 0-5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

 WP 44-71-14
 DIST 6 HWY 401
 DATUM Geodetic

 LOCATION As shown on drawing
 BORING DATE Nov. 2, 1976
 BOREHOLE TYPE H. S. Augers, Cone Test

 ORIGINATED BY H.S.
 COMPILED BY H.S.
 CHECKED BY U.J.

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|--|-------------|---------|------|-----------|----------------------|---|----|----|----|-----|--|-----|-------|-----------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 287.0 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | | | | | | | |
| | Clayey silt to silty clay, traces of sand, gravel, occasional seams of silt or sand. | | 1 | SS | 7 | 285 | | | | | | | | | | 0 2 57 41 |
| 260.6 | Stiff to very stiff. | | 2 | TW | PH | | | | | | | | | | 138 | |
| 6.4 | Clayey sand silt, varying amts. of sand, silt, gravel. (Glacial Till) | | 3 | SS | 26 | 280 | | | | | | | | | | 16 36 40 8 |
| 275.5 | Very stiff to hard. | | 4 | SS | 54 | | | | | | | | | | | 15 33 41 11 |
| 11.5 | End of borehole | | | | | 275 | | | | | | | | | | |
| 272.0 | | | | | | | | | | | | | | | | |
| 15.0 | End of cone test | | | | | | | | | | | | | | | |
| | NOTE: W.L. not established. | | | | | | | | | | | | | | | |

 20
 15 0-5 % STRAIN AT FAILURE
 10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 44-71-14

LOCATION As shown on drawing

ORIGINATED BY H.S.

DIST 6 HWY 401

BORING DATE Nov. 2, 1976

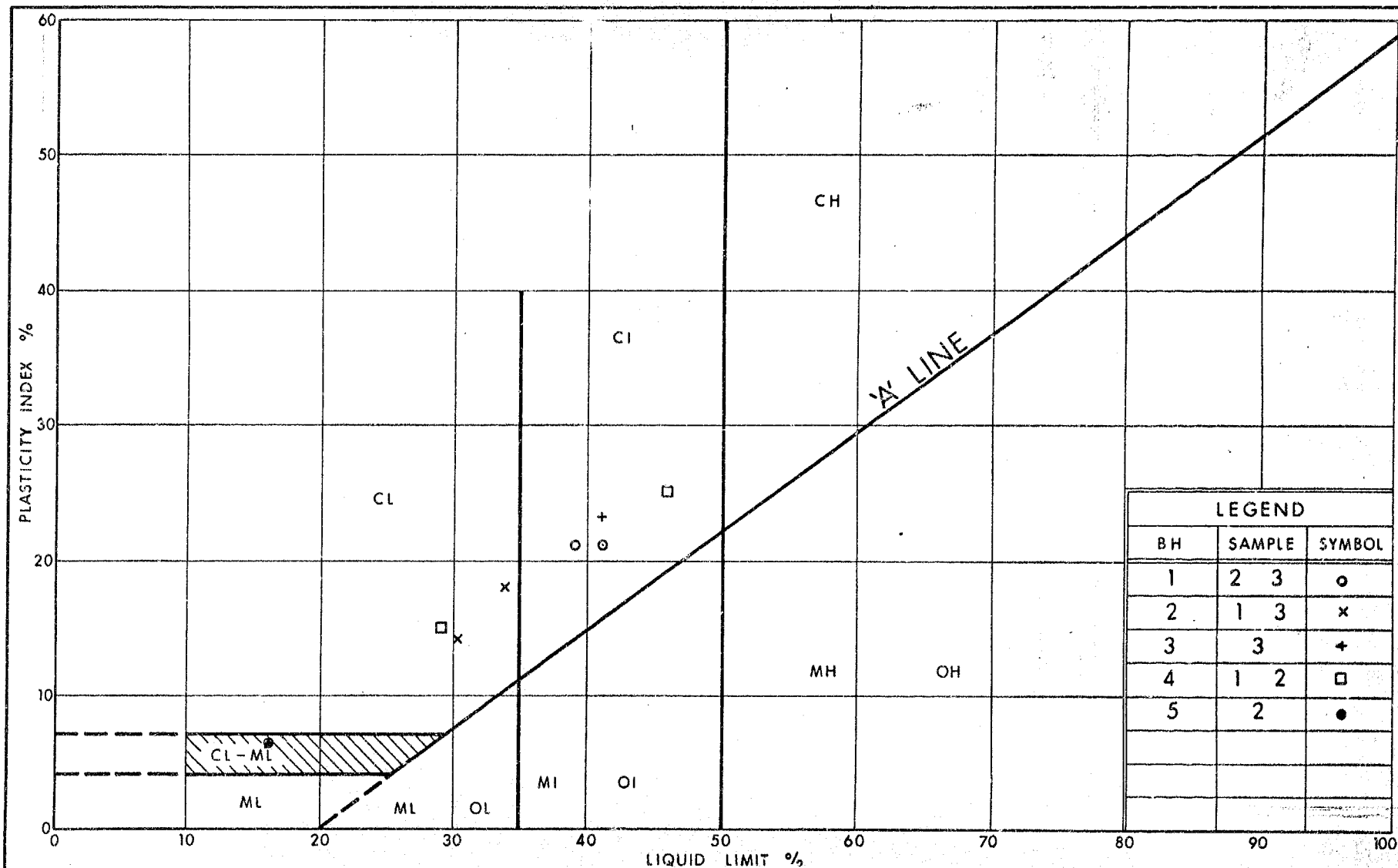
COMPILED BY H.S.

