

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

From: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: January 19, 1970

Our File Ref.

IN REPLY TO

JAN 21 1970

SUBJECT:

PRELIMINARY FOUNDATION REPORT

For

Proposed Crossing

Hwy. 417 and South Indian Creek

Twp. of Cambridge -- Co. of Russell

District No. 9 (Ottawa)

W.J. 69-P-100 -- W.P. 35-66-10

1. INTRODUCTION:

In a memo dated October 30, 1969, the Foundation Section was requested by Mr. T. C. Kingsland, Regional Bridge Planning Engineer (Eastern Region), to provide preliminary subsoil information at the site of the above proposed crossing. Subsequently, one sampled borehole was carried out in the vicinity of the proposed crossing. At the time of writing this memo, no site plan was available; consequently, we are unable to include a site plan showing the location of the borehole. This memo presents preliminary information on the subsoil conditions encountered at the site, together with our recommendations pertaining to foundation design and the stability and settlement of the approach fills.

The site is located about 1500 ft. north of Twp. Rd. #4 and some 2500 ft. east of County Rd. #5, due approximately 2 miles southeast of Linoges. At this site, South Indian Creek is about 12 ft. wide and the creek banks are 5 to 7 ft. high. The surrounding area is heavily wooded. The ground surface slopes gently towards the creek.

2. SUBSOIL CONDITIONS:

Underlying about 1.5 ft. of a surficial cover of organic soil is an extensive deposit of clay, some 95 ft. in thickness, followed by a cohesive glacial till stratum.

2. SUBSOIL CONDITIONS: (cont'd.) ...

The boring revealed the presence of occasional silty clay layers within the clay deposit and, also, silt and clayey silt seams at random below a depth of 45 ft. The physical properties of the overall deposit, as determined from field and laboratory testing, are tabulated below and summarized on the borelog sheet and figures attached to this memo:

				<u>Range</u>
Natural Moisture Content (W) - %	:			32 - 71
Liquid Limit (WL) - %	:			44 - 73
Plastic Limit (Wp) - %	:			20 - 28
Liquidity Index (LI) -	:			0.4 - 1.0
Bulk Density (γ) - PCF				104 - 113
Undrained Shear Strength (C_u) - PSF -		<u>Range</u>	<u>Sensitivity</u>	
Field Vanes -		560 - 1440	3 - 14	
Lab. Vanes -		620 - 1340	4 - 9	
Lab. Test: -		460 - 760	-	

Consolidation Test:

Initial Void Ratio (e_0) -	1.32
Compression Index (C_c) -	0.74
Preconsolidation ($P'_c - P'_o$) -	800 - 1200 PSF

The undrained shear strength measurements indicate that the consistency of the overall deposit ranges from stiff in the upper 10 to 15 ft. to firm down to a depth of about 60 ft. The variation of the undrained shear strength with depth for the clay deposit generally corresponds to a C_u/P_o ratio of about 0.25. One consolidation test indicates that the overall deposit may be preconsolidated by about 1000 PSF (see Figure 2).

The clay deposit is underlain by a cohesive glacial till stratum encountered at this site at a depth of about 95 ft. The glacial till consists of clayey silt with sand and some gravel, and exhibits a hard consistency, with Standard Penetration Resistance 'N' values in excess of 100 blows/ft.

During the period of this investigation, the water in the creek was 2 to 3 ft. deep. The water level in the open borehole corresponded to the creek water level.

3. RECOMMENDATIONS:

It is proposed to construct either a culvert or a structure at the crossing of the East and Westbound lanes of Hwy. 417 across relocated South Indian Creek. The profile grade of Hwy. 417, across the relocated creek, will be at about elevation 226, which may necessitate fill heights at the approaches of in the order of 12 ft. Details pertaining to the proposed stream relocation are not available as of this writing. However, it is understood that the relocated creek will have an invert elevation of 206[±] - i.e., some 3 ft. lower than the existing stream bed level.

Stability computations indicate that 12-ft. high fills constructed with standard 2:1 slopes will be stable.

