FOUNDATION REPORT

on

Sutton Creek Bridge, Highway # 65
and Sutton Creek crossing 3 miles East of

New Liskeard

Site Plan No: S-2645-1

Station: 6480

Distribution:

Mr. A. Foye Bridge Engineer	(2)
Mr. H. Tregenzas Construction Engineer	(1)
Mr. J. Walter Design Engineer	(1)
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FILE	(1)

W.P. 637-56
W.J. P-56-10

I. INTRODUCTION

This report deals with foundation investigation carried out to determine the safe bearing capacity of the subsoil for supporting the proposed new bridge. The location is at about 3 miles east of New Liskeard, where Highway No. 65 crosses the Sutton Creek (profile No. 65-A-12, station 6+80).

II. PROCEDURE

The soil investigations were carried out by means of a skid mounted core drill machine. One borehole and two dynamic cone penetrations were made on each side of the creek. The penetrations were carried down to a depth of about 100 ft. below ground level without encountering bedrock.

Further enquiries from the neighbouring farmers led to the presence of two wells, less than a mile away from the bridge site. Both these wells are about 200 feet deep. The bedrock had been drilled some five feet and the water is collecting by infiltration.

The locations and elevations of the boreholes are shown in drawing No. F-56-10A, and their logs under Appendix I.

III. SUBSOIL FINDINGS AND ANALYSIS

The terrain is lacustrine deposit and is referred to as New Liskeard clay. The layer is more than 100 ft. deep and can be possibly assumed to be about 200 ft. deep to the bedrock. From two boreholes of 55 ft. depth samples were obtained. The laboratory test results of these samples indicated the layer being inorganic clay of medium plasticity.

SUBSOIL FINDINGS AND ANALYSIS (continued)

Below the creek water level the layer is saturated and of uniform consistency throughout the observed depth of about 100 ft.

For a spread footing foundation the bearing capacity of the soil at about elevation 98 ft., or about 6 ft. below the surface is calculated to be 0.6 T.s.f. with a safety factor of 3. This value is derived from the penetration resistance (average 7 blows per foot) and unconfined compression (shear strength 0.5 T.s.f.) data. Also, under these circumstances an ultimate settlement of 5 inches is anticipated. Accordingly the low bearing value of the soil and anticipated differential settlement hazards increase considerably the risk of using spread footing foundations.

Consideration would be given to the use of friction piles for support. However, the clay is believed to be quite sensitive. All attempts to perform sensitivity tests on samples obtained from below ground water level failed. Piles driven into this material would have the same effect as remoulding and the clay would undergo a temporary great loss of strength. The time required to repair this strength may be quite long and cannot easily be estimated.

The flow of the water is very gentle, and even during times of flood the high water level is confined to its basin.

IV. CONCLUSIONS AND RECOMMENDATIONS

From the above discussions it will be concluded that:

1. The bearing value of this homogeneous clay layer is inadequate to support spread footing foundations. The existing structure is placed on spread footings and differential settlement is evident.

CONCLUSIONS AND RECOMMENDATIONS (continued)

2. Friction piles should be considered. However, considerable reduction in frictional resistance can be expected because of the pile driving operation and because of the sensitive nature of the clay, and the time required to regain this strength is difficult to estimate. On the basis of the average minimum cohesion value, as determined from unconfined compression tests on undisturbed samples, piles with a diameter of 1.5 ft. and embedded 50 ft. into this layer should develop about 16 tons per pile of frictional resistance with a safety factor of 3, neglecting point resistance (1).

3. It is recommended that the final design load for each pile be obtained from pile load tests. It is pointed out that a piled foundation would involve a long drawn out and costly operation. And it should conform to the following procedure:

a) driving of piles.

b) waiting period for the soil to regain its strength.

c) pile load tests.

It is evident that the above procedure does not appear to be practical.

4. In view of the fact [illegible] Sutton Creek is quite small, it would appear that a flexible [illegible]ate structure would be most economical and practical and consequently this is recommended.

5. As the existing grade line is not changed, no approach fill problem is anticipated.

V. Karlu
Foundation Engineer

(1) Meyerhof G.G., "Recent studies of Foundation Behaviour" The Engineering Journal, February 1954, Volume 37, No. 2, p.124.