DATUM Geodetic

BOREHOLE TYPE H.S. Augers

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | UNIT WEIGHT γ PCF | REMARKS % GR SA SI CL |
|---------------|---|-------------|---------|------|-----------|----------------------|---|----|----|----|-----|--|-----|-------|--------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 287.0 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Topsoil | | 1 | SS | 5 | 285 | | | | | | | | | | |
| | Clayey silt to silty clay, trace of sand, occasional seams of silt or sand. | | 2 | TW | PH | | | | | | | | | | | |
| 281.5 | Stiff to very stiff | | | | | | | | | | | | | | | |
| 5.5 | Clayey silt, varying amts. of sand, silt gravel. (Glacial Till) | | 3 | TW | PH | 280 | | | | | | | | | | |
| 278.0 | Stiff to hard. | | 4 | SS | 28 | | | | | | | | | | | |
| 9.0 | End of Borehole | | | | | | | | | | | | | | | |
| | NOTE: W.L. not Established. | | | | | 275 | | | | | | | | | | |

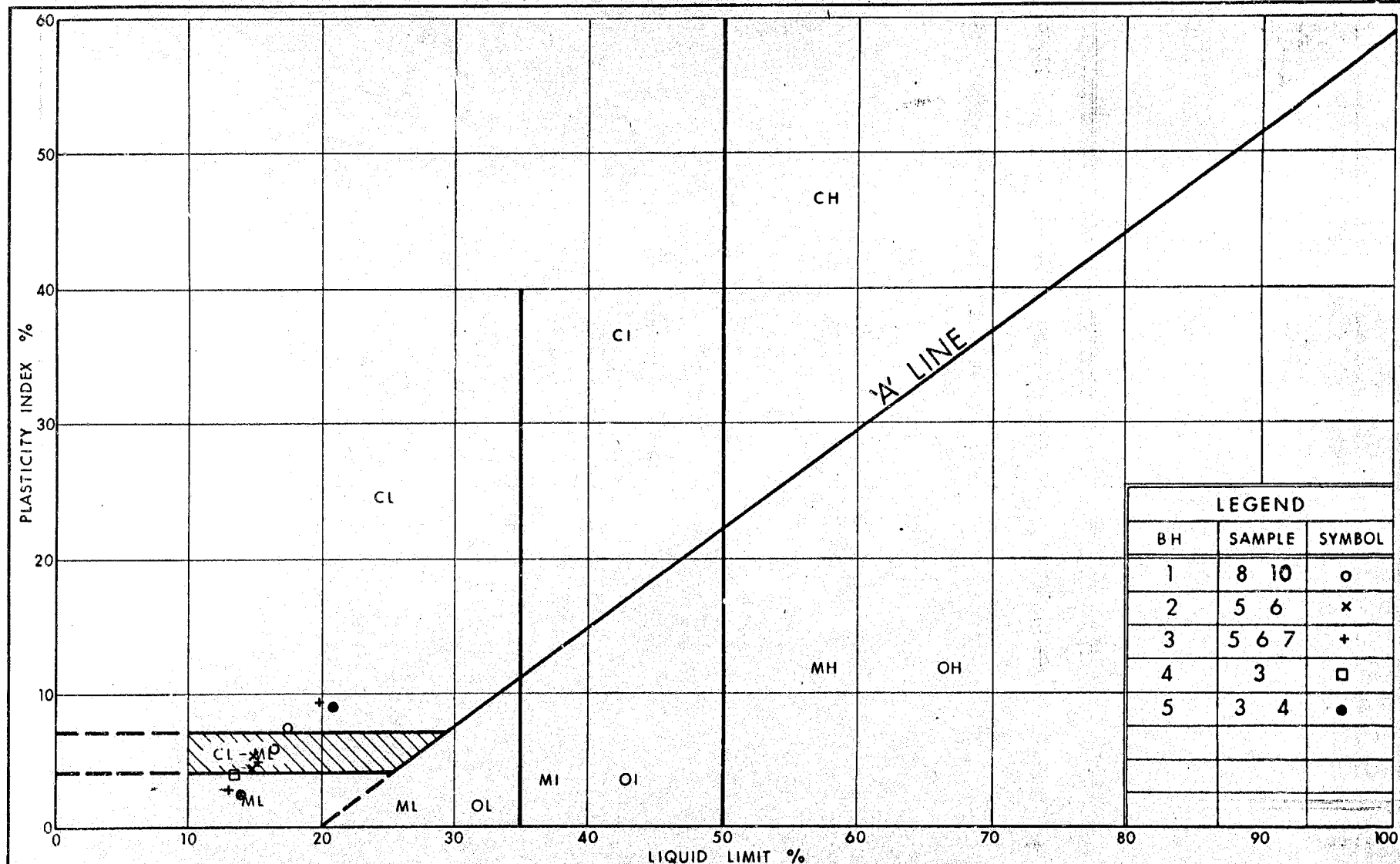


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PLASTICITY CHART CLAYEY SILT TO SILTY CLAY TRACE OF SAND

FIG No 1

W P 44-71-14



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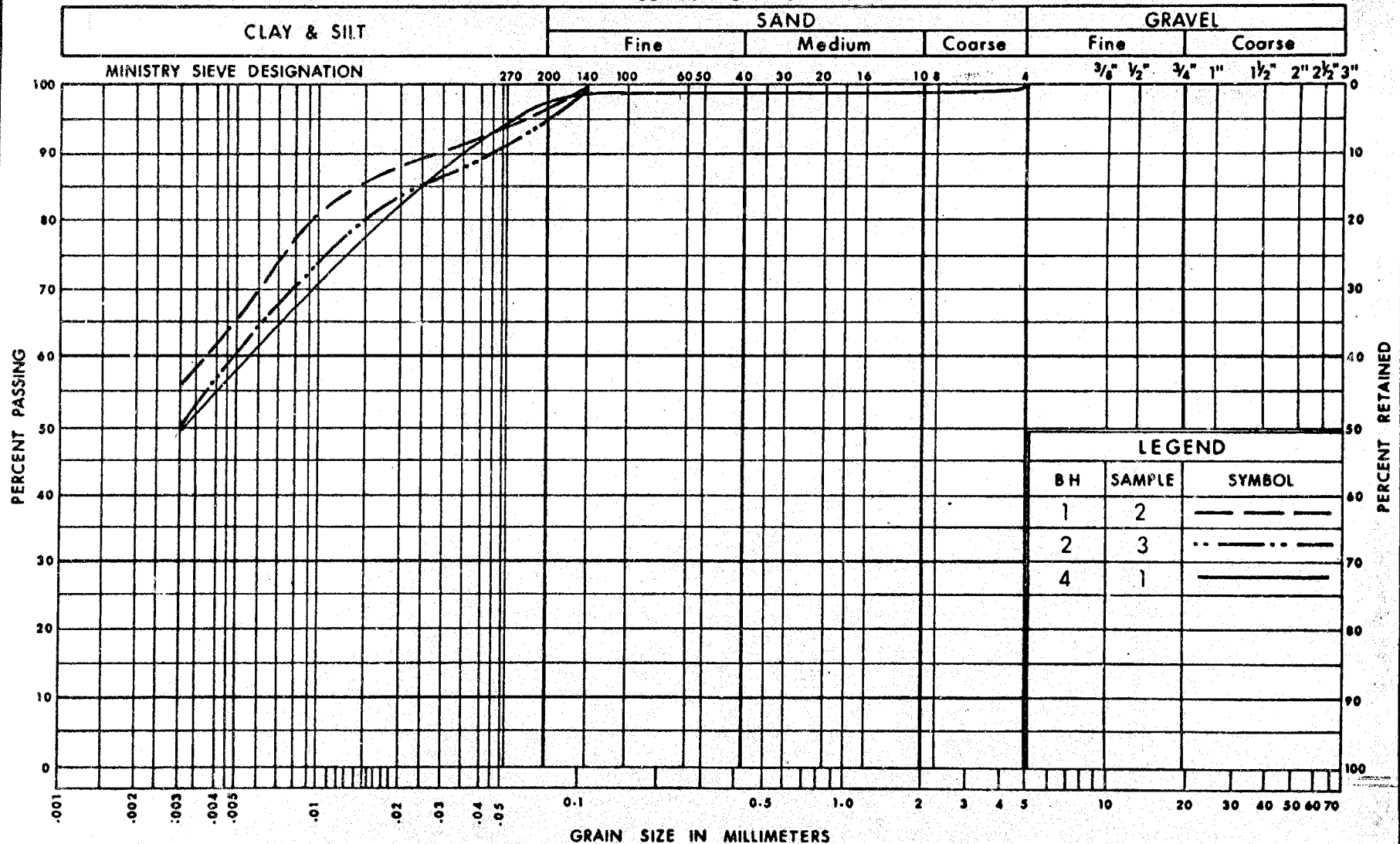
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT VARYING AMOUNTS OF
SAND SILT GRAVEL (GLACIAL TILL)

