

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 3165-153

DIST. 9 REGION

W.P. No. 120-87-05

CONT. No. 90-36

W. O. No.

STR. SITE No.

HWY. No. 417

LOCATION E-S. Ramp over E.B. Hwy 417
(Structure #2)

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 120-87-05

DIST 9

HWY 417

STR SITE 3-52-532

E-S Ramp Over Hwy. 417
Structure #2
Hwy. 416/417 Interchange

DISTRIBUTION

E.C. Lane (2)
T.W. Murphy
D.J. Kimmett
E. Zavitski (2)
K.G. Bassi
D. Aspinwall
T. Yakutchuk
G. Szekreny
L. Saulnier (Cover Only)
M. MacLean (Cover Only)
File

FOUNDATION INVESTIGATION REPORT

for

E-S Ramp Over Hwy. 417

Structure #2

Hwy. 416/417 Interchange

District 9, Ottawa

W.P. 120-87-05, Site #3-52-532

INTRODUCTION

This report summarizes the results of a foundation investigation for the above site.

The fieldwork was carried out from 88 07 25 to 88 08 12 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow stem augers, solid stem augers, BW casing and BXL rock core barrel. Additional fieldwork was performed from 88 10 25 to 88 10 26.

The investigation consisted of 8 sampled boreholes, and 4 dynamic cone penetration tests. The boreholes ranged in depth from 7 to 39 metres.

Groundwater levels were measured in open boreholes at each borehole location.

SITE DESCRIPTION

The proposed structure site is located immediately south of the existing interchange of highway 417 and Acres Road. The surrounding area is generally flat with slightly rolling corn fields to the south and east of the site. Boreholes were advanced through varying heights of the existing approach fill of the Acres Road overpass and surrounding area.

Approximately 500 m to the west of the site, bedrock outcrops can be seen.

SUBSURFACE CONDITIONS

The subsoil conditions in this area can generally be described as sand and clayey silt fill, overlying a 3.0 m deposit of silty clay, overlying a 6.0 m deposit of clayey silt to silt with interbedded layers of silty sand.

Beneath this cohesive zone lies a thick deposit of silty sand to sand, which in turn overlies a zone of sand, gravel and boulders (Glacial Till) which extends to bedrock.

The boundaries of the subsoil types, laboratory test results and groundwater levels are shown on the Record of Borehole log sheets contained in the Appendix. The locations and elevations of the boreholes along with the stratigraphical profile are shown on Drawing 1208705-A.

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

Sand, Some Clayey Silt (Fill)

The existing south approach fill to the Acres Road overpass consists of sand with a trace of gravel and pockets of clayey silt.

The top layer consists of granular road bed material with the remainder composed primarily of sand. Some pockets of clayey silt were encountered, particularly at the toes of the approach fill slopes. The thickness of the material corresponds to the height of the approach fill above original ground, ranging up to 4.0 m.

The material is generally non-cohesive and dry. The clayey silt encountered is cohesive and of low plasticity, similar to the natural material located in the area.

Based on 'N' values obtained from the Standard Penetration test, the fill is in a compact to dense state.

Silty Clay, Some Sand

This material was encountered in all boreholes with the exception of borehole 2-4A and 2-4B, where sampling frequencies bypassed this layer. It represents the beginning of the native material for this area.

The layer consists of brown silty clay with a trace to some sand. It is cohesive, has low plasticity and low moisture content. Based on shear strength data, the material has a firm to very stiff consistency.

Figure 1 illustrates a typical plasticity chart for this material based on representative samples from the site. Figure 2 represents a typical gradation envelope for the material.

Laboratory values are contained on the Record of Borehole log sheets in the Appendix.

Clayey Silt to Silt with Interbedded Layers of Silty Sand

Beneath the silty clay layer lies a deposit of clayey silt to silt. This material is cohesive and ranges from low plasticity to intermediate plasticity. It is characterized by frequent thin seams of silty sand located throughout the deposit.

The material is wet, indicating that the water table is located within this layer. 'N' values from the field investigation indicate very soft conditions throughout this layer, however field vane tests and laboratory shear strength tests indicate that the consistency of the material ranges from soft to firm.

Consolidation tests were performed on this material to investigate its settlement characteristics.

The results of the laboratory test are summarized below:

| <u>Atterberg Limits</u> | <u>Range (%)</u> | <u>Average (%)</u> |
|---------------------------------|------------------|--------------------|
| Water Content (w) | 28-43 | 33.1 |
| Plastic Limit (w _p) | 12-20 | 15.1 |
| Liquid Limit (w _L) | 19-43 | 28.9 |

| <u>Undrained Shear Strength (Cu)</u> | <u>Range (kPa)</u> | <u>Sensitivity</u> |
|--------------------------------------|--------------------|--------------------|
| Field Vane | 38-115 | 2-12 |
| Laboratory Vane | 45-75 | 3-14 |
| Unconfined Compression Test | 27-141 | N/A |

| <u>Consolidation Results</u> | <u>Range</u> |
|-------------------------------------|--------------|
| Initial Void Ratio (e_0) | 0.969-1.266 |
| Compression Index (C_c) | 0.65-1.43 |
| Preconsolidation Pressure (P_c) | 383-530 |

Figure 3 represents a typical plasticity chart for this material while Figure 4 represents a gradation envelope for this material.

Silty Sand to Sand

Underlying the clayey silt to silt layer is a deposit of medium to coarse silty sand, with a trace to some gravel. The deposit ranges in thickness from 2.5 m to 14.2 m.

It is non cohesive, water bearing and is in a very loose to very dense state, based on 'N' values. Cobbles were encountered at varying depths throughout the deposit.

Figure 5 represents a typical grain size distribution envelope for this material.

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

This layer is a very dense deposit of sand, gravel and boulders, which lies directly over bedrock.

During the field investigation, augering through this layer was very difficult and time consuming. Rock coring procedures were utilized for sampling due to the high percentage of boulders encountered.

The material is non cohesive and ranges in thickness from 10 m to greater than 16 m. The full vertical extent of the deposit was not determined during the investigation, as the boreholes could not be advanced past elevation 36 m.

Bedrock

Bedrock was encountered in 5 boreholes and cored in 3 boreholes.

On the west side of Acres Road (Boreholes 2-1, 2-2, 2-3 & 2-6) bedrock was encountered at relatively shallow depths.

It is sloped and rises from east to west, from 23 m below ground surface to within 8.5 m. Further west, bedrock outcrops can be seen.

To the east of Acres Road, bedrock was encountered at elevation 35 m, considerably lower than on the west side of Acres Road. There appears to be a fault line or glacial valley running between Boreholes #2-3 and #2-5, as boreholes #2-4A and #2-4B both were advanced to a lower elevation than borehole #2-5 without encountering bedrock (see Drawing 1208705-A).

Analyses of the recovered core samples indicate that bedrock is composed of sandstone and dolostone. For a complete description of the bedrock, refer to the appendix.

Groundwater

Groundwater was measured in open boreholes at all locations with the exception of Borehole #2-6.

It is located within the clayey silt to silt layer at an estimated elevation of 64.0 m.

For ground water levels in the vicinity of the structure footings, refer to the Record of Borehole log sheets in the Appendix.

DISCUSSION AND RECOMMENDATIONS

Structure #2 is one of three structures that comprise Ramp E-S which will carry westbound highway 417 traffic to south bound highway 416.

The ultimate layout of the 416/417 interchange includes the realignment of Acres Road and the eastbound lanes of highway 417. It is not known at this time whether the existing Acres Road overpass will be kept in service during construction of structure #2.

During the field investigation it became quickly evident that the proposed structure could not be founded economically on spread footings, as competent founding material was not encountered until 7.0 m below the existing ground surface, 19 m below the proposed profile grade.

The presence of a soft layer of clayey silt to silt precluded the option of founding the structure on engineered fills consisting of granular pads, as excessive settlement would be anticipated. The layer also poses problems for the stability of the approach fills and their related settlement.

Therefore, based on the results of the field investigation, the following recommendations are proposed:

APPROACH EMBANKMENT RECOMMENDATIONS

Stability

The proposed fill heights for the embankment approaches are in the order of 10 to 12 m. A slope stability analysis in terms of total stresses was performed for the fills in both the longitudinal and transverse direction.

It is assumed that the approach fills will be composed of well-compacted granular-type material. The assumed unit weight of the fill is 20 kN/m^3 . It is important to stress that if the proposed fill material has a higher density than 20 kN/m^3 , that this section be contacted to re-analyse the overall stability of the embankment fills.

The results of the stability analysis indicate;

i) Fills less than 8.0 m in height may be constructed with standard 2H:1V side slopes.

ii) Fills in excess of 8.0 m should be constructed with a single berm at mid-height in accordance with Figure 6. Berms are to be constructed in conjunction with the approach fills as a complete unit up to the height of the berm, at which point the remainder of the fill may be constructed. Side slopes are to be 2H:1V.

iii) At the proposed profile grade, berms will be required in both the longitudinal and transverse directions in the vicinity of the structure. In order to accomodate berms in the longitudinal direction, the proposed spans of the structure may have to be modified. It may be advantageous to minimize the berm requirements by limiting the height of fill, if possible.

Settlement

Settlement of the approach fills under their own weight and from consolidation of the soil beneath can be anticipated.

Settlement is estimated to be in the order of 150 mm, based on a 12.0 m fill. This settlement is expected to occur over time, with 90 % of the settlement occurring within 3 years of construction. It is recommended that the approach fills be allowed to settle for a minimum 6 month period prior to paving.

