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ENGINEERING MATERIALS OFFICE

FOUNDATION DESIGN SECTION

EGG 000-31 DIST 6

HWY 401

STR SITE LIVERPOOL ROAD

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DATE JANUARY 31, 1984

GEOTECHNICAL INVESTIGATION

PROPOSED CROSSING AT

LIVERPOOL ROAD AND GO-ALRT

PICKERING, ONTARIO

PROJECT NO: EGG 000-31

Town of Pickering
Regional Municipality of Durham
District #6, Central Region

Ref. No. 83-9-17
January 1984

Prepared For:

GO-ALRT

Distribution

12 copies - Ministry of Transportation and Communications
2 copies - Dominion Soil Investigation Inc.

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APPENDIX

ENCLOSURES

1. INTRODUCTION

Dominion Soil Investigation Inc., Consulting Geotechnical Engineers, have been authorized by GO-ALRT to conduct a soil investigation at the site of the proposed Highway 401/Liverpool Road interchange in the Town of Pickering, Ontario. The new structure will replace the existing bridge which carries Liverpool Road over the CN tracks and Highway 401. The project forms a part of the GO-ALRT construction program and will also include the addition of CN railway tracks (at present three additional tracks are being considered) and the widening of Highway 401.

Two schemes are considered for the approximately 190 m long structure: one consists of a four-span bridge and the other a six-span bridge. Although the future grades will not significantly differ from the existing, the roadway will be substantially widened and therefore space must be provided for the added tracks and the widened Highway.

Eleven boreholes were drilled at the site of the proposed structure. The purpose of the geotechnical investigation was to determine the subsoil and groundwater conditions at the site and to define the engineering soil properties pertinent to the design of the foundations. The report also deals with the anticipated construction conditions.

The Engineering Agreement (No. EGG 000-31) authorizing the geotechnical investigation is dated September 27, 1983, and conceptual design information was transmitted to us by Mr. M.S. Devata, P.Eng., Senior Foundations Engineer of the Ministry of Transportation and Communications, Technical Adviser to GO-ALRT on the project.

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2. SUMMARY

The geotechnical investigation at the site of the proposed Highway 401/ Liverpool Road structure indicates that the subsoil consists predominantly of a very dense sandy silt till and, to a lesser extent, very stiff to hard silty clay tills, all of which are suitable foundation bearing materials. The proposed structure therefore can be supported by spread footing foundations placed at shallow depths below the existing grade.

No construction difficulties are foreseen when excavating for the footings. Although there are wet sand lenses or layers in the till from which water seepage could occur, in our opinion, the excavations can be dewatered by pumping from temporary sumps.

At the north abutment there will be an approach embankment therefore in the report the foundations for a "perched" abutment are discussed in detail. Such an abutment could be supported on an engineered structural fill or on steel H-bearing piles driven into the very dense glacial till.

Geometric and excavation constraints permitting, the new structure could be built half-width initially while maintaining traffic over the existing bridge. Once the traffic is redirected over the partially completed new structure, the existing bridge can be demolished and the second half of the new structure can be built.

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3. SUBSURFACE CONDITIONS

3.1 The Subsoil

The eleven boreholes drilled at the site revealed favourable subsurface conditions; the predominant soil deposits are heavily preconsolidated glacial tills which were deposited by the ice during the Pleistocene period and compressed under the enormous weight of the glaciers. The detailed soil profile encountered in each boring is shown on the borehole logs (Figures 1 through 10, also including 7A) which also contain the field and laboratory test results. The purpose of this section of the report is to summarize the data and highlight those soil properties which should be known for a sound decision regarding the proposed bridge structure. The Drawings at the end of the report contain stratigraphic sections which were inferred on the basis of the boring results.

The terminology and abbreviations used throughout this report are explained on Page I of the Appendix.

The surficial deposits consist of granular fill (encountered in Boreholes 1 and 4 and 7A) or topsoil (encountered in the remaining eight boreholes). The fill generally appears to be a Granular 'B' type aggregate placed during the road construction and whose thickness ranged from 0.5 to 1.2 m in the three borings. The thickness of the topsoil ranged from 0.15 to 0.3 m.

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Within the sandy silt till there are zones where sand and gravel predominate; such material was encountered in Borehole 4. The gradation of this silty sand till is shown on Figure 14; the tested sample consisted of 18 per cent gravel, 57 per cent sand, 23 per cent silt and 2 per cent clay-size particles. The water content is very low (5.7%) and the standard penetration resistances (53 and 87 blows/ 0.3 m penetration) reveal a very dense deposit whose engineering characteristics are very similar to those of the previously described sandy silt till.

In most boreholes, in the upper zones, a silty clay till deposit was encountered. There is sand and traces of gravel in this till. Some samples with higher sand content were subjected to grain size analysis with the following results:

Gravel:	8 to 13%
Sand:	56 to 64%
Silt:	2 to 19%
Clay Size:	3 to 6%

The liquid limit and plasticity index of the tested samples ranged from 14 to 23% and 5 to 14%, respectively. The lower values represent the silty clay with higher sand content. The 'N'-values ranged from 17 (indicating a very stiff consistency) to 65 blows per 0.15 m penetration (indicating hard consistency). The water content of tested samples ranged from 5.6 to 10.3 per cent while three unit weight measurements yielded an average of 21.5 kN/m^3 with a corresponding

.../...

void ratio of 0.3. The silty clay till too has high shear strength and low compressibility and is practically impervious with the exception of the wet sand lenses or layers which can be encountered at random locations.

The described variety of tills encountered at the site is not unusual and is due to the mode of deposition of glacial tills. In spite of their differences in gradation and plasticity, however, the tills at this bridge location are generally very dense or hard and have favourable engineering characteristics reflected by their high bearing capacities accompanied by very low compressibility. The boreholes also indicate the presence of occasional cobbles and boulders in the till deposits.

The permeability of the tills, as mentioned before, is very low. There are, however, sand and silt lenses in the till which are saturated and from which water seepage could occur. The thickness of these sand and silt lenses ranges from a few millimeters to several meters, e.g. in Borehole 1 the sand lense or layer was 3.7 m thick. The grain size distribution of a sand sample is shown on Figure 13.

Most of the boreholes encountered extremely hard silty clay till at larger depths in which the presence of shale fragments indicated transition to shale bedrock. The shale could in some instances be penetrated by the auger and in Boreholes 2 and 7 it was cored. The recovery rates ranged from 25 to 75% with RQD values of 0 indicating

.../...

that the shale is weathered. The shale bedrock appears to slope towards the north; in Boreholes 1 and 2 the bedrock surface was at about El. 77 m whilst in Boreholes 7 and 8, which were located about 150 m to the north, at about El. 74 m.

3.2 The Groundwater

The position of the groundwater table was observed during drilling, upon completion of the borings and in the piezometers which were installed in five of the boreholes (Nos. 2, 4, 5, 7 and 10). Due to the low permeability of the tills encountered at the site, in our opinion, the measured water levels indicate the head existing in the more pervious sand and silt layers or lenses. From the observed water levels a gradient towards the north is inferred. The water level was at El. 88.7 m in Borehole 1 near the south end and at El. 81.0 m in Borehole 9, near the north end of the site. The boreholes in between indicate water levels lying between these two extremes.

The groundwater level in Borehole 7A did not reach a state of equilibrium in the short period of time that elapsed between completion of the boring and backfilling.

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4. DISCUSSION AND RECOMMENDATIONS

4.1 Conceptual Arrangement

The conceptual arrangement of the proposed bridge is shown on a Preliminary Site Plan (Dwg. No. PDI 600 221) which we received from the Ministry of Transportation and Communications. Accordingly, the structure will be approximately 190 m long and will have four or six spans. The positions of the eleven boreholes in the present soil investigation were arranged so as to obtain information for both alternatives.

4.2 The Design of Foundations

The subsoils at the site consist of very dense or hard glacial tills which were encountered at shallow depths, therefore, the proposed structure can be supported on spread footing foundations. In the following table the bearing capacities are stated for each individual borehole or for pairs of boreholes in order that they may be used for designing the foundations of the piers and abutments. In the event that a pier is located between borings or pairs of borings, conservatively, the lower bearing capacity may be used in the design.

.../...

Borehole No.	Appr. Exist. Gr. Elev. at BH (m)	Appr. Future Lowest Grade El. (m) Note (1)	Probable Founding El. (m) Note (2)	Bearing Capacity F.C. at U.L.S. kPa Note (3)	Bearing Capacity S.L.S. TYPE II kPa Note (4)
1 - 2 (South Abutment)	92 to 95	87.8	87.0 or lower	1200	800
3 - 4	92 to 94	86.0	85.0 or lower	1200	800
5 - 6	91 to 94	85.0	84.0 or lower	1500	1000
7 A	88	87.0	86.0 to 85.5	800	500
			85.0 or lower	1500	1000
8	87	87.0	85.5 to 85.0	800	500
			84.5 or lower	1500	1000
9 - 10 (North Abutment)	86 - 91	87.0	85.0 to 84.0	300	200
			83.5 to 83.0	540	360
			82.5 to 81.0	800	500

For Notes (1) (2) (3) and (4) see following page

.../...