FIG No 2

W P 44-71-14

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILTY CLAY
TRACE OF SAND

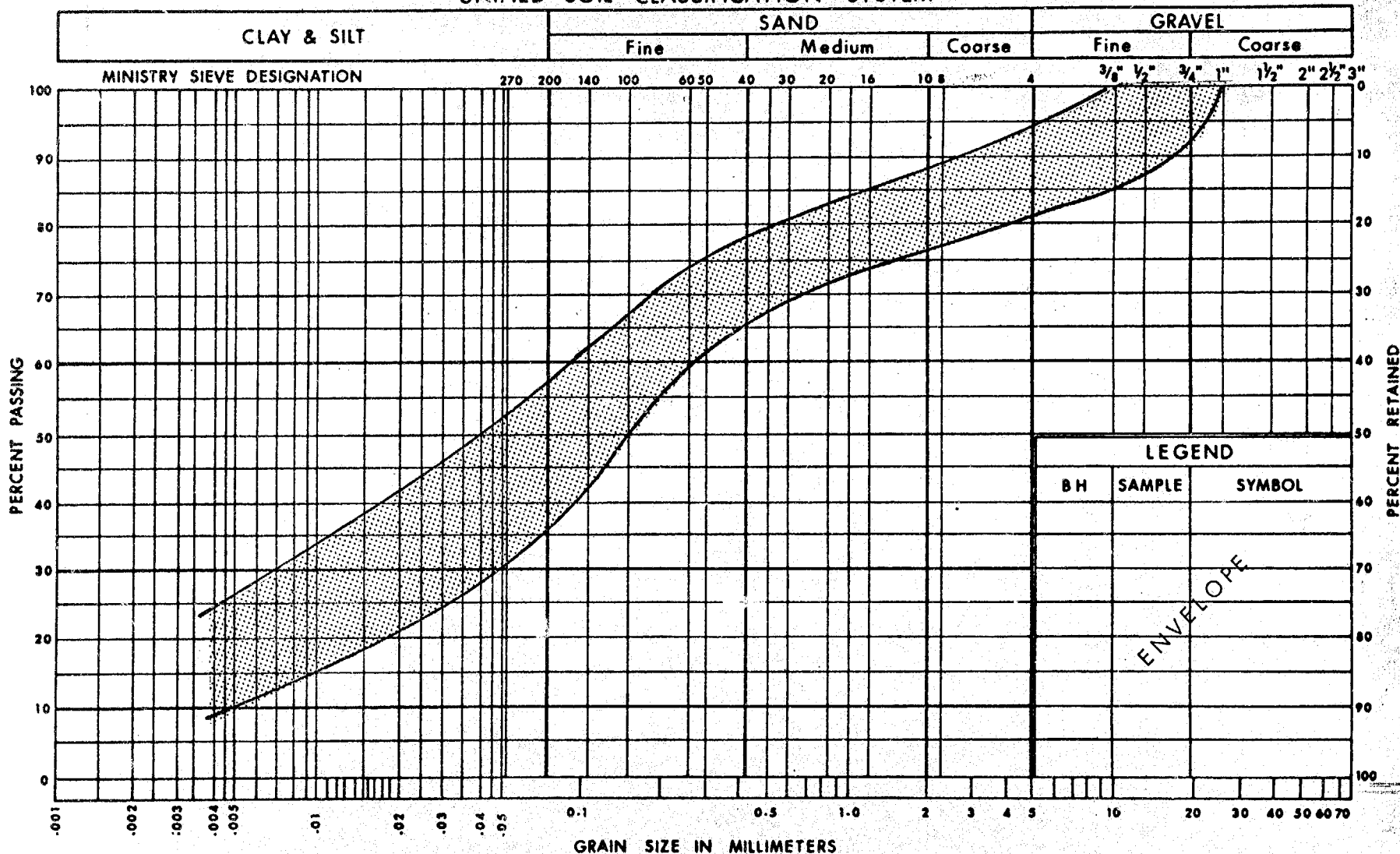
FIG No 3

W P 44-71-14



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UNIFIED SOIL CLASSIFICATION SYSTEM



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GRAIN SIZE DISTRIBUTION
CLAYEY SILT VARYING AMOUNTS OF
SAND SILT GRAVEL (GLACIAL TILL)

FIG No 4

WP 44-71-14

VOID RATIO - PRESSURE CURVES

JOB NO.

