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Ministry of  
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# foundation investigation and design report

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**ENGINEERING MATERIALS OFFICE**  
**PAVEMENT & FOUNDATION DESIGN SECTION**

WO 7241-80-11

Formerly

WO 79-50066

DIST 13

HWY

STR SITE 43-233

Tomiko River Tributary Bridge  
Twp. of Lyman, Lot 1, Conc. IV

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# MUNICIPAL FOUNDATION INVESTIGATION REPORT

For

Tomiko River Tributary Bridge  
Twp. of Lyman, Lot 1, Conc. IV  
W.O. 79-50064, Site: 43-233  
District 13, North Bay

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## INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project during the period of 1979 11 13 - 16. The field work was done with a continuous flight auger machine mounted on a muskeg vehicle. The borings were advanced by employing 3¼ inch I.D. hollow stem augers and conventional washboring techniques (NX Casing).

## SITE DESCRIPTION

The proposed new structure site is located just downstream from the outlet of Tilden Lake, east of Hwy. 11 on a local road at approximately 22 miles north of North Bay. This tributary to Tomiko River flows in a north to south direction, and width of the channel is about 40' measured along the proposed alignment (Line 'B'). A temporary detour structure (60 ft. long Bailey Bridge) is located some 25 feet north of Line 'B'. The depth of the river at this point is controlled by a dam at the outlet of Tilden Lake.

The surrounding terrain is gently rolling and covered with light bush.

## SUBSURFACE CONDITIONS

### General

Generally uniform subsoil conditions were found to exist at the proposed new structure location. The subsoil (apart from

a thin layer of topsoil in B.H. #1) consists of an approx. 8 - 12 ft. thick of bouldery sand and gravel with traces of fines, stratum, followed a 29 - 35 deep deposit of uniform sand containing traces of silt, followed a very dense sand and gravel zone.

References should be made to the Record of Borehole Sheets and Drawing No. 79-50066-A contained in the Appendix of this report for different soil type boundaries and also for locations and elevations of the individual borings.

#### Bouldery Sand and Gravel Traces of Fines

This deposit was encountered at both boring location to a maximum depth of about 12 ft. (elevation 89  $\pm$ ). The material consists mainly of boulders, sand, gravel and traces of fines. Diamond drilling techniques were used to advance the borings in the stratum.

#### Sand Trace Silt

Beneath the bouldery zone, a stratum of sand with trace of silt zone was observed in B.H. #1 and B.H. #2 down to elevation 56.5 and elevation 59.8 respectively. Gravel sizes were also encountered in the upper 2 - 5 ft. portion of this zone. Standard penetration tests 'N' values are ranged from 2 - 13 blows per foot, indicating a very loose to compact denseness. The natural moisture content varies from 19 to 31%. Grain size distribution curves are shown in an envelope form on Figure 1 of the Appendix.

#### Sand and Gravel, Trace of Silt

A very dense sand and gravel with traces of silt layer was intersected below the sand deposit. The lower boundary was not determined since the borings were terminated within this stratum at elevation 53 (B.H. #1) and at elevation 50.8 (B.H. #2). The natural moisture content is in the order of 9%.

### Groundwater Conditions

The following groundwater levels were observed during the field investigation:

B.H. #1 - Elevation 97.5

B.H. #2 - Elevation 98.0

It is pointed out that these levels may fluctuate due to the controlling affect of the upstream dam.