Notes:

(1) Approximate future lowest grade elevation: this was obtained from the conceptual arrangement drawing provided by M.T.C.; the presence of drainage ditches are taken into account wherever such ditches are shown on the drawing.

(2) Probable founding elevation: soil conditions permitting, the tabulated bearing capacities are stated as high as 0.8 m below the approximate future grade elevation; attention is called to the need of providing at least 1.2 m earth cover above the foundation base level for frost protection. If the highest specified founding elevation is more than 1.2 m below the assumed future grade elevation, this means that foundations should not be placed above this elevation because of unsuitable bearing strata.

(3) F.C. at U.L.S. = Factored Capacity at Ultimate Limit States, determined in accordance with the Ontario Highway Bridge Design Code, 1979 Edition (OHBDC).

(4) S.L.S. TYPE II = Serviceability Limit State - Type II, as determined in accordance with the OHBDC. This bearing capacity was arrived at on the basis of the following estimated settlements:

.../...

(i) Where the specified bearing capacity is 800 to 1000 kPa the maximum settlement should not exceed 12 mm.

(ii) Where the specified bearing capacity is 500 kPa or less, the maximum settlement should not exceed 25 mm.

It is to be noted that these estimated settlements apply only in the event that the foundation subgrade is undisturbed and consists of the strata identified in the nearest borehole.

The maximum differential settlement of the footings, designed in accordance with the values given in the above table, are estimated to be about 13 mm which should be taken into consideration when deciding on the type of structure to be built (statically indeterminate structure vs. statically determinate one).

.../...

4.3 The Construction of Foundations

The walls and bottom of the excavations for the footings of the proposed bridge will generally be in the very dense or hard till strata which are anticipated to be stable and relatively impervious for the short duration of construction. Notwithstanding the apparent stability of the walls of the excavation, if the excavation is deeper than 1.2 metres, the sides should be cut back to 1 to 1 slope or supported by skeleton sheeting and bracing.

When discussing the subsurface conditions, we mentioned the presence of saturated sand and silt lenses or layers in the till deposits. Water seepage should be anticipated from such materials and the quantity of seepage would depend on the size of these lenses, and, if they form a continuous layer which is part of an aquifer, provisions should be made to handle larger flows. Wherever seepage occurs, the water can be collected in temporary sumps cut into the till outside the footing areas and removed by pumping. The sumps should be protected against erosion with a suitable filter cloth (e.g. Terrafix 270R) and crushed stone ballast.

If the subgrade itself or parts thereof consist of saturated sand, which becomes unstable when exposed, such materials should be removed until the less pervious till strata are encountered. According to the findings in the boreholes, the wet sand and silt lenses are generally of limited thickness in the upper soil zones.

.../...

As soon as the foundation grade was reached and approved, a minimum 100 mm thick concrete mudmat should be spread over the subgrade to minimize disturbance and to provide a neat working area for the construction of the foundations.

4.4 Perched Abutment Foundations

The foundation of the north abutment may be perched in the approach embankment about 5 to 7 metres above the existing ground level. In this case the footings can either be supported by engineered fill or by piles driven through the approach embankments.

In the case that the footings are placed on engineered structural fill, all topsoil, fill and other unsuitable and soft materials should be removed to the surface of the undisturbed dense to very dense or very stiff to hard natural substrata. The material used for embankment construction under the footings should be well-graded, clean crushed stone fill conforming to M.T.C. Std. Form 1010, Granular 'A' aggregate. The geometry of the structural fill and footing is shown on Figure 15; a minimum earth cover of 1.2 m should be provided for frost protection.

For footings meeting the above requirements, the Factored Bearing Capacity at Ultimate Limit States is 600 kPa. The Bearing Capacity at Serviceability Limit States, Type II, is 250 kPa. With this value, the maximum total settlement should be limited to 25 mm.

.../...

For the evaluation of the sliding resistance of a foundation, the ultimate value of the angle of friction between the concrete and structural fill should be taken as 31 degrees.

Alternatively, end bearing steel-H piles could be used to support a "perched" abutment. (Closed-end pipe piles are displacement type piles therefore they are more difficult to drive. At this site they are not considered to be an advantageous choice.) These piles would probably penetrate to El. 79 m at the north abutment. To minimize damage to the pile during driving and to get a good seating in the till, we recommend that the flanges should be reinforced with welded steel plates.

The estimated pile capacities for some common sizes of steel piles driven to a final set of about 1 blow for 2 mm penetration with a pile driving hammer capable of delivering an energy of 40 000 to 70 000 Joules/blow are tabulated below. It is estimated that the settlement of the pile head will be negligibly small.

ESTIMATED PILE CAPACITY (kN)

Pile Type	Size	Factored Capacity at Ultimate Limit States	Capacity at Serviceability Limit States Type II
Steel H	HP 310 x 110	1600	1150
	HP 310 x 79	1150	850

.../...

It is recommended that the driving of the piles in the field be controlled by a recognized dynamic pile driving formula such as the Hiley formula.

Unbalanced horizontal forces should be resisted by battered piles and for frost protection, the underside of the pile caps should be established at least 1.2 m below finished grade.

4.5 Lateral Earth Pressure

It is recommended that properly compacted and free-draining granular material should be used as backfill behind retaining walls. Perforated pipes and/or drainage holes should be incorporated in the design to minimize the build-up of hydrostatic pressure. The perforated pipes should be surrounded with Terrafix 270R or approved equal to prevent clogging.

Assuming that free-draining granular material and adequate drainage is provided behind retaining structures (Figure 6.9.6.1 Ontario Highway Bridge Design Code, 1979 edition) the lateral earth pressure can be calculated by using the following equivalent pressure:

On the major portion of the retaining wall where active earth pressure conditions could develop:

At Ultimate Limit State	8 kPa/m
At Serviceability Limit State Type II	6.5 kPa/m

.../...

Rigid retaining walls of bridge abutments should be designed to withstand the at-rest earth pressures which can be approximated using the following equivalent fluid pressure:

At Ultimate Limit State	10 kPa/m
At Serviceability Limit State Type II	8.5 kPa/m

When using the above values, it is assumed that the slope of the backfill behind the retaining structure is approximately level.

Construction joints should be provided between the portions of retaining walls which can yield and which are rigidly restrained.

Care should be given to avoid the development of large horizontal pressures by the compaction of the backfill behind the retaining walls and abutments. Vibratory compaction equipment, for use behind retaining structures, must be restricted in size as per current M.T.C. specifications.

4.6 Construction of the Bridge

To minimize disruption of traffic during the construction of the proposed structure, consideration may be given to constructing the eastern half of the new structure alongside the existing bridge. The conceptual arrangement (albeit at a relatively small scale) shows that this could be a practicable solution and the half-width of the new bridge would be about the same as the full width of the existing structure. (The northern-most third of the new bridge could be built full width without encroaching on the existing bridge) Steel or precast concrete

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girders supporting a reinforced concrete slab may prove to be suitable because these girders could be erected from above without costly falsework and without interfering with the traffic on Highway 401.

After the east half of the new structure was completed and traffic is redirected over it, the existing structure can be demolished and the west half of the new bridge constructed.

The suggested method of construction should be decided upon only after a thorough study of the general arrangements and foundation elevation of the existing structure prove it to be feasible. Safeguarding the stability of the existing foundations during excavating for the new footings is of paramount importance.

5.0 CLOSURE

The Statement of Limitation, as quoted in the Appendix, is an integral part of this report.

DOMINION SOIL INVESTIGATION INC.

L.S. Rolko, P.Eng.

REGISTERED PROFESSIONAL ENGINEER L.S. ROLKO PROVINCE OF ONTARIO

LSR:bh

A P P E N D I X

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:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX $= w_L - w_P$
I_L	1	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE
e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

PROCEDURES

Field Work

The boreholes were set out in the field by Dominion Soil Investigation Inc., with the aid of a "Preliminary Site Plan, GO-ALRT EXTENSION, LIVERPOOL ROAD STRUCTURE, Dwg. No. PDI 600 221", undated, which shows the layout of the existing and proposed structures. The borehole locations were selected in order to obtain maximum information about the subsurface conditions at the foundations, however, this was not always possible due to the restricted room available for setting up the machine.

The elevations of the boreholes were tied to a benchmark which is identified as a plate in the existing CN bridge and is defined as being of Elevation 95.25 m, geodetic datum. This information was given to us by the surveyors of M.T.C.

The field work was carried out between September 29 and October 13, 1983, and consisted of drilling eleven boreholes varying in depth from 12.8 m to 20.0 m. The eleventh borehole, numbered 7A, was put down on December 15, 1983. The following schedule summarizes the boring details:

.../...