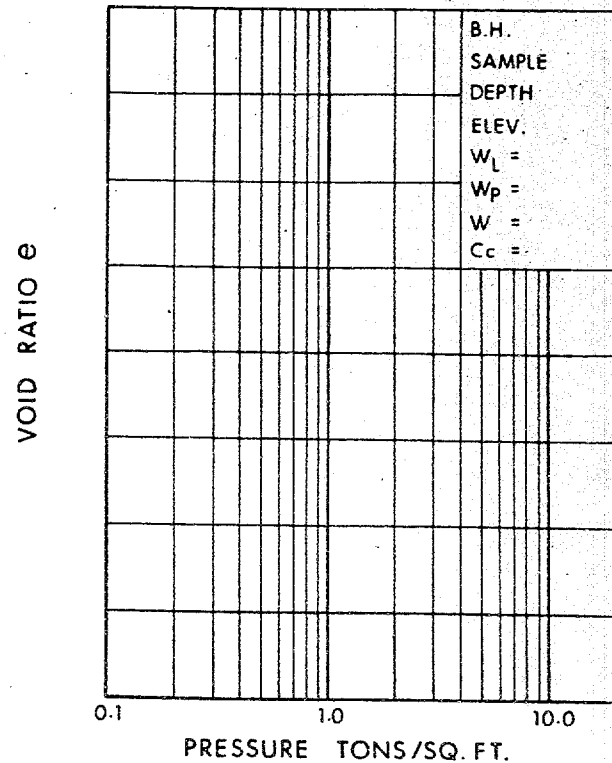
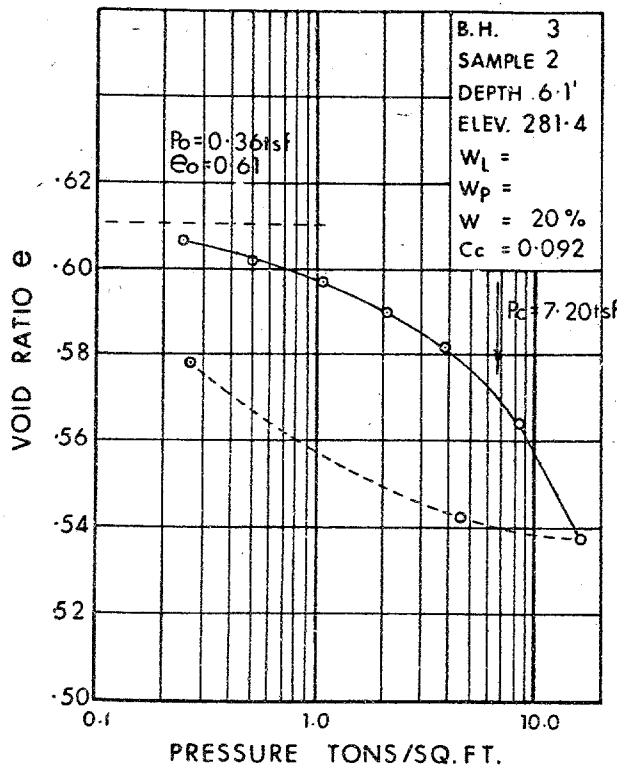
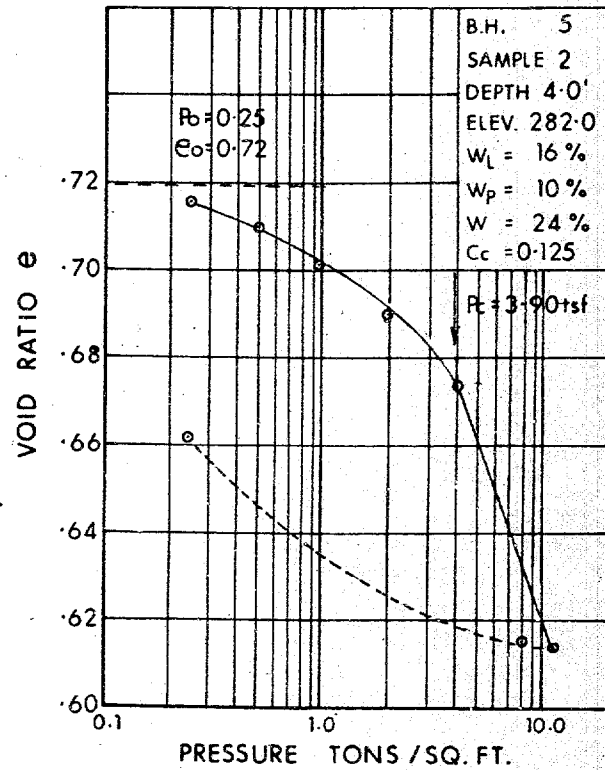
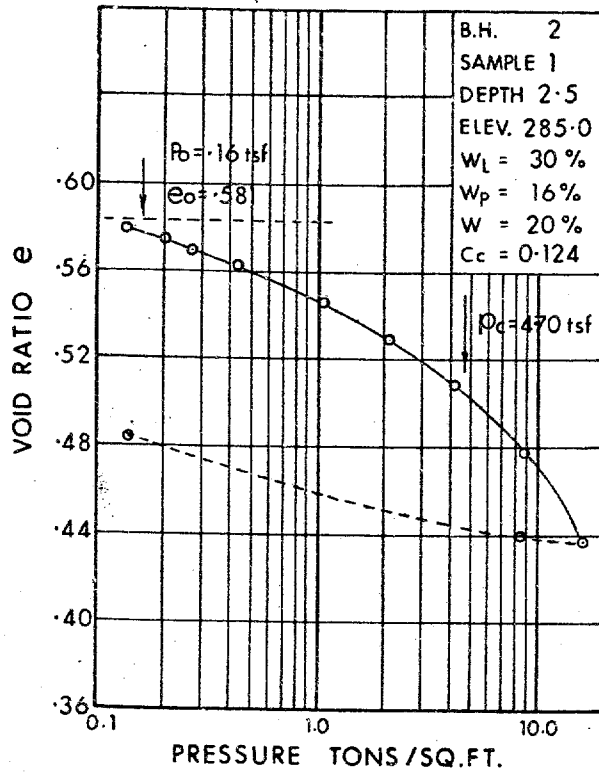