STRUCTURE RECOMMENDATIONS

Abutments

The abutments can be founded on Steel H end-bearing Piles driven to bedrock or into the glacial till.

The following O.H.B.D.C. loads may be utilized for design:

| | File Type | Tip Elevation | Factored Capacity at U.L.S. | S.L.S. Type II |
|---------------|--------------|------------------|--------------------------------|-------------------|
| West Abutment | 310x110 | 52.8-53.8 | 1650 kN | 1150 kN |
| East Abutment | 310x110 | 40.0 | 1600 kN | 900 kN |

Piles for the east abutment should be driven into the glacial till deposit. Pile driving should be controlled using the Hiley Formula, from elevation 44.0.

Excessive settlement of the proposed approach fills is anticipated and will impose considerable negative skin frictional loads on the piles supporting the abutments. Therefore to account for this downdrag loading, the above mentioned pile capacities must be reduced by 15%.

In addition to the negative skin frictional forces, settlement of the approach fills will induce additional lateral loading on the abutments which may cause rotation of the abutments. In order to improve the stability of the abutments in the longitudinal direction, it is recommended to support the extreme ends of the wing walls on end-bearing piles. The capacities stated for the abutments may be utilized for the design of the wing wall piles.

Piers

Piers #1 and #2 may be founded on steel H end-bearing piles driven to bedrock or into the glacial till.

The following O.H.B.D.C. capacities may be utilized for design:

| | Pile Type | Tip Elevation | Factored Capacity at U.L.S. | S.L.S. Type II |
|-----------|--------------|------------------|--------------------------------|-------------------|
| West Pier | 310x110 | 44.0 | 1600 kN | 900 kN |
| East Pier | 310x110 | 40.0 | 1600 kN | 900 kN |

Pile Driving

All piles are to be driven in accordance with OPSS 903. Piles not driven to bedrock are to be controlled by the Hiley Formula (MTO Standard SS-103-11) utilizing an ultimate pile capacity of 3300 kN with a minimum hammer energy of 50,000 joules/blow.

All piles should be equipped with driving tips to prevent damage during driving.

2700

Roadway Protection

Shoring will not be required for the construction of either abutment. If the existing Acres Road overpass is to be kept in service during construction of this structure, shoring will be required for excavation of both piers, if the excavations exceed 1.2 m in depth and 1:1 slopes cannot be maintained.

Dewatering

No dewatering problems are anticipated, as all excavations (if any) will be above the water table. Sump pumps may accomodate any surface run off into the excavations.

Earth Pressure

Backfill to structures should consist of free-draining granular materials in accordance with MTO Special Provision 121.

Computation of earth pressure should be in accordance with section 6.6.1.2 of the O.H.B.D.C. For abutment walls, the active case should be considered for design. The 'at-rest' case should only be used for design when the propping action of the deck prevents deflection of the abutment walls.

The following unfactored values can be used for calculating lateral earth pressures:

| | γ | ϕ | K_A | K_O |
|--------------|------------------------|--------|-------|-------|
| Granular 'A' | 22.8 kN/m ³ | 35° | 0.33 | 0.50 |
| Granular 'B' | 21.2 kN/m ³ | 30° | 0.27 | 0.43 |

Compaction of granular backfill in the vicinity of the structure walls shall be in accordance with OPSS 501 and MTO Directive B-131.

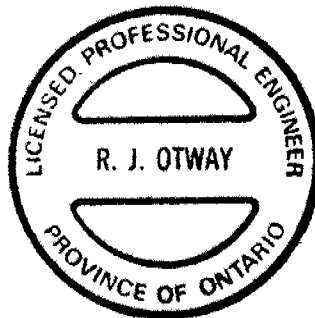
Frost Protection

A minimum of 1.8 m of earth cover, or equivalent, to the base of the footing or pile cap, is required for frost protection.

MISCELLANEOUS

The fieldwork was carried out under the supervision of R. Otway, Foundation Engineer, using equipment rented from Marathon Drilling Co. Ltd., Ottawa, and F.E. Johnston Drilling Co. Ltd., Ottawa.

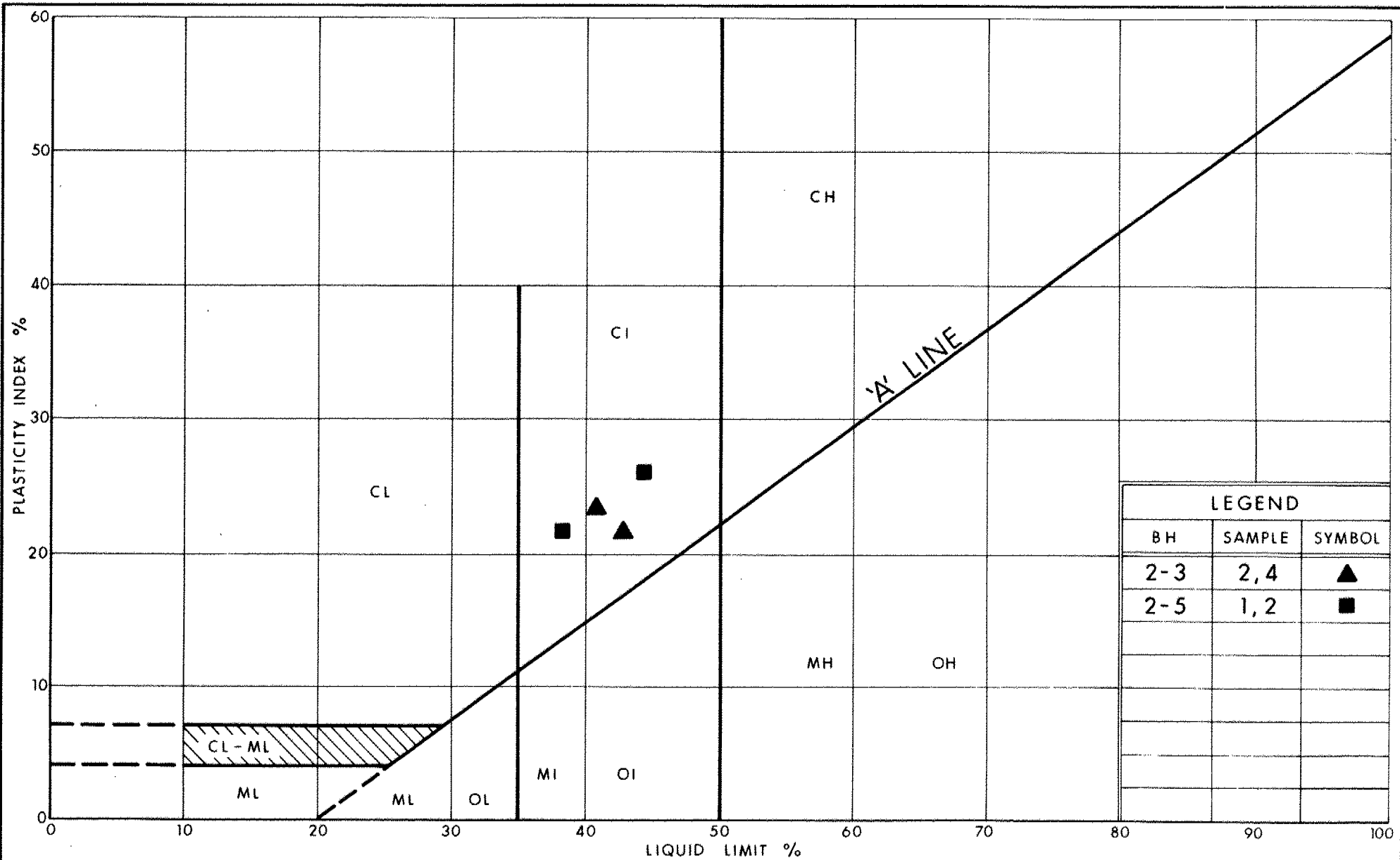
The report was written by R. Otway, Foundation Engineer, and reviewed by M. Devata, Chief Foundations Engineer.