BH No.	Depth	Boring Date	Remarks
1	19.7 m	Sept. 29, 1983	-
2	18.0 m	Oct. 5-6, 1983	7.6 m long piezometer 1.2 m diamond drilling
3	17.4 m	Oct. 3-4, 1983	-
4	18.1 m	Sept. 30, 1983	18.0 m long piezometer
5	20.0 m	Oct. 3, 1983	11.9 m long piezometer
6	19.3 m	Oct. 4-5, 1983	-
7	15.2 m	Oct. 12-13, 1983	11.9 m long piezometer 1.2 m diamond drilling
7A	15.4 m	Dec. 15, 1983	-
8	13.9 m	Oct. 11, 1983	-
9	12.8 m	Oct. 7, 1983	0.8 m diamond drilling
10	15.1 m	Oct. 11-12, 1983	7.6 m long piezometer
Total Drilling	184.9 m		Total length of piezometers: 57.0 m Total diamond drilling: 3.2 m

The borehole locations are shown on the Drawing, while the logs of the boreholes are shown on Figures 1 through 10, including 7A. The borehole locations are also defined with coordinates.

The boreholes were advanced by a power auger equipped with hollow-stem augers. When the shale bedrock surface was reached augering was continued until practical refusal was encountered. In two boreholes, however, the bedrock was explored by diamond drilling. B-size

The grain-size distribution curves are shown on Figures 11 to 14. All laboratory test results are shown on the logs of the boreholes too and a summary of laboratory tests is presented in Table I which follows.

BH	SA	DEPTH	w	w_L	w_P	I_P	I_L	GRADATION				γ	γ_d	e	c	σ_3	ε_f		GROUP SYMB.
								GR	SA	SI	CL								
No.		m	per cent					per cent				kN/m^3					%		
1	3	4.9	8.8	14	11	3	-0.7	1	47	51	1								ML-SM
	5	7.8	6.9	15	8	7	-0.2	8	64	22	6	19.7	18.4	0.4					CL
	6	8.5	7.3																
	7	9.4	7.3																
	11	14.0						25	68	7	~0								
	13	16.9	9.5	23	14	9	-0.5												CL
2	7	9.3	6.9	17	7	10	~ 0												CL
3	2	3.4	7.1	17	8	9	-0.1					21.6	20.2	0.3					CL
	3	4.9	8.6																
	4	6.2	11.2																
	5	7.0	10.5									25.5	23.1	0.2					
	6	7.8	10.3	14	9	5	0.3	13	55	29	3	22.7	20.6	0.3					CL-ML
	7	9.3	7.0																
4	3	4.9	5.7					18	57	23	2								
	8	10.8	6.4	14	12	2	-2.8												ML
6	2	3.4	9.2	17	10	7	-0.1												CL
7	4	4.0	5.6	16	10	6	-0.7					22.1	20.9	0.3					CL-ML
	5	4.9	7.5					13	63	19	5								

SUMMARY OF LABORATORY TESTS

TABLE I SHEET 1 of 2

BH	SA	DEPTH	w	w_L	w_P	I_P	I_L	GRADATION G	GRADATION S	GRADATION F	GRADATION -2μ	γ	γ_d	e	c	σ_3	ε_f		GROUP SYMB.
No.		m	per cent					per cent				kN/m^3					%		
7A	1	0.9	7.5	17	13	4	-1.4					23.2	21.6	0.2					CL-ML
	2	1.8	7.3									24.1	22.5	0.2					
	3	2.7	12.5	18	10	8	0.3												CL
	4	3.4	8.2									25.1	23.2	0.1					
	5	4.0	8.2																
	6	4.6	9.0																
	7	6.1	9.0																
	8	7.6	7.1																
	9	9.1	7.2																
	10	10.7	8.7																
	11	12.2	8.1																
	12	13.7	7.5																
	13	15.2	6.0																
8	1	1.8	7.8	16	9	7	-0.2												CL
10	2	3.4	10.1	16	14	2	-2.0					19.4	17.6	0.5					ML

SUMMARY OF LABORATORY TESTS

TABLE

APPENDIX

STATEMENT OF LIMITATION

The conclusions and recommendations in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigations.

We recommend that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known, in our analysis certain assumptions had to be made. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis.

<u>In cases where these recommendations are not followed, the company's responsibility is limited to report accurately the information encountered in the testholes.</u>

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

E N C L O S U R E S

RECORD OF BOREHOLE No 1

METRIC

W P: EGG 000-31 | LOCATION: CO-ORDS. 4,854,243N; 337,924E | ORIGINATED BY: S.D.

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: HOLLOW STEM AUGER | COMPILED BY: F.L.

DATUM: GEODETIC | DATE: 1983.09.29 | CHECKED BY: [signature]

ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
95.1	GROUND LEVEL							
0.0 / 93.9	Fill - (Gran. "B" aggregate)					94		AS = Auger Sample
1.2	Sandy silt, traces of gravel and silt lenses. Dense / Very dense. Damp. Brown / Grey (Glacial Till), occasionally slightly cemented	1	SS	31				
		2	SS	50/	0.15m	92		Borehole relocated once 2 m S. because of boulder
		3	SS	63		90		1 47 51 1
88.9	Boulder	4	SS	15/	0.15m ▼			SS4 - Blows on Sample: 15/0.15 m + 30/0 m
6.2	Silty clay, sandy, traces of gravel and wet sand lenses. Hard. Damp. Grey (Glacial Till)					88		
		5	SS	60/	0.15m		19.7	8 64 22 6
		6	SS	77				
		7	SS	102		86		
83.5		8	SS	89		84		Plug and augers sanded together after SS9
11.6 / 82.3	Sandy silt, traces of gravel. Very dense (Glacial Till)	9	SS	62/	0.15m			
12.8	Sand, some gravel, trace silt. Very dense. Saturated. Grey	10	AS	-		82		
		11	SS	55				25 68 7←0
78.6		12	SS	67/	0.15m	80		
16.5 / 77.1	Silty clay with black shale fragments. Hard. Damp. Grey	13	SS	50/	0.10m	78		
18.0	Shale, black thin flakes (3 to 6 mm) mixed with clay	14	SS	160/	0.10m			
75.4	Hard. Black. Dry	15	SS	120/	0.05m	76		
19.7	END OF BOREHOLE (Auger refusal)							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

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

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 2

METRIC

W P EGG 000-31 | LOCATION CO-ORDS. 4,854,264N; 337,951E | ORIGINATED BY S.D.

DIST 6 HWY GO-ALRT | BOREHOLE TYPE HOLLOW STEM AUGER & BXL ROCK CORE | COMPILED BY F.L.

DATUM GEODETIC | DATE 1983.10.05 - 06 | CHECKED BY [signature]

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.9	GROUND LEVEL						
0.0	0.2 m Topsoil Silty clay, sandy, traces of gravel Hard Brown moist	1	SS	42	PIEZOMETER	90	
89.5							
2.4	Sandy silt, traces of gravel Very dense Grey Damp	2	SS	52		88	
		3	SS	62/0.15m			
		4	SS	85/0.15m	SEAL		
	(Glacial Till) Cobbles	5	SS	80/0.07m		86	
84.6							
7.3	Silty fine sand Very dense Grey Wet	6	SS	50/0.07m		84	
83.7							
8.2	Silty clay, some sand, trace of gravel	7	SS	50/0.07m			
	Grey Damp Hard					82	
	(Glacial Till)	8	SS	50/0.07m			
80.0						80	
11.9	Sandy silt, trace gravel V.dense (Glacial Till) moist	9	SS	50/0.07m			Groundwater encountered during drilling at 12.8 m depth
79.1							
12.8	Sand with traces of silt Very dense Grey Saturated	10	SS	50/0.15m		78	
76.7							
15.2	Shale, 3 to 6 mm thick bands, with clay layers	11	SS	50/0.02m		76	
		12	RC BXL	75%			
73.9						74	
18.0	END OF BOREHOLE						

Column headings also include: SOIL PROFILE; STRAT PLOT; SAMPLES; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ

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

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 3

METRIC

W P EGG 000-31 LOCATION CO-ORDS, 4,854,310N; 337,922E ORIGINATED BY S.D.
DIST 6 HWY GO-ALRT BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.10.03 and 1983.10.04 CHECKED BY [signature]

ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
91.7	GROUND LEVEL							
0.0	0.15 m Topsoil							
	Silty clay, sandy, traces of gravel	1	SS	35		90		
	Brown / Grey							
	Hard Damp	2	SS	56		88	21.6	
		3	SS	55	▽ (water level)			
85.9 / 5.8	Sandy silt, traces of gravel, Very dense, Grey, Damp	4	SS	55/0.15m		86		
		5	SS	50/0.10m			25.5	
84.4 / 7.3	Silty clay, sandy, traces of gravel, Hard (Glacial Till)	6	SS	65/0.15m		84	22.7	13 55 29 3
83.2 / 8.5	Sandy silt, traces of gravel	7	SS	50/0.10m		82		
	Very dense, Damp	8	SS	50/0.10m		80		
	Grey	9	SS	52/0.15m				
	Wet sand lense	10	SS	50/0.10m		78		
	(Glacial Till)	11	SS	62/0.15m		76		
75.3 / 16.4	Shale, black, Hard, Damp	12	SS	50/0.07m				
74.3 / 17.4	END OF BOREHOLE (Auger refusal)							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH: o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE
PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

$+^3$, $\times^5$: Numbers refer to Sensitivity   15 ◇ 5 (20 / 10) (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P: EGG 000-31 | LOCATION: CO-ORDS. 4,854,290N; 337,885E | ORIGINATED BY: S.D.

