

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M15-76

DIST. 7 REGION

W.P. No. 187-79-03

CONT. No. 87-27

W. O. No.

STR. SITE No. 21-6-188

HWY. No. 2

LOCATION Wilmut Creek

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DIST. NO. 7
CONT No
WP No 187-79-03
WILMOT CREEK BRIDGE
AT HWY. 2
GENERAL ARRANGEMENT



SHEET

NOTES:

CLASS OF CONCRETE

- FOOTINGS 20 MPa
- REMAINDER 30 MPa

REINFORCING STEEL

- REINF. STEEL SHALL BE GRADE 400
- REINF. BARS WITH THE DESIGNATION 'C' AT THE END OF THE BAR MARKS SHALL BE COATED BARS.

CLEAR COVER TO REINF. STEEL

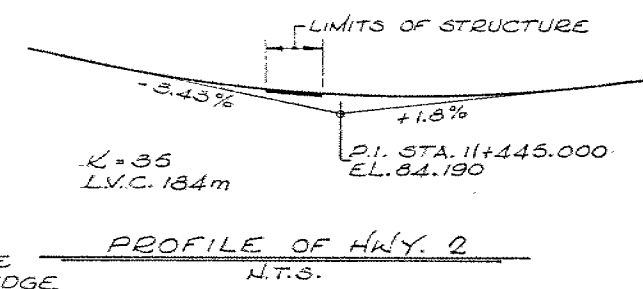
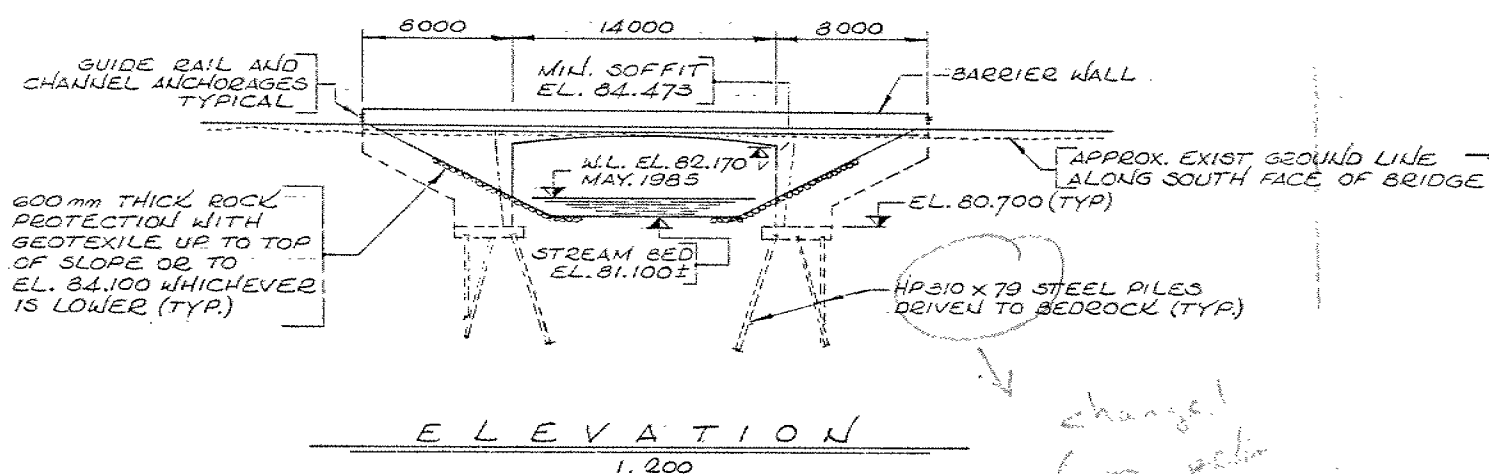
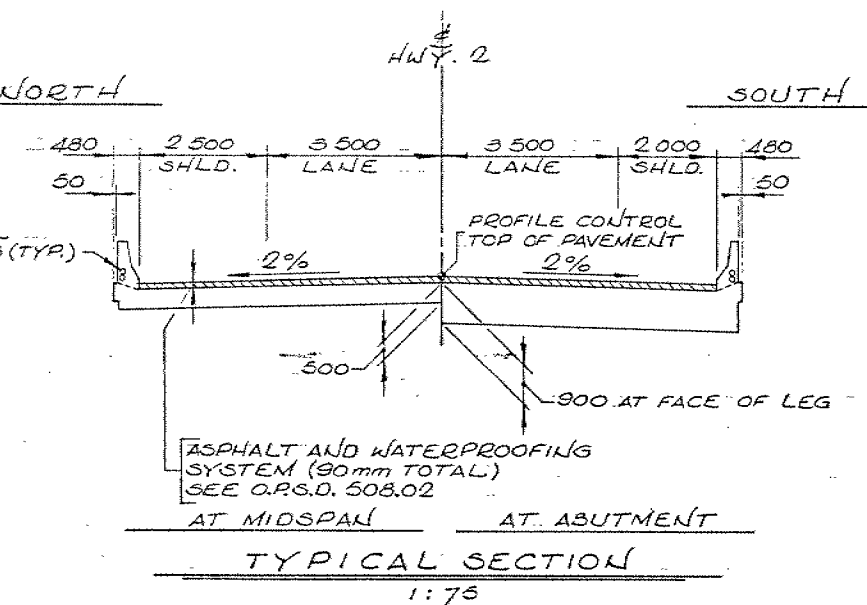
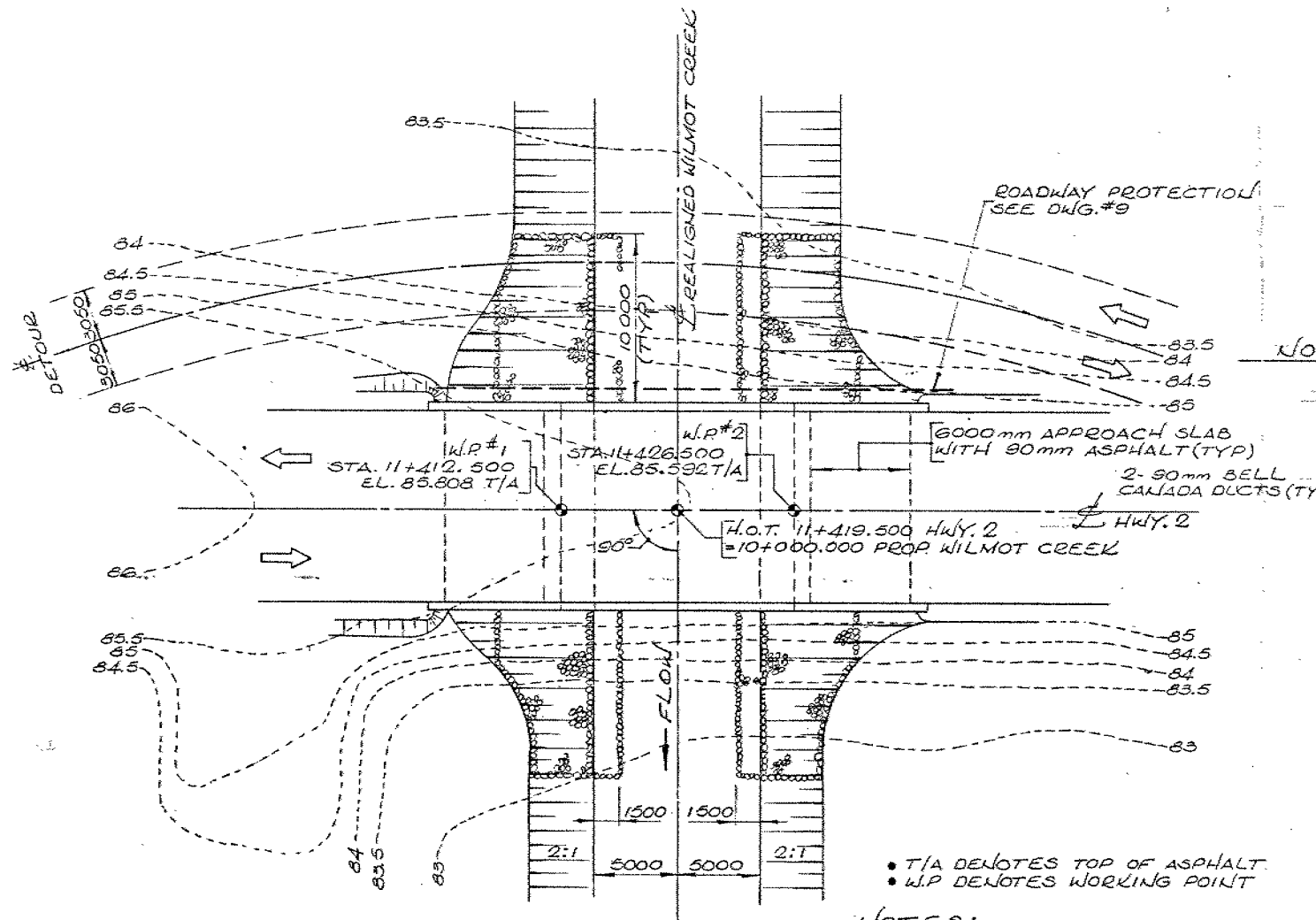
- FOOTINGS 100 ± 25
- ABUTMENTS & WINGWALLS 80 ± 20 F.F. 70 ± 20 B.F.
- DECK 70 ± 20 TOP 50 ± 10 BOT.
- BARRIER WALLS 70 ± 20
- REMAINDER 70 ± 20 OR AS NOTED

CONSTRUCTION

BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATIONS BE GREATER THAN 500mm.

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT
2. BORE HOLE LOCATION & SOIL STRATA
3. FOOTINGS & WINGWALLS
4. FRAME
5. 6000mm APPROACH SLAB
6. BARRIER WALL
7. BRIDGE DATE & SITE NUMBER DATA
8. AS CONSTRUCTED ELEV. & DIM.
9. ROADWAY PROTECTION
10. QUANTITIES - STRUCTURE



B.M. EL. 86.765
GEODETIC DATUM
N. 1/4 W. 1/4 WEST ROOT OF 1.4 MAPLE
53.50m RT 11+329.500

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

| REVISIONS | DATE | BY | DESCRIPTION |
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| DESIGN 4. K.J. | CHECK | LOADING O.H.B.C.-A-83 | DATE APR. 86 |
| DRAWING B.S. | CHECK H.R.T. | SITE No 21-06-183 | DWG 1 |

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 187-79-03

WILMOT CREEK BRIDGE
AT HWY. 2
FOOTINGS & WINGWALLS

SHEET

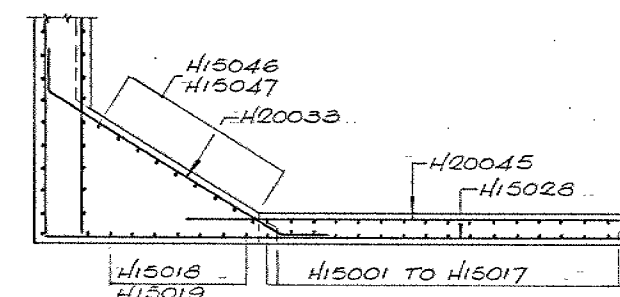
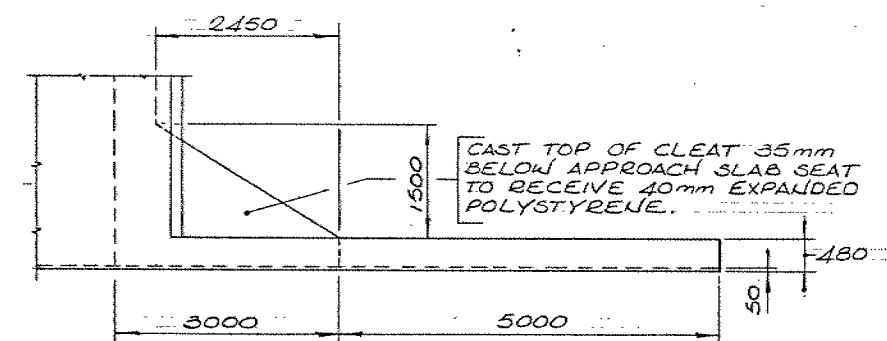
| PILE DATA TABLE | | | |
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| LOCATION | NO. | BATTER | LENGTH |
| W. ABUT. | 2 | VERT. | 6000 |
| | 12 | 3:1 | 6400 |
| E. ABUT. | 2 | VERT. | 6000 |
| | 12 | 3:1 | 6400 |

PILE DESIGN DATA:

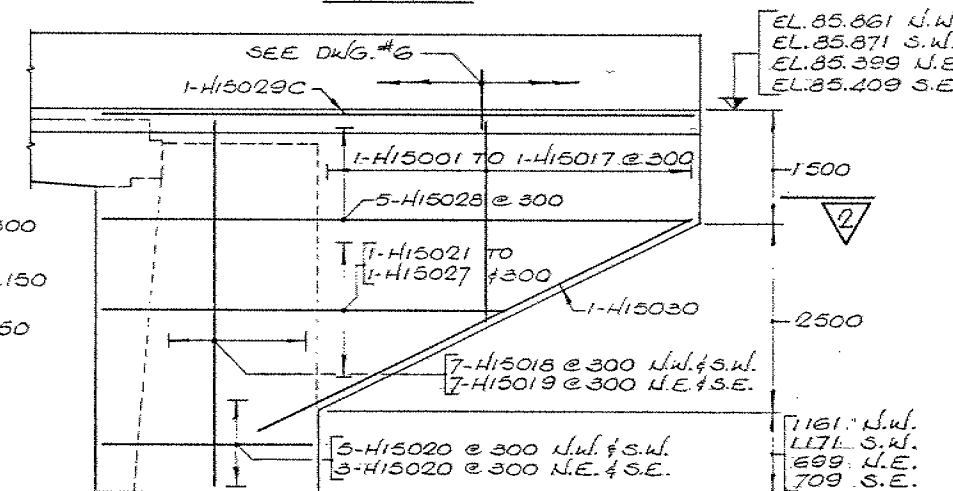
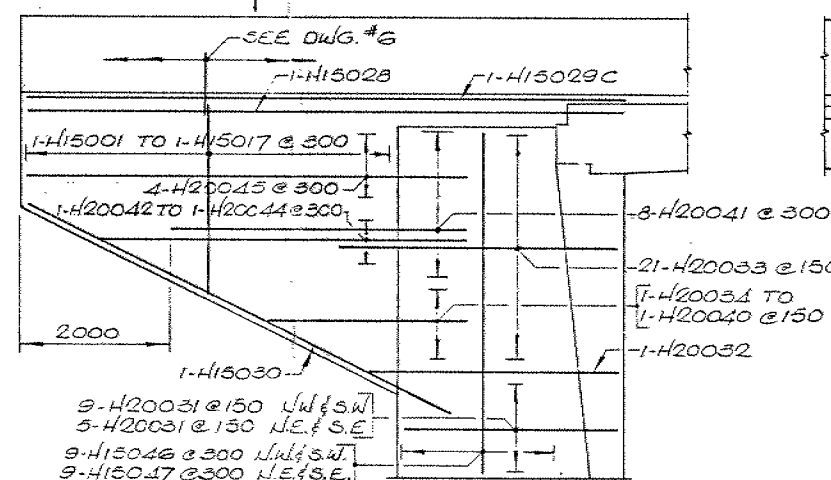
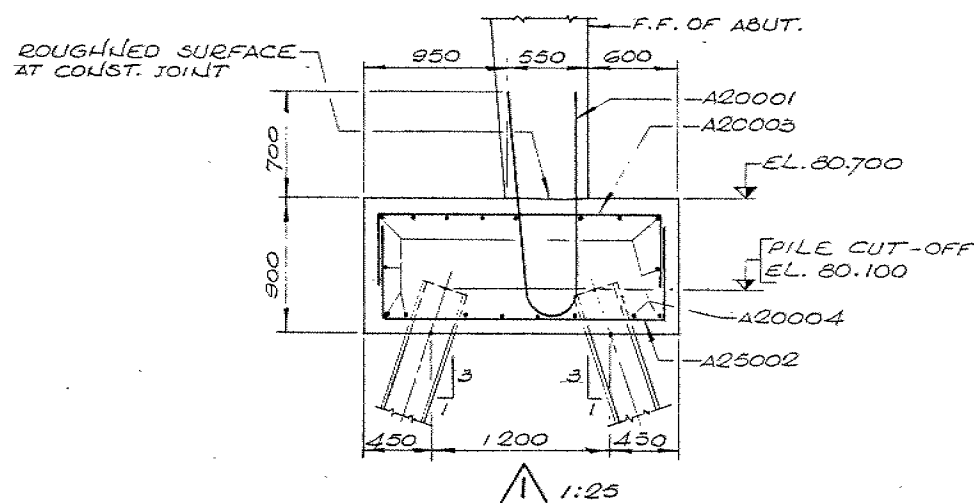
- FACTORED CAPACITY AT U.L.S. 1150 KN
- CAPACITY AT S.L.S. TYPE II 850 KN

NOTES:

- ALL PILES ARE HP310x79 STEEL PILES
- PILES TO BE DRIVEN TO BEDROCK.
- LENGTH OF PILES SHOWN ARE THEORETICAL LENGTHS BELOW CUT-OFF.
- PILE LAYOUT DIMENSIONS ARE MEASURED AT THE UNDERSIDE OF FTGS.
- ALL PILES SHALL BE EQUIPPED WITH DRIVING SHOES TO ACCORDANCE WITH DD-3301.



