

GEOCRETS No. 40P2-56DIST. 2 REGION W.P. No. 819/820-93-01CONT. No. W. O. No. STR. SITE No. 23-118HWY. No. 401LOCATION Hwy 401 & CPR. Overhead
(EBL & WBL)No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



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LAB REPORT NO.
WP 319/320-93-01

FILE No. _____ DATE _____

REMARKS OLD GEOCRETS # 40P2-8



Ministry of
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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 819/820-93-01 DIST 31
HWY 401 STR SITE 23-118/1/2

Hwy. 401 and CPR Overhead EBL/WBL

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FOUNDATION INVESTIGATION REPORT
FOR
Hwy. 401 and CPR Overhead EBL/WBL
WP 819/820-93-01, Site 23-118/1/2
Hwy. 401, District 31, London

Introduction

This report summarizes the results of a Foundation Investigation conducted at the aforementioned site. It is proposed that the existing twin structure crossing the CPR approximately 0.5 km west of Drumbo Road be widened in the median due to traffic staging. This report contains factual information obtained from this investigation pertaining to structural foundations and earthworks.

Site Description

The site is located along Hwy. 401 approximately 0.5 km west of Drumbo Road within Blenheim Township, County of Oxford.

The topography of the area consists of undulating or gently rolling landscapes containing farm lands. The highway at this location is built on approach fills in the order of 8 to 10 metres. At the base of the highway embankments, particularly to the north are some marshes. The ground surface of the highway is at an elevation of approximately 311 m whilst the bottom of the railway ballast passing beneath the existing structure was 302 m.

Physiographically the site is located in the geological domain known as the Oxford Till Plain. The area is characterized with gentle slopes, good drainage, medium texture, and lack of extreme stoniness, making this favourable soil. It consists of London and Berrien Sandy Loams. With the morainic soils being clay loams while the alluvial soils in the hollows are silt loams and sandy or gravelly loams. The tills are a pale brown, calcareous loam in which Middle Devonian limestone is the dominant material, although grey or pale brown dolostone is also abundant.

Field Investigation

The fieldwork for the investigation was carried out on 95 01 11 to 95 01 16 and consisted of two boreholes located within the median of Hwy. 401 at the abutment location of the existing structures. Boreholes were advanced to depths of 24.8 m to the west and 29.4 m to the east.

The boreholes were advanced using conventional solid stem augering techniques. Track and truck mounted continuous flight auger drilling rigs were employed for the operation.

In general, subsoil samples were retrieved at 0.7 m intervals near the natural ground surface and at 1.5 m intervals elsewhere. Disturbed subsoil samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). A cone penetration test was conducted at each borehole location. All subsoil samples were identified in the field and returned to the laboratory for further examination and applicable testing.

Water levels were monitored through out the duration of the investigation in open boreholes. All boreholes were backfilled upon completion of the fieldwork.

Survey information related to the location and elevation of boreholes was provided by the surveys and plans office in southwestern region, London.

Laboratory Analysis

The following laboratory tests were carried out on select soil samples:

1. Atterberg Size Distributions
2. Grain Size Distributions
3. Unit Weights
4. Natural Moisture Contents

Laboratory test results are given in the following section of this report and are illustrated on figures and borehole logs included in the Appendix.

Subsurface Conditions

General

The current investigation confirmed the results of the borings conducted in 1958 for the existing structures. A borehole was placed within the median at each abutment location atop the existing fill. The fill was found to consist of Sand and Silt, trace to some Gravel, interbedded with layers of Clayey Silt and had a thickness of 9 m to the west and 9.8 m to the east. Underlying the above fill was a Sandy Silt to Silty Sand, trace Clay layer. This non-cohesive layer is in turn underlain by a Clayey Silt, trace Sand, trace Gravel (Glacial Till) which extended beyond the termination depths of each borehole. This layer can be considered end bearing having a hard consistency.

The plan and location of borings and the stratigraphical profile are shown on drawing No. 819/8209301-A in the attached appendix. The field and laboratory test results are plotted on the record of borehole sheets and in the appendix of this report. A brief description of the different soil types are given below.

Sand and Silt, trace to some Gravel (Fill)

As the two boreholes are located within the median, 9 - 9.8 metres of fill was encountered. This material consisted of Sand and Silt with a trace to some Gravel and had random Clayey Silt pockets.

Results of grain size distribution tests carried out on select samples are shown on Figure 1 in the appendix. The deposit is comprised of 1 - 11 % Gravel, 47 - 73 % Sand, 23 - 39 % Silt and 3 - 14 % Clay.

Standard penetration resistance 'N' values ranged from 22 Blows/0.3 m to 85 Blows/0.3 m indicating a compact to very dense state. It should however be kept in mind that this embankment is manmade with its compactness being subject to unnatural conditions.

Sandy Silt to Silty Sand, trace Clay

Underlying the fill a Sandy Silt to Silty Sand was encountered which had a thickness of 10.3 - 12.5 metres. This material contained pockets of Gravel.