FIG. 5

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

| <u>CONSISTENCY</u> | <u>c LB/SQ. FT.</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT.</u> |
|--------------------|---------------------|------------------|------------------------|
| VERY SOFT | 0 - 250 | VERY LOOSE | 0 - 4 |
| SOFT | 250 - 500 | LOOSE | 4 - 10 |
| FIRM | 500 - 1000 | COMPACT | 10 - 30 |
| STIFF | 1000 - 2000 | DENSE | 30 - 50 |
| VERY STIFF | 2000 - 4000 | VERY DENS. | > 50 |
| HARD | > 4000 | | |

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC

TYPE OF SAMPLE

| | | | |
|-----|---------------------|-----|-------------------|
| S.S | SPLIT SPOON | T.W | THINWALL OPEN |
| W.S | WASHED SAMPLE | T.P | THINWALL PISTON |
| S.T | SLOTTED TUBE SAMPLE | O.S | OESTERBERG SAMPLE |
| A.S | AUGER SAMPLE | F.S | FOIL SAMPLE |
| C.S | CHUNK SAMPLE | R.C | ROCK CORE |

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

| | | | |
|-----|---|-----|-----------------|
| U | UNCONFINED COMPRESSION | L.V | LABORATORY VANE |
| UU | UNCONSOLIDATED UNDRAINED TRIAXIAL | F.V | FIELD VANE |
| CIU | CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| CID | " " DRAINED " | S | SENSITIVITY |
| CAU | " " ANISOTROPIC UNDRAINED " | | |
| CAD | " " DRAINED " | | |

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

| | |
|------------|--|
| γ | UNIT WEIGHT OF SOIL (BULK DENSITY) |
| γ_s | UNIT WEIGHT OF SOLID PARTICLES |
| γ_w | UNIT WEIGHT OF WATER |
| γ_d | UNIT DRY WEIGHT OF SOIL (DRY DENSITY) |
| γ' | UNIT WEIGHT OF SUBMERGED SOIL |
| G | SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$ |
| e | VOID RATIO |
| n | POROSITY |
| w | WATER CONTENT |
| S_r | DEGREE OF SATURATION |
| w_L | LIQUID LIMIT |
| w_p | PLASTIC LIMIT |
| I_p | PLASTICITY INDEX |
| w_s | SHRINKAGE LIMIT |
| I_L | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ |
| I_C | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ |
| e_{max} | VOID RATIO IN LOOSEST STATE |
| e_{min} | VOID RATIO IN DENSEST STATE |
| I_D | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| | RELATIVE DENSITY D_r IS ALSO USED |
| h | HYDRAULIC HEAD OR POTENTIAL |
| q | RATE OF DISCHARGE |
| v | VELOCITY OF FLOW |
| i | HYDRAULIC GRADIENT |
| k | COEFFICIENT OF PERMEABILITY |
| j | SEEPAGE FORCE PER UNIT VOLUME |
| m_v | COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$ |
| C_v | COEFFICIENT OF CONSOLIDATION |
| C_c | COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$ |
| T_v | TIME FACTOR = $\frac{C_v t}{d^2}$ (d, DRAINAGE PATH) |
| U | DEGREE OF CONSOLIDATION |
| τ_f | SHEAR STRENGTH |
| c' | EFFECTIVE COHESION INTERCEPT |
| ϕ' | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| c_u | APPARENT COHESION |
| ϕ_u | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| μ | COEFFICIENT OF FRICTION |
| S_t | SENSITIVITY |