## DISCUSSION AND RECOMMENDATIONS

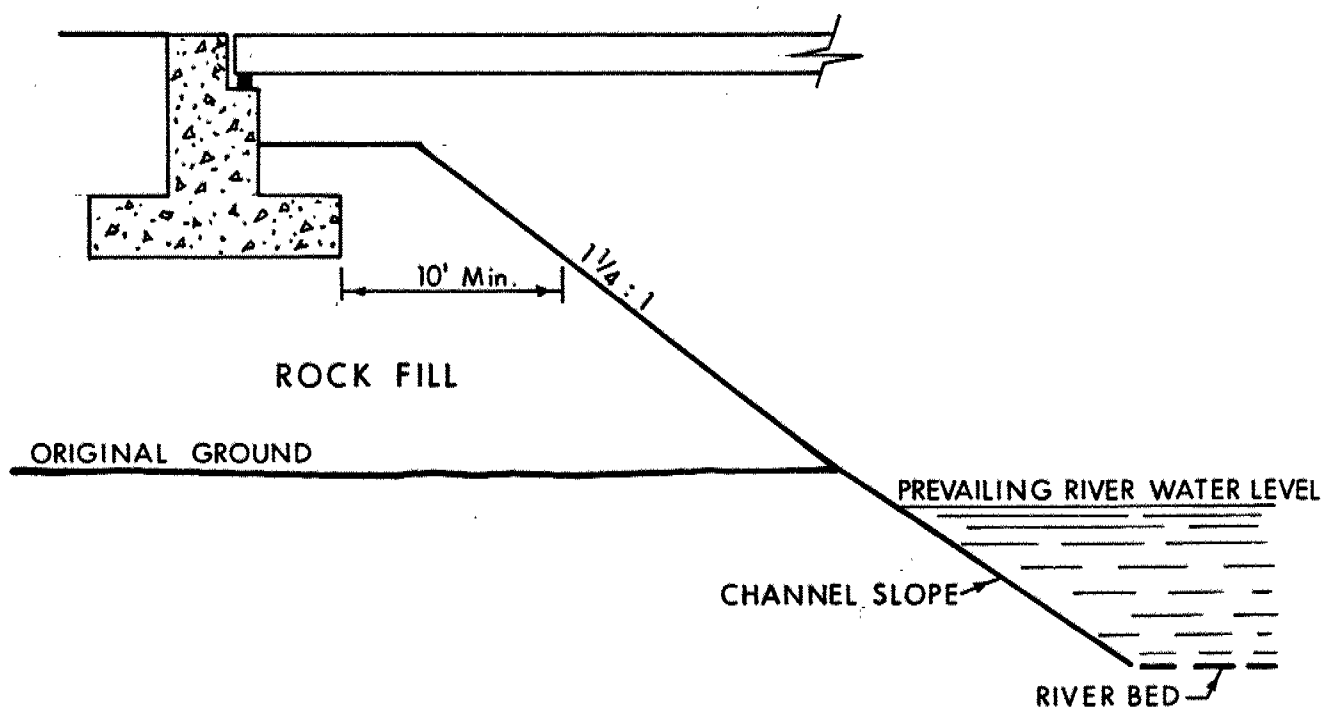
### General

It is proposed to construct a new structure at the crossing of Twp. Rd. and a tributary to Tomiko River approximately on the same alignment (Line 'B') as existed prior to the failure of an original timber beam bridge and the subsequent erection of a Bailey structure some 25' upstream.

The proposed new structure will have an opening of about 38 ft., and the profile grade is set at elevation 109 at the centre line (Sta. 13+40). Up to 10 ft. high approach fills will be required to attain the proposed profile grade.

### Structure Foundations

The proposed structure may be founded on spread footings placed within rock fill approach embankments. Design pressures up to 2 TSF may be assumed. The rock fill embankment should be built with  $1\frac{1}{4}:1$  side and forward slopes at the structure location as shown below.



N.T.S.

It should be advantageous to provide for shimming up the bridge deck to accommodate settlements which may occur after completion of the project. In order to protect the footings from frost action, it will be necessary to provide a minimum of 7 ft. cover to the underside of the footings. A lean concrete pad should be poured on the rock fill at the footing locations. As an alternative to spread footings within rock fill, the proposed new structure may be supported on rock filled timber cribs. For design purposes, a bearing pressure of 1 TSF is recommended. All topsoil and soft material should be removed at the cribs locations.

#### Approach Fills

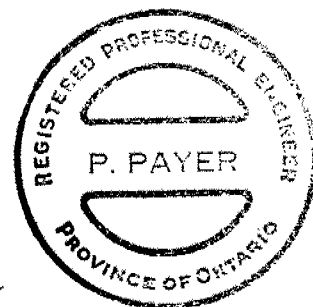
To accommodate the proposed profile grade up to 10 ft. high, fills will be required. No stability problems are anticipated provided the forward and side slopes are constructed with 2:1 (earth fill) or 1½:1 (rock fill) slopes. The settlements under the fill will be instantaneous as soon as the load is applied.

If earth fills will be used, the slopes should be protected against erosion. The river channel (slopes and bed) should be protected against scour by a 2 ft. thick rip-rap for a distance of about 20 ft. upstream and downstream and a minimum of 5 ft. front of the footings.

MISCELLANEOUS

The fieldwork was supervised by Mr. R. Riske, Student Technician. This report was written by Mr. P. Payer, and reviewed by Mr. K. G. Selby.

Equipment used was owned and operated by Longyear Canada Inc.



*P. Payer*

P. Payer, P. Eng.  
Foundations Engineer.

*K. G. Selby*

K. G. Selby, P. Eng.  
Senior Foundations Engineer.

December, 1979.