PLAN OF FOOTINGS 1:50



WINGWALL ELEVATION 1:50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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FOUNDATION INVESTIGATION REPORT

CONTRACT NO 87-27



Ministry of
Transportation and
Communications

INDEX

| <u>PAGE NO.</u> | <u>DESCRIPTION</u> |
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| 2 | Abbreviations and Symbols |
| 3-26 | Foundation Investigation Report for W.P. 187-79-03, Hwy. 2 Wilmot Creek Structure District 7 - Port Hope |

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

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/0.3 m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|-----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

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

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

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

| 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^2 | SEEPAGE FORCE |
| γ' | kN/m^3 | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

For

Wilmot Creek Structure

W.P. 187-79-03, Hwy. 2

District 7, Port Hope

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above noted site between 85 04 12 and 85 04 16. The fieldwork consisted of 5 sampled boreholes advanced by means of hollow stem augers and BXL rock coring equipment. The depth of the boreholes ranged from 8.4m to 12.4m. Bedrock was proven in 2 boreholes (BH1, BH4) by obtaining 1.5 m rock cores.

In 1984, an investigation consisting of 5 sampled boreholes and one cone penetration test was carried out at the existing Wilmot Creek crossing of Hwy. 2 approximately 85m east of this proposed structure site. The locations of the 1984 investigation boreholes (1A - 6A) are shown on Dwg. No. 2 of the contract drawings and the log sheets are included in the Appendix. This information is provided for reference only and is not used for the description of the subsurface conditions at this proposed site.

SITE DESCRIPTION

The site is located east of the intersection of Hwy. 35/115 and Hwy. 2 and approximately 85m west of the existing Wilmot Creek crossing of Hwy. 2. The site is situated in the Township of Clarke, County of Durham.

The site is located in the physiographic region known as the Iroquois Plain which typically exhibits level to gently undulating topography. The area is characterized by glaciolacustrine sediments deposited by the glacial Lake Iroquois. The bedrock underlying the site is generally a limestone and shale of the Lindsay Formation.

SUBSURFACE CONDITIONS

General

The existing embankment fill, where present, consists of a silty clay with sand, trace gravel. Underlying this fill is generally a thin veneer of organic silt which probably represents the original topsoil across the site. Below this original organic deposit is generally a relatively thin seam of sandy gravel. Underlying the sandy gravel is a silty clay deposit which in turn overlies a silt and sand mixture. Beneath this non-cohesive deposit is the limestone and shale bedrock of the Lindsay Formation.

The boundaries of the subsoil types, insitu and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The location and ground elevation of each borehole are shown on Dwg. No. 2 of the contract drawings, together with stratigraphical sections.

The description of the various soils encountered at this site are described as follows:

FILL

Fill used for the grading of Hwy. 2 was encountered in BH1, BH2, BH3 and BH4. The height of the fill ranged from 2.1m to 2.9m and was found to overlie the original topsoil.

The results of Atterberg Limits testing carried out on 5 samples of this cohesive material are plotted on Fig. 1 and indicate that the fill is generally composed of a silty clay of low plasticity (CL group).

Generally, the moisture content of this fill ranges from 11 to 19%, however, one sample tested (BH2, #3) indicated a moisture content of 41%.

No field or lab shear tests were conducted on this fill material. Based on Standard Penetration test 'N' values of 5-10 blows /0.3m, the fill has a medium degree of compaction and could be considered to be in a firm state.

The results of grain size distribution tests carried out on 4 samples of this material are shown on Fig. 2 and are summarized as follows:

| | <u>Range</u> |
|--------|--------------|
| Clay | 6 - 28% |
| Silt | 39 - 68% |
| Sand | 12 - 37% |
| Gravel | 0 - 21% |

ORGANIC SILT

Dark brown to black organic silt with traces of wood and roots was encountered in all boreholes with the exception of BH2. In BH1, BH2 and BH3 this organic deposit was found to underlie the silty clay fill, and ranged in thickness from 0.3m to 0.8m. In BH5 where no fill was placed this slightly cohesive organic material was found as the surficial deposit and had a thickness of 0.9m. No testing was conducted on any samples of this material.

SANDY GRAVEL

Waterbearing sandy gravel was encountered in each of the 5 boreholes. Generally the deposit was found to underlie the original topsoil across the site. This non-cohesive deposit varied in thickness from 1.8 to 2.1m and is generally found at a depth of 2.9m with the exception of BH1 where the depth was found to be 0.9m.

The results of grain size distribution tests carried out on 3 samples of this material are shown on Fig. 3 in the Appendix. Based on these results it is evident that this sandy gravel contains a trace of clay and some silt. The results of the 3 tested samples are follows:

| | <u>Range</u> |
|--------|--------------|
| Gravel | 44 - 56% |
| Sand | 26 - 37% |
| Silt | 7 - 15% |
| Clay | 2 - 20% |

Based on Standard Penetration Test 'N' values generally between 28 and 32 blows/0.3m, this granular deposit is in a compact state. In BH5, 'N' values were between 9 and 11 blows/0.3m indicating the material to be in a loose to compact state.

It is to be noted that in this type of deposit, cobbles may be encountered.

SILTY CLAY

A grey silty clay deposit was encountered in all boreholes. This cohesive deposit was found to underlie the sandy gravel deposit and varied in thickness from 3.0 to 3.8m. This material was found at a depth of 2.9 to 4.1m corresponding to an elevation of 80.6 to 81.7m.

Results of Atterbreg Limits testing conducted on 7 samples of this material are shown on Fig 4 in the Appendix. The results can be summarized as follows:

| | | <u>Range</u> |
|------------------|-------------------|--------------|
| Moisture Content | (W) | 8.0 - 19.0% |
| Liquid Limit | (W _L) | 12.0 - 28.5% |
| Plastic Limit | (W _P) | 10.5 - 14.0% |
| Plasticity Index | (I _P) | 1.5 - 14.5% |

The results indicate that this silty clay is generally of low plasticity (CL to CL-ML group).

Results of Grain Size Distribution testing carried out on 4 samples of this material are shown in envelope form on Fig. 5 in the Appendix. Based on the grain size distribution this deposit can be considered generally as a silty clay, some sand, trace gravel.

Based on Standard Penetration Test 'N' values ranging from 8 to 18 blows/0.3m, it is estimated that this material is in a stiff to very stiff state.

It is to be noted that within the silty clay stratum in BH3 a 0.8m± non-cohesive seam of waterbearing silty sand was encountered. The lateral extent of this seam was not investigated.

SILT & SAND

A grey silt and sand mixture was encountered in all boreholes immediately underlying the silty clay deposit. The thickness of this stratum ranged from 2.8m to 3.6m, and was found at a depth ranging from 5.6m in BH5 to 7.5m in BH1. In all cases, this silt and sand deposit was found to immediately overlie the limestone and shale bedrock.

Grain Size Distribution testing was conducted on 6 samples of the material and the results are shown in envelope form on Fig. 6 in the Appendix.

The results can also be summarized as follows:

| | <u>Range</u> |
|--------|--------------|
| Gravel | 4 - 17% |
| Sand | 24 - 52% |
| Silt | 30 - 56% |
| Clay | 10 - 15% |

Based on the distribution this material can be considered to be a heterogeneous mixture of silt and sand, some gravel, and clay.

Based on Standard Penetration Test 'N' values ranging from 3 to 97 blows/0.3m, this material has a denseness ranging from very loose to very dense. However it is possible that the lower 'N' values were obtained as a result of the sampling

procedures (unbalanced hydro-static pressure was present) and consequently may not accurately indicate the denseness of this material.

A characteristic of this stratum was that in the upper zones the deposit was slightly cohesive. However, with depth the material became totally non-cohesive. In addition, thin seams of sand were evident as were zones of higher sand contents. Occasional cobbles and boulders may also be encountered in this deposit.

BEDROCK

Bedrock at the site was proven in two boreholes (BH1 and BH4) by coring 1.5m into the rock. In the remaining 3 boreholes, augering was advanced to refusal which in this case is considered to be the bedrock surface.

Bedrock at the site was found approximately 8.5m below the natural ground surface and between 10 and 11m below the existing embankment fill. This corresponds to a bedrock elevation of between 74.5 and 75.1.

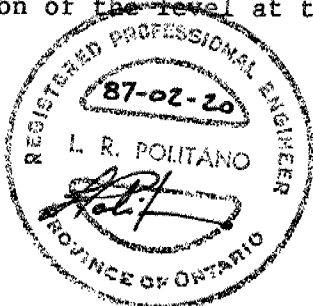
Bedrock at this location consists of black limestone and shale of the Lindsay Formation. The upper 0.3 - 0.4m of this formation is slightly weathered across the site. Below this the bedrock is in unweathered condition.


A description of the recovered rock core, prepared by MTC Geologist E. R. Magni, is included in the Appendix.

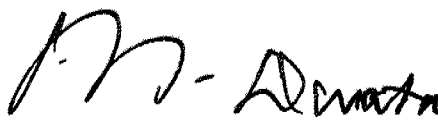
GROUNDWATER CONDITIONS

The groundwater level was determined by measuring in the cased boreholes immediately after the boreholes were completed. In the two measurements made the groundwater was found to be at Elev. 82.5±.

Given the nature of the subsoils across this site, it was not possible to take stabilized measurements in the open boreholes after 24 hours since the boreholes caved-in. However, it is believed that the measurements made give a realistic indication of the level at the immediate vicinity of the site.




 L. Politano, P.Eng.
 Project Foundations Engineer

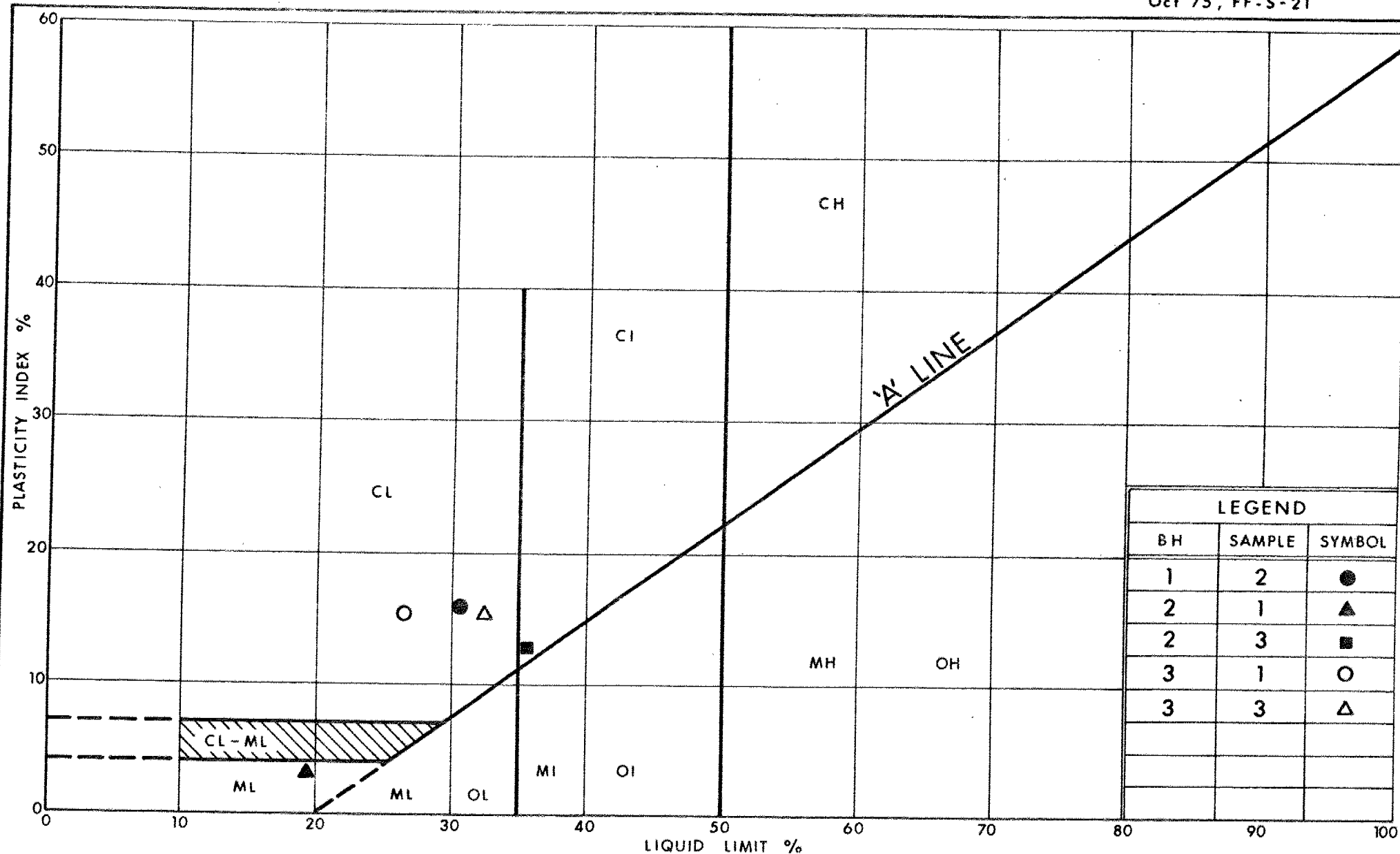

 M. Devata, P.Eng.
 Chief Foundations Engineer (East)

A P P E N D I X

DESCRIPTION OF ROCK CORE - W.P. 187-79-03

| BOREHOLE NUMBER | | | | CORE DESCRIPTION | |
|--------------------|-------------|-------|--------|------------------|--|
| | DEPTH (m) | % CR* | % RQD* | DEPTH (m) | DESCRIPTION |
| 1 | 10.88-12.41 | 100 | 90 | 10.88-11.13 | Limestone (60%), slightly weathered, closely spaced joints, with shale and shaley limestone (40%), black, slightly weathered |
| | | | | 11.13-12.41 | Limestone (95%), unweathered, widely spaced joints, with shale partings (5%) |
| 4 | 9.97-11.49 | 100 | 71 | 9.97-10.36 | Limestone (60%), slightly weathered, closely spaced joints, with shale (40%), black, slightly weathered |
| | | | | 10.36-11.49 | Limestone (60%), unweathered, medium spaced joints, with shale and shaley limestone (40%), black, unweathered |
| | | | | | |

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION



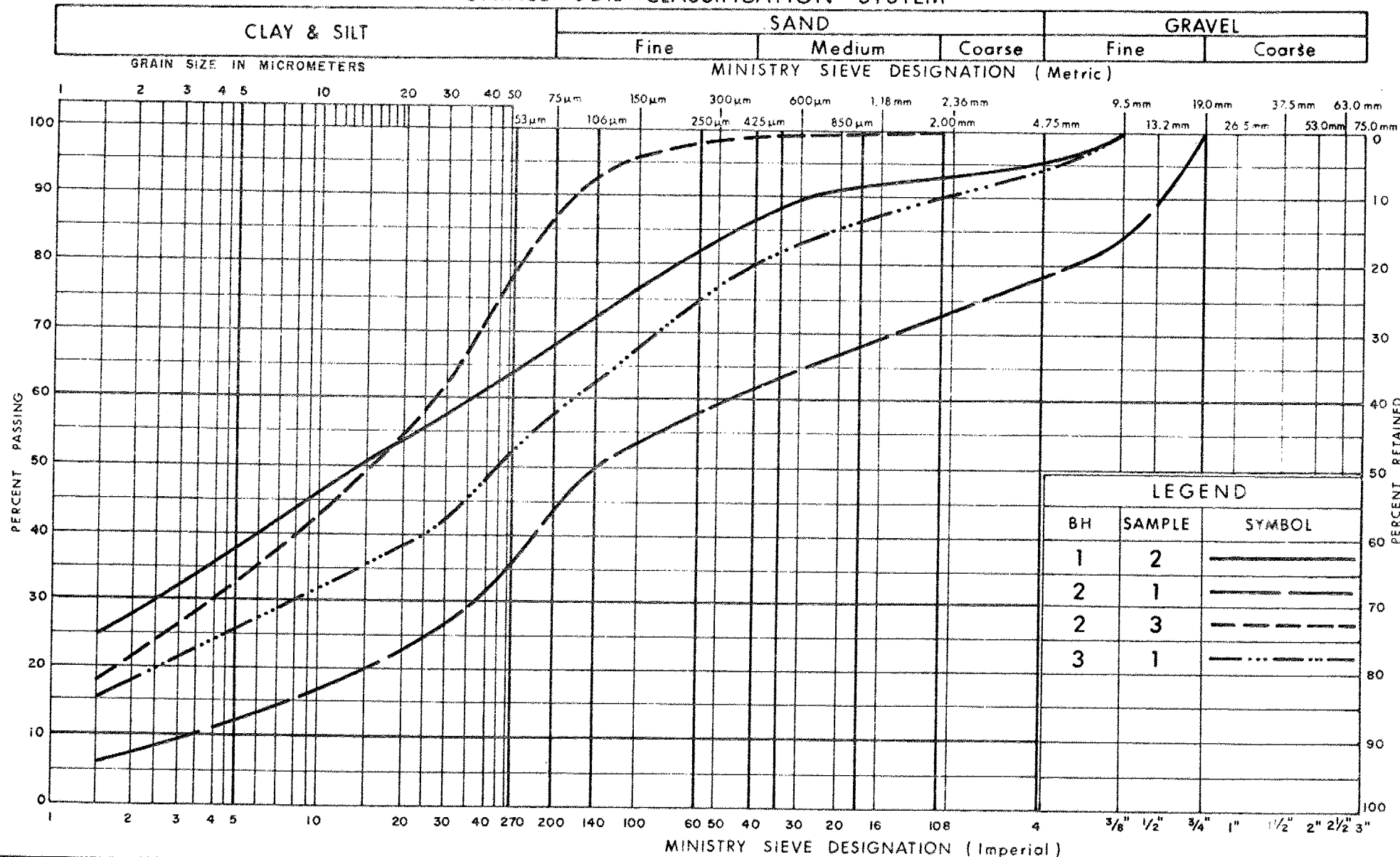
Ministry of
Transportation and
Communications
Ontario

PLASTICITY CHART SILTY CLAY WITH SAND TRACE OF GRAVEL (FILL)