Results of the grain size distribution tests carried out on select samples are shown Figure 2 in the appendix, in an envelope form. The results summarize grain size distribution tests carried out on this material throughout the site. The deposit is comprised of 0 - 17 % Gravel, 23- 92 % Sand, 6 - 73 % Silt and 1 - 5 % Clay.

In this stratum the Standard Penetration Resistance 'N' values ranged from 10 Blows/0.3 m to 101 Blows/0.3 m having a compact to very dense state. Sampling within this deposit was difficult due to blow up conditions within the sand causing the samples to be disturbed. Thus blow counts are questionable in this layer.

Clayey Silt, trace Sand, trace Gravel (Glacial Till)

Underlying the above is a Clayey Silt (Glacial Till) which extended beyond the termination depth of the borings.

The results from grain size distribution tests carried out on two samples are shown in Figure 3 in the appendix. The deposit comprises of 0 - 2 % Gravel, 5 - 7 % Sand, 63 - 73 % Silt and 18 - 32 % Clay.

The results from the Atterberg Limit Tests performed on the fine fraction of this deposit is summarized as follows:

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	13.5, 15	2
Liquid Limit (W_L)	15, 21	2
Plastic Limit (W_P)	13, 14	2

Plastic Index (I_p)

1, 10

2

From the plasticity chart (figure 4), the layer can be classified as a Clayey Silt of medium plasticity.

In this stratum the Standard Penetration Test Resistance 'N' values ranged from 27 Blows/0.3 m to > 120 Blows/0.3 m indicating a Stiff to Hard consistency.

Groundwater Conditions

Ground water levels obtained at the time of the investigation revealed that the groundwater table is generally 3 m below the original ground surface at an approximate elevation of 289 m.

Groundwater levels are subject to seasonal fluctuations with conditions varying from those in this report.

Discussion and Recommendations

The existing twin bridge reinforced concrete tee beam structures appear to be performing satisfactorily. According to plans provided by the structural section, southwestern region the bridge foundations consist of steel H piles driven to the end bearing material to depths of 23 metres (El. 288.5 m). The pile caps at the abutments are located perched within the fill at an elevation of 308 m, while the pier pile caps are located just below the natural ground surface at an elevation of approximately 299 metres.

To facilitate the design and construction of the proposed structure foundations the following foundation and geotechnical recommendations are provided in the scope of this report.

1. Structure Foundation
2. Slope Stability
3. Lateral Earth Pressure
4. Construction Consideration

Structural Foundations

While the surficial soils at the site are suitable for conventional shallow spread footings, in order to minimize differential settlement it is recommended that the abutment and pier foundations be founded on end-bearing steel H piles driven to the very dense glacial till. Abutment foundations should be perched within the approach fills.

For purposes of the O.H.B.D.C., the steel H-piles can be designed using the axial capacities below:

<u>Axial Capacities - Driven Steel H-Piles</u>				
<u>Pile Type</u>	<u>Structure</u>	<u>Factored Axial Capacity at ULS (kN)</u>	<u>Factored Axial Capacity at SLS (kN)</u>	<u>Estimated pile Tip El. (m)</u>
HP 310x110	E. Abut.	1600	1150	+/- 285
	W. Abut.	1600	1150	+/- 288
	E. Pier	1600	1150	+/- 285
	W. Pier	1600	1150	+/- 288
HP 310x79	E. Abut.	1150	890	+/- 285
	W. Abut.	1150	890	+/- 288
	E. Pier	1150	890	+/- 285
	W. Pier	1150	890	+/- 288

To facilitate pile penetration through the fill, it is recommended that the steel H-piles be equipped with reinforced tips.

The pile spacing shall conform with Section 6-11.1 of the O.H.B.D.C. for centrally loaded piles equal load sharing of the deep foundation units can be assumed.

Lateral Earth Pressure on Structure

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the abutments to prevent hydrostatic pressure build-up. Design parameters of the soil are given below:

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction (ϕ)	35°	30°
Unit Weight (kN/m^3)	22.8	21.2
Coefficient of Active Earth Pressure (k_a)		
S.L.S.	0.27	0.33
U.L.S.	0.33	0.4
Coefficient of Earth Pressure at Rest (k_o)		
S.L.S.	0.43	0.5
U.L.S.	0.5	0.58

The earth pressure coefficient at rest is to be used in design if the abutment walls are rigid and unyielding. Weep holes in the abutment walls should be designed to drain any accumulation of water in the backfill.

Slope Stability

The existing forward and side slopes constructed to a grade of 2H:1V appear to be stable. In consideration of the proposed widening in the median no slope stability problems are anticipated. As provided for the existing structures the forward slopes should include a surface treatment such a grouted rip rap to prevent any erosion of the embankment due to surface runoff.

Construction Considerations

The pile caps located at the abutments will be perched within the fill, requiring no dewatering scheme. Those being constructed at the piers locations are not expected to be below the water table. However, if the ground water level is higher during construction, consideration may be given to handle any groundwater inflow into the excavation by means of perimeter ditches together with oversized excavations. If a great deal of sloughing occurs at the pile cap elevation mass concrete could be placed to provide a sound base.

