

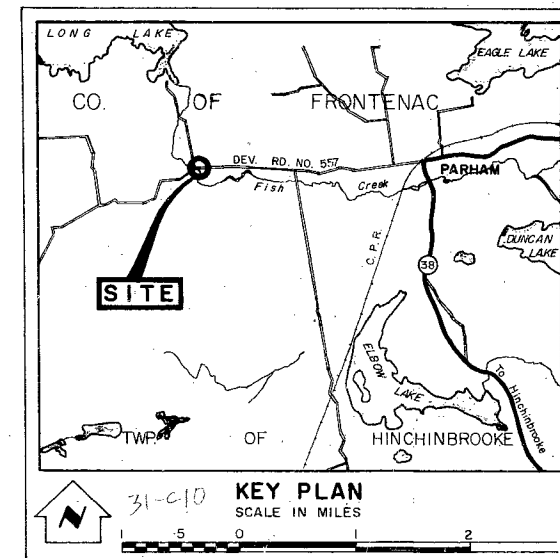
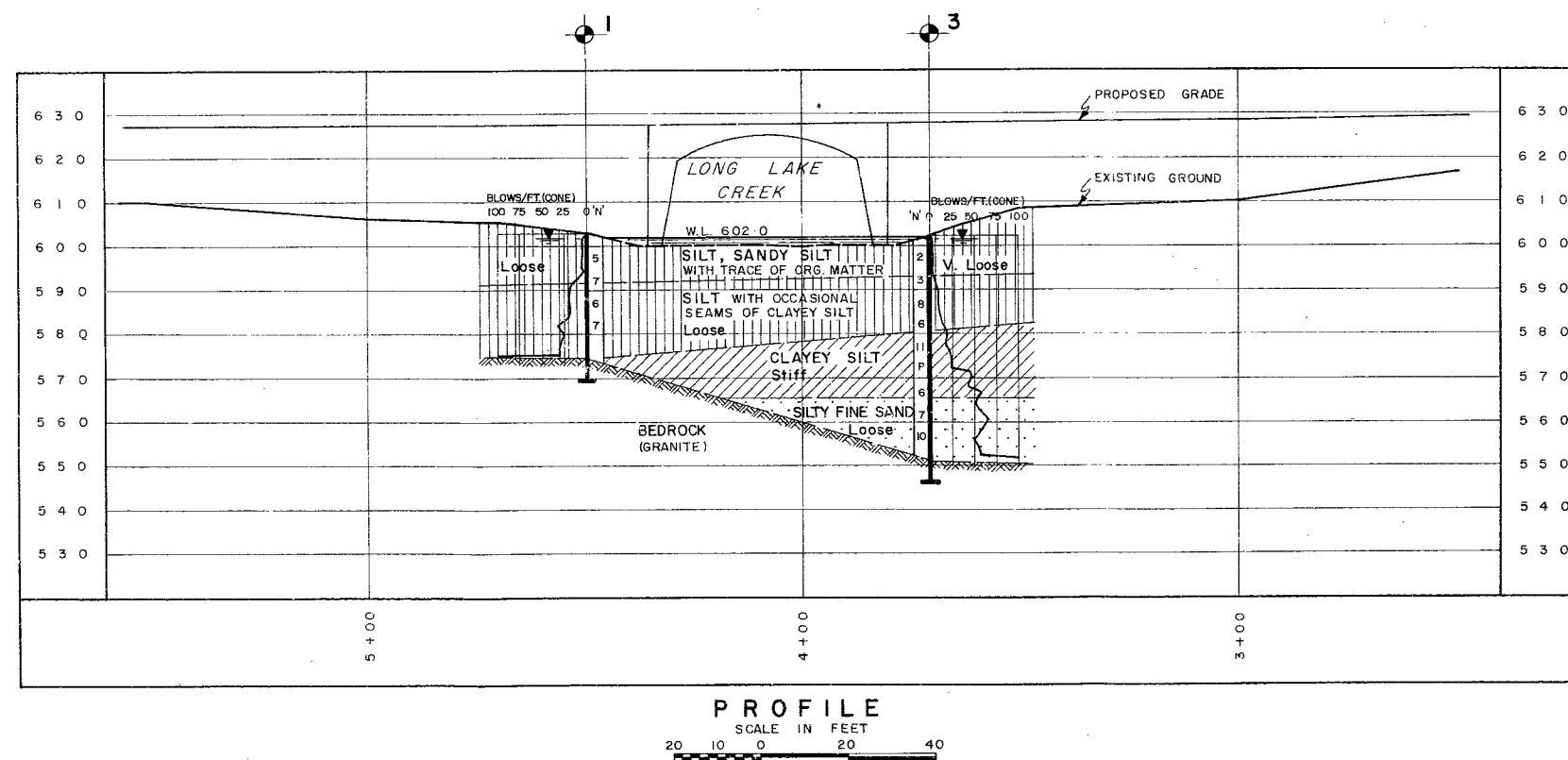