APPENDIX I

DEPARTMENT OF HIGHWAYS ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 34-1 OPERATION BORE & PENETN JOB F-56-10 WP 637-56 BORING 1 STA 0+96 49 LT

CASING N X (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT 1959

SAMPLER HAMMER WT 250 LBS DROP 25 INCHES COMPILED BY H S CHECKED BY DATE BORING SEPT 7 1959

ABBREVIATIONS

V - IN SITU VANE SHEAR TEST; M - MECHANICAL ANALYSIS; U - UNCONFINED COMPRESSION; Q_c - TRIAXIAL CONSOLIDATED QUICK; Q - TRIAXIAL QUICK; S - TRIAXIAL SLOW; WL - WATER LEVEL IN CASING; WT - WATER TABLE IN SOIL; k - PERMEABILITY; C - CONSOLIDATION; CA - CASING; γ - UNIT WEIGHT

SAMPLE TYPES

CS - CHUNK; DO - DRIVE OPEN; DF - DRIVE FOOT VALVE; TO - THIN WALLED OPEN; SS - SLEEVE SAMPLE; PS - PISTON SAMPLE; WS - WASHED SAMPLE; RC - ROCK CORE

SAMPLE CONDITION

D = DISTURBED; F = FAIR; G = GOOD; L = LOST

SOIL PROFILE

ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT
94.3		GROUND LEVEL	
93.3 1.0		TOPSOIL	
92.3 2.0		VERY SOFT BROWN SANDY CLAY	
91.3 3.0	WL	SOFT BROWN SANDY CLAY	
89.3 5.0		MEDIUM BLUISH GREY CLAY	
84.3 10.0		MEDIUM BLUE GREY CLAY	
79.3 15.0		MEDIUM TO STIFF BLUE GREY CLAY	
74.3 20.0		STIFF BLUE CLAY	
64.3 30.0		VERY STIFF BLUE CLAY	
59.3 35.0		END OF BOREHOLE	

ELEVATION SCALE: 90, 80, 70, 60, 50, 40, 30, 20, 10

WATER CONTENT W % - O - NAT □ - Pw △ - LW

PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (#200 IN. LBS PER BLOW)

O CORE PEN. 50 100 STAND PEN. 150 200

NOT NECESSARY TO GO FURTHER

SAMPLES

CASING BLOWS (AC TOOLS)	OTHER TESTS	CONDITION	TYPE	NO	PENETRATION RESISTANCE	ELEV RECOV %
						94.3
						93.3
						92.3
						91.3
						89.3
						84.3
						79.3
						74.3
						64.3
						59.3

DEPARTMENT OF HIGHWAYS ONTARIO

MATERIALS & RESEARCH BRANCH = FOUNDATIONS SECTION = DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-1 OPERATION PENETRATION TEST JOB 56-10 WP 637-56 BORING 2 STA 7+53.33

CASING 3X (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT 1956

SAMPLER HAMMER WT. 250 LBS. DROP 23 INCHES COMPILED BY H.S. CHECKED BY DATE BORING SEPT 11, 1956

ABBREVIATIONS

V = INSITU VANE SHEAR TEST Q - TRIAXIAL QUICK K - PERMIABILITY
M - MECHANICAL ANALYSIS S - TRIAXIAL SLOW C - CONSOLIDATION
U - UNCONFINED COMPRESSION WL - WATER LEVEL IN CASING CA - CASING
Q_c TRIAXIAL CONSOLIDATED QUICK WT - WATER TABLE IN SOIL γ - UNIT WEIGHT