FIG No 1

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



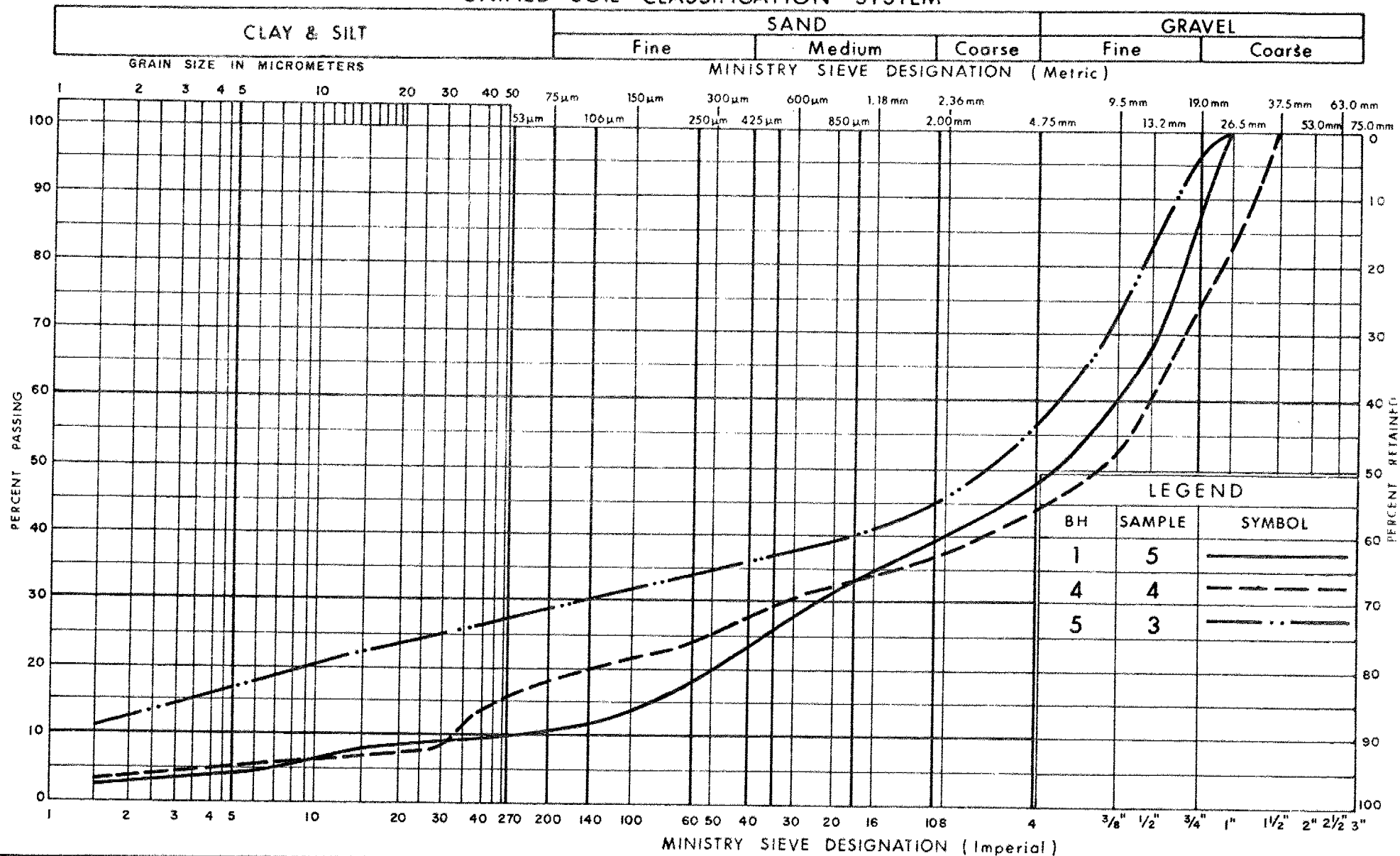
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND TRACE OF GRAVEL
(FILL)

FIG No 2

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



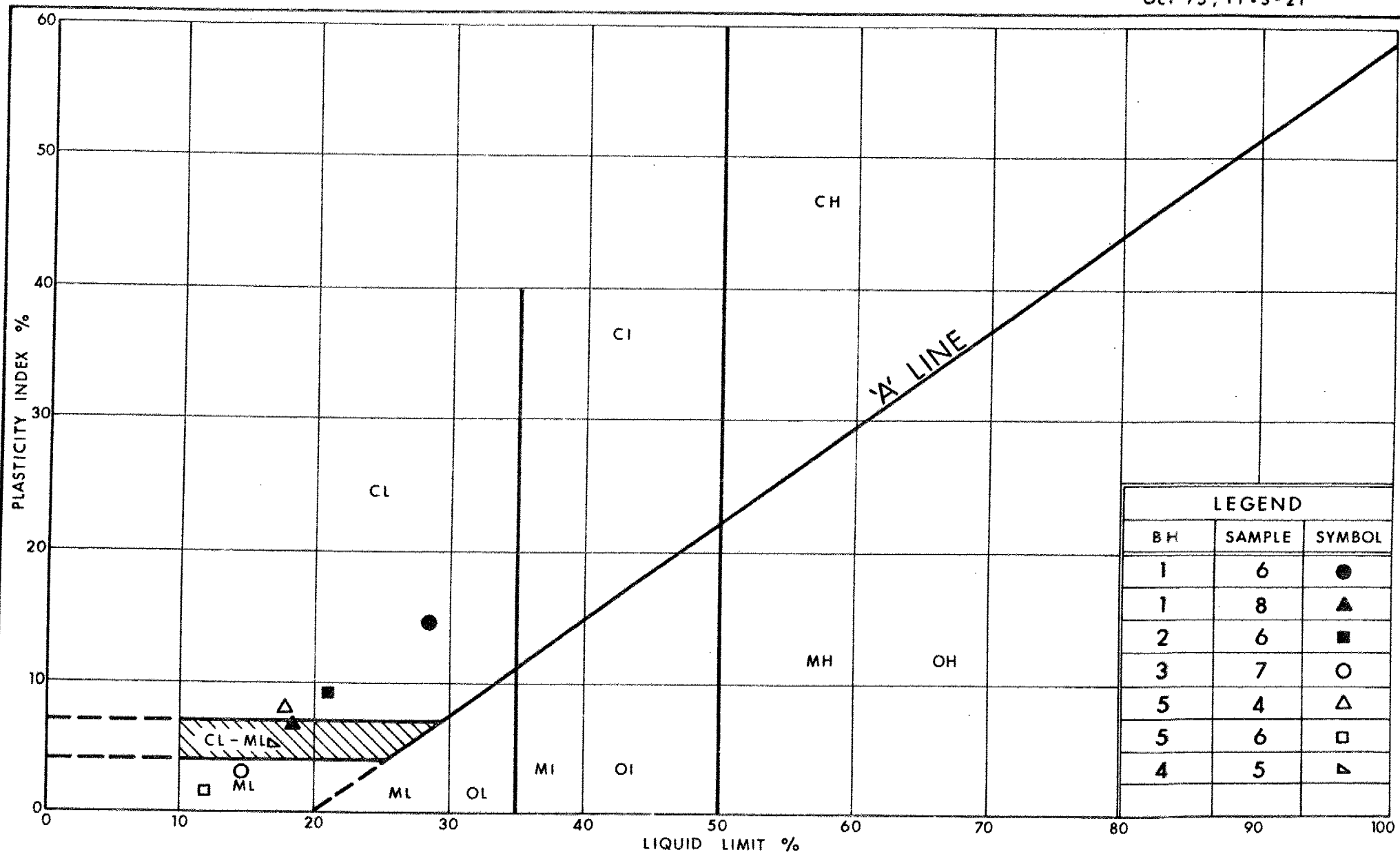
Ontario

 Ministry of
Transportation and
Communications

 GRAIN SIZE DISTRIBUTION
SANDY GRAVEL SOME SILT TRACE OF CLAY

FIG No 3

W P 187-79-03

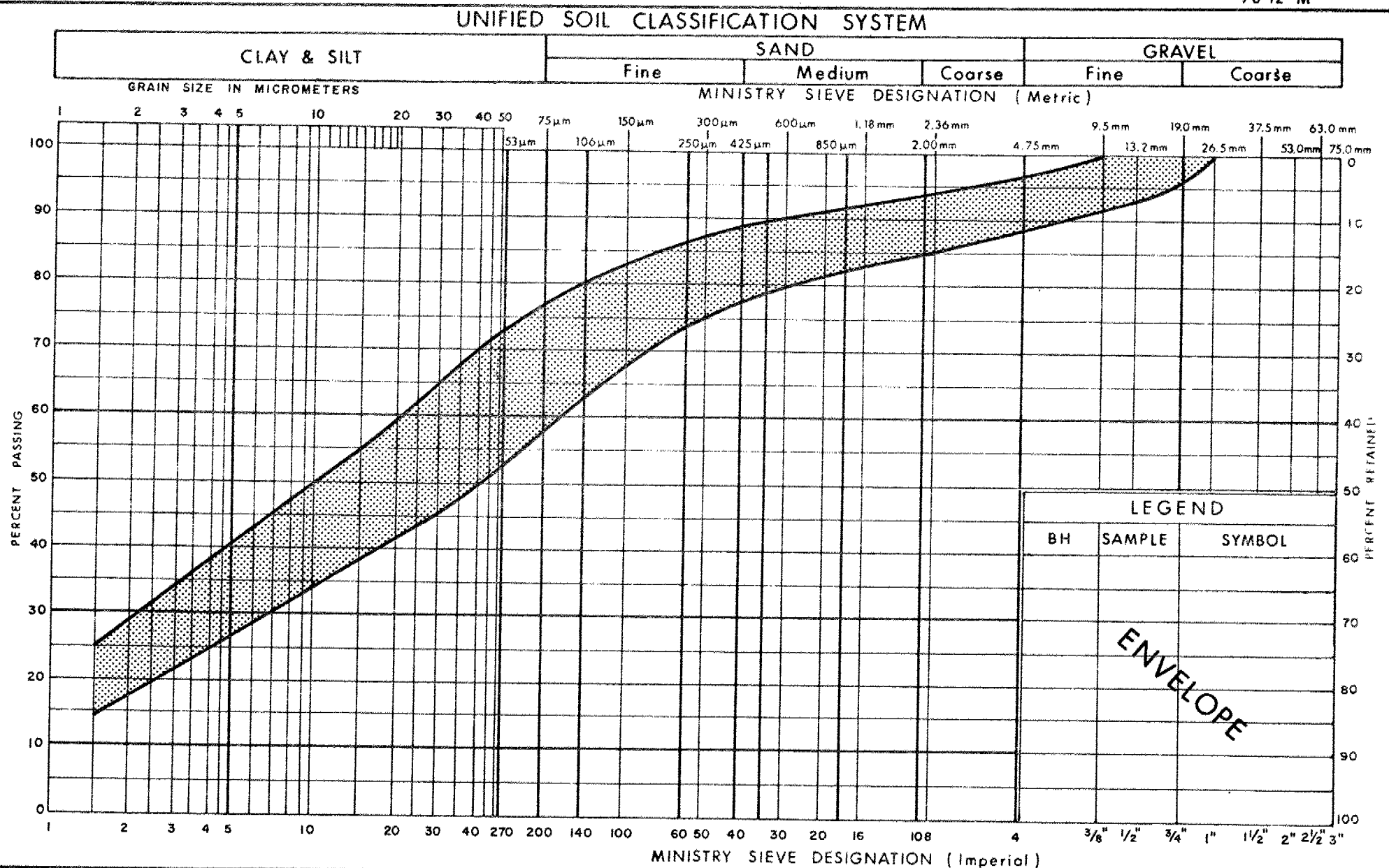


Ministry of
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Communications
Ontario

PLASTICITY CHART SILTY CLAY SOME SAND TRACE OF GRAVEL

FIG No 4

W P 187-79-03



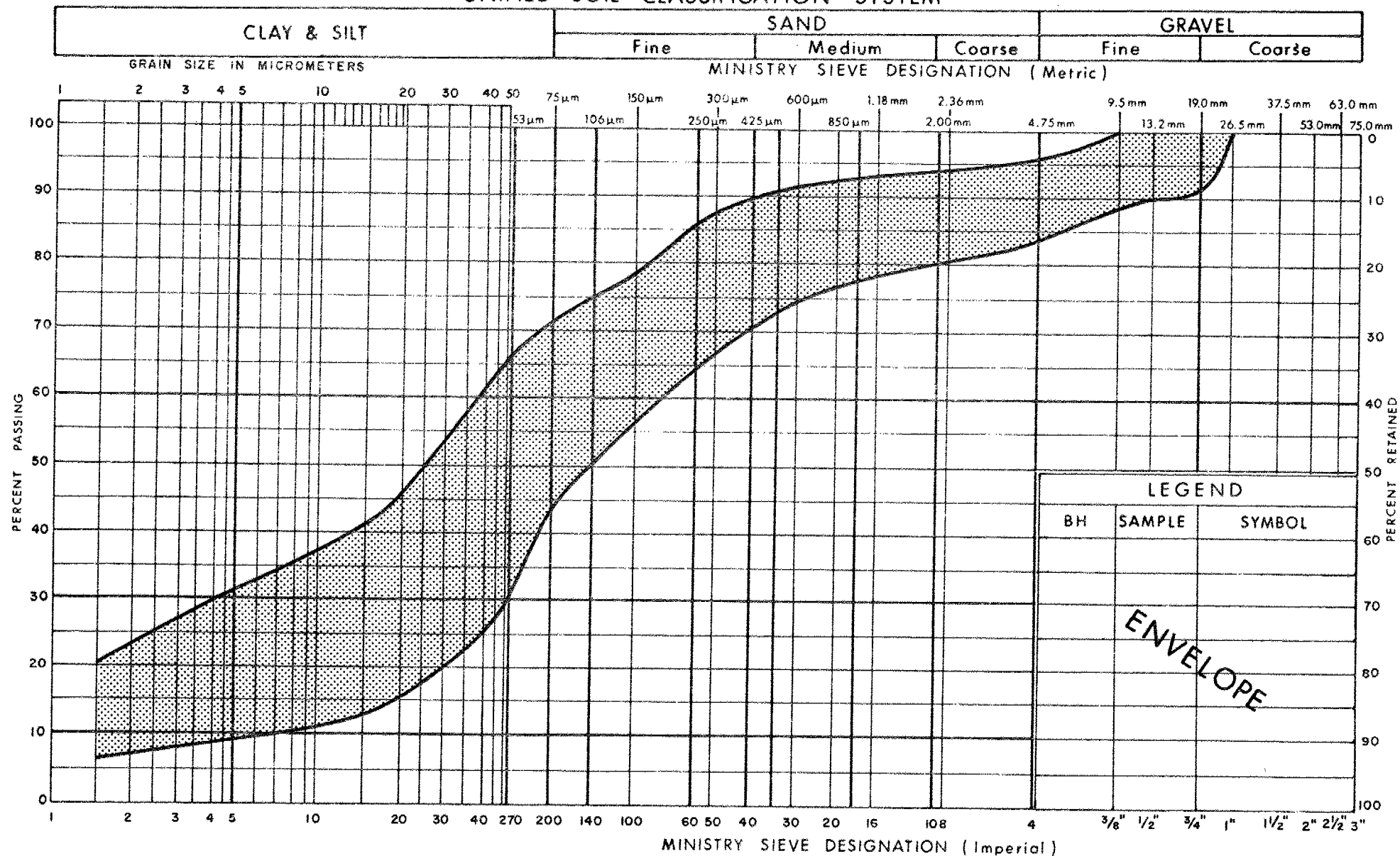
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY SOME SAND TRACE OF GRAVEL

FIG No 5

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILT & SAND SOME GRAVEL AND CLAY

FIG No 6

W P 187-79-03

RECORD OF BOREHOLE No 1

METRIC

W P 187-79-03

LOCATION Sta. 11+408.1; O/S 6.0 m RT & Hwy. 2

ORIGINATED BY SW

DIST 7

HWY 2

BOREHOLE TYPE Hollow Stem Auger, BXL Core and Cone Test

COMPILED BY SW

DATUM

Geodetic

DATE

85 04 12

CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT | | 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 | Wp | W | W _L | | |
| 85.4 | Ground Level | | | | | | | | | | | | |
| 0.0 | Fill | | 1 | SS | 9 | | | | | | | | |
| | Silty Clay some sand trace gravel Firm to Stiff | | 2 | SS | 5 | | | | | | | | 4 29 39 28 |
| | Brown | | 3 | SS | 10 | | | | | | | | |
| 82.3 | Organic silt Stiff | | 4 | SS | 9 | | | | | | | | |
| 82.5 | Black | | 5 | SS | 28 | | | | | | | | 52 37 9 2 |
| 2.9 | Sandy gravel, trace silt, clay Compact Brown | | 6 | SS | 18 | | | | | | | | |
| 3.7 | Silty Clay some sand trace gravel Firm to Very Stiff | | 7 | SS | 4 | | | | | | | | |
| | Grey | | 8 | SS | 14 | | | | | | | | 3 21 47 29 |
| | | | 9 | SS | 10 | | | | | | | | |
| 77.9 | | | 10 | SS | 7 | | | | | | | | |
| 7.5 | Silt and Sand Mixture some gravel trace clay Loose to Very Dense Grey | | 11 | SS | 17 | | | | | | | | 11 32 43 14 |
| | | | 12 | SS | 45 | | | | | | | | |
| | | | 13 | SS | 97 | | | | | | | | 16 41 34 9 |
| 74.5 | | | 14 | SS | 90/15 cm | | | | | | | | |
| 10.9 | Bedrock (Limestone & Shale) | | 15 | BXL RC | 100% REC | | | | | | | | RQD = 90% |
| 73.0 | | | | | | | | | | | | | |
| 12.4 | End of Borehole | | | | | | | | | | | | |