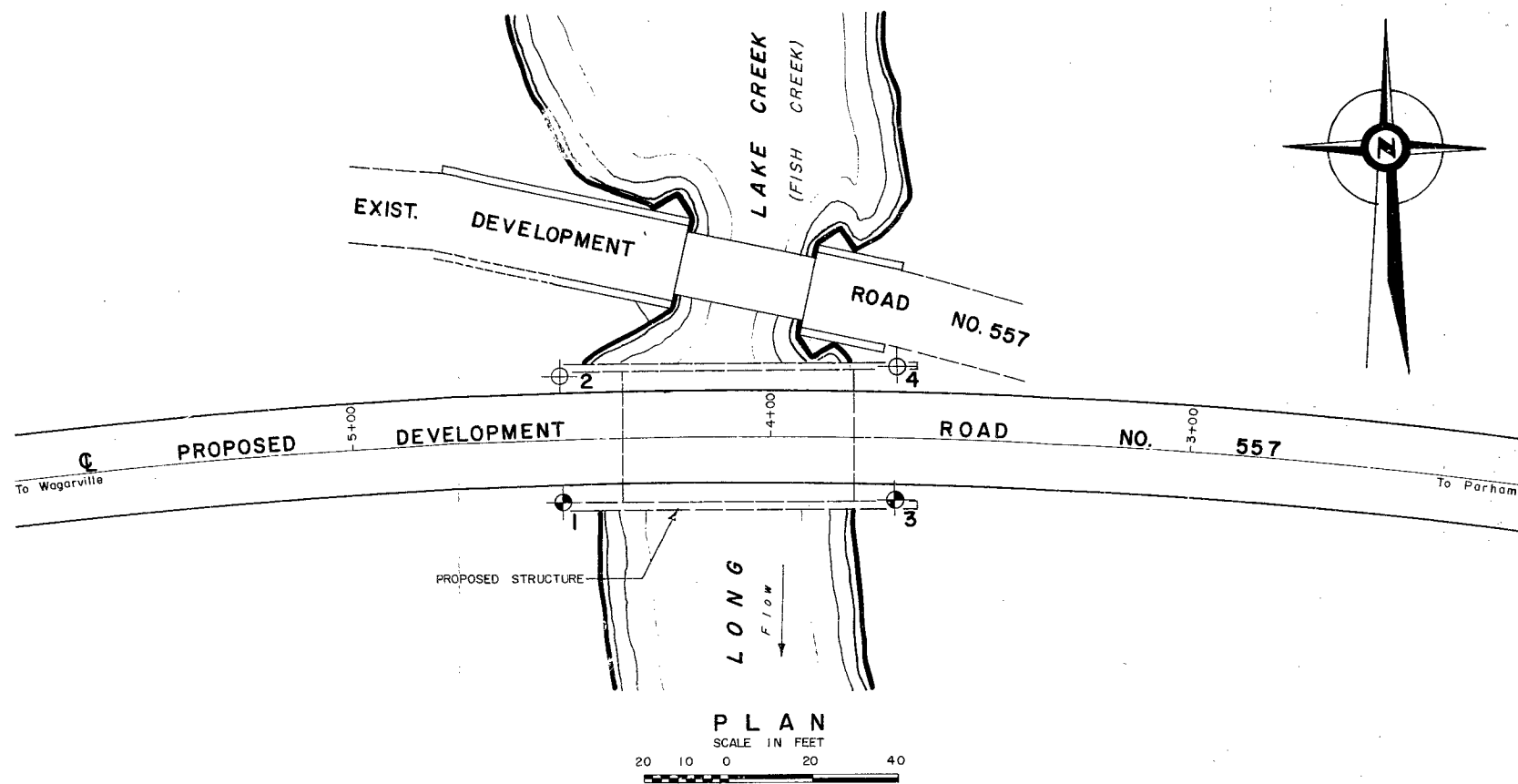
#63-F-86