R.J. Otway, P.Eng.
Foundation Engineer

M.S. Devata, P.Eng.
Chief Foundations Engineer

APPENDIX



Ministry of
Transportation

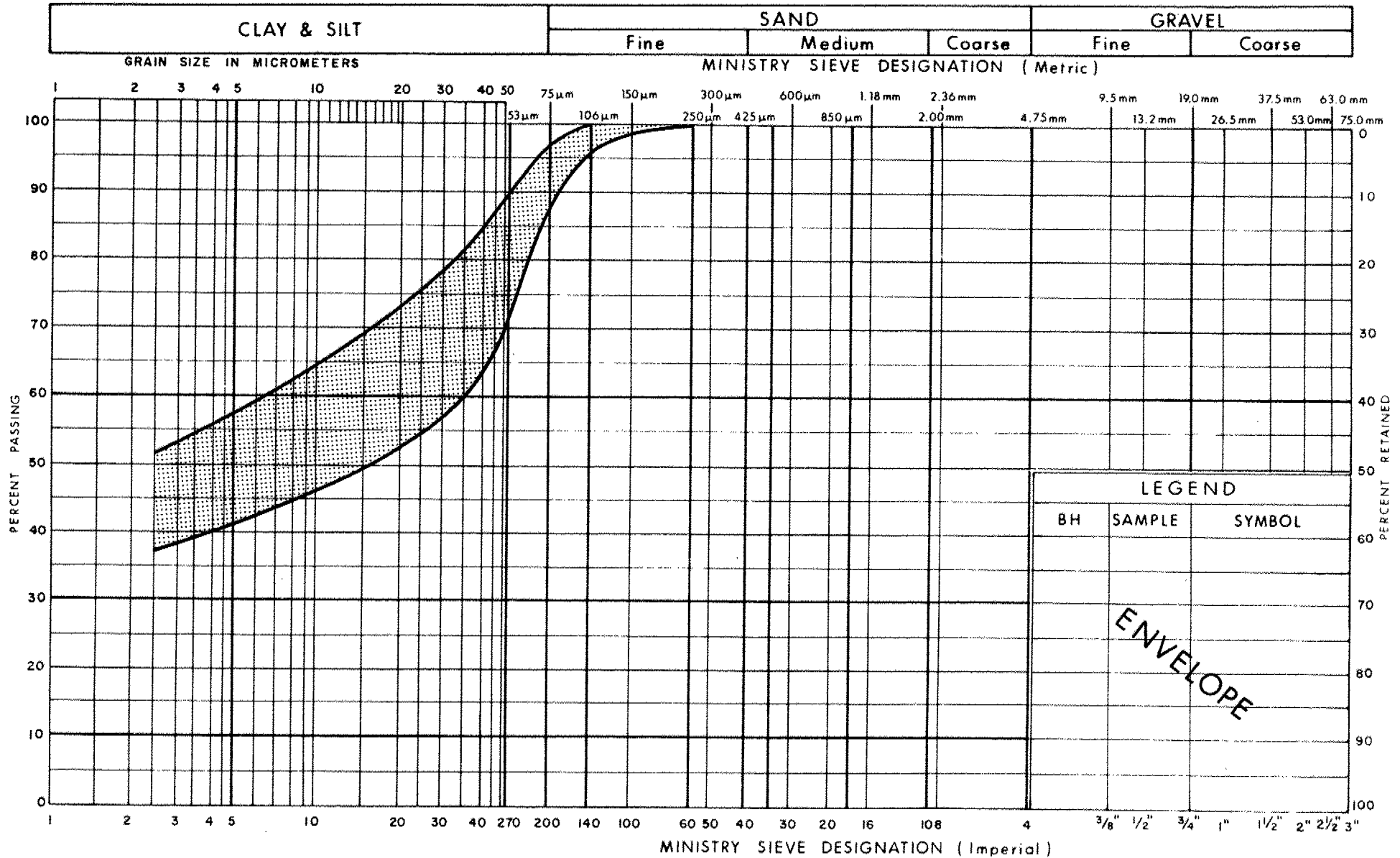
Ontario

PLASTICITY CHART SILTY CLAY, SOME SAND

FIG No 1

W P 120-87-05

UNIFIED SOIL CLASSIFICATION SYSTEM

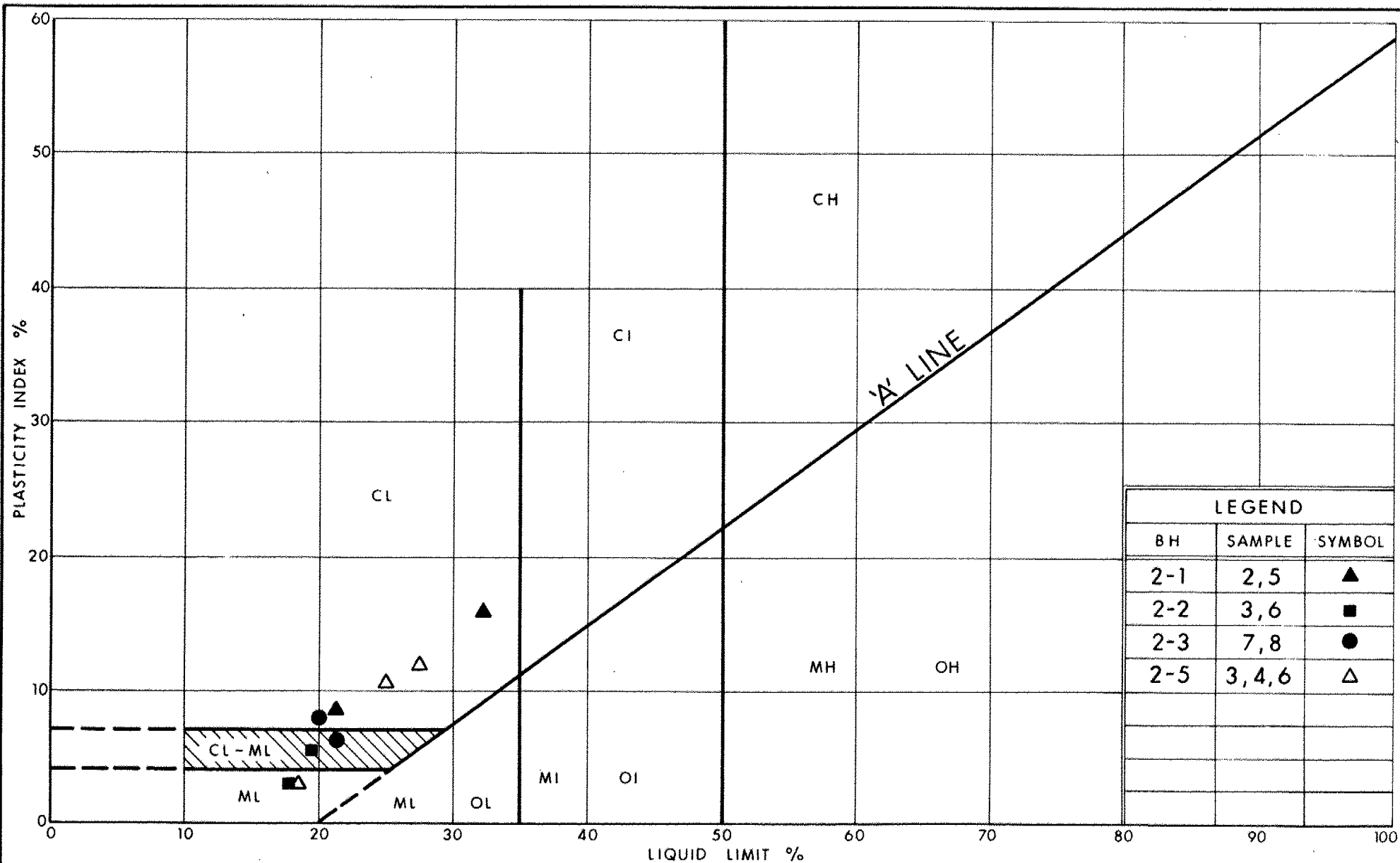


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY, SOME SAND

FIG No 2

W P 120-87-05



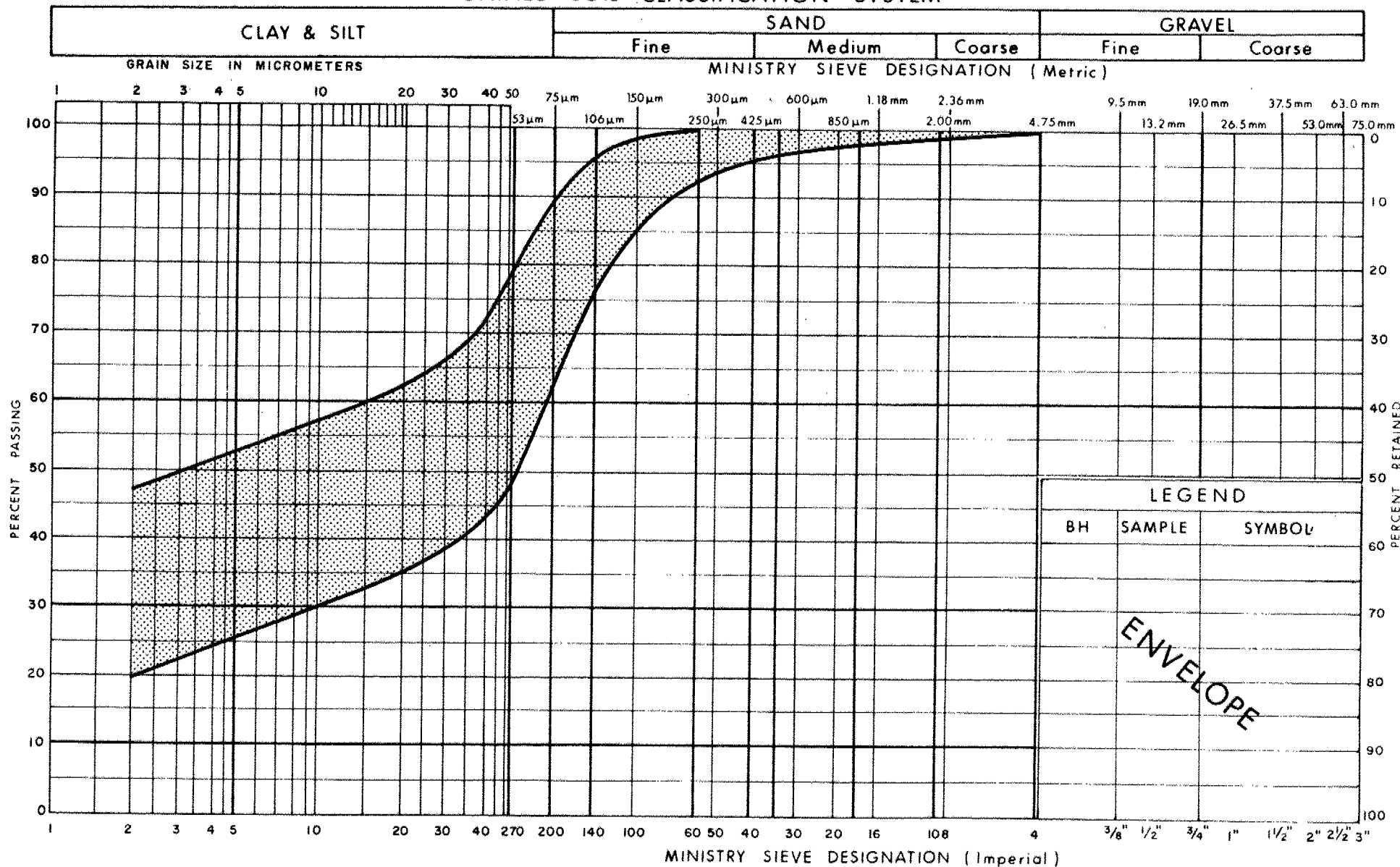
Ministry of
Transportation
Ontario

PLASTICITY CHART CLAYEY SILT TO SILT

FIG No 3

W P 120-87-05

UNIFIED SOIL CLASSIFICATION SYSTEM



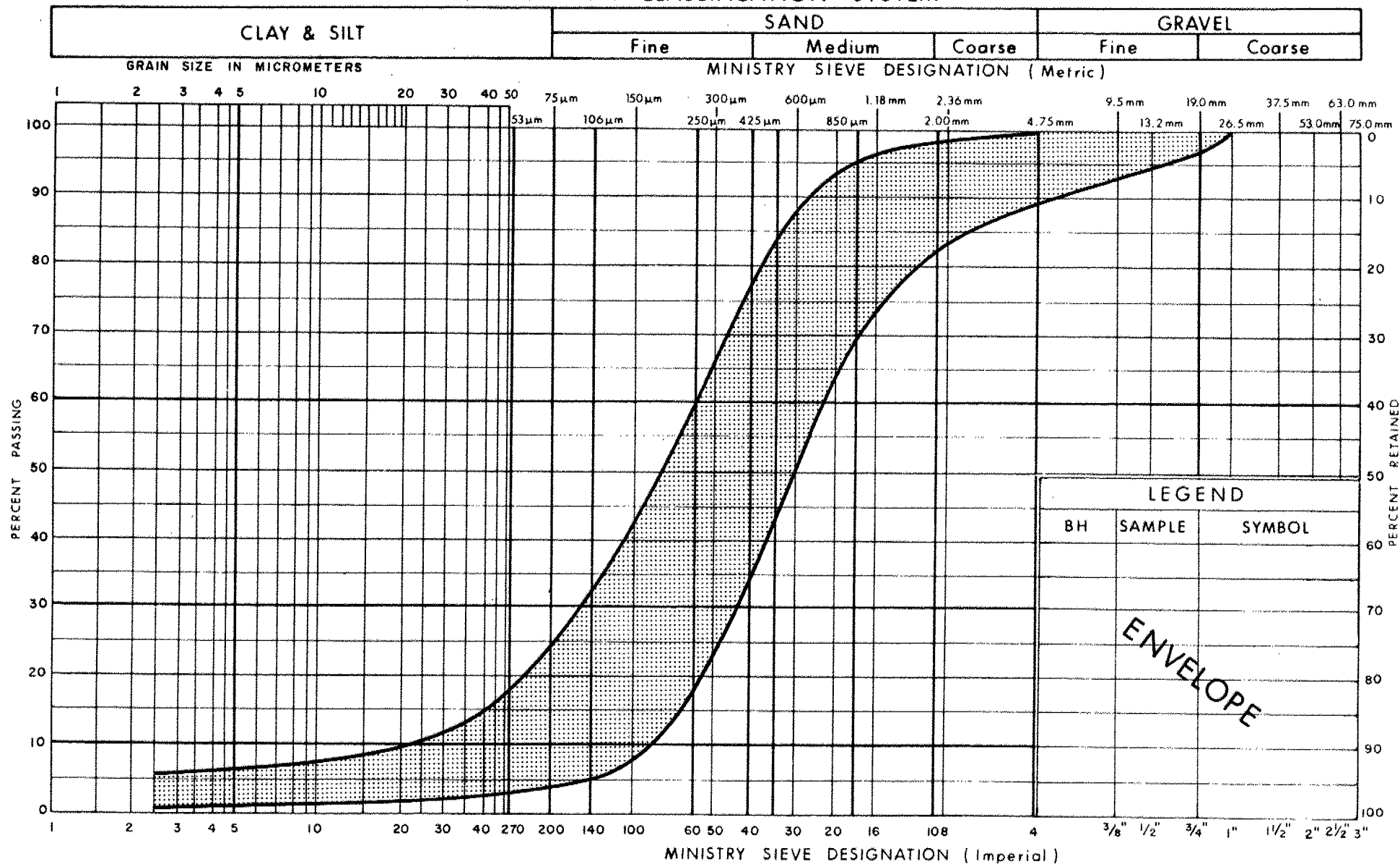
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION CLAYEY SILT TO SILT

FIG No 4

W P 120-87-05

UNIFIED SOIL CLASSIFICATION SYSTEM



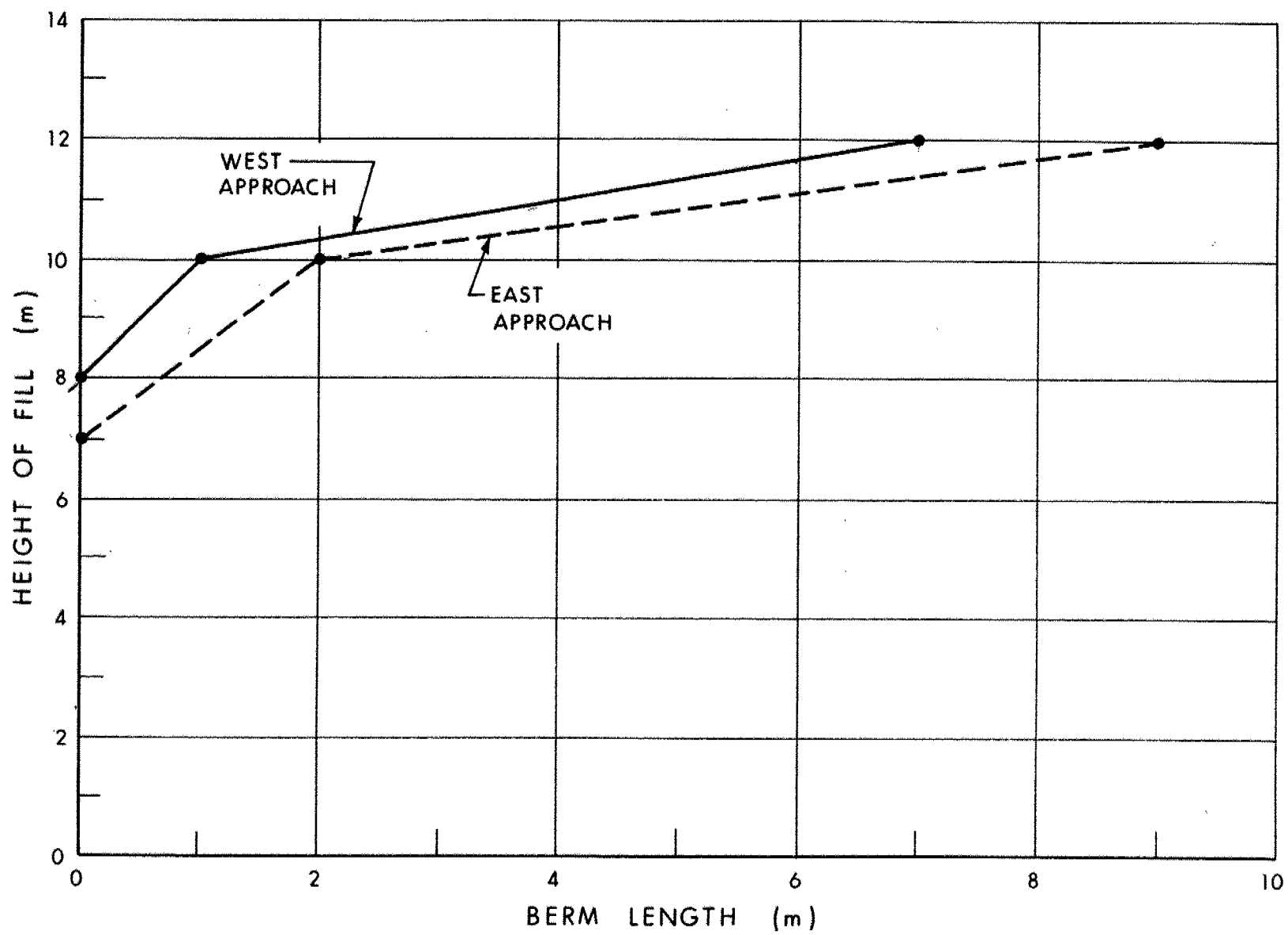
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY SAND TO SAND, TRACE OF GRAVEL

FIG No 5

W P 120-87-05



WP 120-87-05
FIG 6

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

| | | | |
|----|---------------------|----|---------------------------|
| SS | SPLIT SPOON | TP | THINWALL PISTON |
| WS | WASH SAMPLE | OS | OSTERBERG SAMPLE |
| ST | SLOTTED TUBE SAMPLE | RC | ROCK CORE |
| BS | BLOCK SAMPLE | PH | TW ADVANCED HYDRAULICALLY |
| CS | CHUNK SAMPLE | PM | TW ADVANCED MANUALLY |
| TW | THINWALL OPEN | FS | 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'_{v0} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|-------------------|--------------------------------|-----------|------|---|-----------|-------------------|---|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kN/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | 1 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kN/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| 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 | | | | | | |