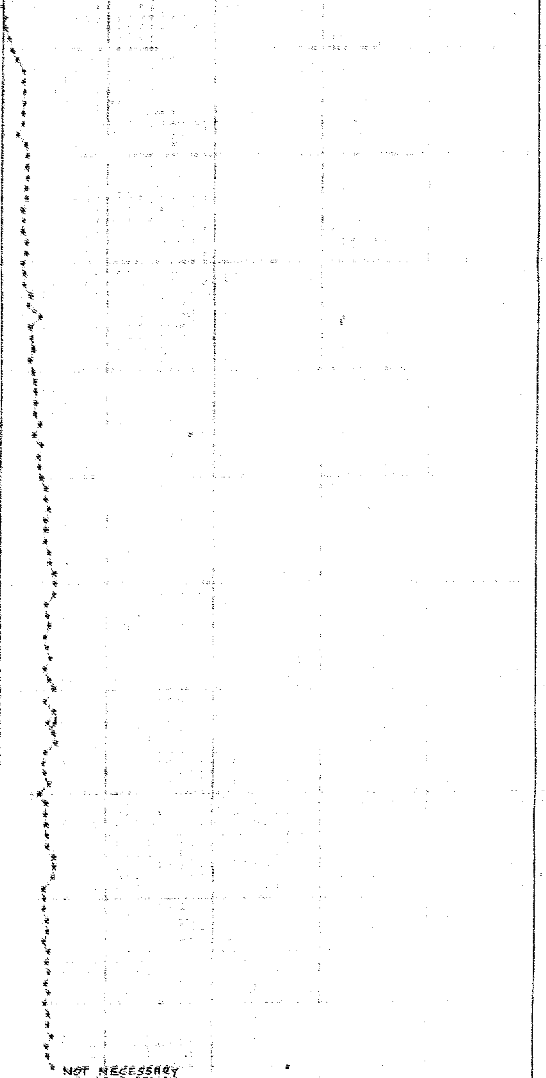
SAMPLE TYPES

CS - CHUNK SS - SLEEVE SAMPLE
DO - DRIVE OPEN PS - PISTON SAMPLE
DF - DRIVE FOOT VALVE WS - WASHED SAMPLE
TO - THIN WALLED OPEN RC - ROCK CORE

SAMPLE CONDITION

DISTURBED
FAIR
GOOD
LOST

SOIL PROFILE						SAMPLES					
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	WATER CONTENT W % — ○ NAT ◻ PW △ LW; PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (4200 IN. LBS PER BLOW) ⊙ CONE PEN. ×---×---× STAND. PEN. •——• 50 100 150 200	CASING BLOWS (ACTUAL)	OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE
94.2'		GROUND LEVEL									
4				90							
14				80							
24				70							
34				60							
44				50							
54				40							
64				30							
74				20							
84				10							
94											
104											



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH BRANCH = FOUNDATIONS SECTION = DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-1 OPERATION BORE & PENET'N JOB 50-10 W.P. 637-56 , BORING 3 STA. 6+38.43

CASING N X (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT. 1956

SAMPLER HAMMER WT. 250 LBS. DROP 23 INCHES COMPILED BY H.S. CHECKED BY ___ DATE BORING SEPT 12, 195

ABBREVIATIONS

V = INSITU VANE SHEAR TEST
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Q = TRIAXIAL QUICK
S = TRIAXIAL SLOW
WL = WATER LEVEL IN CASING
WT = WATER TABLE IN SOIL
K = PERMIABILITY
C = CONSOLIDATION
CA = CASING
γ = UNIT WEIGHT

SAMPLE TYPES

CS = CHUNK
DO = DRIVE OPEN
DF = DRIVE FOOT VALVE
TO = THIN WALLED OPEN
SS = SLEEVE SAMPLE
PS = PISTON SAMPLE
WS = WASHED SAMPLE
RC = ROCK CORE