Road protection placed inside the excavation adjacent to the travelled highway will be required at the abutment locations if their foundations are to be placed matching the elevations of the existing pile caps. Soldier piles and timber lagging would be the most practical alternative for excavation shoring. The depth of the soldier pile toe embedment

below the base of the excavation will depend on the shoring design used (whether cantilever, braced or tied back). Longitudinal temporary excavations of depths of 3 m or less below grade may be carried out using 1V:1H slopes provided the excavation materials are not stockpiles near the crest of the slopes.

Excavations at the pier locations will entail partial removal at the toe of the forward slopes. Thus a shoring scheme will be required at the eastern face for the east pier and at the west face for the west pier. As described for the abutments, soldier piles and timber lagging would be the most practical.

During construction care must be taken to prevent any damage to the existing pile caps and piles. Constructed pile caps should be doweled on both sides into the adjoining foundations.

The pile caps shall be protected against frost protection by providing a minimum of 1.2 m earth cover or equivalent frost protection.

If you have any questions regarding the above recommendations please do not hesitate to contact this office.

Miscellaneous

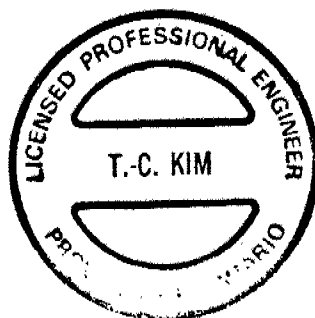
The field work for this investigation was carried out under the supervision of M. Michalek, Jr. Foundation Engineer and T. Hickey, Construction Inspector, utilizing equipment owned and operated by London Soils Investigations.

The project was carried out under the general supervision of T. C. Kim, Sr. Foundation Engineer. The report was written by M. Michalek, reviewed and approved by T. C. Kim, Sr. Foundation Engineer.



A handwritten signature in cursive script, appearing to read 'M. Michalek'.