DESCRIPTION OF ROCK CORE - WP 120-87-05

| CORE RECOVERY | | | | CORE DESCRIPTION | |
|---------------|-------------|------|-------|------------------|--|
| HOLE # | DEPTH (m) | %CR* | %RQD* | DEPTH (m) | DESCRIPTION |
| 2-1 | 8.66-10.39 | 92 | 47 | 8.66-10.21 | SANDSTONE , very light grey; medium grained; medium bedded (10-60 cm); well cemented; medium strong rock; slightly weathered to unweathered; moderately close spaced fractures: (1) flat, open, rough, slightly altered; and (2) near vertical, open, calcite filled. |
| | 10.39-11.99 | 98 | 75 | | |
| | | | | 10.21-11.99 | SANDSTONE , calcareous; light to medium grey; medium to fine grained; thin to medium bedded (1-40 cm), with very thin argillaceous laminations and thin conglomeratic beds; close spaced fractures: flat, rough, planar, slightly open, slightly altered, clean; intensely fractured zone from 10.06-10.21 m. |
| 2-2 | 12.62-13.49 | 96 | 76 | 12.62-13.44 | SANDSTONE , calcareous; light to medium grey; medium to fine grained; thinly bedded with very thin argillaceous laminations; strong to medium strong rock; moderately close spaced fractures: flat, irregular, rough, open, unaltered, clean. |
| | 13.49-14.48 | 97 | 50 | | |
| | 14.48-14.98 | 94 | 0 | 13.44-14.98 | SANDSTONE , very light grey to light brown; fine grained; thick bedded (to 50 cm); strong rock; close spaced fractures: (1) flat, rough, slightly altered, clean; (2) near vertical, planar, open, calcite filled. |

NOTE: Depths are approximated in zones of poor core recovery.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - WP 120-87-05

| CORE RECOVERY | | | | CORE DESCRIPTION | |
|---------------|----------------------|------|-------|------------------|---|
| HOLE # | DEPTH (m) | %CR* | %RQD* | DEPTH (m) | DESCRIPTION |
| 2-4a | RC10 24.04-25.76 | 62 | - | 24.04-39.04 | OVERBURDEN , containing foreign and locally derived bedrock material, boulders up to 11 cm. May also contain heavily fractured bedrock (SILTY DOLOSTONE dark grey; fine grained; thinly bedded with minor argillaceous laminations) of very poor drillable quality. -EOH- BEDROCK NOT CONFIRMED BY DRILLING. |
| | RC11 25.76-26.82 | | | | |
| | 26.82-27.03 | NOT | CORED | | |
| | RC13 27.03-28.65 | 6 | - | | |
| | 28.65-29.13 | NOT | CORED | | |
| | RC14 29.13-30.23 | 2 | - | | |
| | RC15 30.23-31.62 | 9 | - | | |
| | 31.62-36.27 | NOT | CORED | | |
| | RC16 36.27-37.90 | 30 | - | | |
| | RC 17 37.90-38.35 | 47 | - | | |
| | RC18 38.35-39.04 | 30 | - | | |

NOTE: Depths are approximated in zones of poor core recovery.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - WP 120-87-05

| CORE RECOVERY | | | | CORE DESCRIPTION | |
|---------------|--------------------|------|-------|------------------|---|
| HOLE # | DEPTH (m) | %CR* | %RQD* | DEPTH (m) | DESCRIPTION |
| 2-4b | RC1 22.86-23.77 | 38 | - | 22.86-35.89 | OVERBURDEN, containing foreign and locally derived bedrock material. May also contain heavily fractured bedrock (SILTY DOLOSTONE, dark grey; fine grained; thinly bedded with minor argillaceous laminations) of very poor drillable quality. |
| | 23.77-24.99 | NOT | CORED | | |
| | RC3 24.99-25.60 | 25 | - | -EOH- | |
| | 25.60-26.52 | NOT | CORED | | |
| | RC4 26.52-27.43 | 19 | - | | |
| | 27.43-32.89 | NOT | CORED | | |
| | RC5 32.89-34.04 | 18 | - | | |
| | 34.04-34.32 | NOT | CORED | | |
| | RC7 34.32-35.89 | 35 | - | | |

NOTE: Depths are approximated in zones of poor core recovery.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

DESCRIPTION OF ROCK CORE - WP 120-87-05

| CORE RECOVERY | | | | CORE DESCRIPTION | |
|---------------|-------------|------|-------|------------------|--|
| HOLE # | DEPTH (m) | %CR* | %RQD* | DEPTH (m) | DESCRIPTION |
| 2-5 | 20.27-21.34 | 71 | - | 20.27-30.33 | OVERBURDEN, containing foreign and locally derived bedrock material, boulders up to 40 cm. |
| | 21.34-22.56 | NOT | CORED | 30.33-32.08 | |
| | 22.56-23.47 | 14 | - | | |
| | 23.47-24.13 | 8 | - | | |
| | 24.13-24.38 | NOT | CORED | | |
| | 24.38-27.25 | 8 | - | | |
| | 27.25-27.74 | NOT | CORED | | |
| | 27.74-28.96 | 32 | - | | |
| | 28.96-30.56 | 78 | 0 | | |
| | 30.56-30.99 | 94 | 44 | | |
| | 30.99-31.47 | 100 | 32 | | |
| | 31.47-32.08 | 100 | 56 | | |

NOTE: Depths are approximated in zones of poor core recovery.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

RECORD OF BOREHOLE No 2-1

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 523.6; E 358 448.7
 DIST 9 HWY 417 BOREHOLE TYPE H-S Auger, BW Casing, BXL Rock Core & Cone Test
 DATUM Geodetic DATE 88 07 25
 ORIGINATED BY RO
 COMPILED BY RO
 CHECKED BY *OP*

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 kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L | WATER CONTENT (%) 20 40 60 | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|-------------|---------|-----------|------------|-------------------------|-----------------|---|--|-------------------------------|------------------|--|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | |
| 65.9 | Ground Surface | | | | | | | | | | | |
| 0.0 | Silty Clay Some Sand Firm | | 1 | SS | 6 | | | | | | | |
| 64.7 | | | 2 | SS | 2 | | | | | | | |
| 1.2 | Clayey Silt to Silt With Interbedded Layers of Silty Sand Soft to Firm | | 3 | TW | PH | | | | | | | 0 18 35 47 |
| | | | 4 | SS | 1 | | | | | | | |
| | | | 5 | SS | 1 | | | | | | | |
| 59.9 | | | 6 | SS | 3 | | | | | | | 1 28 33 38 |
| 6.0 | Silty Sand to Sand Trace Gravel Occasional Cobbles Very Loose to Loose | | 7 | SS | 5 | | | | | | | 7 81 (12) |
| 57.4 | | | 8 | SS | 8 | | | | | | | |
| 8.5 | Sandstone Bedrock Sound | | 9 | BXL RC | REC 92% | | | | | | | RQD = 47% |
| | | | 10 | BXL RC | REC 98% | | | | | | | RQD = 75% |
| 53.9 | | | | | | | | | | | | |
| 12.0 | End of Borehole | | | | | | | | | | | |

RECORD OF BOREHOLE No 2-2

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 542.6; E 358 463.8 ORIGINATED BY RO
 DIST 9 HWY 417 BOREHOLE TYPE H-S Auger, 'B' Casing, BXL Rock Core & Cone Test COMPILED BY RO
 DATUM Geodetic DATE 88 07 25 & 88 10 25 to 26 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 | | | | | |
| 66.4 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Clay Trace of Sand Stiff | | 1 | SS | 12 | | | | | | | | | GR SA SI CL |
| 64.9 | | | 2 | TW | PH | | | | | | | | | |
| 1.5 | Clayey Silt to Silt with Interbedded Layers of Silty Sand Soft to Firm | | 3 | SS | 2 | | | | | | | | | 0 64 (36) |
| | | | 4 | SS | 2 | | | | | | | | | 0 29 26 45 |
| | | | 5 | SS | 1 | | | | | | | | | |
| | | | 6 | SS | 1 | | | | | | | | | |
| | | | 7 | SS | 1 | | | | | | | | | 0 9 54 37 |
| | | | 8 | SS | 4 | | | | | | | | | |
| 59.4 | | | | | | | | | | | | | | |
| 7.0 | Silty Sand to Sand Trace of Gravel Occasional Cobbles Very Loose to Very Dense | | 9 | SS | 4 | | | | | | | | | |
| | | | 10 | SS | 80 | | | | | | | | | |
| | | | 11 | SS | 120/25 cm | | | | | | | | | 2 94 (4) |
| | | | 12 | SS | 100 | | | | | | | | | |
| 53.8 | | | | | | | | | | | | | | |
| 12.6 | Bedrock Sandstone, Sound | | 13 | BXL RC | REC 96% | | | | | | | | | RQD = 76% |
| | | | 14 | BXL RC | REC 97% | | | | | | | | | RQD = 50% |
| 51.4 | | | 15 | RC | REC | 94% | | | | | | | | RQD = 0% |
| 15.0 | End of Borehole | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2-3