+3, x⁵: Numbers refer to
Sensitivity

20
15 \div 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P 187-79-03 LOCATION Sta. 11 + 408.1; C/S 6.7 m LT & Hwy. 2 ORIGINATED BY SW
 DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY SW
 DATUM Geodetic DATE 85 04 16 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 (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | |
| 85.4 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | <u>Fill</u> Silty Clay with sand, some gravel to silty clay some sand Firm Brown | | 1 | SS | 6 | * | 85 | | | | | | | | | 21 34 39 6 |
| | | | 2 | SS | 7 | | 84 | | | | | | | | | |
| 82.5 | | | 3 | SS | 5 | | 83 | | | | | | | | | 0 12 68 20 |
| 2.9 | sandy gravel, some silt, clay | | 4 | SS | 32 | | 82 | | | | | | | | | |
| 81.7 | Dense Brown | | | | | | | | | | | | | | | |
| 3.7 | Silty Clay some sand trace gravel Stiff Grey | | 5 | SS | 15 | | 81 | | | | | | | | | 10 24 44 21 |
| | | | 6 | SS | 10 | | 80 | | | | | | | | | |
| | | | 7 | SS | 11 | | 79 | | | | | | | | | |
| 78.2 | | | | | | | 78 | | | | | | | | | |
| 7.2 | Silt and Sand Mixture trace gravel clay Loose to Very Dense Grey | | 8 | SS | 9 | | 77 | | | | | | | | | |
| | | | 9 | SS | 25 | | 76 | | | | | | | | | |
| 74.6 | | | 10 | SS | 100 | 2 cm | 75 | | | | | | | | | 6 44 40 10 |
| 10.8 | End of Borehole Refusal to Auger Probable Bedrock * Groundwater Level not Established | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P 187-79-03 LOCATION Sta. 11 + 430.0; O/S 6.0 m RT of Hwy. 2
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger
DATUM Geodetic DATE 85 04 15
ORIGINATED BY SW
COMPILED BY SW
CHECKED BY *JP*

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | |
| 85.0 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Fill | | | | * | | | | | | | | | |
| | Silty Clay with sand trace gravel | | 1 | SS | 5 | 84 | | | | | | | | 7 36 39 18 |
| | Firm | | | | | | | | | | | | | |
| | Brown | | 2 | SS | 6 | 83 | | | | | | | | |
| 82.1 | Organic Silt | | 3 | SS | 8 | | | | | | | | | |
| 2.9 | Sandy Gravel some silt, clay | | 4 | SS | 28 | 82 | | | | | | | | |
| 81.3 | Compact Brown | | | | | | | | | | | | | |
| 3.7 | Silty Clay and sand, some gravel | | 5 | SS | 15 | 81 | | | | | | | | |
| | Silty Sand some gravel clay | | 6 | SS | 9 | 80 | | | | | | | | 11 43 29 17 |
| | | | | | | | | | | | | | | |
| | Stiff | | 7 | SS | 9 | 79 | | | | | | | | |
| 77.8 | | | | | | 78 | | | | | | | | |
| 7.2 | Silt and Sand Mixture trace gravel some clay | | 8 | SS | 5 | 77 | | | | | | | | 5 24 56 15 |
| | Loose to Compact | | | | | 76 | | | | | | | | |
| | Grey | | 9 | SS | 15 | 75 | | | | | | | | |
| 74.8 | | | | | | | | | | | | | | |
| 10.2 | End of Borehole | | | | | | | | | | | | | |
| | Refusal to Auger Probable Bedrock | | | | | | | | | | | | | |
| | * Groundwater Level not Established | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 187-79-03 LOCATION Sta. 11 + 431.0; O/S 6.3 m LT 4 Hwy. 2 ORIGINATED BY SW
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger and BXL Core COMPILED BY SW
DATUM Geodetic DATE 85 04 15 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 (%) |
|---------------|--|------------|---------|-----------|-------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 84.9 | Ground Level | | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | <u>Fill</u> Silty Clay with sand trace gravel Firm | | 1 | SS | 8 | | | | | | | | | | | | |
| 82.8 | Organic Silt | | 2 | SS | 6 | | | | | | | | | | | | |
| 2.1 | Silt and Sand trace gravel, clay | | 3 | SS | 26 | | | | | | | | | | | | |
| 80.8 | sandy gravel some silt trace clay Compact | | 4 | SS | 28 | | | | | | | | | | | | 56 26 15 3 |
| 4.1 | Silty Clay with sand some gravel Firm to Very Stiff Grey | | 5 | SS | 6 | | | | | | | | | | | | 12 31 36 21 |
| 77.8 | | | 6 | SS | 16 | | | | | | | | | | | | |
| 7.1 | Silt and Sand Mixture some gravel trace clay Loose to Compact | | 7 | SS | 3 | | | | | | | | | | | | 17 33 40 10 |
| 74.9 | gravel Grey | | 8 | SS | 33 | | | | | | | | | | | | |
| 10.0 | Bedrock (Limestone and Shale) | | 9 | BXL RC | 100% REC | | | | | | | | | | | | RQD = 71% |
| 73.4 | | | | | | | | | | | | | | | | | |
| 11.5 | End of Borehole | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 187-79-03 LOCATION Sta. 11 + 416.0; O/S 16.5 m LT & Hwy. 2 ORIGINATED BY SW
 DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY SW
 DATUM Geodetic DATE 85 04 16 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | 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 | | | | | | | | |
| 83.5 | Ground Level | | | | | | | | | | | | |
| 0.0 | Organic Silt some sand | | | | | * | | | | | | | |
| 82.6 | | | | | | | | | | | | | |
| 0.9 | Sandy gravel trace silt some clay | | 1 | SS | 24 | | | | | | | | |
| | Compact | | 2 | SS | 11 | | | | | | | | |
| | | | 3 | SS | 9 | | | | | | | | 44 29 7 20 |
| 80.6 | | | | | | | | | | | | | |
| 2.9 | Silty Clay with sand | | 4 | SS | 16 | | | | | | | | |
| | trace gravel | | 5 | SS | 14 | | | | | | | | |
| | Stiff Grey | | 6 | SS | 8 | | | | | | | | 3 37 26 34 |
| 77.9 | | | | | | | | | | | | | |
| 5.6 | Silt and Sand Mixture | | 7 | SS | 3 | | | | | | | | |
| | trace gravel some clay | | | | | | | | | | | | 4 52 30 14 |
| | Very Loose to Dense Grey | | 8 | SS | 38 | | | | | | | | |
| 75.1 | | | | | | | | | | | | | |
| 8.4 | End of Borehole Refusal to Auger Probable Bedrock | | | | | | | | | | | | |
| | * Groundwater Level Not Established | | | | | | | | | | | | |

*3, *5: Numbers refer to Sensitivity 20
 15 5 (%) STRAIN AT FAILURE
 10

| RECORD OF BOREHOLE No 1A | | | | | | | | | | METRIC | | | | |
|--------------------------|--|---|---------|-------------------------------|------------|----------------------------|--------------------|---|-------------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| W P 187-79-03 | | LOCATION Sta. 11 + 486.0; O/S 6.0 m RT E Hwy. 2 | | ORIGINATED BY DT | | | | | | | | | | |
| DIST 7 HWY 2 | | BOREHOLE TYPE Hollow Stem Auger | | COMPILED BY DT | | | | | | | | | | |
| DATUM Geodetic | | DATE 84 09 10 | | CHECKED BY <i>[Signature]</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 | WATER CONTENT (%) | | | | | |
| 85.3 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill Silty Clay trace organics Very Stiff to Stiff Brown | | 1 | SS | 25 | * | 85 | | | | | | | |
| | | | 2 | SS | 13 | | 84 | | | | | | | |
| 82.5 | Organic Silt Topsoil Stiff Black | | 3 | SS | 9 | | 83 | | | | | | | |
| 2.8 | | | | | | 82 | | | | | | | | |
| 81.4 | Silty Clay with sand and gravel to Silty Sand some gravel trace clay Firm to Hard (Glacial Till) | | 4 | SS | 20 | | 81 | | | | | | | |
| 3.9 | | | | | | 80 | | | | | | | | |
| | | | 5 | SS | 7 | 79 | | | | | | | | |
| | | | 6 | SS | 58 | 78 | | | | | | | | |
| 76.1 | Shale Bedrock Weathered | | 7 | SS | 100/15 cm | | 77 | | | | | | | |
| 75.9 | | | | | | 76 | | | | | | | | |
| 9.4 | End of Borehole | | | | | | | | | | | | | |
| | Refusal to Auger | | | | | | | | | | | | | |
| | * Water Table not observed | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

FOR INFORMATION ONLY

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 524.7; O/S 6.2 m RT 6 Hwy. 2 ORIGINATED BY DT
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 10 CHECKED BY *CP*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|---|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 85.3 | Ground Surface | | | | | | | | | | |
| 0.0 | Fill Silty Clay trace organics Stiff to Very Stiff | | 1 | SS | 12 | | 85 | | | | |
| | | | 2 | SS | 10 | | 84 | | | | |
| 82.4 | | | 3 | SS | 18 | | 83 | | | | |
| 2.9 | Sand with gravel some silt occasional boulders Dense | | 4 | SS | 48 | | 82 | | | | 25 47 24 4 |
| 81.2 | | | | | | | 81 | | | | |
| 4.1 | Silty Clay Stiff | | 5 | SS | 15 | | 80 | | | | |
| 79.8 | | | | | | | 79 | | | | |
| 5.5 | Silty Sand some gravel trace clay to Silty Clay with sand and gravel Hard occasional boulders (Glacial Till) | | 6 | SS | 58 | | 78 | | | | |
| | | | 7 | SS | 37 | | 77 | | | | 20 40 33 7 |
| 76.1 | | | | | | | | | | | |
| 9.2 | End of Borehole Refusal to Auger Probable Bedrock | | | | | | | | | | |

FOR INFORMATION ONLY

+3, x5: Numbers refer to
Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 514.3; O/S 8.6 m LT & Hwy. 2
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger
DATUM Geodetic DATE 84 09 06
ORIGINATED BY BR
COMPILED BY DT
CHECKED BY *GP*

| 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 | WATER CONTENT (%) 10 20 30 | | | | | |
| 83.2 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Clay with sand to silty sand some organics Firm | | 1 | SS | 8 | | 83 | | | | | | | |
| 81.2 | | | 2 | SS | 6 | | 82 | | | | | | | 0 49 47 4 |
| 2.0 | Silty Clay some sand Stiff to Very Stiff | | 3 | SS | 22 | | 81 | | | | | | 47.5% | |
| 79.4 | | | 4 | SS | 12 | | 80 | | | | | | | |
| 3.8 | Silty Sand some gravel trace clay to Silty Clay with sand and gravel occasional boulders Hard (Glacial Till) | | 5 | SS | 55 | | 79 | | | | | | | |
| 75.7 | | | 6 | SS | 39 | | 78 | | | | | | | |
| 75.7 | | | | | | | 77 | | | | | | | 24 37 32 7 |
| 75.7 | End of Borehole | | | | | | 76 | | | | | | | |
| 7.3 | Refusal to Auger Probable Bedrock | | | | | | | | | | | | | |

FOR INFORMATION ONLY

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 489.0; O/S 15.0 m LT & Hwy. 2 ORIGINATED BY BR
DIST 7 HWY 2 BOREHOLE TYPE Cone Penetration Test COMPILED BY DT
DATUM Geodetic DATE 84 09 06 CHECKED BY CP

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT Wp W Wl WATER CONTENT (%) | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|----------------------|------------------|------------|--------|------|-------------------------|-----------------|--|---|------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | | | | |
| 82.2 | Ground Surface | | | | | | | | | |
| 0.0 | | | | | | | | | | |
| 78.0 | | | | | | | | | | |
| 4.2 | End of Cone Test | | | | | | 100/28 cm | | | |
| FOR INFORMATION ONLY | | | | | | | | | | |

⁺₃, x⁵ : Numbers refer to Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 5A | | | | | | | | | | METRIC | |
|--------------------------|--|--|--|--|--|------------------|--|--|--|--------|--|
| W P 187-79-03 | | LOCATION Sta. 11 + 471.3; O/S 20.0 m LT & Hwy. 2 | | | | ORIGINATED BY BR | | | | | |
| DIST 7 HWY 2 | | BOREHOLE TYPE Solid Stem & Hollow Stem Auger | | | | COMPILED BY DT | | | | | |
| DATUM Geodetic | | DATE 84 09 06 | | | | CHECKED BY | | | | | |

| SOIL PROFILE | | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | NATURAL MOISTURE CONTENT | | | 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 | W _p | W | W _L | | |
| 82.6 | Ground Surface | | | | | | | | | | | | |
| 0.0 | | | | | | | | | | | | | |
| | Alluvium | | 1 | SS | 24 | | | | | | | | |
| | Silty Sand with gravel | | 2 | SS | 18 | | | | | | | | |
| | Compact occasional boulders | | | | | | | | | | | | |
| 80.2 | | | 3 | SS | 8 | | | | | | | | |
| 2.4 | | | 4 | SS | 7 | | | | | | | | |
| | Silty Sand with gravel, some to trace clay to silty clay with sand and gravel occasional boulders | | | | | | | | | | | | |
| | Firm to Hard (Glacial Till) | | 5 | SS | 27 | | | | | | | | |
| 76.2 | | | 6 | SS | 100/11 cm | | | | | | | | |
| 6.4 | End of Borehole | | | | | | | | | | | | |
| | Refusal to Auger Probable Bedrock | | | | | | | | | | | | |

FOR INFORMATION ONLY

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

| RECORD OF BOREHOLE No 6A | | | | | | | | | | METRIC | | | | | |
|--------------------------|--|--|---------|------|------------|----------------------------|-----------------|---|----|--------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| W P 187-79-03 | | LOCATION Sta. 11 + 504.4; O/S 26.6 m LT & Hwy. 2 | | | | ORIGINATED BY BR | | | | | | | | | |
| DIST 7 HWY 2 | | BOREHOLE TYPE Hollow Stem Auger | | | | COMPILED BY DT | | | | | | | | | |
| DATUM Geodetic | | DATE 84 09 06 | | | | 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 Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | | | | | |
| 83.0 | Ground Surface | | | | | | | | | | | | | | |
| 0.0 | Silty Clay some organics Firm to Stiff | | 1 | SS | 6 | | | | | | | | | | |
| 81.2 | | | 2 | SS | 11 | | | | | | | | | | |
| 1.8 | Silty Clay Firm | | 3 | SS | 8 | | | | | | | | | | |
| 80.6 | | | 4 | SS | 46 | | | | | | | | | | |
| 2.4 | Silty Sand some clay trace gravel to Silty Clay with sand and gravel occasional boulders Firm to Hard (Glacial Till) | | 5 | SS | 24 | | | | | | | | | | |
| 76.6 | | | 6 | SS | 70 | 12 cm | | | | | | | | | 8 40 42 10 |
| 6.4 | End of Borehole Refusal to Auger Probable Bedrock | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

FOR INFORMATION ONLY

+³, x⁵: Numbers refer to Sensitivity
20
15 \pm 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Communications

CONY 87-27

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

**ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION**

WP 187-79-03

DIST 7

HWY 2

STR SITE 21-6-188

Wilmot Creek Bridge

DISTRIBUTION

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FOUNDATION INVESTIGATION REPORT

For

Wilmot Creek Structure

W.P. 187-79-03, Hwy. 2

District 7, Port Hope

INTRODUCTION

This report summarizes the factual information obtained from a foundation investigation carried out at the above noted site between 85 04 12 and 85 04 16. The fieldwork consisted of 5 sampled boreholes advanced by means of hollow stem augers and BXL rock coring equipment. The depth of the boreholes ranged from 8.4 m to 12.4 m. Bedrock was proven in 2 boreholes (BH 1, BH 4) by obtaining 1.5 m rock cores.

In 1984, an investigation consisting of 5 sampled boreholes and one cone penetration test was carried out at the existing Wilmot Creek crossing of Hwy. 2 approximately 85 m east of this proposed structure site. The locations of the 1984 investigation boreholes (1A - 6A) are shown on Dwg. No. 1877903-A and the log sheets are included in the Appendix. This information is provided for reference only and is not used for the description of the subsurface conditions at this proposed site.

SITE DESCRIPTION

The site is located east of the intersection of Hwy. 35/115 and Hwy. 2 and approximately 85 m west of the existing Wilmot Creek crossing of Hwy. 2. The site is situated in the Township of Clarke, County of Durham.

The site is located in the physiographic region known as the Iroquois Plain which typically exhibits level to gently undulating topography. The area is characterized by glaciolacustrine sediments deposited by the glacial Lake Iroquois. The bedrock underlying the site is generally a limestone and shale of the Lindsay Formation.

SUBSURFACE CONDITIONS

General

The existing embankment fill, where present, consists of a silty clay with sand, trace gravel. Underlying this fill is generally a thin veneer of organic silt which probably represents the original topsoil across the site. Below this original organic deposit is generally a relatively thin seam of sandy gravel. Underlying the sandy gravel is a silty clay deposit which in turn overlies a silt and sand mixture. Beneath this non-cohesive deposit is the limestone and shale bedrock of the Lindsay Formation.

The boundaries of the subsoil types, insitu and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix. The location and ground elevation of each borehole are shown on Dwg. No. 1877903-A, together with stratigraphical sections.

The description of the various soils encountered at this site are described as follows:

FILL

Fill used for the grading of Hwy. 2 was encountered in BH 1, BH 2, BH 3 and BH 4. The height of the fill ranged from 2.1 m to 2.9 m and was found to overlie the original topsoil.

The results of Atterberg Limits testing carried out on 5 samples of this cohesive material are plotted on Fig. 1 and indicate that the fill is generally composed of a silty clay of low plasticity (CL group).

Generally, the moisture content of this fill ranges from 11 to 19%, however, one sample tested (BH 2, #3) indicated a moisture content of 41%.

No field or lab shear tests were conducted on this fill material. Based on Standard Penetration test 'N' values of 5-10 blows /0.3 m, the fill has a medium degree of compaction and could be considered to be in a firm state.