M. Michalek, P. Eng.
Jr. Foundation Engineer

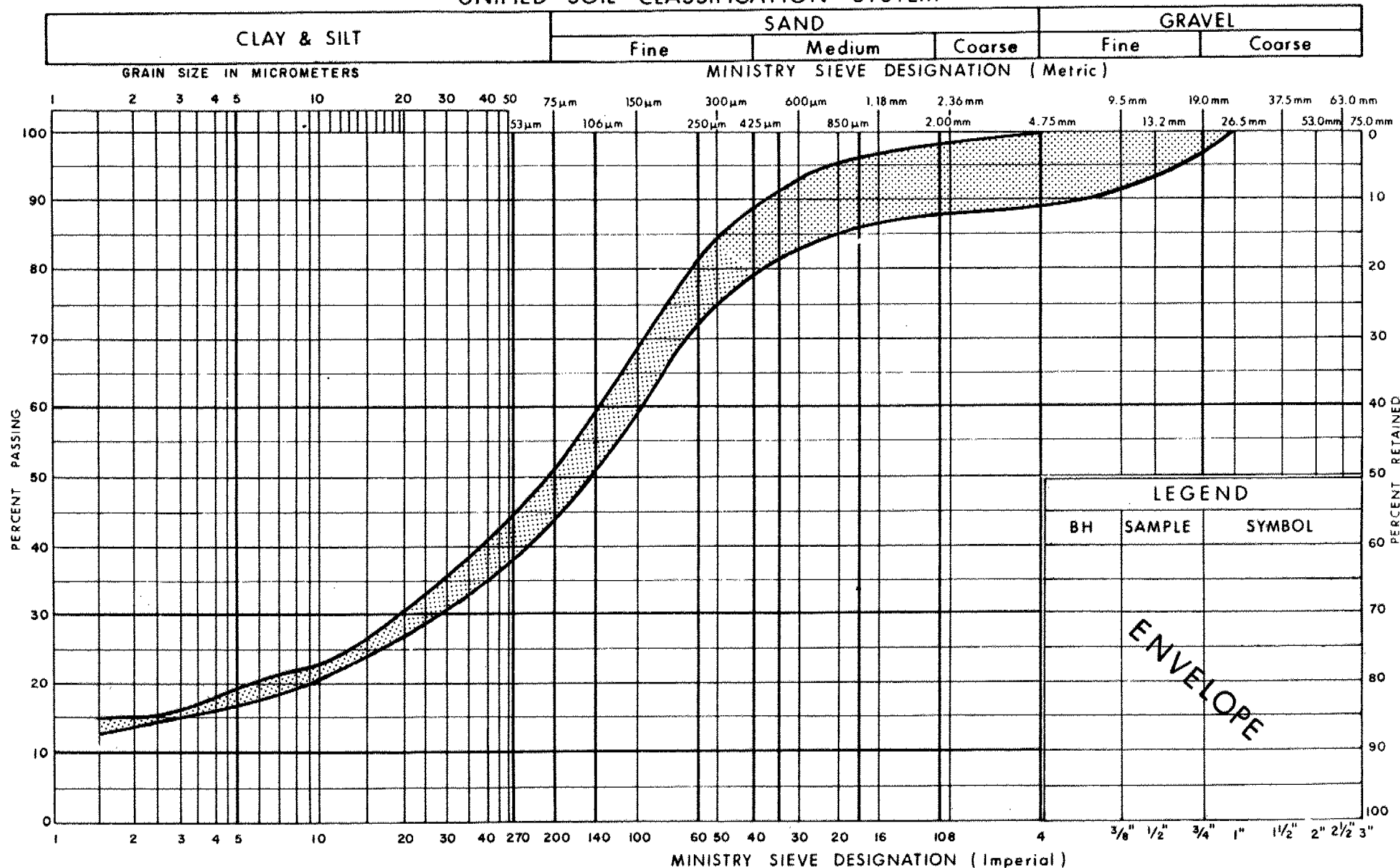


A handwritten signature in cursive script, appearing to read 'Taechul Kim'.

T. C. Kim, P. Eng.
Sr. Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
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Ontario

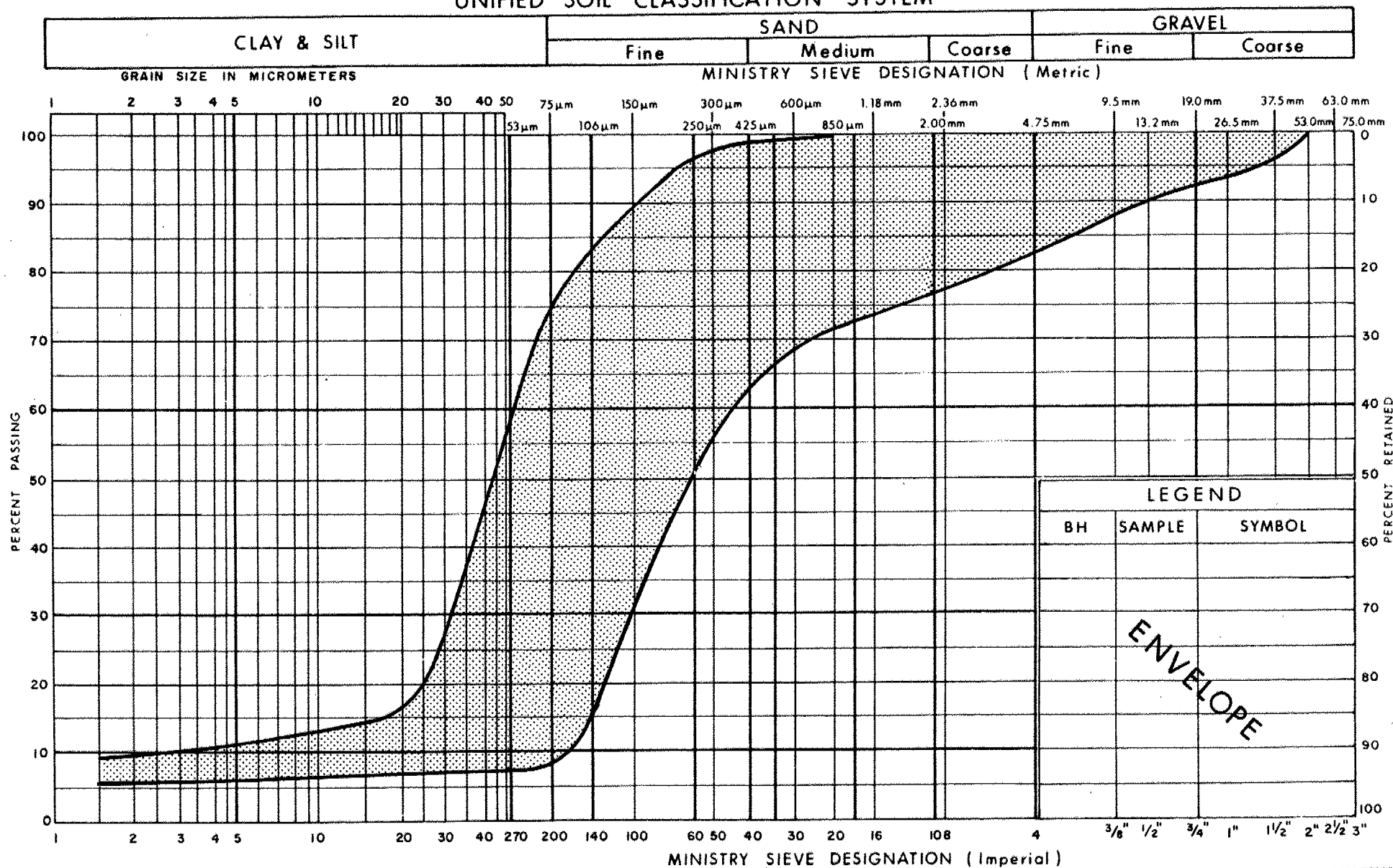
GRAIN SIZE DISTRIBUTION SAND & SILT (FILL)