Preliminary estimates indicate that the settlements will be negligible for fills up to 3 ft. in height. The settlement beneath fills 12 ft. in height is estimated to be in the order of 6 to 8 inches over the long term. Of this total amount of settlement, 50 per cent should be realized within a period of 1-1/2 to 2 years.

The choice of either a culvert or a bridge structure for the proposed crossing at this site will depend on economic and other considerations, since from the foundations viewpoint, both schemes are considered feasible and practical. The recommendations pertaining to the two types of crossings are given below:

TYPE OF CROSSING	RECOMMENDATIONS
<p>1. <u>Culvert</u></p> <p>a) Multiplate Pipe Arch</p> <p>b) Rigid Frame Box</p>	<p>a) The culvert should be located on an 18 - 24 inch thick granular pad constructed with G.B.C. 'A' material. If the approaches are in the order of 12 ft. in height, a camber of 6 inches should be provided between the centre and the exit in order to accommodate anticipated settlements.</p> <p>b) Spread footings may be used with an allowable net bearing pressure of 1000 PSF or less. A minimum thickness of 5 ft. of soil cover should be provided above the underside of the footings for frost protection.</p>

3. RECOMMENDATIONS: (cont'd.) ...

TYPE OF STRUCTURE	RECOMMENDATIONS
2. <u>Bridge Structure</u>	<p>The structure may be supported on either friction or end-bearing piles:</p> <p>a) <u>Friction Piles</u>:- 45-ft. long timber piles may be used with an allowable load per pile not in excess of 10 tons. An estimate of the anticipated settlements can only be made when the design details become available.</p> <p>b) <u>End-Bearing Piles</u>:- The entire structure may be supported on steel H-piles driven to practical refusal within the glacial till deposit. The allowable load per pile will depend on the pile section chosen - e.g., 12 BP 74 piles may be designed for 90 Tons/pile.</p>

If a bridge structure is adopted at this site for the proposed crossing, additional boreholes will be required at the respective footing locations.

The recommendations given in this report are therefore to be regarded as conditional only and, as such, are subject to revision at a later date when and if new information becomes available.

MD/idef
Attach.

cc: Messrs. B. R. Davis (2)
E. A. Tregaskes
D. W. Ferren
S. J. Markiewicz
C. R. Robertson
T. C. Kingsland (2)
J. E. Gruspier
B. A. Singh