SAMPLE CONDITION

= DISTURBED
= FAIR
= GOOD
= LOST

SOIL PROFILE

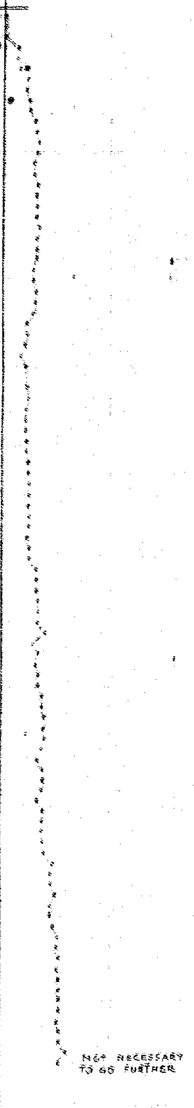
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	ELEVATION SCALE
93.7'		GROUND LEVEL	
4		TOPSOIL; VERY SOFT BROWN CLAY SLIGHTLY STONEY; STIFF TO MEDIUM BROWN CLAY SLIGHTLY STONEY	90
14	WT	MEDIUM TO STIFF BLUE CLAY	80
24			70
		MED. BLUE CLAY	
34		BLUE CLAY	60
		MED. BLUE CLAY	
44		BLUE CLAY	50
		MED TO STIFF BLUE CLAY	
		END OF BOREHOLE	
54			40
64			30
74			20
84			10
94			
104			

WATER CONTENT W % ○ = NAT □ = PW △ = LW

PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (4200 IN. LBS. PER BLOW)

D. CONE PEN. ×-----× STAND PEN. •——•

50 100 150 200



CASING BLOWS (ACTUAL)

SAMPLES

OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	EL. REC. %
	LOST	[illegible]		10	
	LOST	[illegible]		3	
	DISTURBED	DO	1	PUSHED	100%
	GOOD	[illegible]	2	PUSHED	100%
	LOST	[illegible]		PUSHED	
	GOOD	[illegible]	3	PUSHED	100%
	FAIR	[illegible]	4	PUSHED	100%
	GOOD	[illegible]	5	PUSHED	100
	GOOD	[illegible]	6	PUSHED	100%
	GOOD	[illegible]	7	PUSHED	100%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW

OFFICE REPORT ON SOIL EXPLORATION

DRILL RIG 54-1 OPERATION PENETRATION TEST JOB 56-10 WP 637-56 BORING 4 STA. 6+14 43 LT.

CASING BX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT 1956

SAMPLER HAMMER WT. 250 LBS. DROP 23 INCHES COMPILED BY H.S. CHECKED BY ___ DATE BORING SEPT. 13, 1956

ABBREVIATIONS

V = INSITU VANE SHEAR TEST
M = MECHANICAL ANALYSIS
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Q_c TRIAXIAL CONSOLIDATED QUICK
Q TRIAXIAL QUICK
S = TRIAXIAL SLOW
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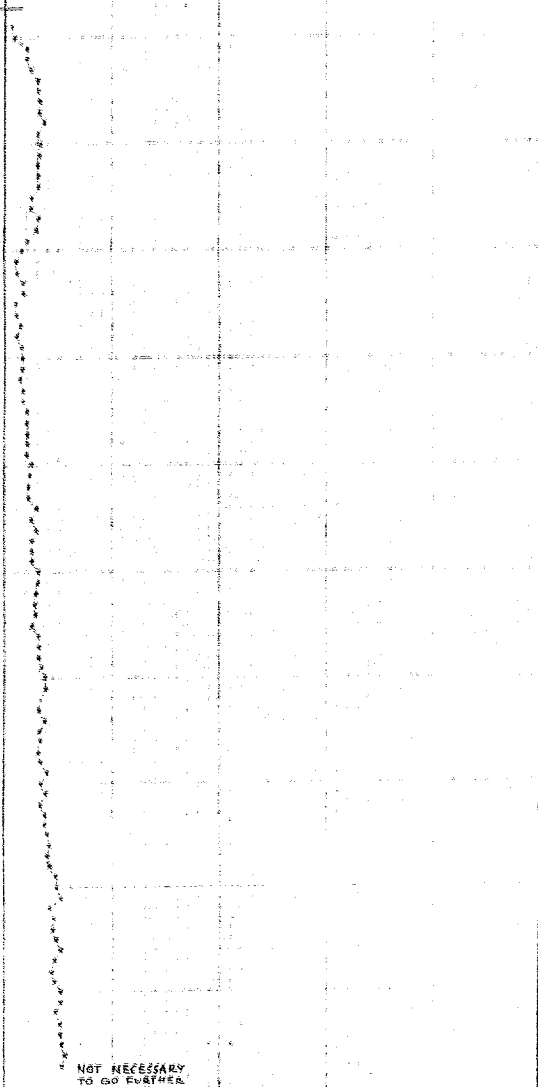
SAMPLE CONDITION