TRACE TO SOME GRAVEL, INTERBEDDED LAYERS OF CLAYEY SILT

FIG No 1

W P 819/820-93-01

UNIFIED SOIL CLASSIFICATION SYSTEM



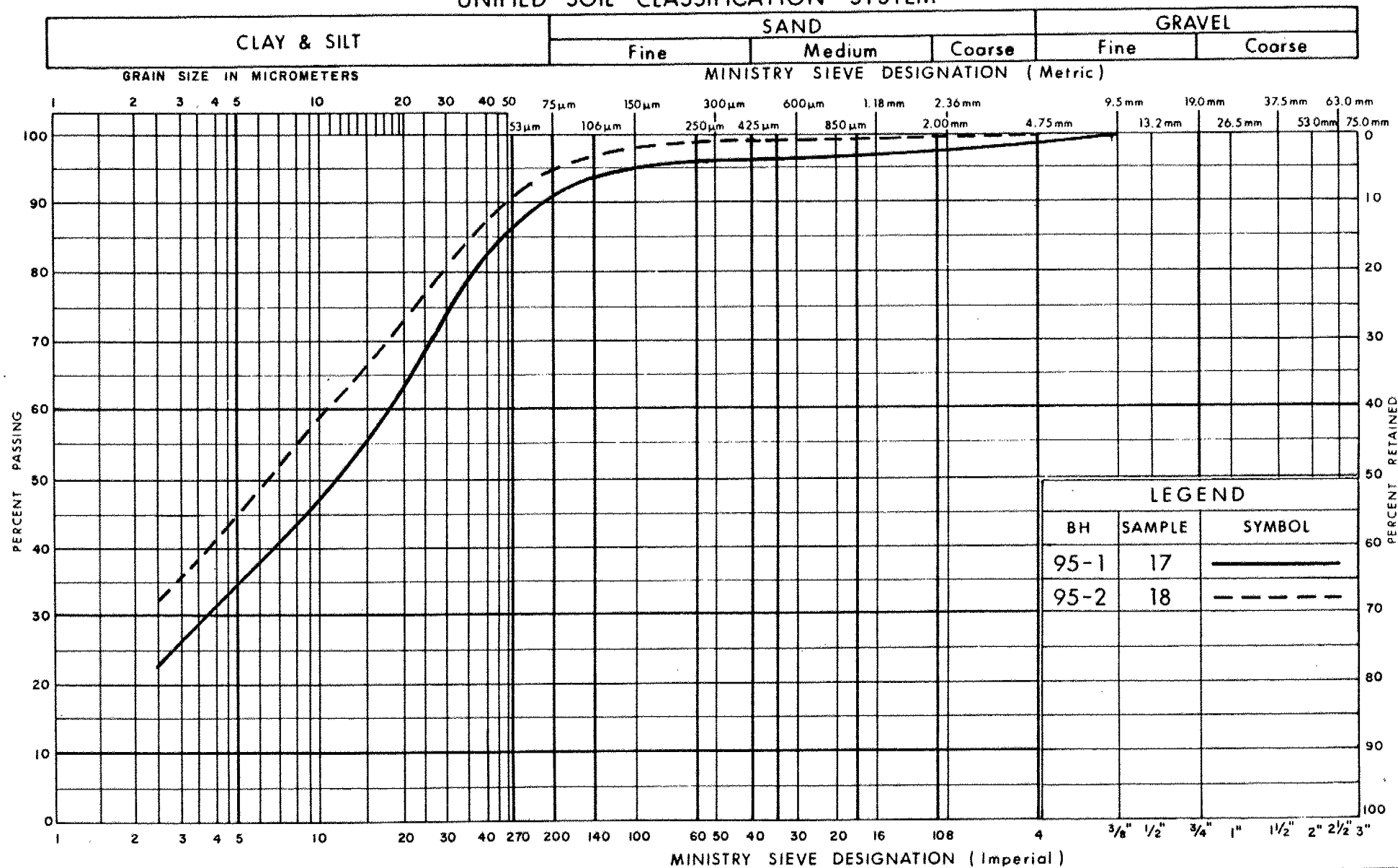
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GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND
TRACE CLAY