The results of grain size distribution tests carried out on 4 samples of this material are shown on Fig. 2 and are summarized as follows:

| | <u>Range</u> |
|--------|--------------|
| Clay | 6 - 28% |
| Silt | 39 - 68% |
| Sand | 12 - 37% |
| Gravel | 0 - 21% |

ORGANIC SILT

Dark brown to black organic silt with traces of wood and roots was encountered in all boreholes with the exception of BH 2. In BH 1, BH 2 and BH 3 this organic

deposit was found to underlie the silty clay fill, and ranged in thickness from 0.3 m to 0.8 m. in BH 5 where no fill was placed this slightly cohesive organic material was found as the surficial deposit and had a thickness of 0.9 m. No testing was conducted on any samples of this material.

SANDY GRAVEL

Waterbearing sandy gravel was encountered in each of the 5 boreholes. Generally the deposit was found to underlie the original topsoil across the site. This non-cohesive deposit varied in thickness from 1.8 to 2.1 m and is generally found at a depth of 2.9 m with the exception of BH 1 where the depth was found to be 0.9 m.

The results of grain size distribution tests carried out on 3 samples of this material are shown on Fig. 3 in the Appendix. Based on these results it is evident that this sandy gravel contains a trace of clay and some silt. The results of the 3 tested samples are follows:

| | <u>Range</u> |
|--------|--------------|
| Gravel | 44 - 56% |
| Sand | 26 - 37% |
| Silt | 7 - 15% |
| Clay | 2 - 20% |

Based on Standard Penetration Test 'N' values generally between 28 and 32 blows/0.3 m, this granular deposit is in a compace state. In BH 5, 'N' values were between 9 and 11 blows/0.3 m indicating the material to be in a loose to compact state.

It is to be noted that in this type of deposit, cobbles may be encountered.

SILTY CLAY

A grey silty clay deposit was encountered in all boreholes. This cohesive deposit was found to underlie the sandy gravel deposit and varied in thickness

from 3.0 to 3.8 m. This material was found at a depth of 2.9 to 4.1 m corresponding to an elevation of 80.6 to 81.7 m.

Results of Atterbreg Limits testing conducted on 7 samples of this material are shown on Fig 4 in the Appendix. The results can be summarized as follows:

| | | <u>Range</u> |
|------------------|-------------------|--------------|
| Moisture Content | (W) | 8.0 - 19.0% |
| Liquid Limit | (W _L) | 12.0 - 28.5% |
| Plastic Limit | (W _p) | 10.5 - 14.0% |
| Plasticity Index | (I _p) | 1.5 - 14.5% |

The results indicate that this silty clay is generally of low plasticity (CL to CL-ML group).

Results of Grain Size Distribution testing carried out on 4 samples of this material are shown in envelope form on Fig. 5 in the Appendix. Based on the grain size distribution this deposit can be considered generally as a silty clay, some sand, trace gravel.

Based on Standard Penetartation Test 'N' values ranging from 8 to 18 blows/0.3 m, it is estimated that this material is in a stiff to very stiff state.

It is to be noted that within the silty clay stratum in BH 3, a 0.8 m± non-cohesive seam of waterbearing silty sand was encountered. The lateral extent of this seam was not investigated.

SILT & SAND

A grey silt and sand mixture was encountered in all boreholes immediately underlying the silty clay deposit. The thickness of this stratum ranged from 2.8 m to 3.6 m, and was found at a depth ranging from 5.6 m in BH 5 to 7.5 m in BH 1. In all cases, this silt and sand deposit was found to immediately overlie the limestone and shale bedrock.

Grain Size Distribution testing was conducted on 6 samples of the material and the results are shown in envelope form on Fig. 6 in the Appendix.

The results can also be summarized as follows:

| | <u>Range</u> |
|--------|--------------|
| Gravel | 4 - 17% |
| Sand | 24 - 52% |
| Silt | 30 - 56% |
| Clay | 10 - 15% |

Based on the distribution this material can be considered to be a heterogeneous mixture of silt and sand, some gravel, and clay.

Based on Standard Penetration Test 'N' values ranging from 3 to 97 blows/0.3 m, this material has a denseness ranging from very loose to very dense. However it is possible that the lower 'N' values were obtained as a result of the sampling procedures (unbalanced hydro-static pressure was present) and consequently may not accurately indicate the denseness of this material.

A characteristic of this stratum was that in the upper zones the deposit was slightly cohesive. However, with depth the material became totally non-cohesive. In addition, thin seams of sand were evident as were zones of higher sand contents. Occasional cobbles and boulders may also be encountered in this deposit.

BEDROCK

Bedrock at the site was proven in two boreholes (BH 1 and BH 4) by coring 1.5 m into the rock. In the remaining 3 boreholes, augering was advanced to refusal which in this case is considered to be the bedrock surface.

Bedrock at the site was found approximately 8.5 m below the natural ground surface and between 10 and 11 m below the existing embankment fill. This corresponds to a bedrock elevation of between 74.5 and 75.1.

Bedrock at this location consists of black limestone and shale of the Lindsay Formation. The upper 0.3 - 0.4 m of this formation is slightly weathered across the site. Below this the bedrock is in unweathered condition.

A description of the recovered rock core, prepared by MTC Geologist E. R. Magni, is included in the Appendix.

GROUNDWATER CONDITIONS

The groundwater level was determined by measuring in the cased boreholes immediately after the boreholes were completed. In the two measurements made the groundwater was found to be at Elev. 82.5±.

Given the nature of the subsoils across this site, it was not possible to take stabilized measurements in the open boreholes after 24 hours since the boreholes caved-in. However, it is believed that the measurements made give a realistic indication of the level at the immediate vicinity of the site.

memorandum



To: Mr. G. C. E. Burkhardt,
Head,
Structural Section,
1st Floor, 5000 Yonge Street
Central Region

Date: 86 02 13

From: Engineering Materials Office,
Foundation Design Section,
Central Building, Rm. 315

Re: W. P. 187-79-03, Site: 21-06-188
Hwy. #2, District #7, Port Hope
Wilmot Creek Structure

It is understood that a reinforced concrete rigid frame structure will be constructed at this site.

Under such circumstances, where the deflection of the abutment is prevented by the propping action of the deck, the at-rest (ko) earth pressures should be used.

A handwritten signature in black ink, appearing to read "L. Politano", with a long horizontal stroke extending to the right.

L. Politano,
Project Foundation Engineer

for
M. Devata, P. Eng.,
Chief Foundations Engineer
(East)

LP:ma

RECOMMENDATIONS

It is proposed to construct a single span (± 13.8 m) reinforced concrete rigid frame type structure approximately 85 m west of the existing Wilmot Creek crossing. The existing crossing will be demolished and Wilmot Creek will be realigned. In order to proceed with this scheme two detours will be required. The existing grade will not be altered.

The following are the foundation recommendations for the design and construction of the above-noted project:

1.0 STRUCTURE FOUNDATIONS

1.1 The structure can be founded on steel H - piles driven to bedrock. The following can be used

| | |
|------------|---------------------------|
| HP 310x110 | 1600 KN at U.L.S. |
| | 1150 KN at S.L.S. Type II |

| | |
|-----------|--------------------------|
| HP 310x79 | 1150 KN at U.L.S. |
| | 850 KN at S.L.S. Type II |

For estimating purposes, it can be assumed that bedrock at the location of the abutments is located at Elev. 74.5 at the west side and Elev. 74.8 at the east side.

1.2 Pile tips should be reinforced

1.3 For frost protection earth cover of 1.3 m or equivalent is required

1.4 Backfill to structures should consist of granular material in accordance with MTC Standard Special Provision #121 (Oct 1983). Computation of earth pressures should be in accordance with Section 6.6.1.2 of the 1983 C.H.B.D.C.

For design purposes, the physical properties of the backfill are as follows:

| | | |
|----------|-----|------------------------|
| Gran 'A' | 35° | 22.0 Kn/m ³ |
| Gran 'B' | 30° | 21.2 Kn/m ³ |

- 1.5 ~~K_a~~ conditions apply to the design of the abutments.

K_a → frame structure to be incorporated here *86-02-13*
See memo *86-02-13*

- 1.6 No dewatering problems are anticipated provided that excavations do not extend into the non-cohesive deposits below Elev. 82.5±.

2.0 STABILITY

- 2.1 No stability problems are anticipated for permanent slopes of 2:1.

- 2.2 Temporary slopes above the groundwater level will be stable at 1.5:1.

- 2.3 All new fill should be benched into the existing as per MTC standards.

- 2.4 Any fill placed below 0.3 m above the prevailing groundwater level should consist of free-draining granular material.

- 2.5 All surficial organic and/or soft material should be removed within the plan limits of the proposed fill and within 10 m back of the abutments prior to placing fill material.

3.0 DETOURS

- 3.1 With the exception of the topsoil, the soil along the alignment of the proposed detours is generally competent and anticipated settlements are negligible for the detour fills.

- 3.2 Embankment slopes should be constructed at 2H:1V

- 3.3 Any fill used for the detours placed below 0.3 m above the prevailing groundwater level should consist of free draining granular material.

4.0 CREEK CHANNEL

- 4.1 Material used to fill the existing creek channel below 0.3 m above the prevailing groundwater level should consist of free-draining, granular material. Especially in the areas under Hwy. 2, Detour 2, or future construction (eg. Parking Lot) the material should be well compacted.
- 4.2 A seal of well-compacted cohesive material (CI-CH group) should be provided across the original creek channel at the point where the new alignment occurs upstream. This seal will prevent seepage of water through its original course.

The seal should be placed across the full cross-section of the original channel and have a minimum thickness of 2 m.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of L. Politano (Project Foundations Engineer) and S. Winchester (Student Engineer), utilizing equipment owned and operated by Atcost Soil Drilling Inc, of Concord, Ont. This report was prepared by L. Politano and reviewed by M. Devata, Chief Foundations Engineer (East).



A handwritten signature in cursive script, reading "L. Politano", followed by a horizontal line.

L. Politano, P. Eng.
Project Foundations Engineer

A handwritten signature in cursive script, reading "M. Devata".

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

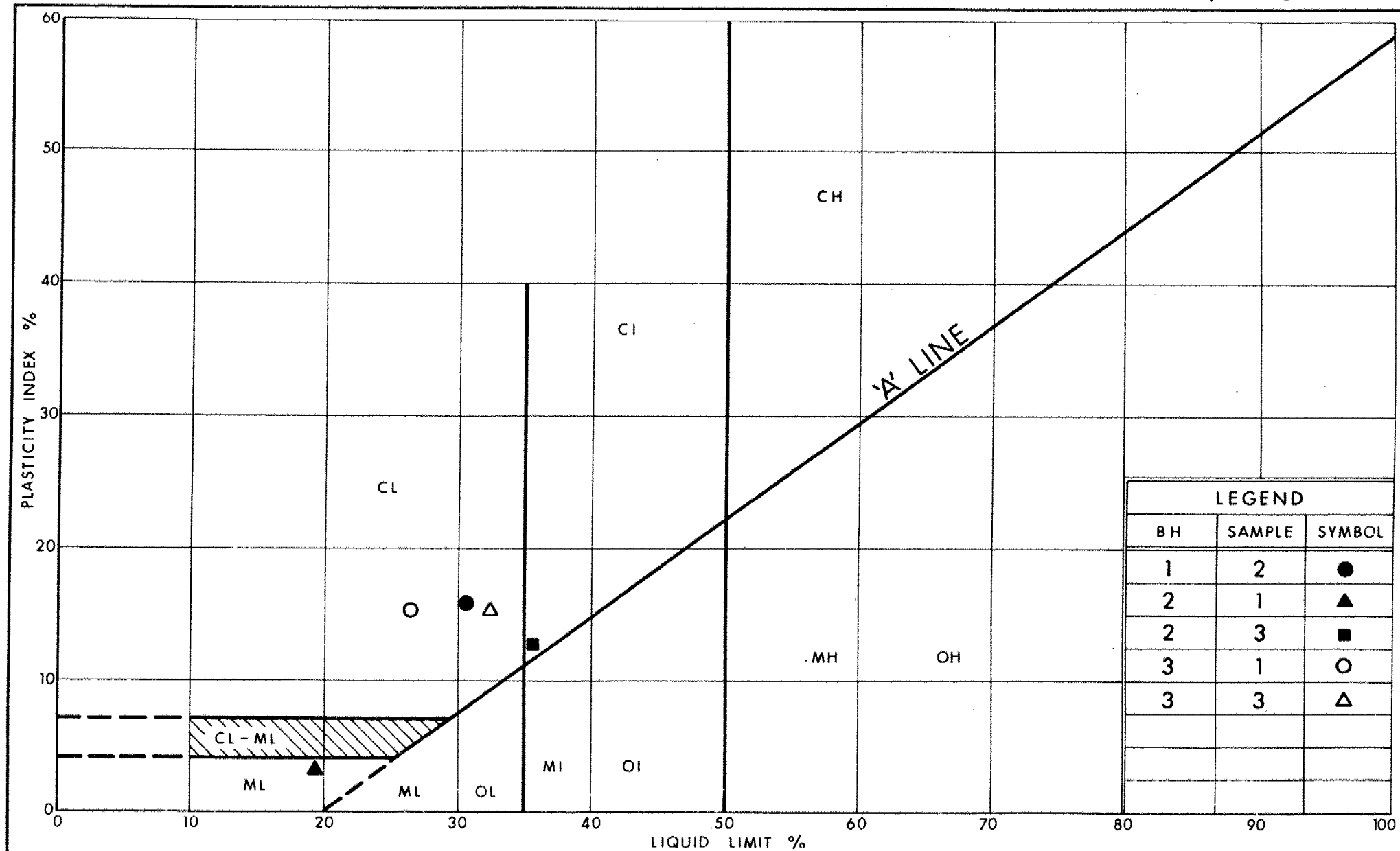
July 1985

A P P E N D I X

DESCRIPTION OF ROCK CORE - W.P. 187-79-03

| BOREHOLE NUMBER | | | | CORE DESCRIPTION | |
|--------------------|-------------|--------|---------|------------------|--|
| | DEPTH (m) | % CR * | % RQD * | DEPTH (m) | DESCRIPTION |
| 1 | 10.88-12.41 | 100 | 90 | 10.88-11.13 | Limestone (60%), slightly weathered, closely spaced joints, with shale and shaley limestone (40%), black, slightly weathered |
| | | | | 11.13-12.41 | Limestone (95%), unweathered, widely spaced joints, with shale partings (5%) |
| 4 | 9.97-11.49 | 100 | 71 | 9.97-10.36 | Limestone (60%), slightly weathered, closely spaced joints, with shale (40%), black, slightly weathered |
| | | | | 10.36-11.49 | Limestone (60%), unweathered, medium spaced joints, with shale and shaley limestone (40%), black, unweathered |
| | | | | | |

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION



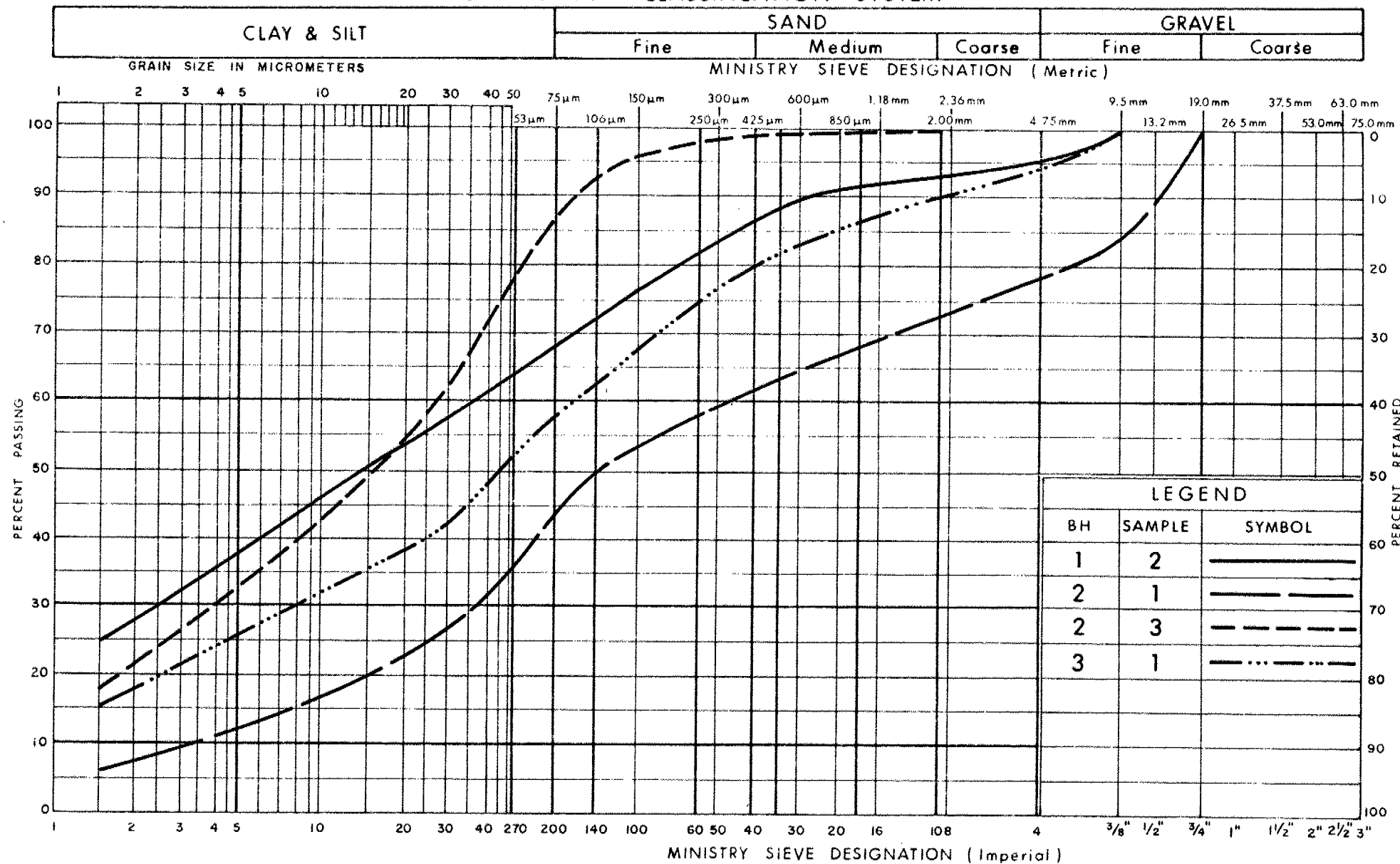
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Communications