METRIC


W P 120-87-05 LOCATION Co-ords. N 5 022 571.5; E 358 475.5 ORIGINATED BY RO
 DIST 9 HWY 417 BOREHOLE TYPE Hollow Stem Auger - BW Casing & Cone Test COMPILED BY RO
 DATUM Geodetic DATE 88 07 25 to 26 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 | 20 40 60 80 100 | | | | | |
| 67.6 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Sand Some Clayey Silt (Fill) Compact | | 1 | SS | 11 | | | | | | | | | 1 50 28 21 |
| 66.2 | | | 2 | TW | PH | | | | | | | | | 0 4 46 50 |
| 1.4 | Silty Clay Trace of Sand Firm to Very Stiff | | 3 | SS | 19 | | | | | | | | | 0 4 45 51 |
| 63.2 | | | 4 | SS | 14 | | | | | | | | | |
| 4.4 | | | 5 | SS | 15 | | | | | | | | | |
| 63.2 | Clayey Silt to Silt With Interbedded Layers of Silty Sand Soft to Firm | | 6 | SS | 1 | | | | | | | | | 0 36 44 20 |
| 4.4 | | | 7 | TW | PH | | | | | | | | | 0 31 30 39 |
| 57.4 | | | 8 | SS | 1 | | | | | | | | | |
| 10.2 | | | 9 | SS | 1 | | | | | | | | | |
| 10.2 | Silty Sand to Sand Trace of Gravel Occasional Cobbles Compact to Very Dense | | 10 | SS | 0 | | | | | | | | | 0 93 (7) |
| 57.4 | | | 11 | SS | 39 | | | | | | | | | |
| 10.2 | | | 12 | SS | 18 | | | | | | | | | |
| 44.7 | | | 13 | SS | 76 | | | | | | | | | |
| 22.9 | | | 14 | SS | 87 | | | | | | | | | |
| 44.7 | | | 15 | SS | 34 | | | | | | | | | |
| 22.9 | End of Borehole Probable Bedrock | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 2-4A

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 604.9; E 358 492.6
 DIST 9 HWY 417 BOREHOLE TYPE H-S Auger, BW Casing, BXL Rock Core
 DATUM Geodetic DATE 88 07 29 to 31
 ORIGINATED BY RO
 COMPILED BY RO
 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 Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | |
| 69.6 | Ground Surface | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Sand Trace of Clayey Silt Dense (Fill) | | | | | | 68 | | | | | | | |
| 66.1 | | | 1 | SS | 35 | | 66 | | | | | | | |
| 3.5 | Clayey Silt to Silt with Interbedded Layers of Silty Sand Soft to Firm | | | | | | 64 | | | | | | | 0 65 29 6 |
| | | | 2 | SS | 22 | | | | | | | | | |
| | | | 3 | SS | 2 | | 62 | | | | | | | |
| 60.0 | | | 4 | SS | 17 | | 60 | | | | | | | |
| 9.6 | Silty Sand to Sand Some Gravel Occasional Cobbles Compact to Very Dense | | | | | | 58 | | | | | | | 19 73 (8) |
| | | | 5 | SS | 16 | | | | | | | | | |
| | | | 6 | SS | 34 | | 56 | | | | | | | |
| | | | | | | | 54 | | | | | | | |
| | | | | | | | 52 | | | | | | | |
| | | | 8 | SS | 62 | | 50 | | | | | | | 5 84 (11) |
| | | | | | | | 48 | | | | | | | |
| | | | 9 | SS | 60 | | 46 | | | | | | | |
| 45.8 | | | | | | | 44 | | | | | | | |
| 23.8 | Heterogeneous Mixture of Sand, Gravel and Boulders (Glacial Till) Very Dense | | 10 | RC | REC | 62% | 42 | | | | | | | |
| | | | 11 | RC | REC | 1% | 40 | | | | | | | |
| | | | 12 | SS | 92 | | | | | | | | | |
| | | | 13 | RC | REC | 6% | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 14 | RC | REC | 2% | | | | | | | | |
| 39.4 | | | | | | | | | | | | | | |

Continued

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 2-4A Cont'd METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 604.9; E 358 492.6 ORIGINATED BY RO
 DIST 9 HWY 417 BOREHOLE TYPE H-S Auger, BW Casing, BXL Rock Core COMPILED BY MS
 DATUM Geodetic DATE 88 07 29 to 31 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|-----------|------------|----------------------------|-----------------|---|--------------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH kPa | | | | | |
| 39.4 | Continued | | 15 | BXL RC | REC 9% | | | | | | | | | |
| 30.2 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Heterogeneous Mixture of Sand Gravel and Boulders (Glacial Till) Very Dense | | 16 | BXL RC | REC 30% | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 30.6 | | | 17 | RC | REC | 47% | | | | | | | | |
| 39.0 | | | 18 | RC | REC | 30% | | | | | | | | |
| | End of Borehole | | | | | | | | | | | | | |

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 613.1; E 358 499.8 ORIGINATED BY MS
DIST 9 HWY 417 BOREHOLE TYPE 'N' Casing, 'B' Casing, BXL Rock Core COMPILED BY RO
DATUM Geodetic DATE 88 08 05 to 12 CHECKED BY [Signature]

[illegible]

+3, x5: Numbers refer to Sensitivity

20
15 20
10

RECORD OF BOREHOLE No 2-5

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 636.0; E 358 517.7 ORIGINATED BY RO
DIST 9 HWY 417 BOREHOLE TYPE H-S Auger, 'B' Casing - BXL Rock Core & Cone Test COMPILED BY RO
DATUM Geodetic DATE 88 07 25 to 28 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 (%) |
|---------------|--|------------|---------|-----------|------------|----------------------------|--------------------|---|-----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 80 100 | | | | | |
| 66.0 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Clay Trace of Sand Stiff | | 1 | SS | 12 | | | | | | | | | 0 5 53 42 |
| 63.9 | | | 2 | TW | PH | | | | | | | | | 0 10 54 36 |
| 2.1 | Clayey Silt to Silt with Interbedded Layers of Silty Sand Soft to Stiff | | 3 | TW | PH | | | | | | | | | 1 15 45 39 |
| | | | 4 | TW | PH | | | | | | | | | 0 22 61 17 |
| | | | 5 | SS | 1 | | | | | | | | | 0 29 25 46 |
| | | | 6 | SS | 2 | | | | | | | | | |
| 58.7 | | | 7 | SS | 24 | | | | | | | | | |
| 7.3 | | | 8 | SS | 25 | | | | | | | | | |
| | | | 9 | SS | 42 | | | | | | | | | 2 80 (18) |
| | Silty Sand to Sand Trace of Gravel Occasional Cobbles Compact to Very Dense | | 10 | SS | 42 | | | | | | | | | |
| | | | 11 | SS | 86 | | | | | | | | | |
| | | | 12 | SS | 34 | | | | | | | | | 10 77 (13) |
| 45.7 | | | 13 | RC | REC | 71% | | | | | | | | |
| 20.3 | | | 14 | SS | 100 | | | | | | | | | |
| | Heterogeneous Mixture of Sand Gravel and Boulders (Glacial Till) Very Dense | | 15 | RC | REC | 14% | | | | | | | | |
| | | | 16 | RC | REC | 8% | | | | | | | | |
| | | | 17 | SS | 60 | | | | | | | | | |
| | | | 18 | RC | REC | 8% | | | | | | | | |
| | | | 19 | RC | REC | 8% | | | | | | | | |
| | | | 20 | SS | 89 | | | | | | | | | |
| | | | 21 | BXL RC | REC 32% | | | | | | | | | |
| | | | 22 | BXL RC | REC 78% | | | | | | | | | |
| 35.8 | | | | | | | | | | | | | | |

30.2 Continued

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

Continued

RECORD OF BOREHOLE No 2-5 Cont'd METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 636.0; E 358 517.7 ORIGINATED BY RO
DIST 9 HWY 417 BOREHOLE TYPE Hollow Stem Auger 'B' Casing - BXL Rock Core COMPILED BY RO
DATUM Geodetic DATE 88 07 25 to 28 CHECKED BY SP

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2-6

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 548.1; E 358 453.7 ORIGINATED BY RO
 DIST 9 HWY 417 BOREHOLE TYPE Solid Stem Auger COMPILED BY RO
 DATUM Geodetic DATE 88 08 02 & 88 10 25 CHECKED BY *RF*

| 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 | 20 40 60 80 100 | 20 40 60 80 100 | | | | | |
| 67.4 | Ground Surface | | | | | | | | | | | | | | | |
| 0.0 | Sand with Silty Clay Trace Gravel | | 1 | SS | 7 | | | | | | | | | | | |
| 66.2 | Loose (Fill) | | 2 | SS | 9 | | | | | | | | | | | |
| 1.2 | Silty Clay | | | | | | | | | | | | | | | |
| 65.0 | Trace of Sand | | | | | | | | | | | | | | | |
| 2.4 | Stiff | | | | | | | | | | | | | | | |
| | Clayey Silt to Silt | | 3 | TW | PH | | | | | | | | | | | |
| | With Interbedded Layers of | | 4 | TW | PM | | | | | | | | | | | |
| | Silty Sand | | | | | | | | | | | | | | | |
| | Stiff | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | TW | PH | | | | | | | | | | | |
| 59.8 | | | | | | | | | | | | | | | | |
| 7.6 | Silty Sand to Sand | | 7 | SS | 9 | | | | | | | | | | | |
| | Trace of Gravel | | | | | | | | | | | | | | | |
| | Occasional Cobbles | | | | | | | | | | | | | | | |
| | Loose | | | | | | | | | | | | | | | |
| 52.8 | | | | | | | | | | | | | | | | |
| 14.6 | End of Borehole Probable Bedrock | | | | | | | | | | | | | | | |