W.P. MUNICIPAL

DEV. RD. #557E

LONG LAKE CREEK

CROSSING



**LEGEND**

- Bore Hole
- Cone Penetration Hole
- /○ Bore & Cone Penetration Hole
- ▽ Water Levels established at time of field investigation. (Aug. 1963)

NO.	ELEVATION	STATION	OFFSET
1	6 0 3 . 0	4 + 5 0	15' LT.
2	6 0 2 . 5	4 + 5 0	15' RT.
3	6 0 2 . 5	3 + 7 0	15' LT.
4	6 0 3 . 0	3 + 7 0	17' RT.

**- NOTE -**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**DEVELOPMENT ROAD NO. 557  
AND  
LONG LAKE CREEK**

ORIGINATED V. KORLU / TA	DISTRICT NO. 8	DATE 6 SEPT. 1963
DRAWN D. MUMFORD	W.P. NO. 7111	JOB NO. 63 - F - 86
CHECKED <i>W. A. H.</i>	SCALE AS SHOWN	DRAWING NO. 63 - F - 86 A
APPROVED <i>agstern</i>		

Mr. A. M. Towe,  
Bridge Engineer,  
Bridge Division.

Attention: Mr. K.L. Kleinstiber  
Mun. Bridge Liaison Engr.

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.  
October 15, 1963

FOUNDATION INVESTIGATION

For

Proposed New Structure at Crossing of  
Long Lake Creek and Dev. Road #557,  
Lot 25, Conc.VI, County of Frontenac,  
District #8

W.J. 63-F-86 -- (Municipal Job)

Attached, we are forwarding to you, our detailed  
foundation investigation report on the subsoil conditions  
existing at the above structure site.

We believe that you will find the factual data and  
recommendations contained therein, adequate for your future  
design work. Should further information be required, please do  
not hesitate to call on our Office.

KYL/MdeF

Attach.

cc: Messrs. A. M. Towe (3)  
J. P. Howard  
G. E. French  
J. E. Gruspier

Foundations Office  
Gen. Files

*KYL*  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGR.  
For  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

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# FOUNDATION INVESTIGATION

For

Proposed New Structure at Crossing of  
Long Lake Creek and Dev. Road #557,  
Lot 25, Conc. VI, County of Frontenac,  
District #8  
W.J. 63-F-86 -- (Municipal Job)

## 1. INTRODUCTION:

A request dated July 26, 1963, for a foundation investigation at the site of the proposed new bridge at the crossing of Long Lake Creek and relocated Dev. Road #557, was received from the Municipal Bridge Liaison Engineer.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Presented in this report are the results of this investigation, together with the recommendations pertaining to the design of the structure foundations and approach embankments.

## 2. DESCRIPTION OF SITE AND GEOLOGY:

Development Road #557 is a two-lane gravel road and runs from east to west, at this location. The proposed bridge will be located just south of the existing single-span structure. Long Lake Creek is a winding stream which flows in a north to south direction at the site of this structure. It then flows parallel to the development road.

The site is located in the area physiographically known as the Canadian Shield. It is known for its rugged topography and covers precambrian rocks of metamorphic and igneous origin.

cont'd. /2 ...

### 3. FIELD AND LABORATORY WORK:

Field work consisted of two boreholes and four dynamic cone penetration tests. The boring was carried out by means of conventional diamond drilling equipment adapted for soil sampling purposes.

Samples were recovered at required depths by means of a 2" O.D. split-spoon sampler and by 2" I.D. Shelby tube sampler. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. In-situ vane tests were carried out wherever possible, in order to determine the shear strengths of the cohesive deposits. Rock core samples were obtained by means of an AXT core barrel.

Detailed logs of each borehole and penetration test are given on the Records of Boreholes at the end of this report. The locations and elevations of all boreholes are shown on Dwg. No. 62-F-86A appended in this report.

Samples were visually examined and identified in the field as well as laboratory. Tests were carried out in the laboratory on a selection of both disturbed and undisturbed samples to determine:

- i) Natural Moisture Contents.
- ii) Bulk Densities.
- iii) Grain Size Distributions.
- iv) Atterberg Limits.
- v) Undrained Shear Strengths.

Laboratory and field test results have been summarized and are included under Appendix I of this report.