PLASTICITY CHART SILTY CLAY WITH SAND TRACE OF GRAVEL (FILL)

FIG No 1

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



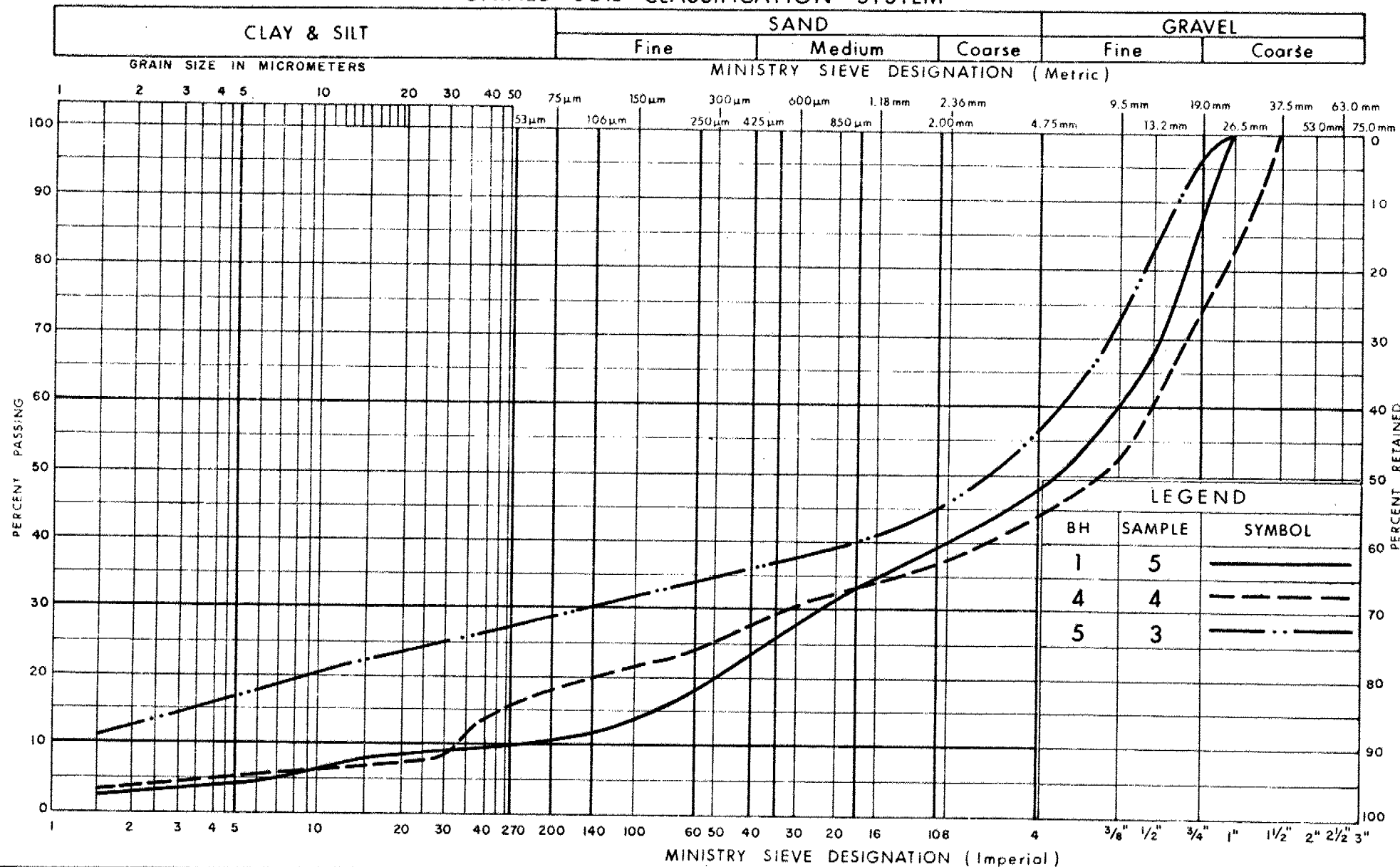
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Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY WITH SAND TRACE OF GRAVEL
(FILL)

FIG No 2

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM

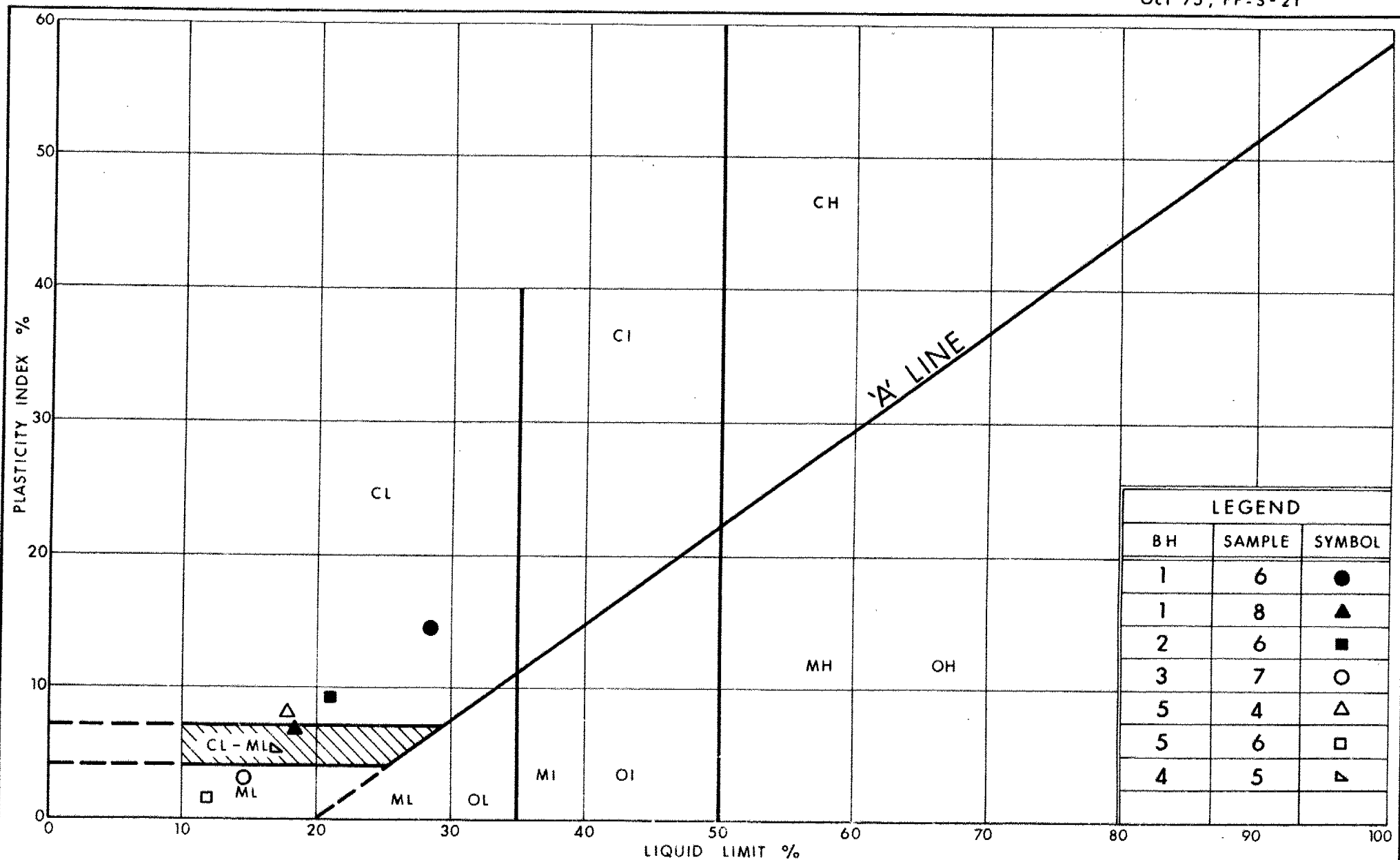


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GRAIN SIZE DISTRIBUTION
SANDY GRAVEL SOME SILT TRACE OF CLAY

FIG No 3

W P 187-79-03



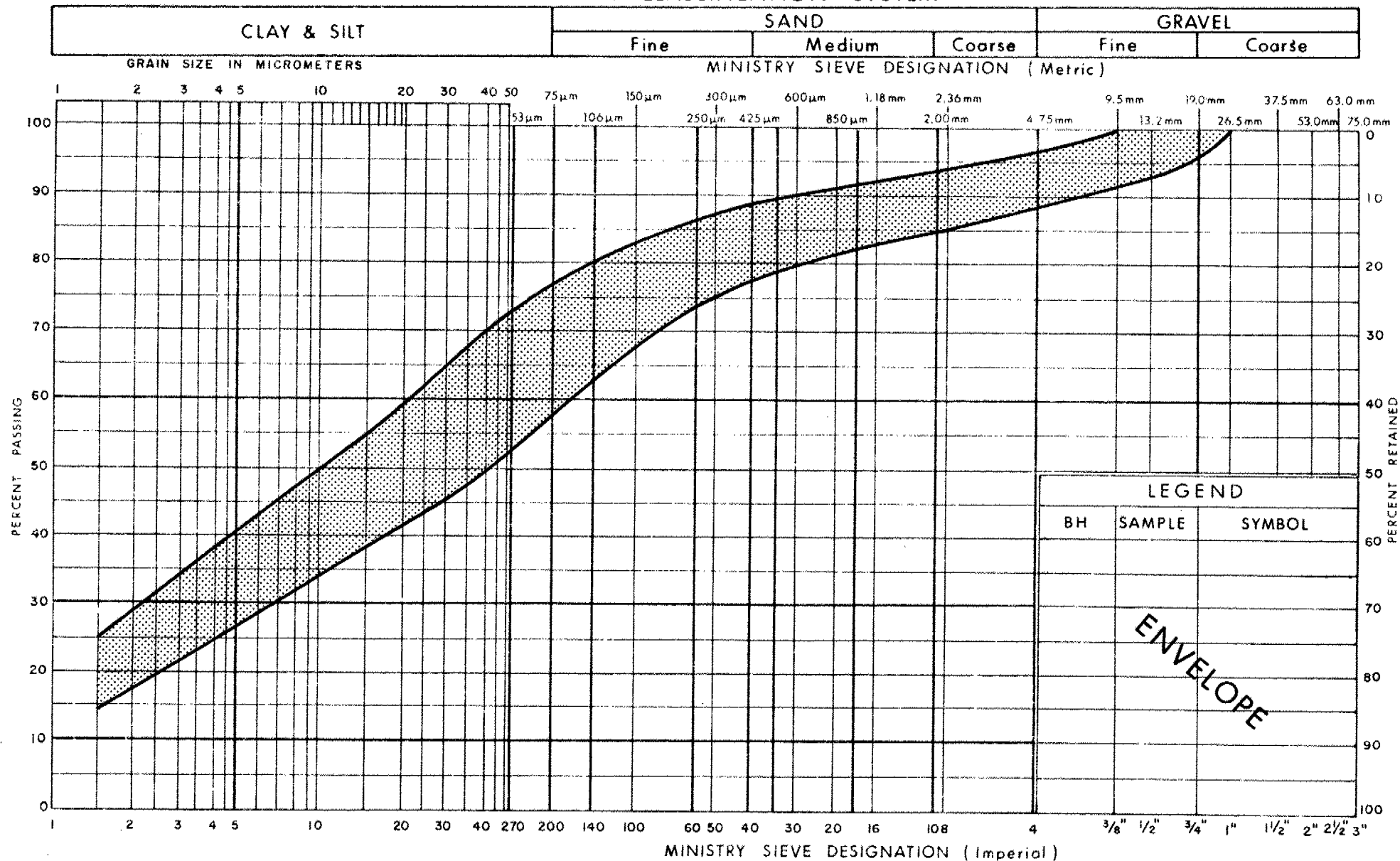
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Communications

PLASTICITY CHART SILTY CLAY SOME SAND TRACE OF GRAVEL

FIG No 4

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



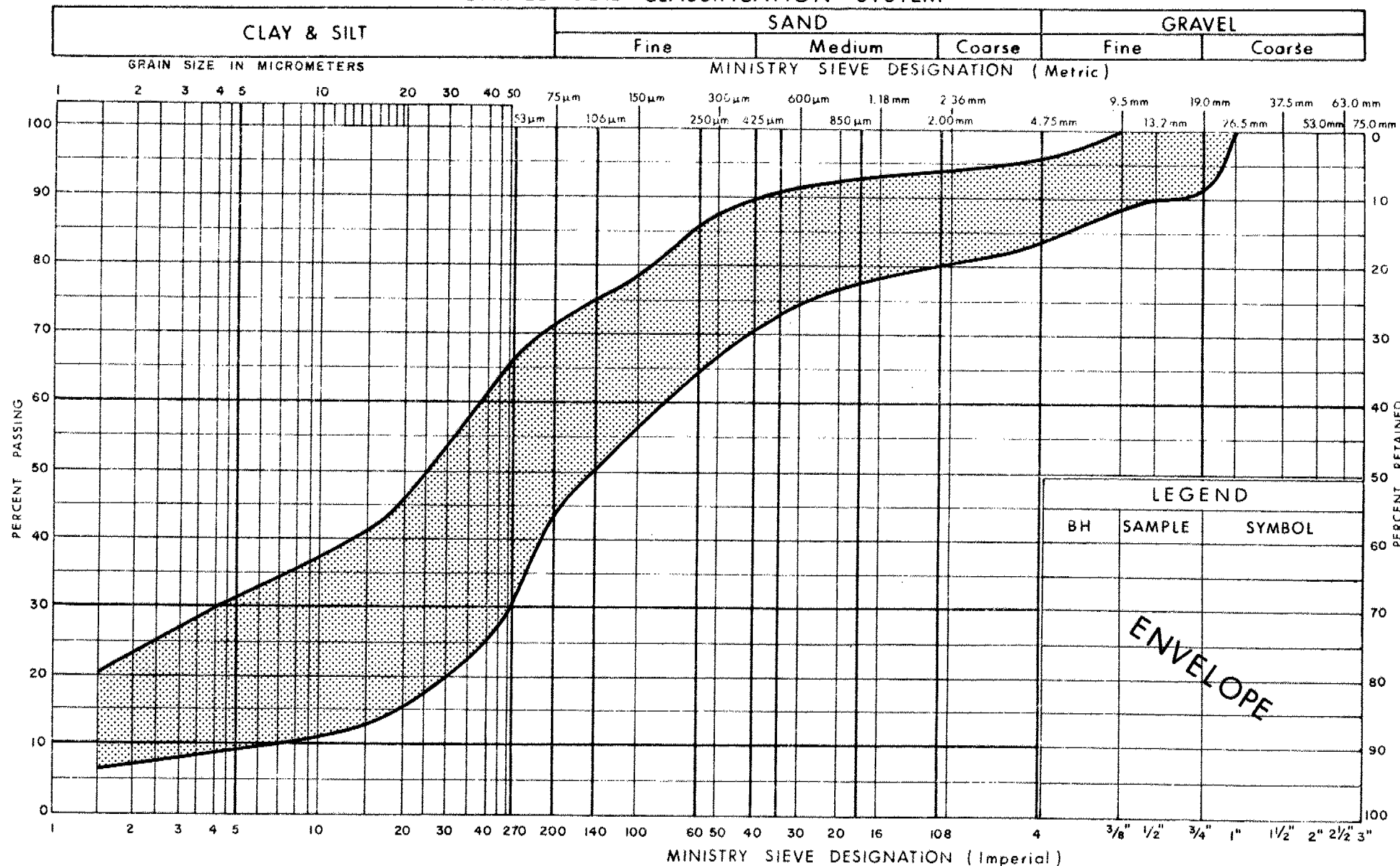
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GRAIN SIZE DISTRIBUTION
SILTY CLAY SOME SAND TRACE OF GRAVEL

FIG No 5

W P 187-79-03

UNIFIED SOIL CLASSIFICATION SYSTEM



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Communications

GRAIN SIZE DISTRIBUTION
SILT & SAND SOME GRAVEL AND CLAY

FIG No 6

W P 187-79-03

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 |

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'_{v0} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