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

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2-7

METRIC

W P 120-87-05 LOCATION Co-ords. N 5 022 628.1; E 358 526.1
 DIST 9 HWY 417 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 88 10 25
 ORIGINATED BY RO
 COMPILED BY RO
 CHECKED BY *ep*

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | | | | | |
| 66.1 | Ground Surface | | | | | | | | | | | | | |
| 0.0 | Silty Clay Trace of Sand Very Stiff | | 1 | TW | PH | | | | | | | | | |
| 63.8 | | | 2 | TW | PH | | | | | | | | | |
| 2.3 | Clayey Silt to Silt With Interbedded Layers of Silty Sand Firm to Very Stiff | | 3 | TW | PH | | | | | | | | | |
| | | | 4 | TW | PM | | | | | | | | | |
| | | | 5 | TW | PM | | | | | | | | | |
| | | | 6 | TW | PM | | | | | | | | | |
| 59.7 | Silty Sand to Sand Trace of Gravel | | 7 | TW | OW | | | | | | | | | |
| 6.4 | Compact | | 8 | SS | 22 | | | | | | | | | |
| 58.8 | | | | | | | | | | | | | | |
| 7.3 | End of Borehole | | | | | | | | | | | | | |
| | Note: O.W. = Own Weight | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

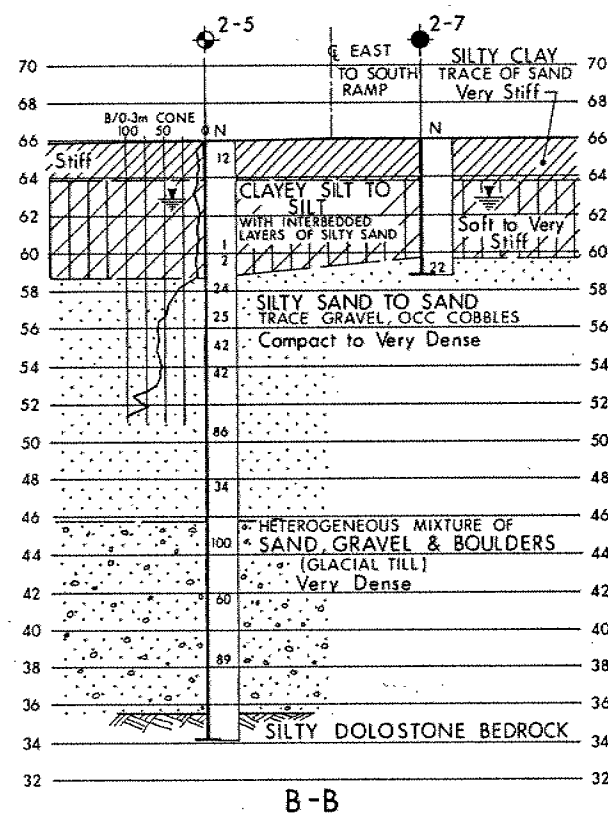
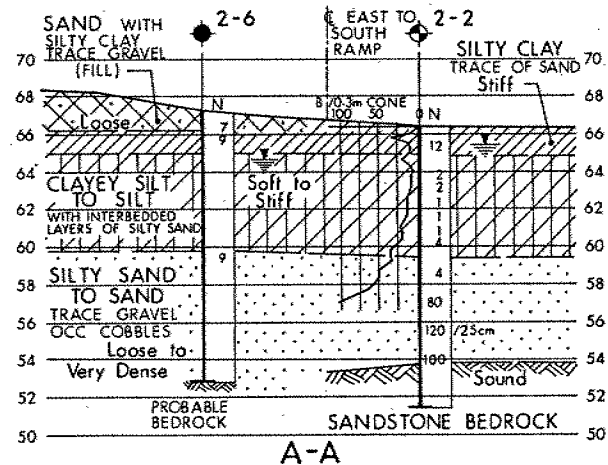
RECORD OF BOREHOLE No 2-8

METRIC

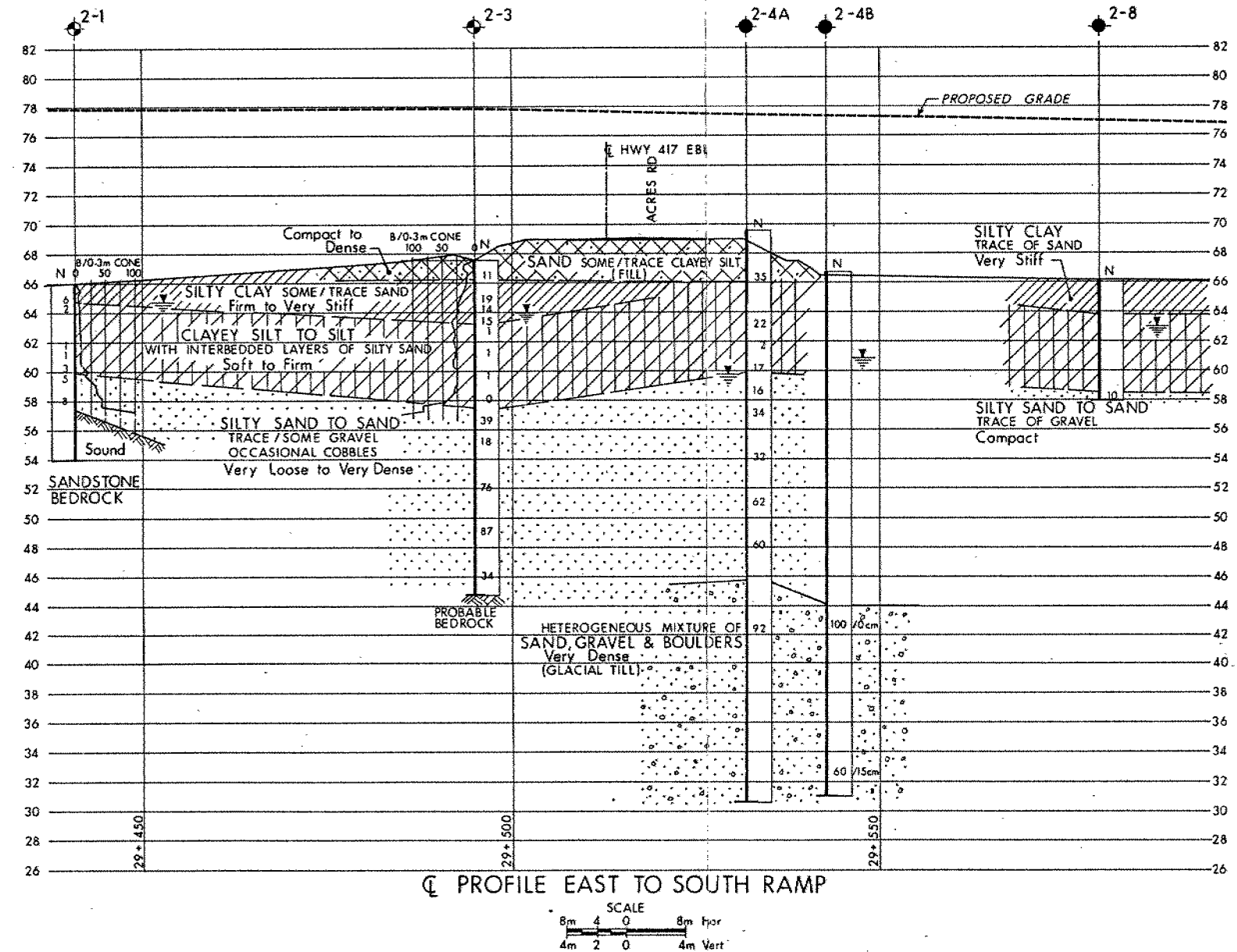
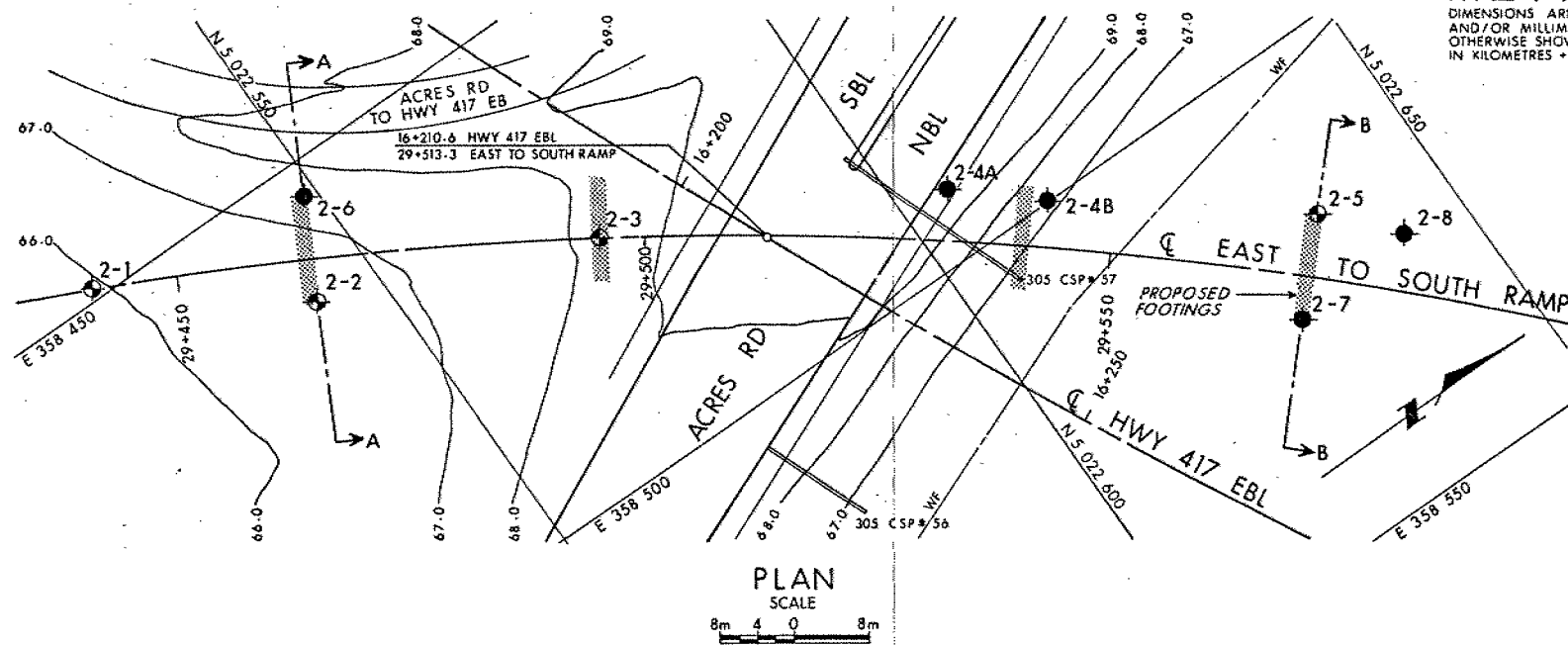
W P 120-87-05 LOCATION Co-ords. N 5 022 642.4; E 358 524.8
 DIST 9 HWY 417 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 88 10 25
 ORIGINATED BY RO
 COMPILED BY RO
 CHECKED BY *CP*