DIST: 6 HWY: GO-ALRT | BOREHOLE TYPE: HOLLOW STEM AUGER | COMPILED BY: F.L.

DATUM: GEODETIC | DATE: 1983.09.30 | CHECKED BY: [signature]

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
94.0	GROUND LEVEL							
0.0 / 93.1	Fill - (Gran. B aggregate)							
0.9	Sandy silt, traces of gravel, Damp, Very dense, Brown (Glacial Till)	1	SS	83	PIEZOMETER	92		
		2	SS	70				
89.9 / 4.1	Silty sand, traces of gravel, Very dense, Grey, Moist (Glacial Till)	3	SS	87		90	o	18 57 23 2
87.0		4	SS	53	▽	88		
7.0	Sandy silt, traces of gravel, Damp, Very dense, Wet sand lense, Grey (Glacial Till)	5	SS	69		86		
		6	SS	96/	0.25m			
		7	SS	50/ 0.12m	SEAL	84		
		8	SS	95			o H	
		9	SS	67/	0.15m SEAL	82		
80.1 / 13.9	Fine sand, traces of gravel & silt, Very dense, Grey, Boulder, Saturated	10	SS	30/	0.0m	80		
78.6 / 15.4	Sandy silt, trace of gravel, Grey, Moist (Glacial Till), Sand lense, Very dense	11	SS	89		78		
76.3		12	SS	140/	0.28m			
75.9	Black shale (Wet)	13	SS	150/	0.07m	76		
18.1	END OF BOREHOLE (Auger refusal)							

Other columns: STRAT PLOT; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE); PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ

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

15 ◇ 5 (20 above, 10 below) (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P EGG 000-31 LOCATION CO-ORDS. 4,854,336N; 337,871E ORIGINATED BY S.D.
DIST 6 HWY GO-ALRT BOREHOLE TYPE SOLID STEM AUGER COMPILED BY F.L.
DATUM GEODETIC DATE 1983.10.03 CHECKED BY [signature]

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp, NATURAL MOISTURE CONTENT W, LIQUID LIMIT WL / WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
93.5	GROUND LEVEL										
0.0	0.3 m Topsoil					SEAL					
	Silty clay, some sand trace gravel		1	SS	64		92				
	Brown Damp Hard										
	(Glacial Till)		2	SS	60/0.15m		90				
89.4 / 4.1	Sandy silt, trace gravel, occasional slightly cohesive zones		3	SS	84	PIEZOMETER					
							88				
	Damp		4	SS	73/0.15m						
	Grey		5	SS	93/0.15 m	▽	86				
	Very dense		6	SS	53/0.15m	SEAL	84				
			7	SS	67/0.15m						
	Wet						82				
	(Glacial Till) sand		8	SS	53/0.15m						
	lenses		9	SS	85/0.15m						
			10	SS	110/0.15m		80				
	occ.shale fragments		11	SS	50/0.07m		78				
	sand lense		12	SS	130/0.15m		76				
	sand lense		13	SS	65/0.15m		74				
73.5	shale fragments		14	SS	50/0.02m						
20.0	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

15 ⌖ 5 (20 / 10) (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P EGG 000-31 LOCATION CO-ORDS. 4,854,346N; 337,902E ORIGINATED BY S.D.

DIST 6 HWY GO-ALRT BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY F.L.

DATUM GEODETIC DATE 1983.10.04 & 1983.10.05 CHECKED BY [signature]

ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
90.7	GROUND LEVEL					
0.0	0.3 m Topsoil					90
	Silty clay, some sand, trace gravel					
	Hard Brown / Grey Damp	1	SS	63		88
86.7	(Glacial Till)	2	SS	63		
4.0	Silt, trace gravel				▽ (water level)	86
	Very dense Grey Damp	3	SS	73		
		4	SS	56/	0.15m	84
82.2		5	SS	50/	0.10m	
8.5	Sandy silt, trace of gravel					82
		6	SS	200/	0.15m	
	Grey	7	SS	70/	0.15m	80
		8	SS	50/	0.10m	78
	Very dense (Glacial Till); wet sand lense	9	SS	62/	0.15m	
	shale fragments					76
74.5		10	SS	63/	0.15m	
16.2	Clayey shale					74
	Hard Dark grey Damp	11	SS	150/	0.15m	
71.4		12	SS	77		72
19.3	END OF BOREHOLE (Auger refusal)	13	SS	160/	0.10m	

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3$, $\times^5$: Numbers refer to Sensitivity   15 -◇- 5 (20 above, 10 below) (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7A

METRIC

W P EGG 000-31 LOCATION CO-ORDS. 4,854,364N; 337,891E ORIGINATED BY S.D.

DIST 6 HWY GO-ALRT BOREHOLE TYPE HOLLOW STEM AUGER COMPILED BY F.L.

DATUM GEODETIC DATE 1983.12.15 CHECKED BY [signature]

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.5	GROUND LEVEL								
0.0	FILL (gravel, sand, silt)								
0.5	SANDY SILT, trace angular gravel; hard, brown / grey, Boulders; Slightly cohesive or occasionally slightly cemented; Damp to moist, thin sand lenses	1	SS	26				23.2	Borehole was re-located once because of boulders at 2.1 m depth.
		2	SS	38		86		24.1	
		3	SS	80					
		4	SS	77		84		25.1	
		5	SS	100					
	(Glacial Till)	6	SS	50/	0.15m	82			
	Grey	7	SS	50/	0.10m				Groundwater level was taken immediately upon completion of boring.
		8	SS	50/	▼ 0.10m	80			(Probably not representative)
		9	SS	50/	0.08m	78			
	wet sand lenses	10	SS	50/	0.10m	76			
		11	SS	50/	0.08m				
73.2		12	SS	100/	0.10m	74			
14.3 / 72.1	Shale with hard clay layers	13	SS	100/	0.10m				
15.4	End of Borehole								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

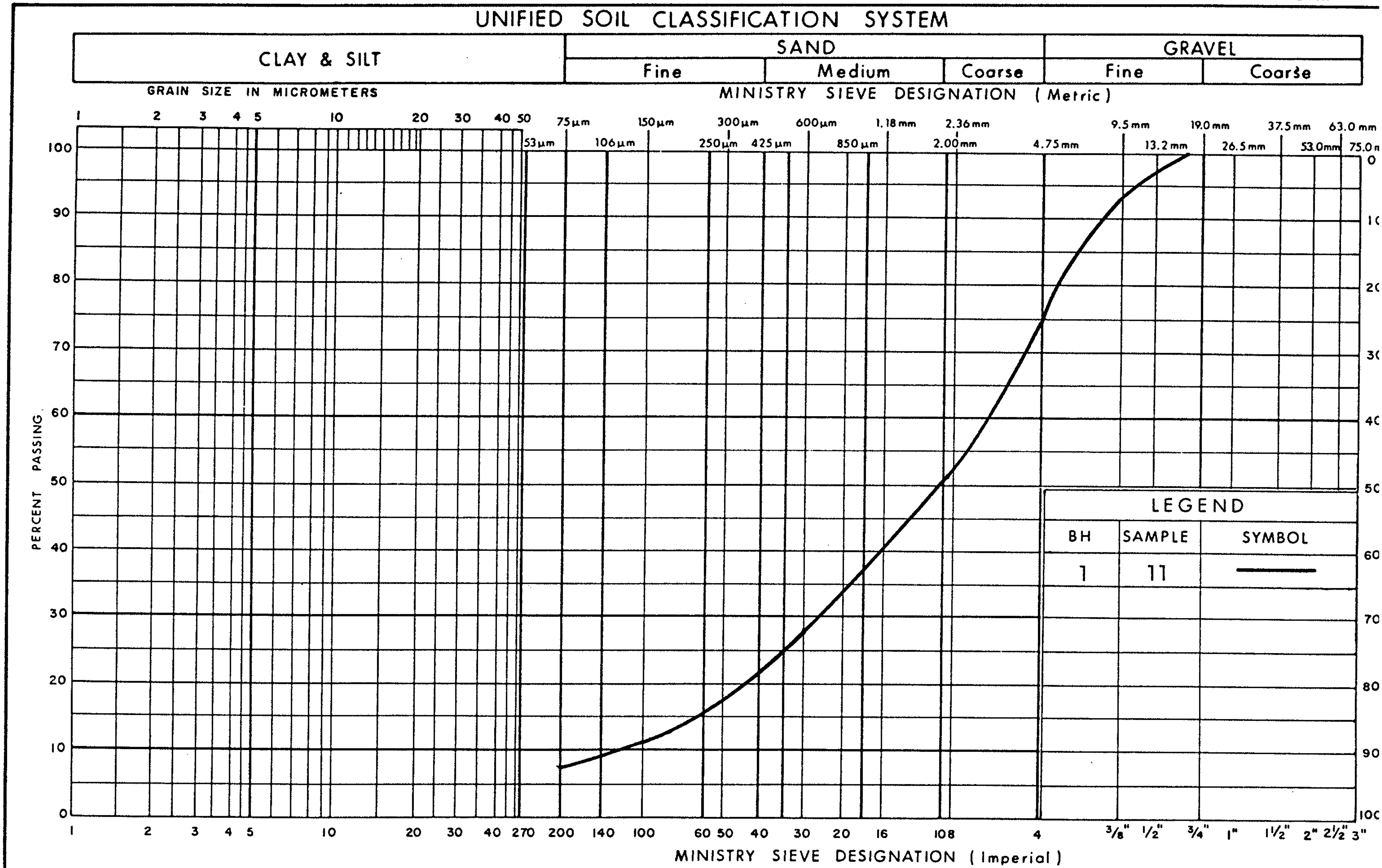
SHEAR STRENGTH: o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE

PLASTIC LIMIT W_p, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

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

DOMINION SOIL INVESTIGATION INC. - REF. NO. 83-9-17

78 12 M



Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION

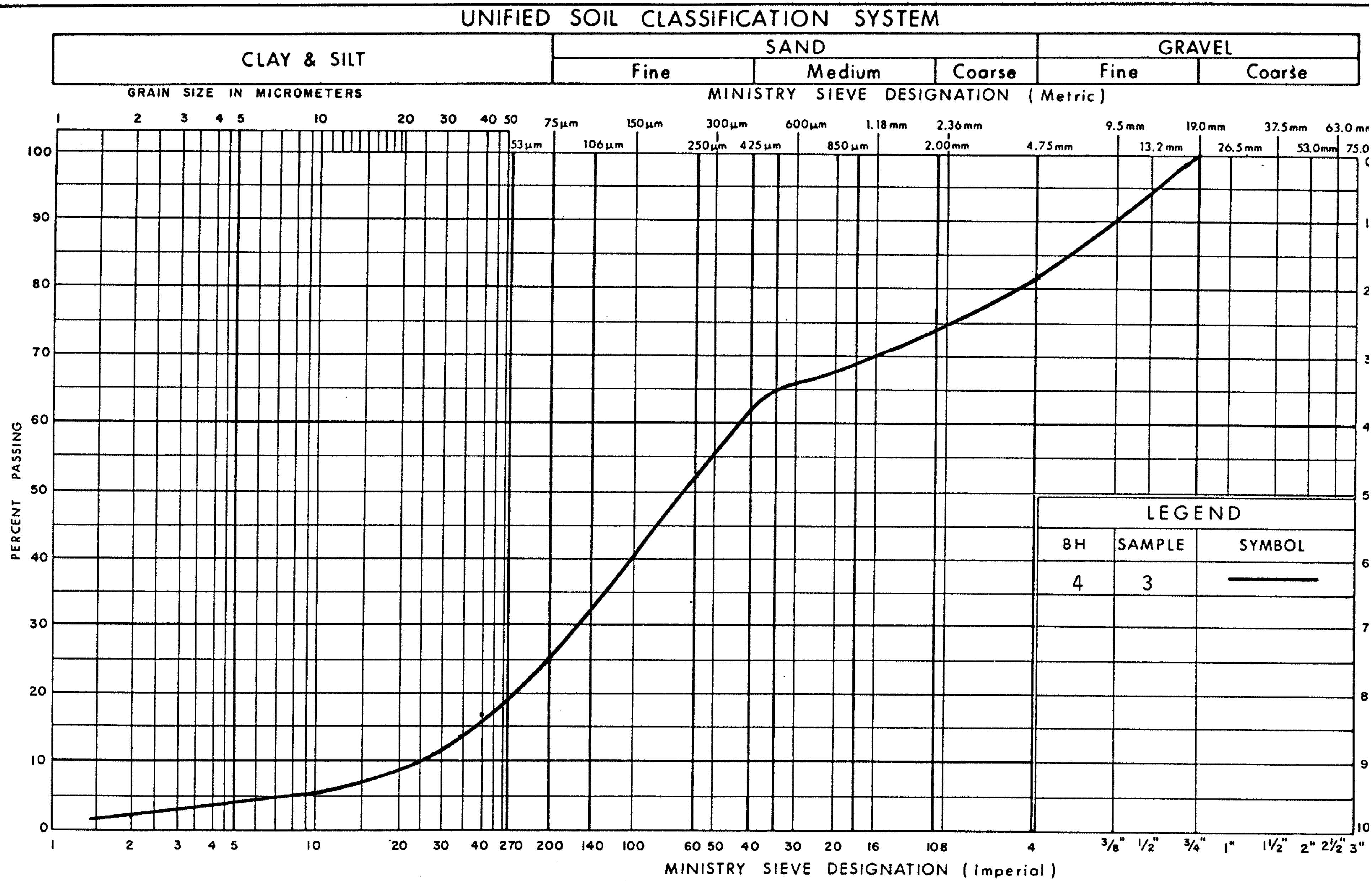
SAND, some Gravel, trace Silt

FIG No 13

W P EGG 000-31

DOMINION SOIL INVESTIGATION INC. - REF. NO. 83-9-17

78 12 M



Ministry of Transportation and Communications
Ontario

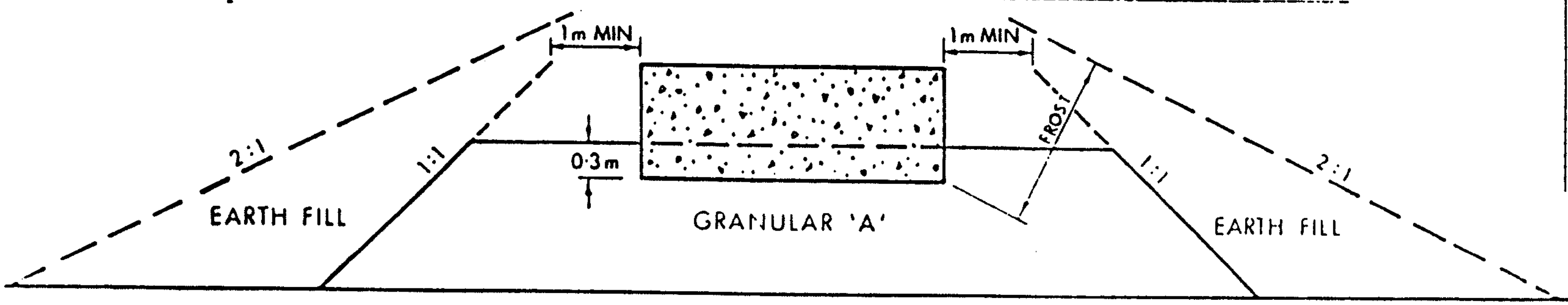
GRAIN SIZE DISTRIBUTION

SILTY SAND, trace Gravel (Glacial Till)

FIG No 14

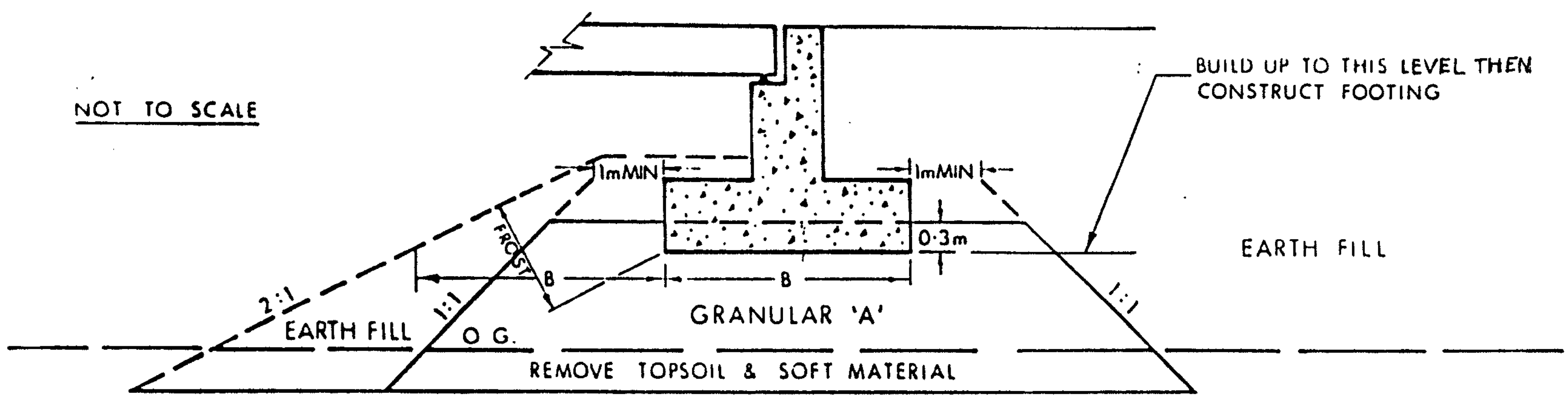
W P EGG 000-31

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

NOTES:

1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.