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 |

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 | | | | | | |

RECORD OF BOREHOLE No 1

METRIC

W P 187-79-03

LOCATION Sta. 11+408.1; O/S 6.0 m RT & Hwy. 2

ORIGINATED BY SW

DIST 7

HWY 2

BOREHOLE TYPE Hollow Stem Auger, BXL Core and Cone Test

COMPILED BY SW

DATUM Geodetic

DATE 85 04 12

CHECKED BY SP

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|-----------|-------------|----------------------------|--------------------|---|---------------------------------|---|--|--|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | W _p W W _L | WATER CONTENT (%) | | | | |
| 85.4 | Ground Level | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Fill | | 1 | SS | 9 | | 85 | | | | | | | 4 29 39 28 |
| | Silty Clay some sand trace gravel Firm to Stiff | | 2 | SS | 5 | | 84 | | | | | | | |
| | Brown | | 3 | SS | 10 | | | | | | | | | |
| 82.3 | | | | | | | | | | | | | | |
| 2.1 | Organic silt | | 4 | SS | 9 | | 83 | | | | | | | |
| 82.5 | Stiff Black | | 5 | SS | 28 | | 82 | | | | | | | 52 37 9 2 |
| 2.9 | Sandy gravel, trace silt, clay Compact Brown | | 6 | SS | 18 | | | | | | | | | |
| 81.7 | | | | | | | | | | | | | | |
| 3.7 | Silty Clay some sand trace gravel | | 7 | SS | 4 | | 81 | | | | | | | |
| | Firm to Very Stiff | | 8 | SS | 14 | | 80 | | | | | | | |
| | Grey | | 9 | SS | 10 | | 79 | | | | | | | 3 21 47 29 |
| 77.9 | | | | | | | | | | | | | | |
| 7.5 | Silt and Sand Mixture | | 10 | SS | 7 | | 78 | | | | | | | |
| | some gravel | | 11 | SS | 17 | | 77 | | | | | | | 11 32 43 14 |
| | trace clay | | 12 | SS | 45 | | 76 | | | | | | | |
| | Loose to Very Dense | | 13 | SS | 97 | 75 | | | | | | | 16 41 34 9 | |
| | Grey | | 14 | SS | 90/15 cm | | | | | | | | | |
| 74.5 | | | | | | | | | | | | | | |
| 10.9 | Bedrock (Limestone & Shale) | | 15 | BXL RC | 100% REC | | 74 | | | | | | RQD = 90% | |
| 73.0 | | | | | | | | | | | | | | |
| 12.4 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 2

METRIC

W P 187-79-03 LOCATION Sta. 11 + 408.1; O/S 6.7 m LT & Hwy. 2
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger
DATUM Geodetic DATE 85 04 16
ORIGINATED BY SW
COMPILED BY SW
CHECKED BY SP

OFFICE REPORT ON SOIL EXPLORATION

| 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 | SHEAR STRENGTH | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | 10 20 30 | | | | | |
| 85.4 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | * | 85 | | | | | | | |
| | Silty Clay with sand, some gravel to silty clay some sand | | 1 | SS | 6 | | 84 | | | | | | | 21 34 39 6 |
| | Firm | | 2 | SS | 7 | | | | | | | | | |
| | Brown | | 3 | SS | 5 | | 83 | | | | | | | 0 12 68 20 |
| 82.5 | | | | | | | | | | | | | | |
| 2.9 | sandy gravel, some silt, clay | | 4 | SS | 32 | | 82 | | | | | | | |
| 81.7 | Dense Brown | | | | | | | | | | | | | |
| 3.7 | | | 5 | SS | 15 | | 81 | | | | | | | |
| | Silty Clay | | | | | | | | | | | | | |
| | some sand | | 6 | SS | 10 | | 80 | | | | | | | 10 24 44 21 |
| | trace gravel | | | | | | | | | | | | | |
| | Stiff | | | | | | | | | | | | | |
| | Grey | | 7 | SS | 11 | | 79 | | | | | | | |
| 78.2 | | | | | | | | | | | | | | |
| 7.2 | | | 8 | SS | 9 | | 78 | | | | | | | |
| | Silt and Sand Mixture | | | | | | | | | | | | | |
| | trace gravel | | | | | | 77 | | | | | | | |
| | clay | | | | | | | | | | | | | |
| | Loose to Very Dense | | 9 | SS | 25 | | 76 | | | | | | | |
| | Grey | | | | | | | | | | | | | |
| 74.6 | | | 10 | SS | 100 | 2 cm | 75 | | | | | | | 6 44 40 10 |
| 10.8 | End of Borehole | | | | | | | | | | | | | |
| | Refusal to Auger Probable Bedrock | | | | | | | | | | | | | |
| | * Groundwater Level not Established | | | | | | | | | | | | | |

+³, x⁵: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 187-79-03 LOCATION Sta. 11 + 430.0; O/S 6.0 m RT & Hwy. 2
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger
DATUM Geodetic DATE 85 04 15
ORIGINATED BY SW
COMPILED BY SW
CHECKED BY *CP*

OFFICE REPORT ON SOIL EXPLORATION

| 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 | SHEAR STRENGTH | | | | | | | WATER CONTENT (%) | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | | | |
| 85.0 | Ground Level | | | | | | | | | | | | | | GR SA SI CL | | | | |
| 0.0 | Fill Silty Clay with sand trace gravel Firm Brown | | 1 | SS | 5 | * | 84 | | | | | | | | 7 36 39 18 | | | | |
| | | | 2 | SS | 6 | | 83 | | | | | | | | | | | | |
| 82.1 | Organic Silt | | 3 | SS | 8 | | 82 | | | | | | | | | | | | |
| 2.9 | Sandy Gravel some silt, clay | | 4 | SS | 28 | | 81 | | | | | | | | | | | | |
| 81.3 | Compact Brown | | 5 | SS | 15 | | 80 | | | | | | | | 11 43 29 17 | | | | |
| 3.7 | Silty Clay and sand, some gravel Silty Sand some gravel clay Stiff | | 6 | SS | 9 | | 79 | | | | | | | | | | | | |
| 77.8 | | | 7 | SS | 9 | | 78 | | | | | | | | | | | | |
| 7.2 | Silt and Sand Mixture trace gravel some clay Loose to Compact Grey | | 8 | SS | 5 | | 77 | | | | | | | | 5 24 56 15 | | | | |
| | | | 9 | SS | 15 | | 76 | | | | | | | | | | | | |
| 74.8 | | | | | | | 75 | | | | | | | | | | | | |
| 10.2 | End of Borehole Refusal to Auger Probable Bedrock * Groundwater Level not Established | | | | | | | | | | | | | | | | | | |

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 4

METRIC

W P 187-79-03

LOCATION

Sta. 11 + 431.0; O/S 6.3 m LT & Hwy. 2

ORIGINATED BY SW

DIST 7 HWY 2

BOREHOLE TYPE

Hollow Stem Auger and BXL Core

COMPILED BY SW

DATUM Geodetic

DATE

85 04 15

CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | | |
| 84.9 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | |
| | Silty Clay with sand | | 1 | SS | 8 | | | | | | | | | |
| | trace gravel | | 2 | SS | 6 | | | | | | | | | |
| | Firm | | | | | | | | | | | | | |
| 82.8 | Organic Silt | | | | | | | | | | | | | |
| 2.1 | Silt and Sand | | 3 | SS | 26 | | | | | | | | | |
| | trace gravel, clay | | | | | | | | | | | | | |
| | sandy gravel | | 4 | SS | 28 | | | | | | | | | 56 26 15 3 |
| | some silt | | | | | | | | | | | | | |
| | trace clay | | | | | | | | | | | | | |
| | Compact | | | | | | | | | | | | | |
| 80.8 | | | | | | | | | | | | | | |
| 4.1 | Silty Clay | | 5 | SS | 6 | | | | | | | | | 12 31 36 21 |
| | with sand | | | | | | | | | | | | | |
| | some gravel | | | | | | | | | | | | | |
| | Firm to | | 6 | SS | 16 | | | | | | | | | |
| | Very Stiff | | | | | | | | | | | | | |
| | Grey | | | | | | | | | | | | | |
| 77.8 | | | | | | | | | | | | | | |
| 7.1 | Silt and | | 7 | SS | 3 | | | | | | | | | 17 33 40 10 |
| | Sand Mixture | | | | | | | | | | | | | |
| | some gravel | | | | | | | | | | | | | |
| | trace clay | | | | | | | | | | | | | |
| | Loose to | | | | | | | | | | | | | |
| | Compact | | | | | | | | | | | | | |
| | gravel | | 8 | SS | 33 | | | | | | | | | |
| | Grey | | | | | | | | | | | | | |
| 74.9 | | | | | | | | | | | | | | |
| 10.0 | Bedrock | | 9 | BXL | 100% | | | | | | | | | RQD = 71% |
| | (Limestone and | | | RC | REC | | | | | | | | | |
| | Shale) | | | | | | | | | | | | | |
| 73.4 | | | | | | | | | | | | | | |
| 11.5 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 10 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

METRIC

W P 187-79-03 LOCATION Sta. 11 + 416.0; O/S 16.5 m LT & Hwy. 2 ORIGINATED BY SW
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY SW
DATUM Geodetic DATE 85 04 16 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | WATER CONTENT (%) 10 20 30 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|--|---------------------------------|-------------------------------------|-----------------------------------|-------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | | | | |
| 83.5 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | Organic Silt some sand | | | | | * | 83 | | | | | | | | |
| 82.6 | | | | | | | 82 | | | | | | | | |
| 0.9 | Sandy gravel trace silt some clay | | 1 | SS | 24 | | | | | | | | | | |
| | Compact | | 2 | SS | 11 | | | | | | | | | | |
| | | | 3 | SS | 9 | | 81 | | | | | | | | 44 29 7 20 |
| 80.6 | | | | | | | | | | | | | | | |
| 2.9 | Silty Clay with sand | | 4 | SS | 16 | | 80 | | | | | | | | |
| | trace gravel | | 5 | SS | 14 | | | | | | | | | | |
| | Stiff Grey | | 6 | SS | 8 | | 79 | | | | | | | | 3 37 26 34 |
| 77.9 | | | | | | | 78 | | | | | | | | |
| 5.6 | Silt and Sand Mixture | | 7 | SS | 3 | | 77 | | | | | | | | 4 52 30 14 |
| | trace gravel some clay | | | | | | | | | | | | | | |
| | Very Loose to Dense Grey | | 8 | SS | 38 | | 76 | | | | | | | | |
| 75.1 | | | | | | | | | | | | | | | |
| 8.4 | End of Borehole Refusal to Auger Probable Bedrock | | | | | | | | | | | | | | |
| | * Groundwater Level Not Established | | | | | | | | | | | | | | |

+³, x⁵: Numbers refer to Sensitivity 20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 1A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 486.0; O/S 6.0 m RT of Hwy. 2 ORIGINATED BY DT
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 10 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 | 20 40 60 80 100 | | | | | |
| 85.3 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill Silty Clay trace organics Very Stiff to Stiff Brown | | 1 | SS | 25 | * | 85 | | | | | | | |
| | | | 2 | SS | 13 | | 84 | | | | | | | |
| 82.5 | | | | | | | 83 | | | | | | | |
| 2.8 | Organic Silt Topsoil Stiff Black | | 3 | SS | 9 | | 82 | | | | | | | |
| 81.4 | | | | | | | 81 | | | | | | | |
| 3.9 | Silty Clay with sand and gravel to Silty Sand some gravel trace clay Firm to Hard (Glacial Till) | | 4 | SS | 20 | | 80 | | | | | | | |
| | | | 5 | SS | 7 | | 79 | | | | | | | |
| | | | 6 | SS | 58 | | 78 | | | | | | | |
| | | | | | | | 77 | | | | | | | |
| 76.1 | | | | | | | 76 | | | | | | | |
| 75.9 | Shale Bedrock Weathered | | 7 | SS | 100/15 cm | | | | | | | | | |
| 9.4 | End of Borehole Refusal to Auger * Water Table not observed | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 524.7; O/S 6.2 m RT & Hwy. 2 ORIGINATED BY DT
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 10 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 Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH | | | | | |
| 85.3 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Fill Silty Clay trace organics Stiff to Very Stiff | | 1 | SS | 12 | | 85 | | | | | | | |
| | | | 2 | SS | 10 | | 84 | | | | | | | |
| 82.4 | | | 3 | SS | 18 | | 83 | | | | | | | |
| 2.9 | Sand with gravel some silt occasional boulders Dense | | 4 | SS | 48 | | 82 | | | | | | | 25 47 24 4 |
| 81.2 | | | | | | | | | | | | | | |
| 4.1 | Silty Clay Stiff | | 5 | SS | 15 | | 81 | | | | | | | |
| 79.8 | | | | | | | 80 | | | | | | | |
| 5.5 | Silty Sand some gravel trace clay to Silty Clay with sand and gravel Hard occasional boulders (Glacial Till) | | 6 | SS | 58 | | 79 | | | | | | | |
| | | | | | | | 78 | | | | | | | |
| | | | 7 | SS | 37 | | 77 | | | | | | | 20 40 33 7 |
| 76.1 | | | | | | | | | | | | | | |
| 9.2 | End of Borehole Refusal to Auger Probable Bedrock | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 514.3; O/S 8.6 m LT & Hwy. 2 ORIGINATED BY BR
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 06 CHECKED BY *CP*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|----------------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 83.2 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Clay with sand to silty sand some organics Firm | | 1 | SS | 8 | | 83 | | | | | | | |
| 81.2 | | | 2 | SS | 6 | | 82 | | | | | | | 0 49 47 4 |
| 2.0 | Silty Clay some sand Stiff to Very Stiff | | 3 | SS | 22 | | 81 | | | | | | 47.5% | |
| 79.4 | | | 4 | SS | 12 | | 80 | | | | | | | |
| 3.8 | Silty Sand some gravel trace clay to Silty Clay with sand and gravel occasional boulders Hard (Glacial Till) | | 5 | SS | 55 | | 79 | | | | | | | |
| 75.7 | | | 6 | SS | 39 | | 78 | | | | | | | |
| 75.7 | | | | | | | 77 | | | | | | | 24 37 32 7 |
| 75.7 | End of Borehole | | | | | | 76 | | | | | | | |
| 7.5 | Refusal to Auger Probable Bedrock | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 489.0; O/S 15.0 m LT & Hwy. 2 ORIGINATED BY BR
DIST 7 HWY 2 BOREHOLE TYPE Cone Penetration Test COMPILED BY DT
DATUM Geodetic DATE 84 09 06 CHECKED BY *CP*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|------------------|------------|---------|------|------------|-------------------------|-----------------|---|---|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 82.2 | Ground Surface | | | | | | | | | | |
| 0.0 | | | | | | | | | | | |
| 78.0 | | | | | | | | | | | |
| 4.2 | End of Cone Test | | | | | | | 100/28 cm | | | |

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 5A

METRIC

W P 187-79-03 LOCATION Sta. 11 + 471.3; O/S 20.0 m LT Hwy. 2
DIST 7 HWY 2 BOREHOLE TYPE Solid Stem & Hollow Stem Auger
DATUM Geodetic DATE 84 09 06
ORIGINATED BY BR
COMPILED BY DT
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 | | | | | |
| 82.6 | Ground Surface | | | | | | | | | | | | | | | | |
| 0.0 | Alluvium | | | | | | | | | | | | | | | | |
| | Silty Sand with gravel | | 1 | SS | 24 | | | | | | | | | | | | |
| | Compact occasional boulders | | 2 | SS | 18 | | | | | | | | | | | | |
| 80.2 | | | | | | | | | | | | | | | | | |
| 2.4 | | | 3 | SS | 8 | | | | | | | | | | | | |
| | Silty Sand with gravel, some to trace clay to silty clay with sand and gravel occasional boulders | | 4 | SS | 7 | | | | | | | | | | | | |
| | Firm to Hard (Glacial Till) | | 5 | SS | 27 | | | | | | | | | | | | |
| 76.2 | | | | | | | | | | | | | | | | | |
| | | | 6 | SS | 100/11 cm | | | | | | | | | | | | |
| 6.4 | End of Borehole | | | | | | | | | | | | | | | | |
| | Refusal to Auger Probable Bedrock | | | | | | | | | | | | | | | | |


+³, x⁵: Numbers refer to
Sensitivity


20
15 ϕ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6A

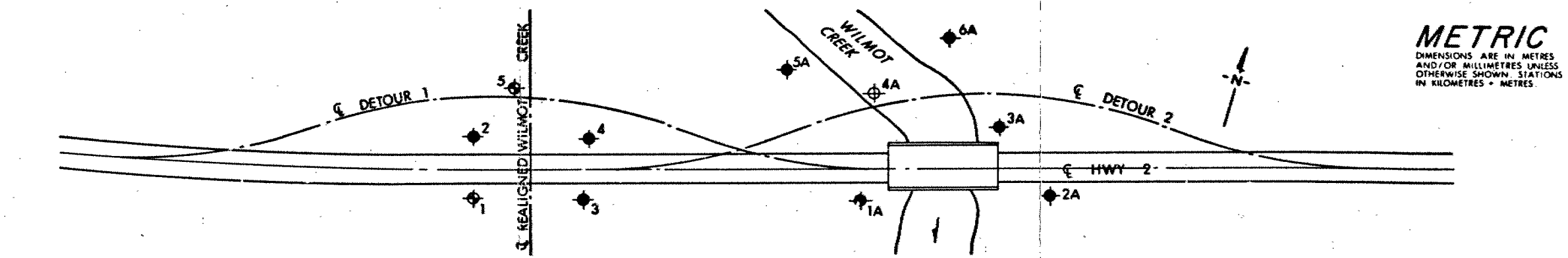
METRIC

W P 187-79-03 LOCATION Sta. 11 + 504.4; O/S 26.6 m LT & Hwy. 2 ORIGINATED BY BR
DIST 7 HWY 2 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DT
DATUM Geodetic DATE 84 09 06 CHECKED BY 

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | NATURAL MOISTURE CONTENT | | | 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 | W _p | W | W _L | | |
| 83.0 | Ground Surface | | | | | | | | | | | | |
| 0.0 | Silty Clay some organics Firm to Stiff |  | 1 | SS | 6 | | | | | | | | |
| 81.2 | | | 2 | SS | 11 | | | | | | | | |
| 1.8 | Silty Clay Firm | | | | | | | | | | | | |
| 80.6 | | | 3 | SS | 8 | | | | | | | | |
| 2.4 | Silty Sand some clay trace gravel to Silty Clay with sand and gravel occasional boulders Firm to Hard (Glacial Till) | | 4 | SS | 46 | | | | | | | | |
| | | | 5 | SS | 24 | | | | | | | | |
| 76.6 | End of Borehole Refusal to Auger Probable Bedrock | | 6 | SS | 70/12 cm | | | | | | | | |