GENERAL

| | |
|---------------------------|-----------------------------------|
| π | = 3.1416 |
| e | BASE OF NATURAL LOGARITHMS 2.7183 |
| $\log_e a$ OR $\ln a$ | NATURAL LOGARITHM OF a |
| $\log_{10} a$ OR $\log a$ | LOGARITHM OF a TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

STRESS AND STRAIN

| | |
|------------|--|
| u | PORE PRESSURE |
| σ | NORMAL STRESS |
| σ' | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| τ | SHEAR STRESS |
| ϵ | LINEAR STRAIN |
| γ | SHEAR STRAIN |
| ν | POISSON'S RATIO (μ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| η | COEFFICIENT OF VISCOSITY |

EARTH PRESSURE

| | |
|----------|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| δ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| K_0 | COEFFICIENT OF EARTH PRESSURE AT REST |

FOUNDATIONS

| | |
|-------|--|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| k_s | MODULUS OF SUBGRADE REACTION |

SLOPES

| | |
|---------|--|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| β | ANGLE OF SLOPE TO HORIZONTAL |



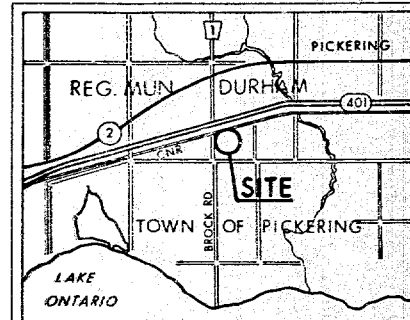
SCALE
10 5 0 10 FT

CONT No
WP No 44-71-14



PATROL YARD
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- "N" Blows/ft (Std Pen Test 350 ft lbs energy)
- COONE Blows/ft (60° Cone, 350 ft lbs energy)
- ↓ WL at time of investigation NOV 1976
NO WL established BH No 3, 4 & 5

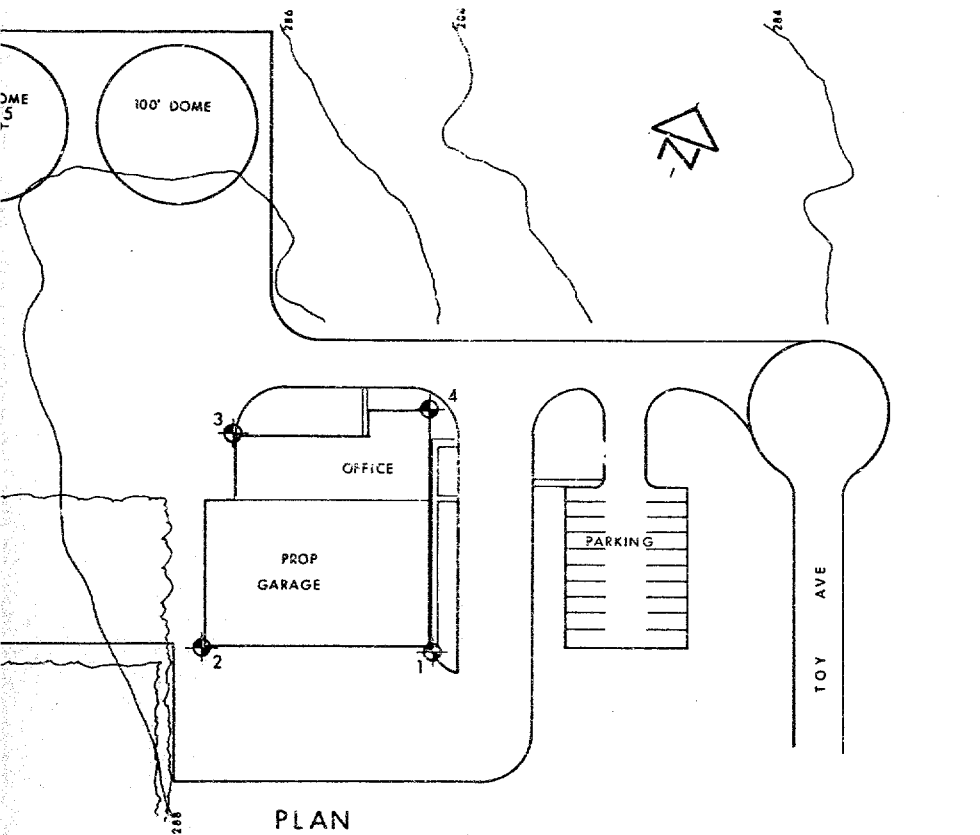
| No | ELEVATION | AS SHOWN ON DRAWING |
|----|-----------|---------------------|
| 1 | 287-5 | |
| 2 | 287-5 | " |
| 3 | 287-5 | " |
| 4 | 287-0 | " |
| 5 | 287-0 | " |