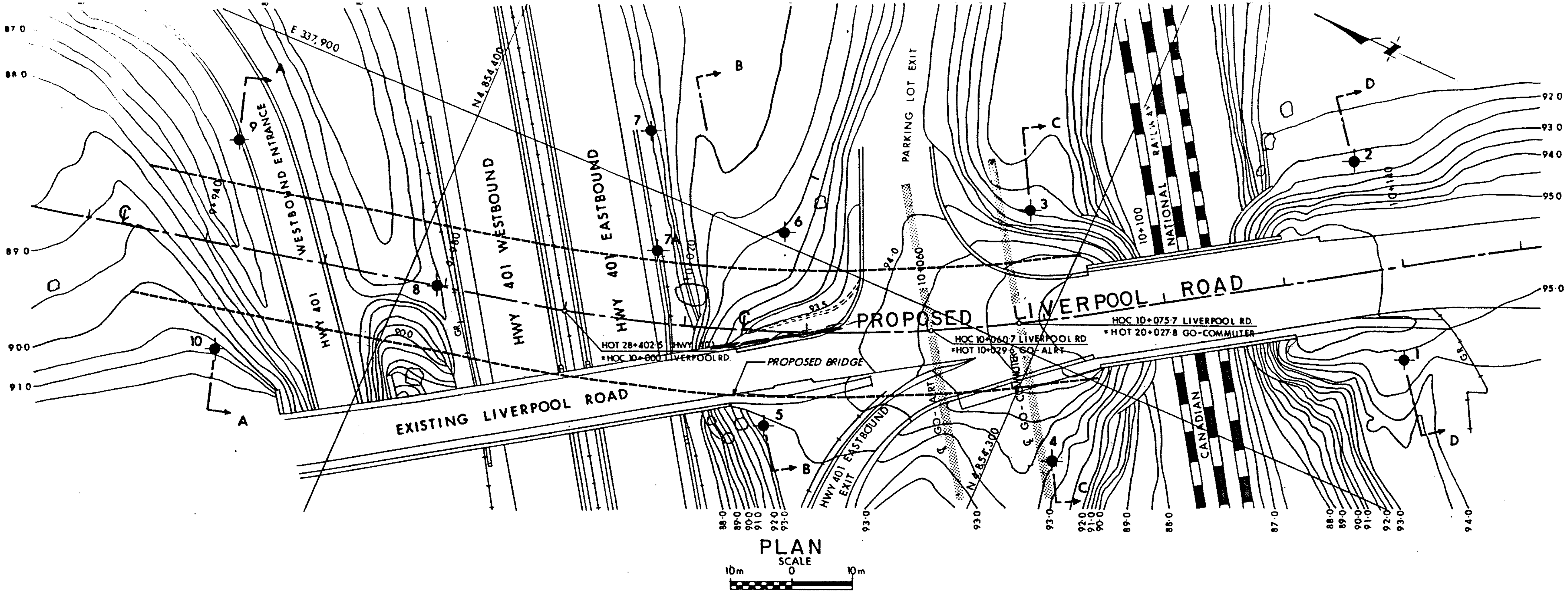
2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.

3 - CONSTRUCT CONCRETE FOOTING

4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED

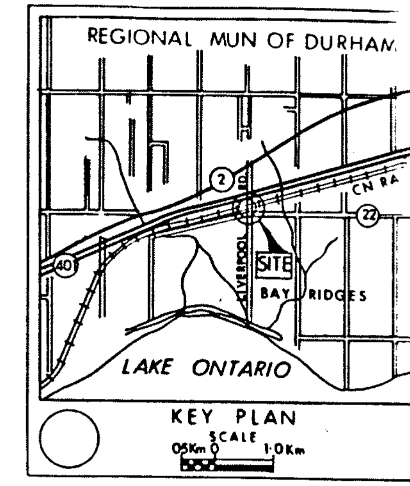
FIG. 15

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



PLAN

SCALE 10m 0 10m



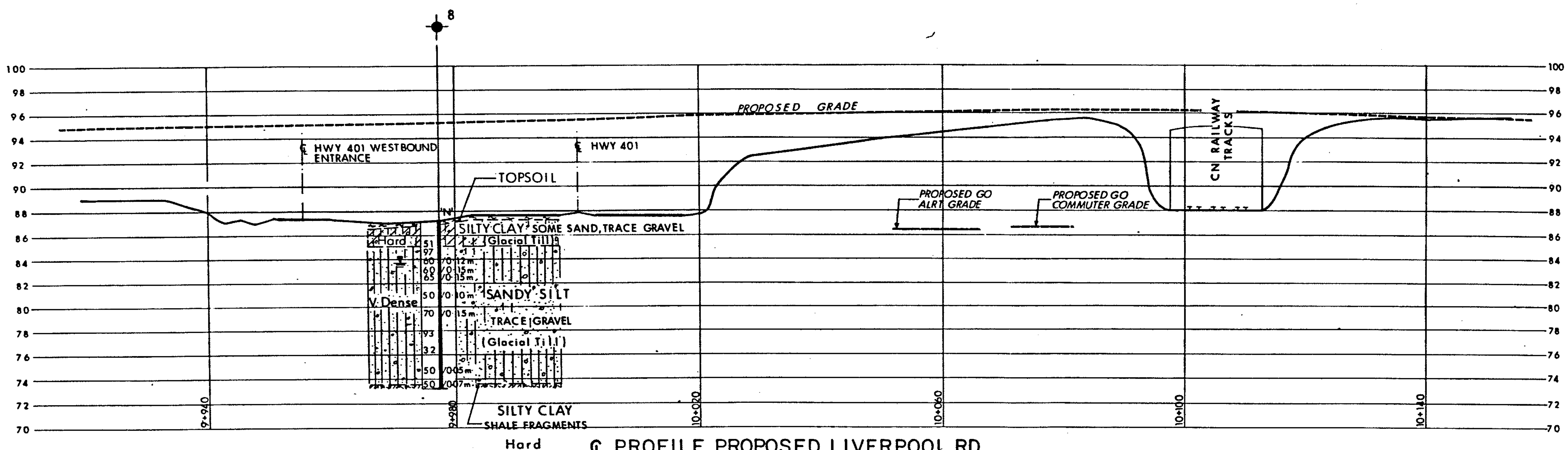
KEY PLAN

SCALE 0·5Km 0 1·0Km

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 1983 10

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	95·1	4,854,243	337,924
2	91·9	4,854,264	337,951
3	91·7	4,854,310	337,922
4	94·0	4,854,290	337,885
5	93·5	4,854,336	337,871
6	90·7	4,854,346	337,902
7	87·7	4,854,373	337,909
7A	87·5	4,854,364	337,891
8	87·2	4,854,395	337,871
9	86·2	4,854,434	337,881
10	90·9	4,854,424	337,847



℄ PROFILE PROPOSED LIVERPOOL RD

SCALE HOR 10m 0 10m VERT 5m 0 5m

Geocres No

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

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

GO-ALRT REF

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: F. L.	DESIGNED BY:
		CHK'D BY: [signature]	APPROVED BY:
		SCALE: FULL SIZE ONLY	

L.S. ROLKO — REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO

WP EGG000-31

DOMINION SOIL INVESTIGATION INC.