FIG No 2

W P 819/820 -93-01

UNIFIED SOIL CLASSIFICATION SYSTEM

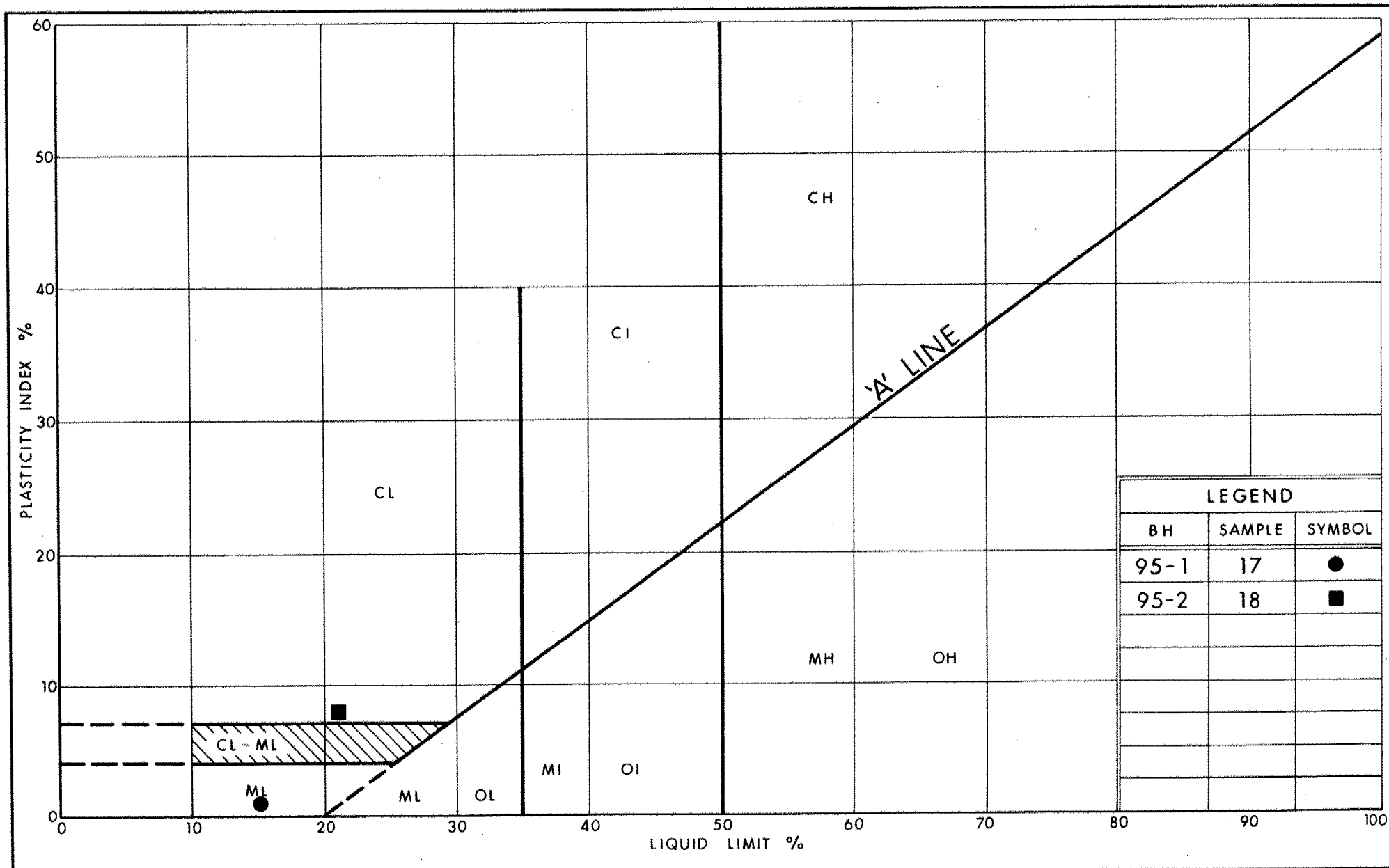


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GRAIN SIZE DISTRIBUTION
CLAYEY SILT, TRACE SAND, TRACE GRAVEL
(Glacial Till)

FIG No 3

W P 819/820-93-01



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PLASTICITY CHART CLAYEY SILT, TRACE SAND, TRACE GRAVEL (Glacial Till)

FIG No 4

W P 819/820-93-01

RECORD OF BOREHOLE No 95-1

1 OF 1

METRIC

W.P. 819/B20-93-01 LOCATION Co-ords: N 4 787 537.3; E 215 154.3 ORIGINATED BY M.M.
DIST 31 HWY 401 BOREHOLE TYPE H.S. Auger & Cone Test COMPILED BY M.M.
DATUM Geodetic DATE 95 01 11 CHECKED BY T.K.

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			SHEAR STRENGTH kPa						
310.7	Ground Surface							20 40 60 80 100						
0.0	Sand and Silt Trace to Some Gravel Interbedded layers of Clayey Silt [Fill] Compact to Very Dense		1	SS	22		310							1 73 23 3
			2	SS	27		308							
			3	SS	52		306			130	150			
			4	SS	42		304			130				
			5	SS	34		302							
301.7	Clayey Silt		6	SS	50		302							1 48 39 12
9.0	Sandy Silt to Silty Sand Trace Clay Compact		7	SS	16									0 47 52 1
			8	SS	13									
			9	SS	17									
			10	SS	24									
			11	SS	15									
			12	SS	22									
			13	SS	10									
			14	SS	11									
			15	SS	75									
			16	SS	100	/15cm								
	17	SS	120	/23cm									2 7 73 18	
	18	SS	120	/20cm										
285.9	End of Borehole													
24.8	'N' values within the Silty Sand to Sandy Silt deposit may be questionable due to blow up and disturbance during sampling.													