Foundations Files
Gen. Files

M. Devata
M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

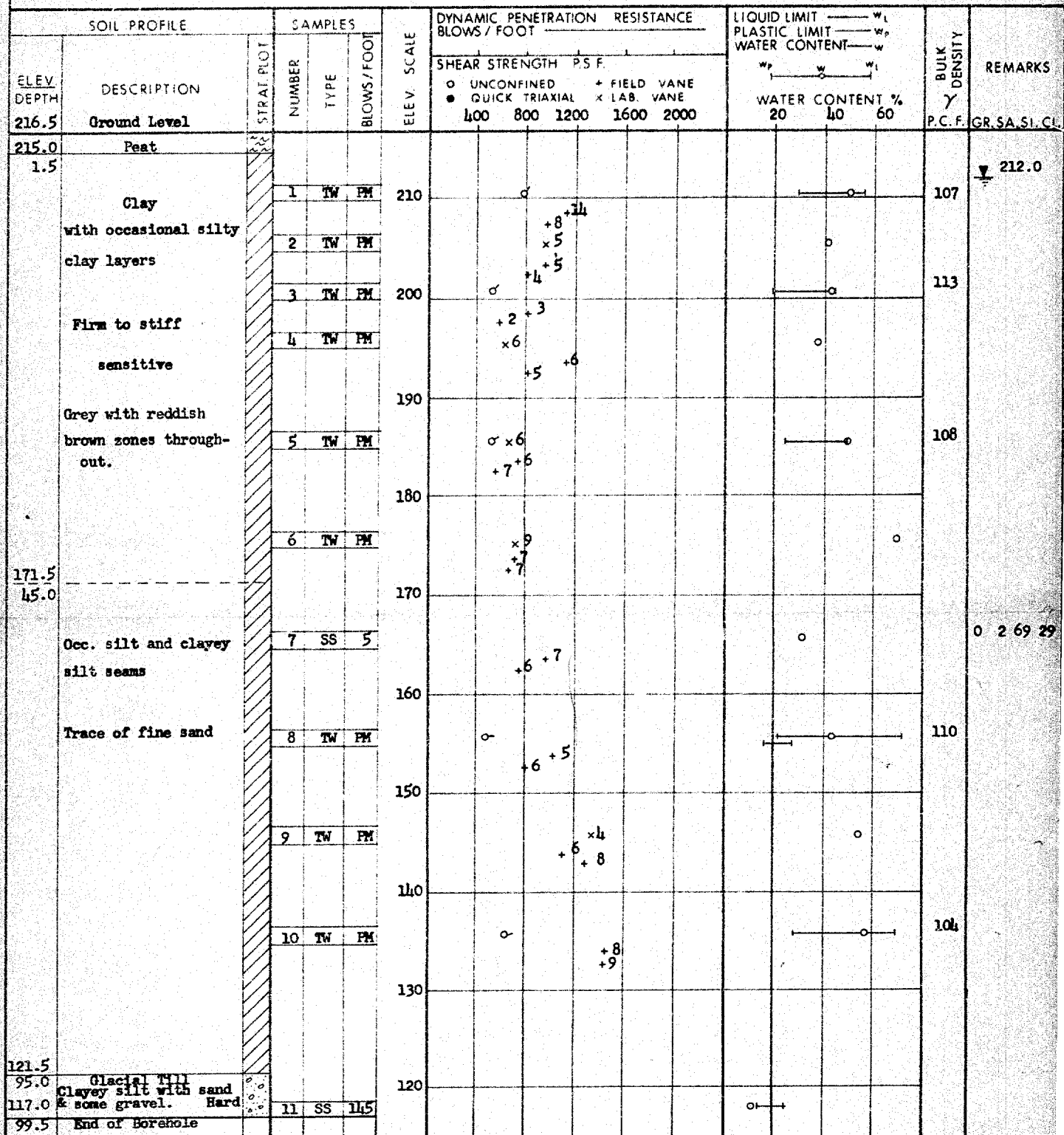