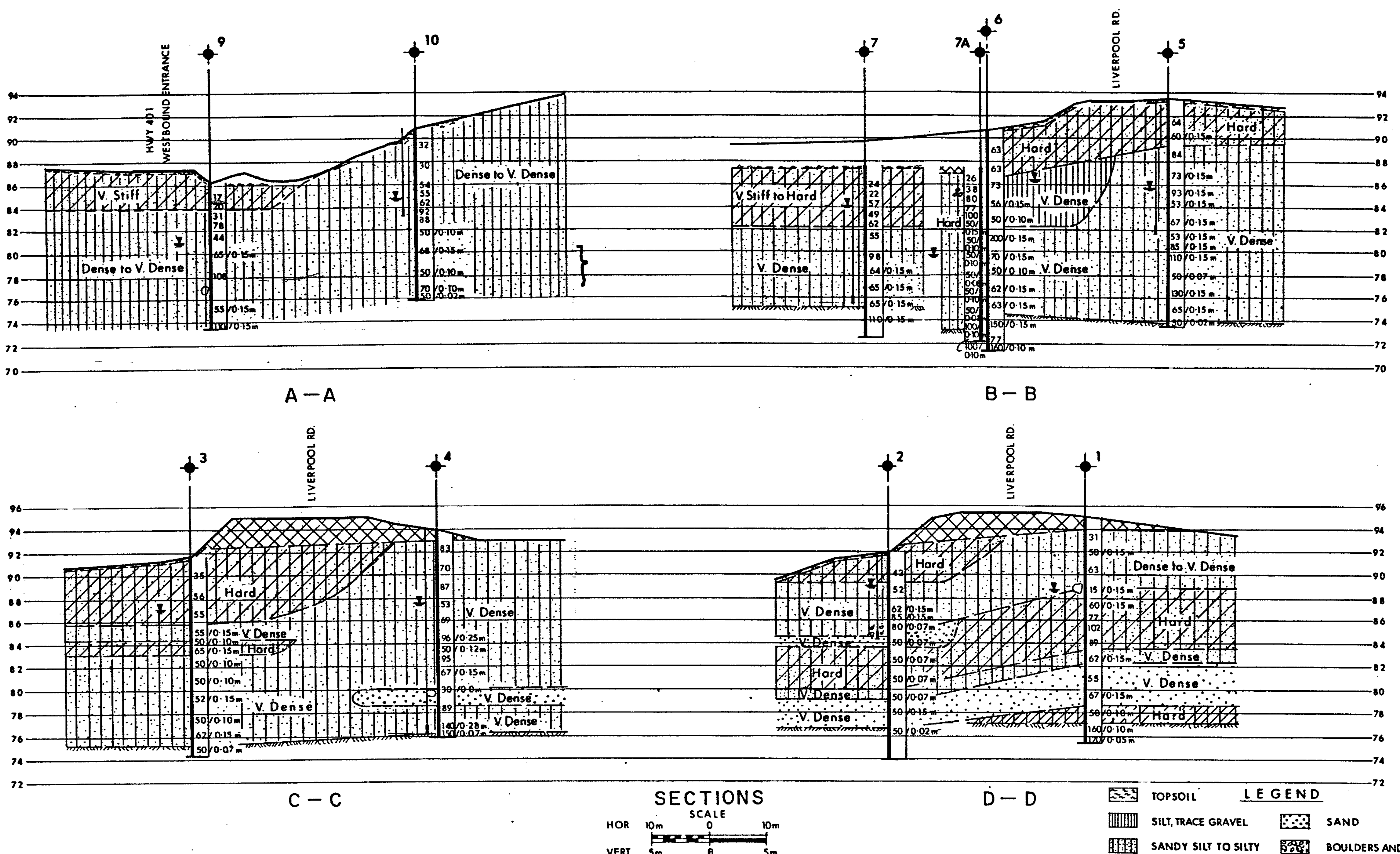
GO-ALRT — Ministry of Transportation and Communications

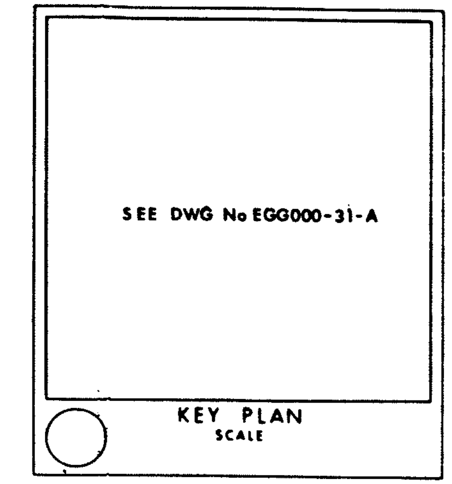
PROJECT MANAGER

PROPOSED CROSSING AT LIVERPOOL RD AND GO A.L.R.T.

CONTRACT NO	DWG NO	REV	SHEET
	EGG000-31-A		

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





LEGEND

Symbol	Meaning
◆	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 1983 10
|	PIEZOMETER

No	ELEVATION		
	SEE DWG EGG000-31-A		

Geocres No

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

LEGEND

- TOPSOIL
- SILT, TRACE GRAVEL
- SANDY SILT TO SILTY SAND, TRACE GRAVEL (G.TILL)
- FILL
- SILTY CLAY, WITH SAND, TRACES OF GRAVEL (G.TILL)
- SAND
- BOULDERS AND COBBLES
- SILTY CLAY, WITH SHALE FRAGMENTS.
- SHALE

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

GO-ALRT REF ____________

REFERENCE DRAWINGS	REVISIONS	DRAWN BY: F.L.	DESIGNED BY:		WP EGG000-31	GO-ALRT Ministry of Transportation and Communications	PROPOSED CROSSING AT LIVERPOOL RD AND GO- A.L.R.T.
		CHK'D BY:	APPROVED BY:	L.S. ROLKO (Registered Professional Engineer, Province of Ontario)	DOMINION SOIL INVESTIGATION INC.	PROJECT MANAGER	CONTRACT NO · DWG NO EGG000-31-B · REV · SHEET
		SCALE: FULL SIZE ONLY					

RECORD OF BOREHOLE No 8 — METRIC

W P: EGG 000-31 | LOCATION: CO-ORDS. 4,854,395N; 337,871E | ORIGINATED BY: S.D.

DIST: 6 | HWY: GO-ALRT | BOREHOLE TYPE: HOLLOW STEM AUGER | COMPILED BY: F.L.

DATUM: GEODETIC | DATE: 1983.10.11 | CHECKED BY: (signature)

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
87.2	GROUND LEVEL							
0.0	0.3 m Topsoil							
	Silty clay, some sand, tr. gravel; Brown / Grey; Hard (Glacial Till) Damp					86		SS 1 - Blows for ea. 0.15 m penetration 23-24-27 (Top El. of Sample : 85.7 m)
85.1		1	SS	51			Wp–W: ~9–13	
2.1	Sandy silt, trace gravel and occasional silt and sand lenses and shale fragments	2	SS	97				
		3	SS	60/0.12 m	▼	84		
		4	SS	60/0.15m				
	Very dense, Grey, Damp	5	SS	65/0.15m		82		
	(Glacial Till)	6	SS	50/0.10m		80		
		7	SS	70/0.15m				
	gravelly lense	8	SS	93		78		
		9	SS	32		76		
	wet sand lenses	10	SS	50/0.05m				
73.5	fragments					74		
73.2	Hard silty clay, shale	11	SS	50/0.07m				
14.0	END OF BOREHOLE							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE

PLASTIC LIMIT W_p — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

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

15 ⌖ 5 (%) STRAIN AT FAILURE (20 above, 10 below)

RECORD OF BOREHOLE No 9

METRIC

W P: EGG 000-31 — LOCATION: CO-ORDS. 4,854,434N; 337,881E — ORIGINATED BY: S.D.

DIST: 6 — HWY: GO-ALRT — BOREHOLE TYPE: HOLLOW STEM AUGER & BXL ROCK CORE — COMPILED BY: F.L.

DATUM: GEODETIC — DATE: 1983.10.07 — CHECKED BY: [signature]

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × 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
86.2	GROUND LEVEL										
0.0	0.2 m Topsoil						86				
	Silty clay, some sand, trace gravel		1	SS	17						
83.9	Very stiff Brown Moist		2	SS	20		84				
2.3	Sandy silt, trace gravel, with occasional sand lenses and slightly cohesive zones		3	SS	31						
			4	SS	78						
	Dense to very dense		5	SS	44	▼	82				
	Dense										
	Damp		6	SS	65/0.15m		80				
	Grey		7	SS	108		78				
	Boulder		8	RC BXL	60%		76				
			9	SS	55/0.15m						
	(Glacial Till)						74				
73.4			10	SS	110/0.15m						
12.8	END OF BOREHOLE										

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

15 ⌖ 5 (%) STRAIN AT FAILURE (20 above, 10 below)

OFFICE REPORT ON SOIL EXPLORATION

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10 — METRIC

W P EGG 000-31	LOCATION CO-ORDS. 4,854,424N; 337,847E	ORIGINATED BY S.D.
DIST 6 HWY GO-ALRT	BOREHOLE TYPE HOLLOW STEM AUGER	COMPILED BY F.L.
DATUM GEODETIC	DATE 1983.10.11 and 1983.10.12	CHECKED BY [illegible]