NOTE-

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

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|----|-------------|
| | | | |
| | | | |
| | | | |

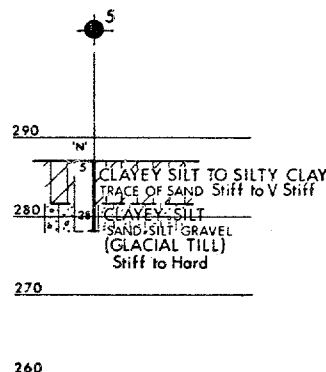
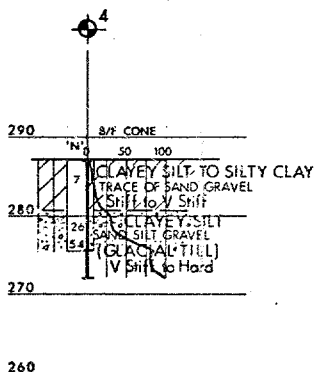
| | |
|-------------------------|-----------------------|
| HWY No 401 & BROCK ROAD | DIST 6 |
| SUBMITTAL SHEET | CHECKED DATE 15 12 76 |
| DRAWN BY J. CHECKED | DATE 15 12 76 |
| | DWG 44-71-14-A |



PLAN

SCALE
50 25 0 50 FT

ONE
100
CLAYEY SILT TO
TY CLAY
OF SAND GRAVEL
BEAMS OF SILT OR SAND
Hard
CLAYEY SILT
SILT GRAVEL
(GLACIAL TILL)
Stiff to Hard



HOLES

10 FT



Memorandum

To: Mr. C. Mirza
Soil Mechanics Section
Geotechnical Office
West Building

From: Materials and Testing Office
Central Region

Date: October 8, 1976

Our File Ref.

In Reply to

Subject:

RE: W.P. 44-71-14, Proposed Brock Road Patrol Yard
Highway 401 at Brock Road
District 6, Toronto

A foundation investigation has been requested for the masonry garage planned at the "Brock Road Patrol Yard". A site plan with the area outlined in yellow is attached. The attached memorandums indicate we have sufficient authority to encroach on the property for this purpose.

The design is to be completed by late 1976. Please confirm your expected completion date for the foundation work.

S.G. Wilson

S.G. Wilson
Project Soils Engineer

For: H.S. Elston
Acting Senior Soils Supervisor

SGW:HSE:vdn
Attach.

c.c. Mr. R. Fitzgibbon





Memorandum

To: Mr. R.D. Gunter,
Materials and Testing Office,
Central Region.

From: R. Kunkel,
Planning and Design Office,
Central Region.

Attention:

Date: October 4, 1976.

Our File Ref.

In Reply to

Subject: W.P. 44-71-14, Proposed Brock Road
Patrol Yard,
Highway 401/Brock Road,
District 6, Toronto.



Attached please find a print sheet showing the above mentioned proposed patrol yard. The area outlined in yellow indicates lands which the M.T.C. is presently acquiring from the C.N.R. Would you please arrange for additional foundations investigation within the area coloured yellow. Previous "Hand & Power Auger" work survey was done in October, 1974 under this work project on the adjoining lands owned by M.T.C. In addition, the soils information should be updated (and added to, as required, in the outlined area). I believe that the attached "speedy memo" copy from J. Neilson (Property Office) to R. Fitzgibbon is sufficient authority to encroach on these lands.

I would appreciate your attention to this matter as our design completion is late 1976. Please confirm a foundations and soils information date at your earliest convenience.

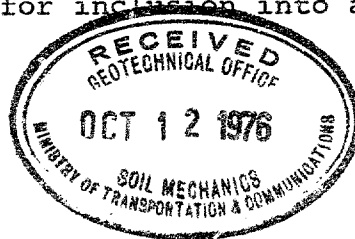
R. Kunkel,
Senior Project Manager,
for:
J. Geo. Celmins,
Area Manager.

JGC:RK:sm
Attach.

cc: R. Fitzgibbon
J. Neilson
H. Greenland
I. Nethercott
M. Sinclair

P. Cerovic, Head Office Structural Office, complete your design as soon as possible for inclusion into a one "award-contact".

3446



FROM

J. S. Neilson

DEPARTMENT

R. Fitzgibbons

DATE

Sept. 29/76

SUBJECT

C.N.R. Land Exchange
Pickering

MESSAGE

Contacted Bill Heggson of the CNR yesterday and requested permission to proceed with soil testing on the former Metro Star property. He looked this out called me back and advised that CNR had no objection. He did indicate that the deed to MTC from Metro Star had not been signed as of 2 weeks ago but that it was expected. I believe that it is in order to proceed on the basis of the information at hand. JSM

REPLY

c.c. L. Kunkel

USE LOWER PORTION FOR REPLY

REPLY FROM

DATE