APPENDIX I

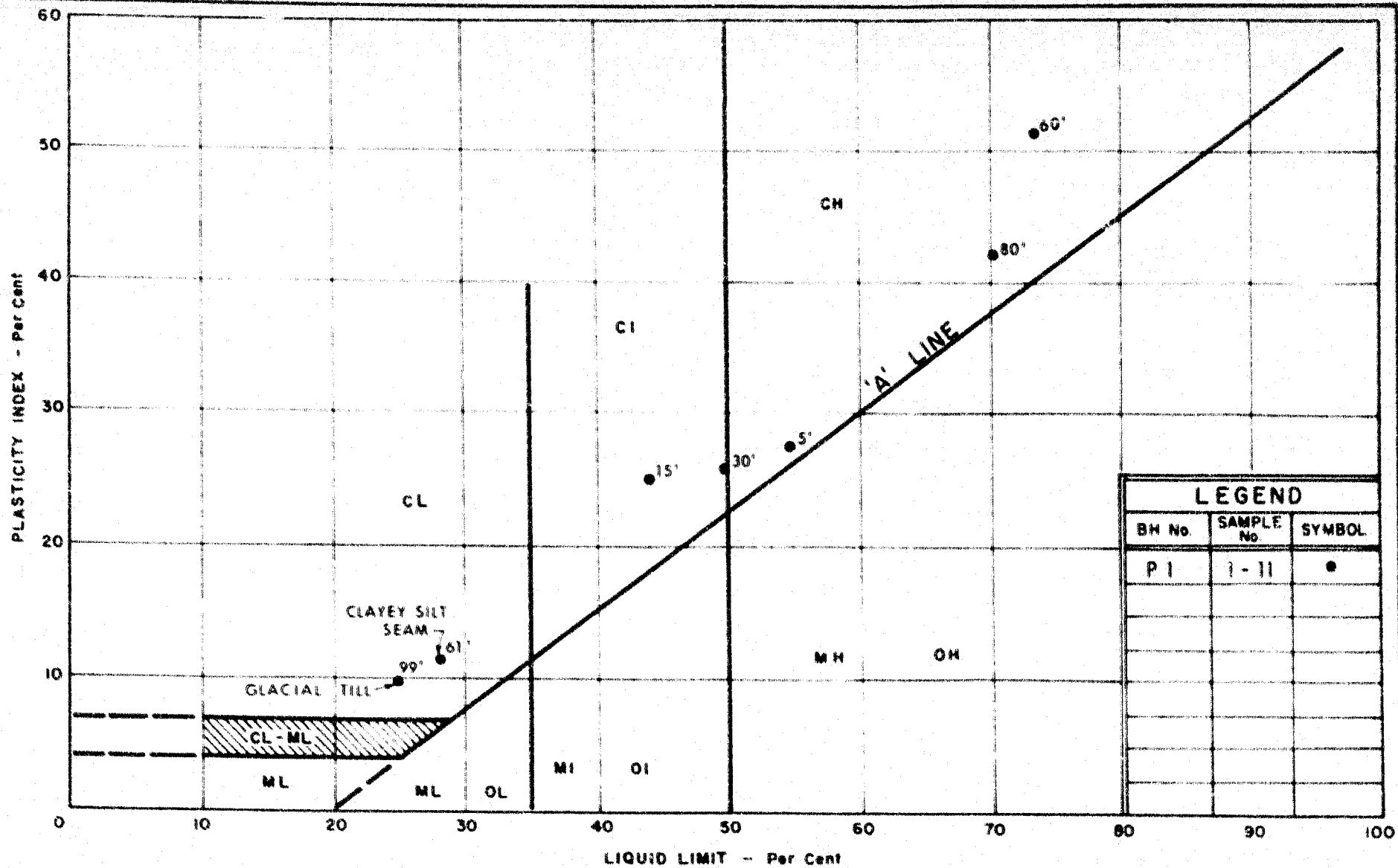
DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. P1