= DISTURBED
= FAIR
= GOOD
= LOST

SOIL PROFILE							SAMPLES					
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT. PLOT	ELEVATION SCALE	WATER CONTENT w % ⊙ - NAT ⊡ - PW △ LW / PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY (4200 IN LBS. PER BLOW) ○ CONE PEN. X-----X-----X STAND. PEN. •——•——• 50 100 150 200	CASING BLOWS (ACTUAL)	OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV. %
92.8'		GROUND LEVEL										
3				90								
13				80								
23				70								
33				60								
43				50								
53				40								
63				30								
73				20								
83				10								
93												
103												



Mr. A. Toye

Bridge Engineer

F. C. Brownridge
Per: A. Rutka

January 15th, 1957.

Re: Foundation Report at
Sutton Creek Hwy #65
W.P. 637-56 W.J. P-56-10

We are forwarding herewith two copies of the above Foundation Report which you will find self-explanatory.

F. C. Brownridge
MATERIALS & RESEARCH ENGINEER

Per: QR
A. Rutka
PRINCIPAL SOILS ENGINEER

AR:JA
Encls. 2

c. c. to:

Mr. H. Trogakos

Mr. J. Walter

Mr. S. F. Wetherall

Foundation Section ✓

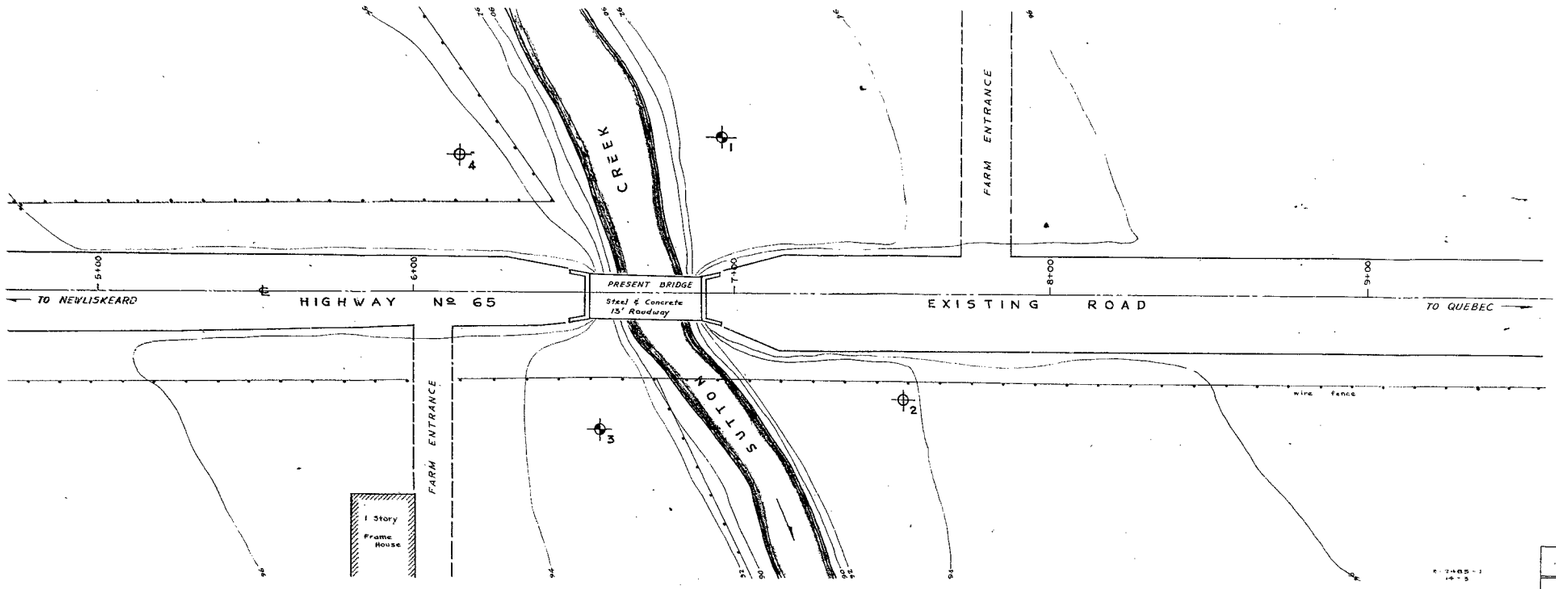
File

56-F-10

W.P.# 637-56

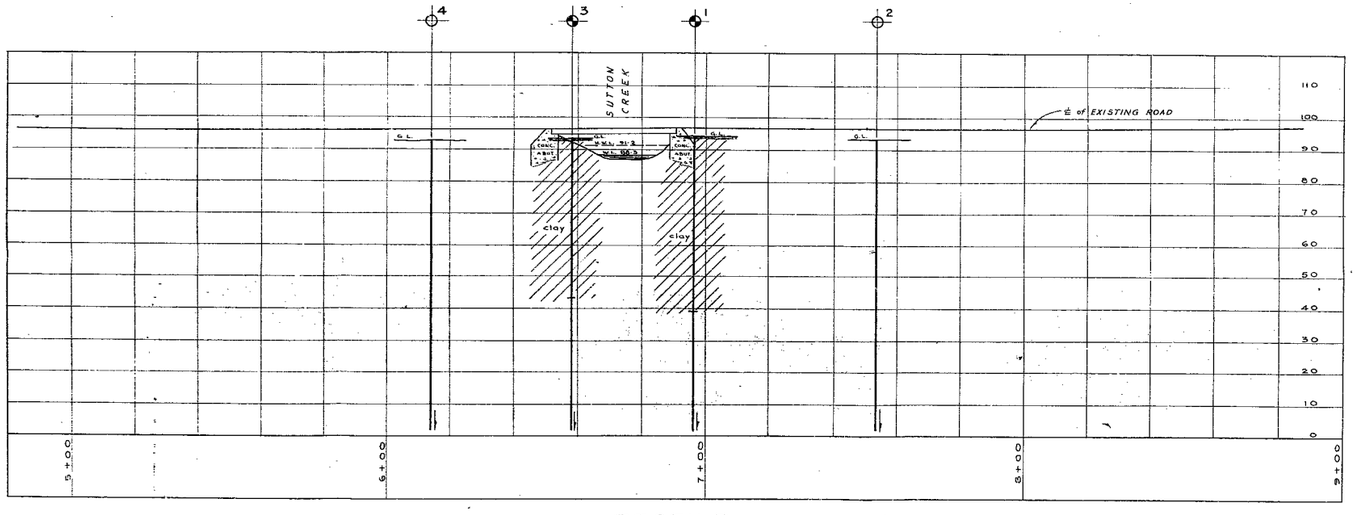
Hwy #65 & SUTTON

CREEK CROSSING



PLAN

Scale - 1 inch = 20 feet



PROFILE

Scale - 1 inch = 20 feet

LEGEND

- Bore Hole
- Penetration Hole
- Bore & Penetration Hole

HOLE NO.	ELEVATION	STATION	DISTANCE FROM ℄
1	94·3	6+96	49' LT.
2	94·2	7+53	33' RT.
3	93·7	6+58	43' RT.
4	92·8	6+14	43' LT.

– 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.

PRINT RECORD

NO	INIT	DATE

REVISIONS

DATE	BY	DESCRIPTION

REFERENCE PLANS

DEPARTMENT OF HIGHWAYS:-ONTARIO-

MATERIALS & RESEARCH SECTION - DOWNSVIEW

SUTTON CREEK CROSSING

THE KING'S HIGHWAY No. 65 DIV. No. 14

CO. TIMISKAMING

TWP. HARRIS LOT 4 CON. V

POSITIONS & ELEVATIONS of HOLES

APPROVED

ENGINEER CHIEF ENGINEER

DESIGN		CHECK		CONTRACT NUMBERS	W.P. 637-56
DRAWING	H.D.R.	CHECK			
TRACING		CHECK		LOADING	DRAWING NUMBER F-56-10 A
DATE	26 SEPT. 1956				