#### 4. SUBSOIL CONDITIONS:

##### 4.1) General:

The site is generally covered with silt to sandy silt deposits. On the east side of the river, the bedrock exists immediately below the silt to sandy silt stratum, whereas on the west side, the bedrock is overlain by clayey silt and silty sand.

A detailed description of various soil types encountered in each boring, is given in Appendix I of this report. The estimated stratigraphical profile of Dwg. 63-F-86A is based on this information.

From ground level downwards, the various soil types encountered are as follows:

##### 4.2) Silt to Sandy Silt with Traces of Organic Matter:

This layer of silt to sandy silt with traces of organic matter, was encountered immediately below the topsoil in all the boreholes. It contains decayed timber and traces of organic matter throughout its entire depth. The thickness of the stratum varied from 9.0' in B.H. #3 to 11.0' in B.H. #1. Standard Penetration resistances or 'N' values of 2 to 7 blows/ft. were obtained in this material. From these values, it is estimated that the relative density varies from very loose to loose.

##### 4.3) Silt with Occasional Seams or Pockets of Clayey Silt:

Underlying the deposit of silt to sandy silt with organic matter, is a stratum of silt with irregular clayey silt seams. The lower boundary varied from elev. 580.5 to elev. 574.5. The silt is predominantly non-cohesive and its denseness, based on 'N' values

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

4.3) Silt with Occasional Seams or Pockets of Clayey Silt:(cont'd.)  
of 3 to 8 blows per foot, is very loose to loose. Wherever possible in the cohesive layers of clayey-silt, Atterberg limits and moisture contents were carried out. The liquid limit varies from 21% - 24%; and the plastic limit ranges from 14% to 16%; the moisture content is typically 21% to 22%.

4.4) Clayey Silt:

A deposit of clayey silt was observed immediately below the above-mentioned stratum on the west bank of the river only - (B.H. #3). This was encountered between elev. 580.5 and elev. 565.5. Occasional thin seams of sand were observed within this deposit. Laboratory tests indicated that the liquid limits of this material ranged from 28% to 31%, and plastic limits ranged from 19% to 22%. Moisture content was found to vary between 20% to 21%.

The Standard Penetration resistances or 'N' values obtained in this material, ranged from 6 to 11 blows/ft. Only one undrained shear strength measurement was carried out in the laboratory, and gave a value of 1500 p.s.f. From the shear strength obtained in the laboratory, together with the measured 'N' values, the consistency of this deposit is estimated to be firm to stiff.

4.5) Silty Fine Sand:

Underlying the above-mentioned deposit, a stratum of silty fine sand was observed in B.H. #3 (west bank only). The lower boundary is at elev. 550.5, where the bedrock was contacted. The thickness of this deposit is 12 ft. with 'N' values ranging from 7 to 10 blows per foot, generally increasing with depth.

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

4.6) Bedrock:

Sound granite bedrock was established by drilling 5 ft. of AXT core in B.H. #1 and #3. The contact with bedrock was established at elev. 574.5 and elev. 550.5 on the east and west banks, respectively.

5. GROUND WATER CONDITIONS:

No attempt was made to establish an accurate ground water level by means of piezometers. Observations carried out during the time of the field investigation, indicated that the ground water level was approximately 1.0' below the natural ground. The exact water levels observed at the time of investigation, are shown in the borehole logs (Appendix I).

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a 55-ft. single-span structure where the relocated Development Road #557 crosses the Long Lake Creek (Fish Creek). The existing structure is a 30-ft. single-span bridge and some 15 ft. wide. The new structure will be located approximately 40 ft. south of the existing one.

Subsoil at the site generally consists of loose silt deposits followed by bedrock on the east bank, whereas on the west bank, the site is underlain by loose silt, followed by clayey silt, silty sand and bedrock. Maximum and minimum depths to bedrock were observed to be 52.0 ft. and 28.5 ft. at the west and east banks, respectively.

cont'd. /6 ...

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

Because of the presence of 22 ft. to 28 ft. loose silt, adequate bearing capacity may not be achieved for spread footing support to the structure. Therefore, the structure should be supported on small displacement end-bearing piles driven to bedrock. For example, for 12 BP 73 steel 'H' piles driven to bedrock, a safe design load of 70 tons/pile may be used.