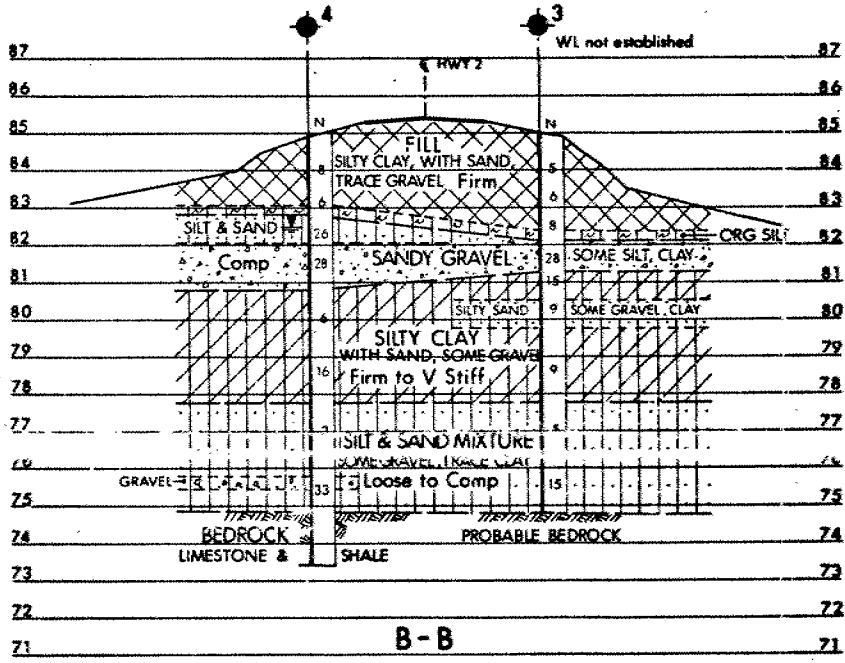
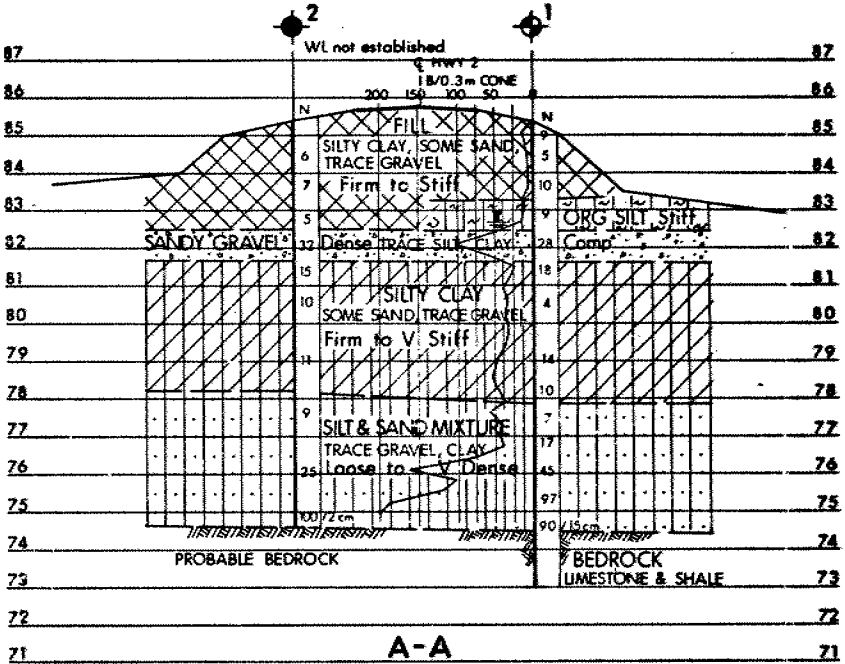
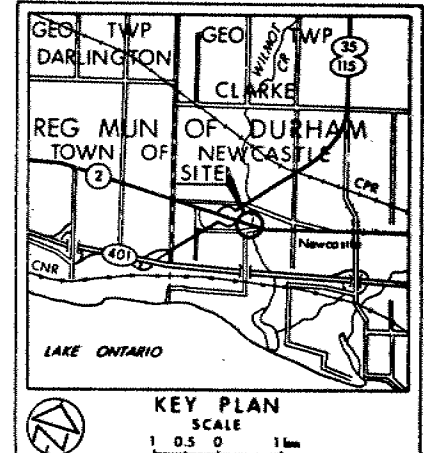
OFFICE REPORT ON SOIL EXPLORATION

+3, x³: Numbers refer to Sensitivity 20
15 5 (%) STRAIN AT FAILURE
10

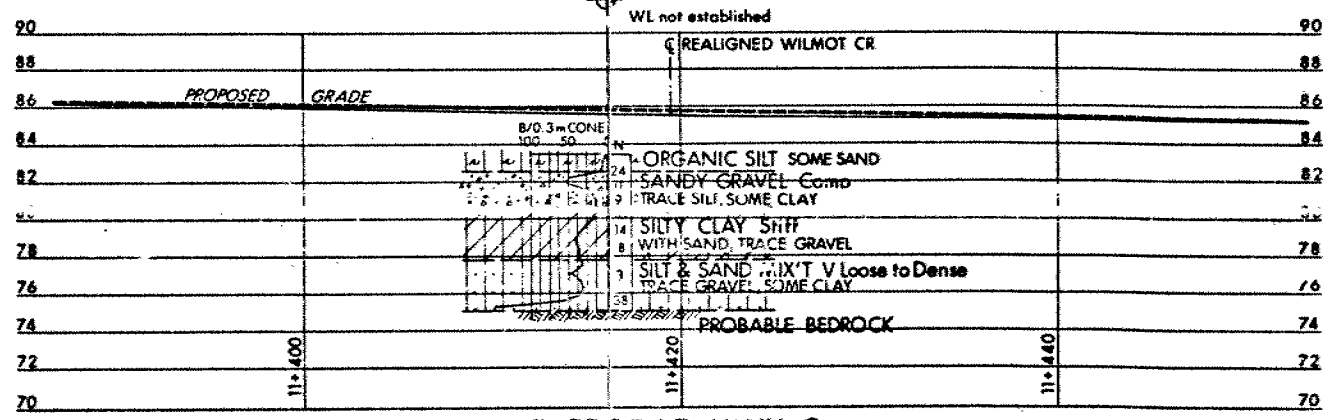
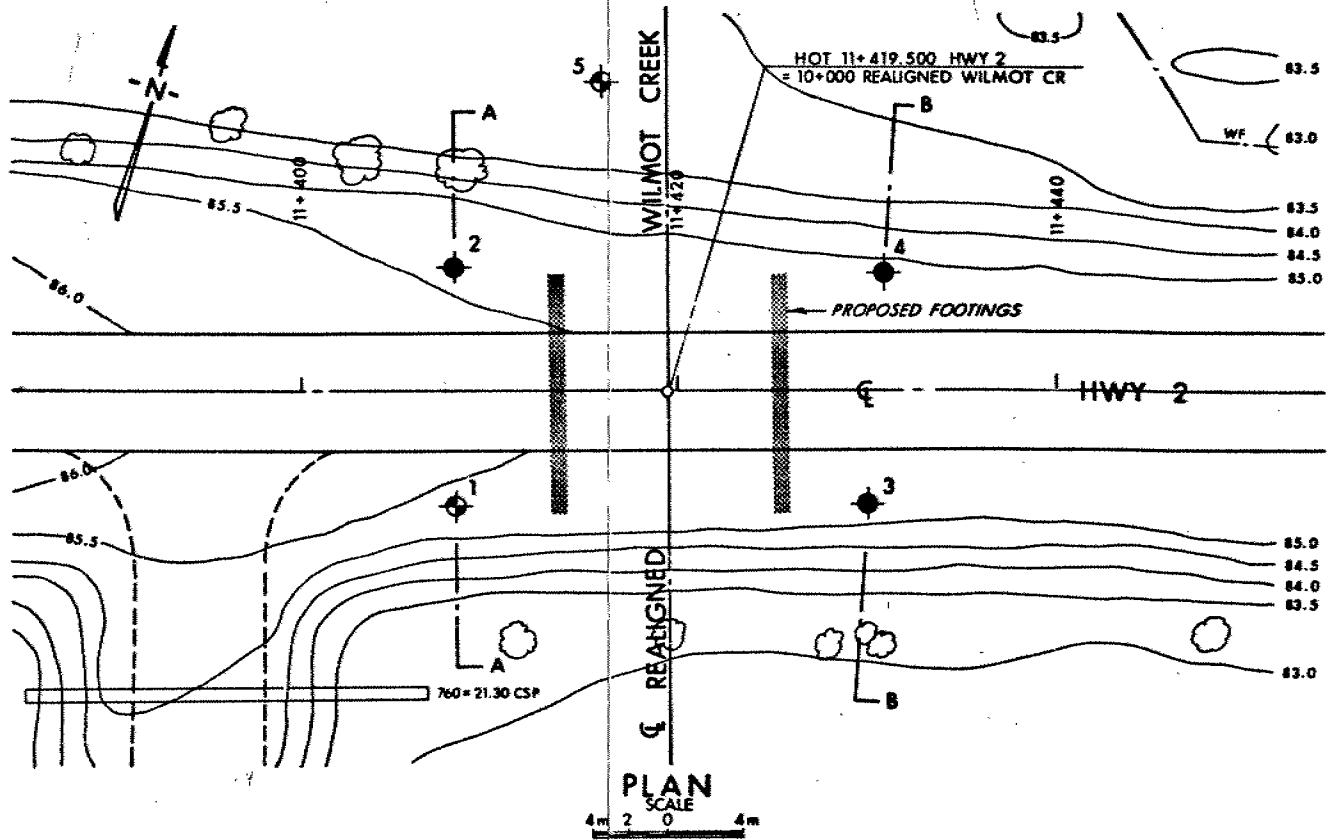


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

| | | |
|-----------------------------------|--|-------|
| CONT No | | SHEET |
| WP No 187-79-03 | | |
| WILMOT CREEK | | |
| BORE HOLE LOCATIONS & SOIL STRATA | | |



SECTIONS
SCALE
4m 2 0 4m Hor
2m 1 0 2m Vert



PROFILE HWY 2

SCALE
4m 2 0 4m

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)
- ⬇ WL at time of investigation 85.04
- ⬇ WL not established in Bore Holes 2, 3 & 5

| No | ELEVATION | STATION | OFFSET |
|----|-----------|----------|-----------|
| 1 | 85.4 | 11+408.1 | 6.0 m RT |
| 2 | 85.4 | 11+408.1 | 6.7 m LT |
| 3 | 85.0 | 11+430.0 | 6.0 m RT |
| 4 | 84.9 | 11+431.0 | 6.3 m LT |
| 5 | 83.5 | 11+416.0 | 16.5 m LT |
| 1A | 85.3 | 11+486.0 | 6.0 m RT |
| 2A | 85.3 | 11+524.7 | 6.2 m RT |
| 3A | 83.2 | 11+514.3 | 8.6 m LT |
| 4A | 82.2 | 11+489.0 | 15.0 m LT |
| 5A | 82.6 | 11+471.3 | 20.0 m LT |
| 6A | 83.0 | 11+504.4 | 25.5 m LT |

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.

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

Geosys No 30M15-76

| | |
|-------------------|-----------------|
| HWY No 2 | DIST 7 |
| SUBMITTAL CHECKED | DATE 1985 09 13 |
| DRAWN SO | SITE 21-6-188 |
| | DWG 1877903-A |

memorandum



Telephone 248-3282

To: G.C.E. Burkhardt
Head, Structural Section
Central Region

Date: 86 07 14

Attn: H.K. Jagasia
Senior Structural Engineer

FROM: Engineering Materials Office
Foundation Design Section
Central Building, Room 315

RE: Wilmot Creek Bridge
W.P. 187-79-03, Site 21-06-188
Hwy. 2, Dist. 7

We have reviewed the General Arrangement and Roadway Protection drawings (dated April 1986) for the above-noted site.

As discussed with H. Jagasia on 86 07 14, we have the following comments:

1. The prevailing groundwater level at the time of the investigation was found to be at Elev. 82.5±. A non-cohesive soil stratum was encountered at approximately Elev. 81. Since the excavation for the structure footing will extend beyond these elevations, it is expected that water will seep into the excavation. However, as discussed with H. Jagasia, it is believed that this water can be controlled by pumping from sumps. No special requirements are necessary.
2. It appears from the drawing that the soldier piles for the roadway protection scheme are expected to penetrate down to Elev. 73.8±. Our subsurface investigation revealed that on the north side of the proposed structure bedrock was encountered at approximately Elev. 74.6 and 74.9 on the west and east limits respectively (ref. BH 2, 4). Soldier piles will not penetrate beyond these elevations. Consequently, we recommend that a note be included on Dwg. 9 stating that soldier piles are to be driven to bedrock. Estimated pile lengths can be provided.

If you require additional information or require clarification please do not hesitate to contact the undersigned.

L. Politano
Project Foundations Engineer

for

M. Devata
Chief Foundations Engineer
(East)

I also asked H. Jagasia if he felt the pile tip depth was sufficient for the two last piles at either end of the roadway protection. He stated that he was comfortable with the design since at those locations, there is not too much earth that is being retained.

LP:jm

memorandum



To: Mr. G. C. E. Burkhardt,
Head,
Structural Section,
1st Floor, 5000 Yonge Street
Central Region

Date: 86 02 13

From: Engineering Materials Office,
Foundation Design Section,
Central Building, Rm. 315

Re: W. P. 187-79-03, Site: 21-06-188
Hwy. #2, District #7, Port Hope
Wilmot Creek Structure

It is understood that a reinforced concrete rigid frame structure will be constructed at this site. Under such circumstances, where the deflection of the abutment is prevented by the propping action of the deck, the at-rest (ko) earth pressures should be used.

A handwritten signature in black ink, appearing to read "L. Politano", with a long horizontal stroke extending to the right.

L. Politano,
Project Foundation Engineer

for
M. Devata, P. Eng.,
Chief Foundations Engineer
(East)

LP:ma

memorandum



To: Mr. G.C.E. Burkhardt,
Head, Structural Section,
1st Floor, 5000 Yonge St.,
Central Region

Date: 86 01 08

Att: H. K. Jagasia

From: Engineering Materials Office,
Foundation Design Section,
Central Building, Room 315

Re: Wilmot Creek Bridge at Hwy. #2
W. P. 187-79-03; Site 21-06-188
Hwy. #2, District #7, Port Hope

We have reviewed Preliminary General Arrangement
Dwg. (P1) [dated: Nov/85] for the above-noted project.
The following are our comments:

1. The excavation required for the construction of the pile caps will extend down to Elev. 80 \pm . As indicated in the Foundation Investigation and Design Report, the prevailing groundwater level is found at Elev. 82.5 \pm . It should be noted that a non-cohesive stratum of soil is encountered at Elev. 80.7 \pm and 81 \pm at the west and east abutment locations respectively. It is anticipated the seepage from these non-cohesive deposits will occur. As a result, the seepage into the excavation should be controlled by means of perimeter ditches and pumping from corner sumps.
2. Pile tips should be reinforced.

A handwritten signature in black ink, appearing to read "L. Politano".

L. Politano,
Project Foundations Engineer

for
M. Devata,
Chief Foundations Engineer
(East)

LP:ma

memorandum



To: G.C.E. Burkhardt
Head, Structural Section
Central Region

Date: 1985 05 16

Atten: H.J. Jagasia

From: Foundation Design Section
Room 315, Central Building

RE: Hwy. 2, W.P. 187-79-03
Wilmot Creek Structure
Site 21-6-188
District 7, Port Hope

It is proposed to construct a single span (± 13.8 m) reinforced concrete rigid frame type structure approximately 85 m west of the existing Wilmot Creek crossing. The existing crossing will be demolished and Wilmot Creek will be realigned. In order to proceed with this scheme, two detours will be required. The existing grade will not be altered.

A foundation investigation was carried out at the proposed structure location. The investigation consisted of 5 boreholes advanced to bedrock, generally between 11 and 12 m deep. The soil conditions are not discussed in this memorandum, but will be described in detail in the final foundation report.

The following are preliminary recommendations for the design and construction of the above-noted project.

1. Structure Foundations

- The structure can be founded on steel H-piles driven to bedrock. The following can be used:
 - . HP 310 x 110 1600 kN at U.L.S.
 1150 kN at S.L.S. Type II
 - . HP 310 x 79 1150 kN at U.L.S.
 850 kN at S.L.S. Type II
- For estimating purposes, it can be assumed that the piles can be driven to Elev. 74.5 at the west abutment and Elev. 74.8 at the east abutment.
- Pile tips should be reinforced
- Frost penetration in this area is 1.3 m
- Earth pressures acting on the abutments should be as per Section 6.6.1.2.2 of the 1983 O.H.B.D.C.
- No dewatering problems are anticipated provided that excavations do not extend into the non-cohesive deposits below Elev. 82.

2. Stability

- any new fill that is required should be benched into the existing
- no stability problems are anticipated for permanent slopes of 2:1
- temporary slopes will be stable at 1.5:1
- all organic and/or soft material should be removed within plan limits of proposed fills prior to placing fill material
- any fill placed below 0.3 m above the prevailing groundwater level should consist of non-cohesive granular material

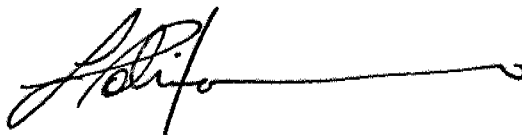
3. Detours

- with the exception of the topsoil, the soil along the alignment of the proposed detours is generally competent and anticipated settlements are negligible for the detour fills
- embankment slopes should be constructed at 2:1

4. Creek Channel

- material used to fill the existing creek channel below 0.3 m above the prevailing groundwater level should consist of non-cohesive, granular material. Especially in the areas under Hwy. 2, Detour 2, or future construction (eg. parking lot) the material should be well compacted.
- the existing channel should be suitably sealed at the upstream end. Details of this seal will be provided in the final Foundation Report.

If you require additional information or clarification of any of the above discussion, please do not hesitate to contact the undersigned.



L. Politano, P. Eng.
Project Foundations Engineer

for

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

LP/MD/mm