| 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 (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 66.1 0.0 | Ground Surface | | | | | | | | | | | | | | | | |
| | Silty Clay Trace of Sand Very Stiff | | 1 | TW | PH | | 66 | | | | | | | | | | |
| | | | 2 | TW | PH | | | | | | | | | | | | |
| 63.8 2.3 | Clayey Silt to Silt With Interbedded Layers of Silty Sand Firm to Very Stiff | | 3 | TW | PH | | 64 | | | | | | | | | | |
| | | | 4 | TW | PM | | | | | | | | | | | | |
| | | | 5 | TW | PH | | 62 | | | | | | | | | | |
| | | | 6 | TW | PH | | | | | | | | | | | | |
| | | | 7 | TW | PM | | 60 | | | | | | | | | | |
| | | | 8 | TW | PM | | | | | | | | | | | | |
| 58.5 7.6 | Silty Sand to Sand Trace of Gravel Compact | | 9 | SS | 10 | | 58 | | | | | | | | | | |
| 57.9 8.2 | End of Borehole | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

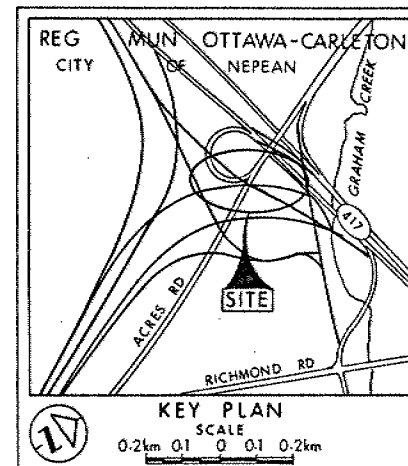


SECTIONS
SCALE
4m 2 0 4m



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

CONT No
WP No 120-87-05
E-S RAMP OVER HWY 417
(STRUCTURE-2)
BORE HOLE LOCATIONS & SOIL STRATA



- LEGEND**
- Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊕ Bore Hole & Cone
 - N Blows/0.3m (Std Pen Test, 475 J/blow)
 - CONE Blows/0.3m (60° Cone, 475 J/blow)
 - W.L. at time of investigation
88 07, 88 08 and 88 10

| No | ELEVATION | CO-ORDINATES | |
|------|-----------|--------------|-----------|
| | | NORTH | EAST |
| 2-1 | 65.9 | 5 022 523.6 | 358 448.7 |
| 2-2 | 66.4 | 5 022 542.6 | 358 463.8 |
| 2-3 | 67.6 | 5 022 571.5 | 358 475.5 |
| 2-4A | 69.6 | 5 022 604.9 | 358 492.6 |
| 2-4B | 66.9 | 5 022 613.1 | 358 499.8 |
| 2-5 | 66.0 | 5 022 636.0 | 358 517.7 |
| 2-6 | 67.4 | 5 022 548.1 | 358 453.7 |
| 2-7 | 66.1 | 5 022 628.1 | 358 526.1 |
| 2-8 | 66.1 | 5 022 642.4 | 358 524.8 |

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

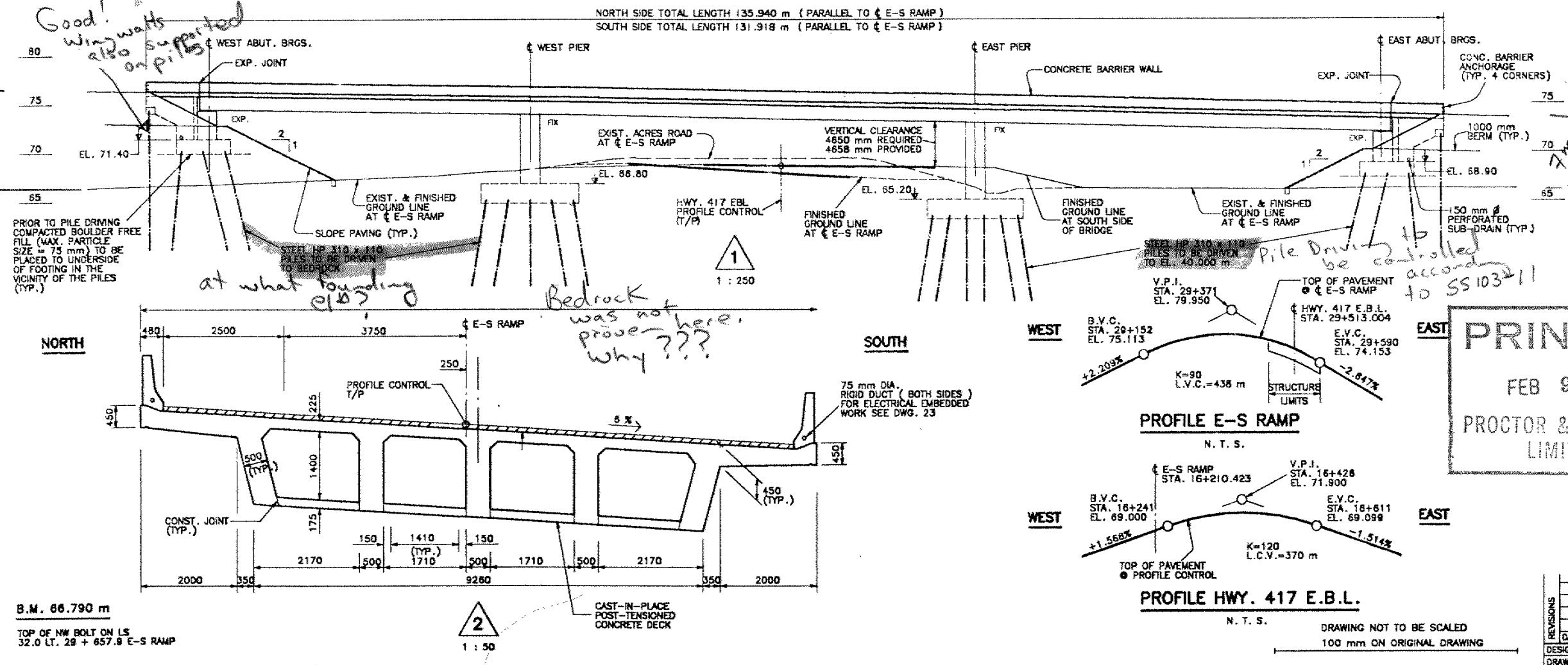
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2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

| REV | DATE | BY | DESCRIPTION |
|-----|----------|----------|-------------|
| 1 | 88 12 12 | APPROVED | |

Geocres No 31G5-153

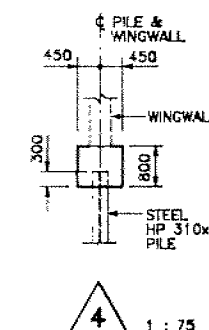
| | | | | |
|------------|----------|----------|---------------|---------------|
| HWY No 417 | SUBMD RO | CHECKED | DATE 88 12 12 | SITE 3-532 |
| DRAWN DT | CHECKED | APPROVED | | DWG 1208705-A |

.. FOR CONSTRUCTION



2
1 : 50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING



| REVISIONS | FOR STEEL R. PILES | | | | | | | | | |
|-----------|--------------------|-----|-------------|------|-------------|--------|---------|------|-----------|--|
| | DATE | BY | DESCRIPTION | | | | | | | |
| DESIGN | T.W. | CHK | G.R.C | CODE | OH-BDC-1983 | LOAD | CLASS A | DATE | NOV. 1983 | |
| DRAWING | S.Y. | CHK | T.W. | SITE | 3-532 | STRUCT | SCHEME | CWG | | |