As it will be necessary to carry out excavations for the pier caps below the ground water level, a dewatering scheme will be required. The subsoil consists of fine-grained granular material and highly susceptible to 'boiling' conditions of unbalanced hydrostatic head. If steel sheeting is used in a dewatering scheme, or as a means of scour protection, this should be driven to a minimum depth below the excavation bottoms equal to the height of the prevailing water above them, in order to prevent boiling.

The maximum height of the approach fill will be in the order of 28 ft. No approach fill stability problems are anticipated for the standard 2:1 side slopes.

7. SUMMARY:

Subsoil at the site generally consists of silt, clayey silt and silty sand followed by granite bedrock. Maximum and minimum depths to bedrock were observed to be 52.0' and 28.5', respectively.

A single-span structure is proposed where Dev. Road #557 (relocated) crosses Long Lake Creek (Fish Creek).

The structure can be supported on end-bearing steel 'H' piles driven to bedrock. A safe design load of 70 tons/pile may

7. SUMMARY: (cont'd.) ...

be used for 12 BP 73 steel 'H' pile.

A dewatering scheme will be necessary for excavations for the pile caps of the piers carried out below river or ground water levels.

Approach fill stability problems are not anticipated for the standard 2:1 side slopes.

8. MISCELLANEOUS:

The field work, performed during the period August 13 to 16, 1963, together with the preparation of this report, was undertaken by Mr. V. Korlu, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engr., who reviewed this report.

Equipment used was owned by Dominion Soil Drilling Co. Ltd.

October 1963

APPENDIX 1.

FOUNDATION SECTION

ORIGINATED BY V.K.

COMPILED BY V.K.

CHECKED BY M.D.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 63-F-86 LOCATION 4450 (15ft. Ht. of G) Dev. Rd. #557, Parham ORIGINATED BY V.K.  
W.P. (Municipal) BORING DATE Aug. 15, 1963. COMPILED BY V.K.  
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY M.D.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.			
602.5	Groundlevel								
0.5	G.W.								
					600				
					590				
					580				
575.5									
27.0	End of cone penetration.				570				

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 63-F-86 LOCATION 3470 (15 ft. Lt. of E) Dev. Rd. #557, Parham ORIGINATED BY V.K.  
W.P. (Municipal) BORING DATE Aug. 15, 1963. COMPILED BY V.K.  
DATUM Geodetic BOREHOLE TYPE Washboring using NX casing. CHECKED BY M.D.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — %L PLASTIC LIMIT — %P WATER CONTENT — %		BULK DENSITY pcf	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100		
602.5	Groundlevel												
0.5	Silt, sandy silt with trace of organic matter. (Very loose)		1	SS	2	600							Sa 21% Si 67% Cl 12%
593.5	Silt with occasional seams of clayey silt. (Loose)		2	SS	3	590							Sa 9% Si 69% Cl 22%
580.5	Clayey silt. (Stiff)		3	SS	8	580							Sa 1% Si 65% Cl 34%
22.0			4	SS	6	580							
565.5			5	SS	11	570							
37.0	Silty fine sand (Loose)		6	T.O. Pushed		570							
550.5			7	SS	6	560							
52.0	Bedrock granite		8	SS	7	560							
545.5	95% AXT core recovery		9	SS	10	550							
57.0						540							



## 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 'D' - 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 360 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>c LB. / SQ. 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
W.S.	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

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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 = $\frac{w_L - w}{I_p}$
$e_{max}$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_i$	SENSITIVITY

### GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\sigma'$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

### EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

~~Mr. A. Stermac~~  
Principal Foundation Eng.  
Lab. Bldg.

Mr. T. Kovich,  
Regional Soils Engineer,  
Lab. Bldg.

G.C.E. Burkhardt

July 26, 1963

Township of Hinchinbrooke,  
Lot 25, Con. VI, Long Lake Creek Bridge  
County of Frontenac, Dev. Road #557  
Structure Site No. 7-29

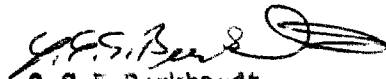
Enclosed please find one (1) copy of the  
Preliminary plan for above mentioned structure.

The District Engineer from the District of  
Kingston requests, that a foundation investigation  
be carried out at this site by the Foundation  
Section.

We would like to know, if you can carry out  
the requested work and at what date we could expect  
the report.

GCEB/m

c.c. A. Stermac

  
G.C.E. Burkhardt,  
for K.L. Kleinstreiber  
Municipal Bridge Liaison Engineer