RECORD OF BOREHOLE No 95-2 1 OF 1 METRIC

W.P. 819/820-93-01 LOCATION Co-ords: N 4 787 479.2; E 215 140.3 ORIGINATED BY M.M.
 DIST 31 HWY 401 BOREHOLE TYPE H. S. Augers & Cone Test COMPILED BY M.M.
 DATUM Geodetic DATE 95 01 16 CHECKED BY T.K.

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 KN/m ³	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					
311.0	Ground Surface													
0.0	Sand and Silt Trace to Some Gravel Interbedded layers of Clayey Silt [Fill] Compact to Very Dense		1	SS	25		310							
			2	SS	68		308							
			3	SS	85		306							
	Clayey Silt		4	SS	59		304			oh			11 47 28 14	
			5	SS	40		302						2 53 35 10	
301.2	Clayey Silt		6	SS	61									
			7	SS	58									
9.8			8	SS	72		300							
			9	SS	64		298							
	Some Gravel		10	SS	48		296						17 50 28 5	
			11	SS	53		294							
	Sandy Silt to Silty Sand Trace Clay Compact to Very Dense		12	SS	17		292							
			13	SS	56		290						0 92 6 2	
			14	SS	29		288							
			15	SS	16		286							
288.7			16	SS	101		284							
22.3			17	SS	72		282							
	Clayey Silt Trace Sand Trace Gravel [Glacial Till] Hard		18	SS	97								0 5 63 32	
			19	SS	105									
			20	SS	123	/10cm								
281.6			21	SS	120	/5cm								
29.4	End of Borehole • Water table not stabilized. • 'N' values within the Sandy Silt to Silty Sand deposit may be questionable													