FOUNDATION SECTION

JOB 69-F-100 LOCATION Prop. Hwy. 417 E.B.L. Sta. 31+52 Ø ORIGINATED BY CM
 W.P. 35-66-10 BORING DATE November 6-7, 1969 COMPILED BY CM
 DATUM Geodetic BOREHOLE TYPE Washboring NX Casing CHECKED BY LL





DEPARTMENT OF HIGHWAYS
 MATERIALS and
 TESTING
 DIVISION

PLASTICITY CHART

CLAY

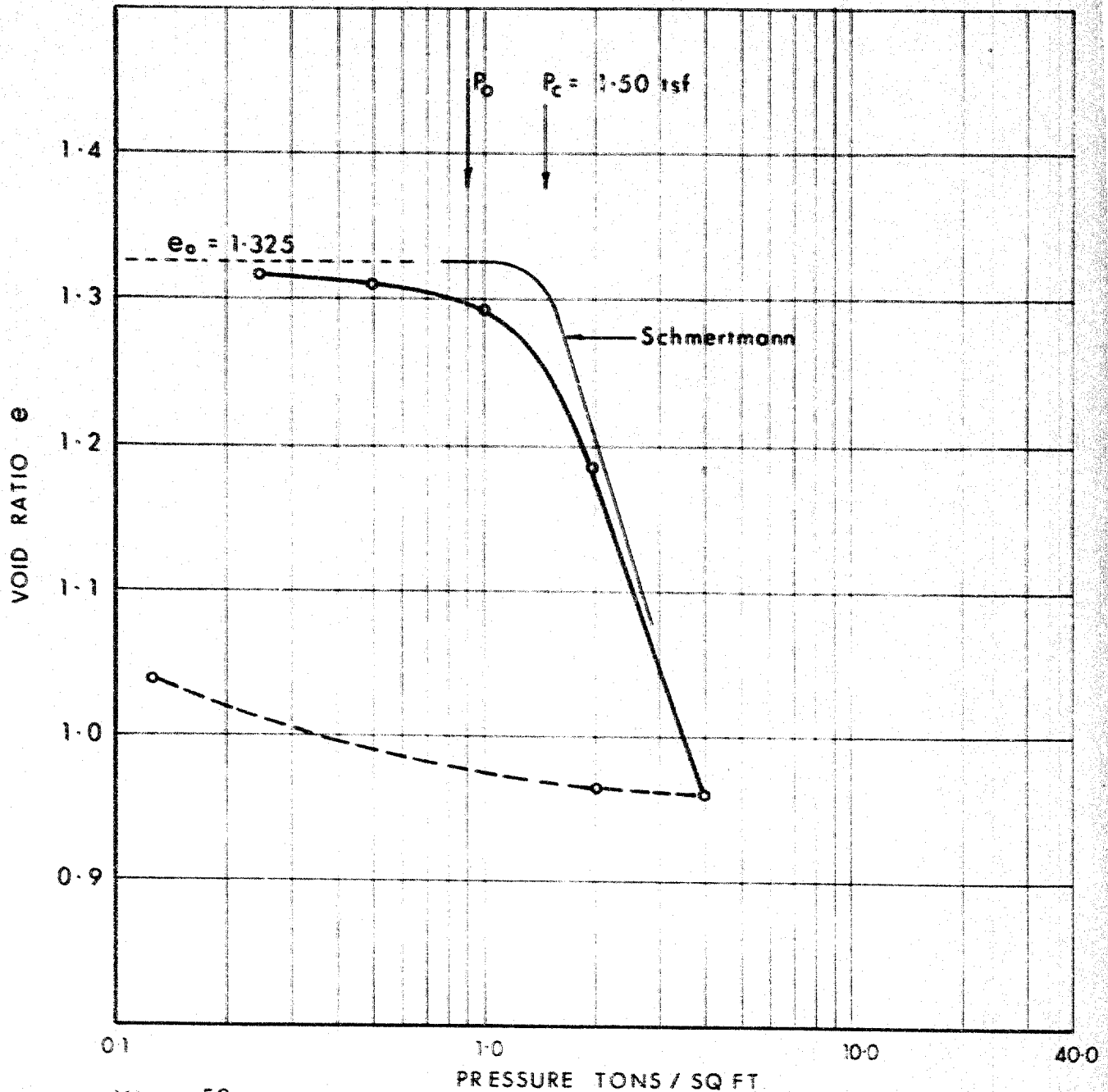
WP. No. 35 - 66 - 10

JOB No. 69 - F - 100

FIG. No. 1

VOID RATIO VS PRESSURE

BORE HOLE P1
SAMPLE 5
DEPTH 31' 3"
ELEV. 185.0



$W_L = 50$
 $W_p = 24$
 $W = 51$
 $C_c = 0.74$

FIG. 2

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

<u>CONSISTENCY</u>	<u>N' BLOWS/FT.</u>	<u>LB./30 FT.</u>	<u>DENSENESS</u>	<u>N' BLOWS/FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
WS	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

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

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Downsview, Ontario.

FROM: Bridge Section,
Kingston, Ontario.

ATTENTION: Mr. M. Devata

DATE: October 30, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 30-10,
Indian Creek Bridge,
Highway 417, District 9

This is to confirm my telephone conversation with Mr. Devata this morning when I said that a borehole would be required at the above site in addition to those at the other three bridge sites in this locality.

There is some question as to whether there will be a structure or a culvert at this site pending the results of hydrological investigations, but it is considered better to carry out a borehole investigation at this site at the present moment while you have a foundation investigation crew in the area than to bring one in especially for the purpose at a later date.



T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl

c.c.

Bridge Office Files Section (Mr. S. McCombie)
Mr. R. Forrest

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: July 23, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: South Indian Creek Crossing
 $\frac{1}{2}$ Mile East of County Rd. #5
W.P. 35-66-10, Site 27-215
Highway 417 E.B.L. & W.B.L.,
District No. 9 - Ottawa

Attached herewith we are submitting a print of the General Layout Drawing, D6822-1, for the above-mentioned structure.

Kindly give us your comments at your earliest convenience.

CSG:rd

Attach.

c.c. Foundation Office

f. C. Grebski
C.S. Grebski,
Bridge Design Engineer

July 24/70
no comments

BTD

15 Jan. 71

#69-F-100

W.P. 35-66-10

H.W.Y. #417 (E.B.L. AND W.B.L.)

SOUTH INDIAN

CREEK.