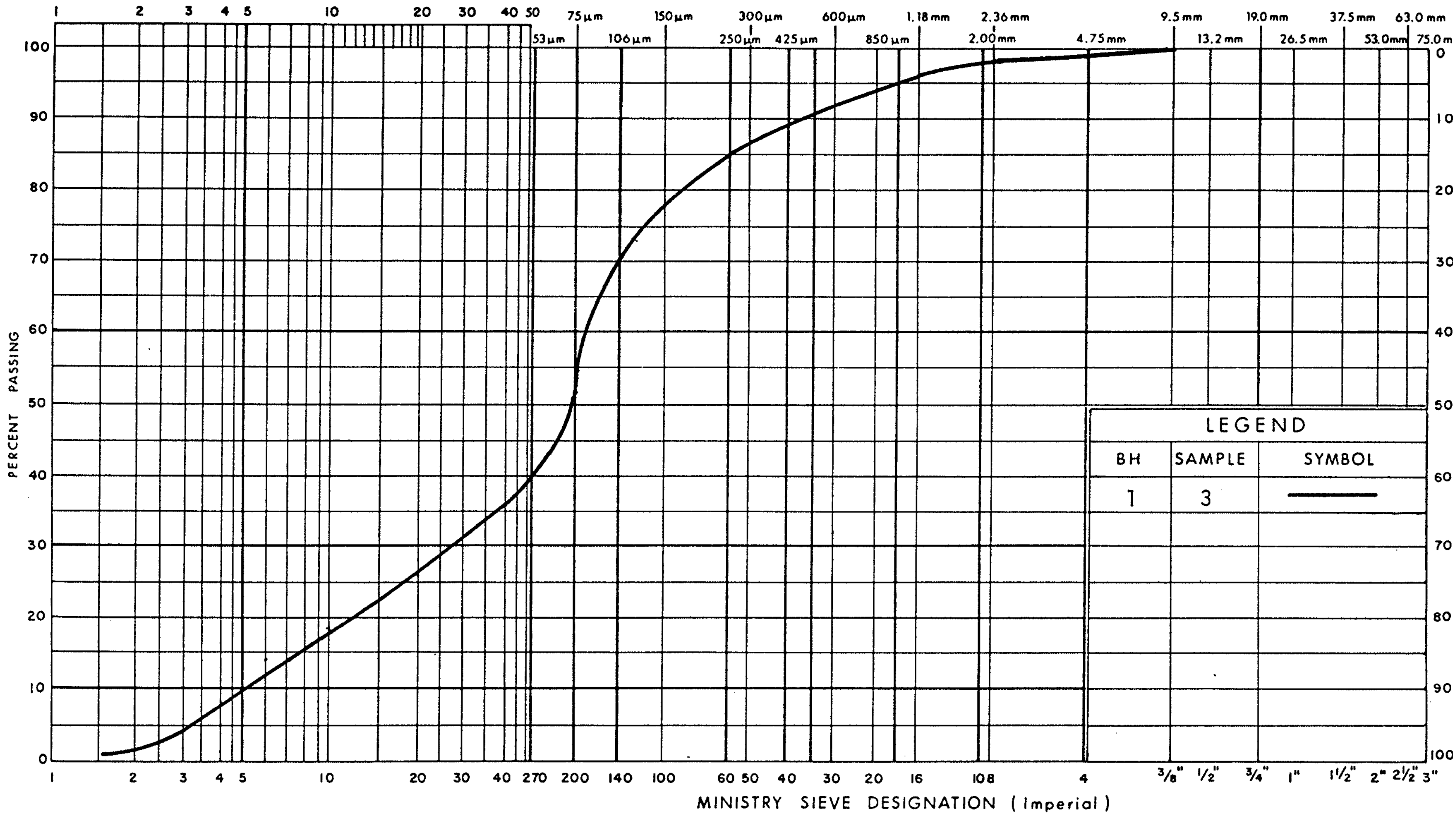
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES						
90.9	GROUND LEVEL									
0.0	0.3 m Topsoil									
	Sandy silt, trace gravel, with occasional thin sand lenses				PIEZOMETER	90				
	Dense	1	SS	32						
						88				
	Brown / Moist	2	SS	30				○	19.4	
	Very dense / Grey / Damp				SEAL					
		3	SS	54		86				
		4	SS	55						
	(Glacial Till)	5	SS	62	▼					
		6	SS	92		84				
		7	SS	88						
	Wet sand lense	8	SS	50/0.10m		82				
	slightly cohesive									
		9	SS	68/0.15m		80				
		10	SS	50/0.10m						
						78				
		11	SS	70/0.10m						
75.8		12	SS	50/0.02m		76				
15.1	END OF BOREHOLE Auger refusal (Possibly Boulder)									

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

$15 \overset{20}{\underset{10}{\diamond}} 5$ (%) STRAIN AT FAILURE

DOMINION SOIL INVESTIGATION INC. - REF. NO. 83-9-17

78 12 M



Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION

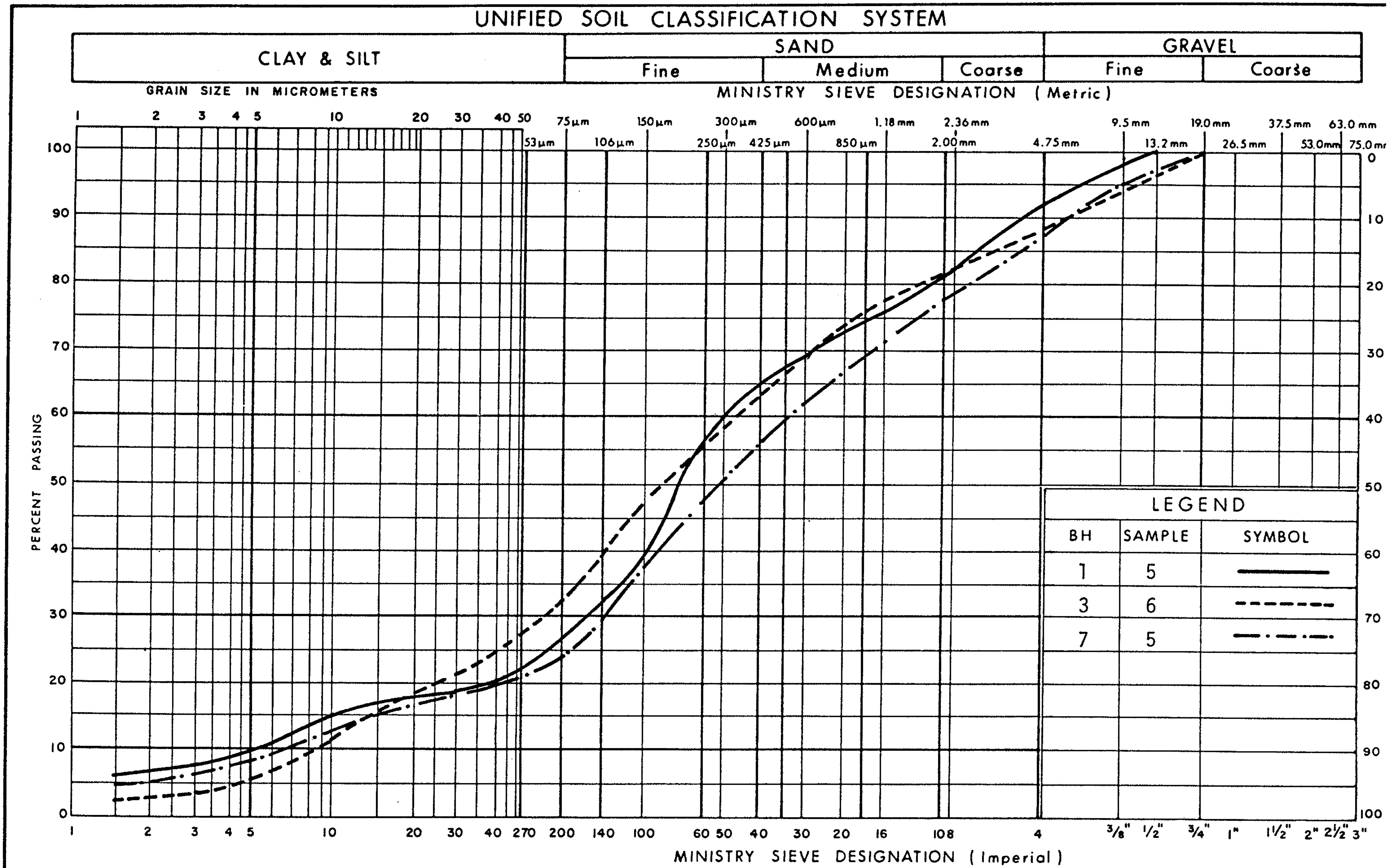
SANDY SILT, traces of Gravel (Glacial Till)

FIG No 11

W P EGG 000-31

DOMINION SOIL INVESTIGATION INC. - REF. NO. 83-9-17

78 12 M



Ministry of Transportation and Communications Ontario	GRAIN SIZE DISTRIBUTION	FIG No 12
	SILTY CLAY, Sandy, trace Gravel (Glacial Till)	W P EGG 000-31