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

MECHANICAL PROPERTIES OF SOIL

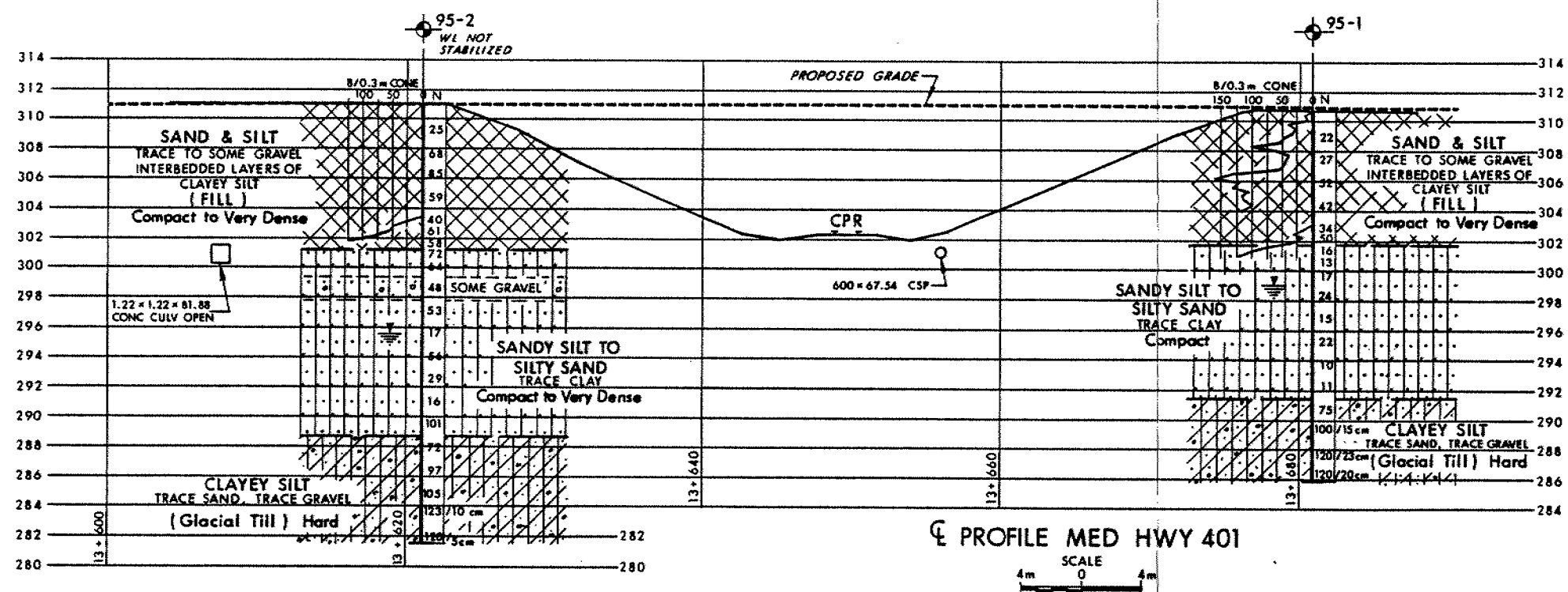
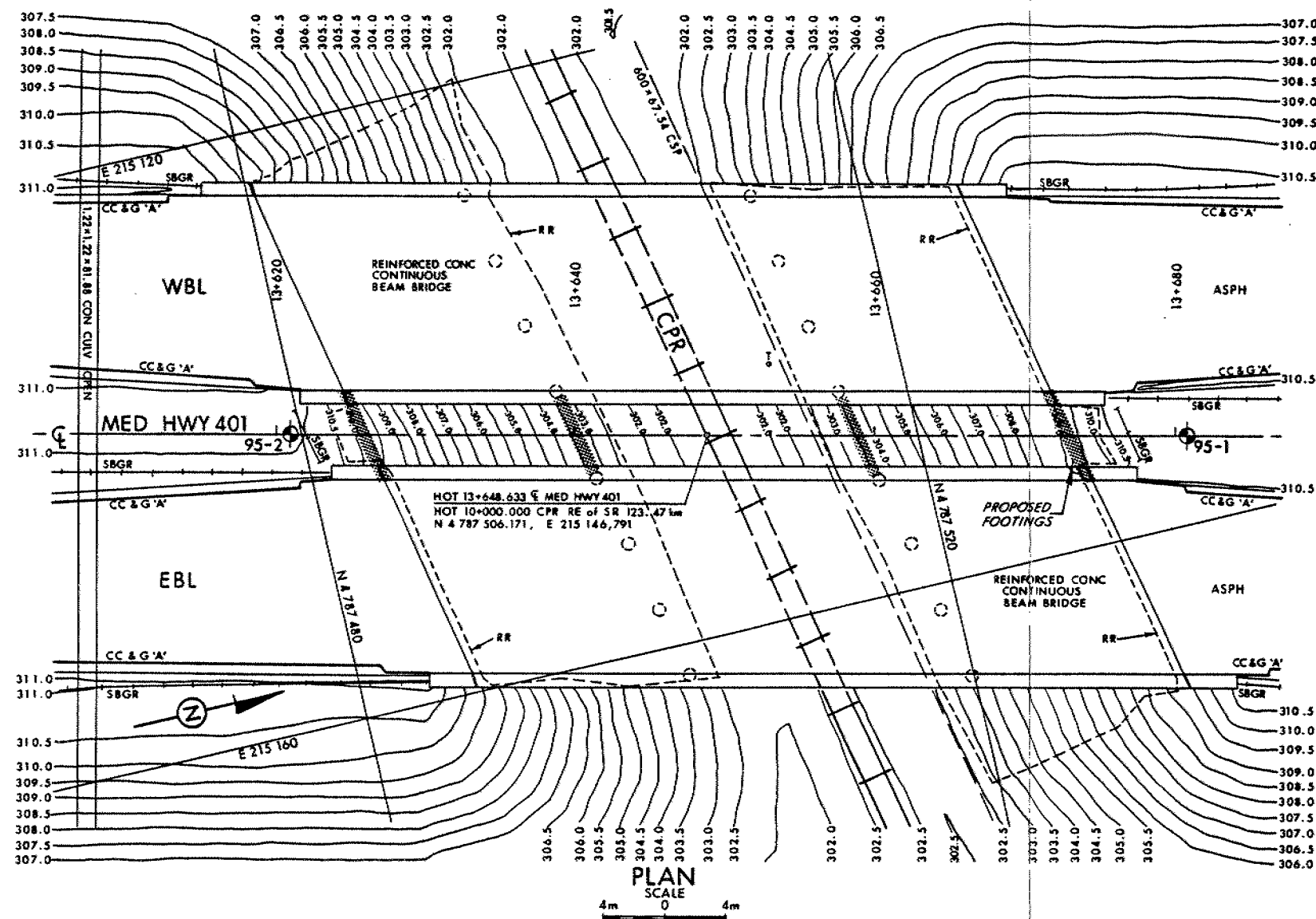
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
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 = $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

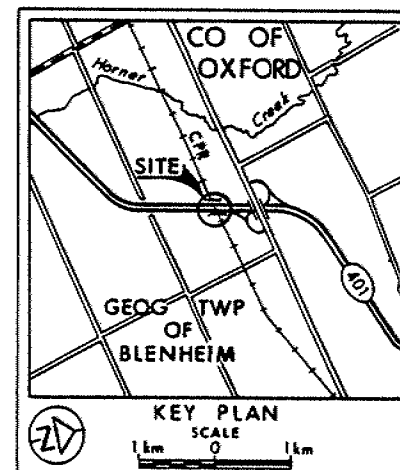
PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $\frac{w_L - w_p}{w - w_p}$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						



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

CONT No
WP No 819/820-93-01
CANADIAN PACIFIC RAILWAY
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)
- ⬇ WL at time of investigation 1995 01

No	ELEVATION	CO-ORDINATES NORTH	EAST
95-1	310.7	4 787 537.3	215 154.3
95-2	311.0	4 787 479.2	215 140.3

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 GC 2.01 of OPS Gen. Cond.



DATE	BY	DESCRIPTION
1995 07 07	RS	DRW
1995 07 07	RS	CHECKED
1995 07 07	RS	APPROVED

Geocres No 40P2-56
HWY No 401 EBL & WBL
SUMPD MM CHECKED MM DATE 1995 07 07 SITE 23-118/1 & 2
DRAWN RS CHECKED RS APPROVED DWG 819/8209301-A