## APPENDIX

RECORD OF BOREHOLE No 1

WO 79-50066 LOCATION Sta. 13+09; E Prop Line 'B' ORIGINATED BY RR  
DIST 13 HWY 404 BOREHOLE TYPE Wash Boring - WW and BW Casing COMPILED BY RR  
DATUM Assumed DATE November 14, 1979 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
99.5	Ground Level													
0.0	Top Soil		1	SS	102									
	Bouldery sand and gravel		2	SS	68									
91.5	Trace of fines		3	SS	6									9 89 (2)
8.0	Trace of gravel		4	SS	10									
			5	SS	10									0 92 (8)
			6	SS	7									
	Sand		7	SS	6									
	Trace of Silt		8	SS	2									
	Very loose to compact		9	SS	8									
			10	SS	5									0 63 (37)
			11	SS	2									
56.5			12	SS	8									0 95 (5)
43.0	Sand and gravel													
53.0	Very dense		13	SS	71									
46.5	End of Borehole													

\*3, \*5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10



Ministry of  
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HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2

WO 79-50066 LOCATION Sta. 13+64: E Prop Line 'B' ORIGINATED BY ER  
DIST 13 HWY 404 BOREHOLE TYPE Wash Boring - BW and BW Casing COMPILED BY ER  
DATUM Assumed DATE November 15, 1979 CHECKED BY RS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
100.8	Ground Level																
0.0	Bouldery sand and gravel Trace of silt		1	SS	100	3"	100										49 50 (1)
88.8			2	SS	20		90										
12.0	Some gravel		3	SS	15		80										25 70 (5)
	Sand Some silt Very loose to compact		4	SS	5		70										0 78 (22)
			5	SS	4												
			6	SS	5												
			7	SS	7												
59.8			8	SS	76		60										6 89 (5)
41.0	Sand and gravel Trace of silt Very dense		9	SS	100	3"											
50.8																	
50.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

\*3, \*5 : Numbers refer to  
Sensitivity

20  
15 \*5 (%) STRAIN AT FAILURE  
10



# EXPLANATION OF TERMS USED IN REPORT

**'N' VALUE:** AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS  $N_c$ .

**DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3):** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 550 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

**SOIL QUALITY:** SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

**CONSISTENCY:** COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

$S_u$ (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

**DENSITY:** COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

**ROCK QUALITY:** 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 DRILLED IN THAT CORING RUN.

**MODIFIED RECOVERY:** SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS & SYMBOLS




### LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. CU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

### FIELD SAMPLING

SS SPLIT SPOON  
WS WASH SAMPLE  
ST SLOTTED TUBE SAMPLE  
BS BLOCK SAMPLE  
CS CHUCK SAMPLE  
TW THINWALL OPEN  
TP THINWALL PISTON  
OS OSTERBERG SAMPLE  
FS FOIL SAMPLE  
RC ROCK CORE  
PH T.W. ADVANCED HYDRAULICALLY  
PM T.W. ADVANCED MANUALLY

### EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_A$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_P$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE   
 $\omega$  SLOPE ANGLE-BACKFACE OF WALL   
 $\beta$  ANGLE OF SLOPE   
 $N, N_q, N_c$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
 $B, L$  FOOTING DIMENSIONS

### INDEX PROPERTIES

$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$  " IN LOOSEST STATE  
 $e_{min}$  " IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_p$  PLASTIC LIMIT  
 $w_s$  SHRINKAGE LIMIT  
 $I_p$  PLASTICITY INDEX =  $w_p - w_L$   
 $L_L$  LIQUIDITY INDEX =  $\frac{w - w_p}{w_p - w_L}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w - w_p}{w_p - w_L}$   
 $A_c$  ACTIVITY =  $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$   
 $OM$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

### STRENGTH PARAMETERS

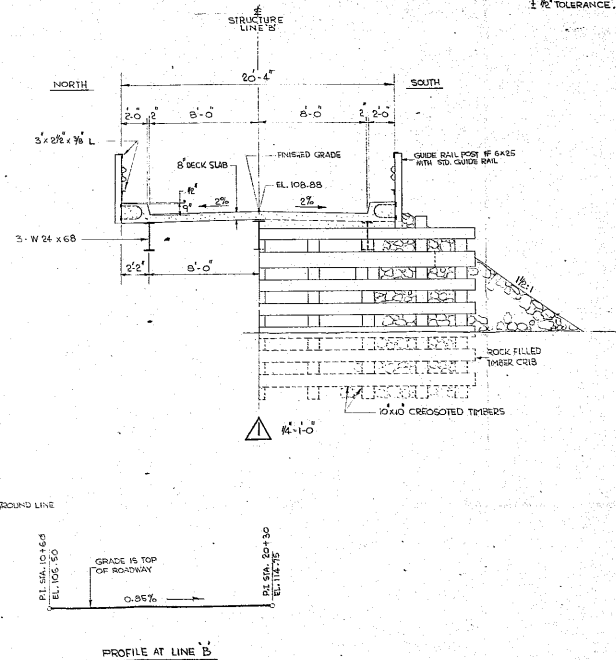
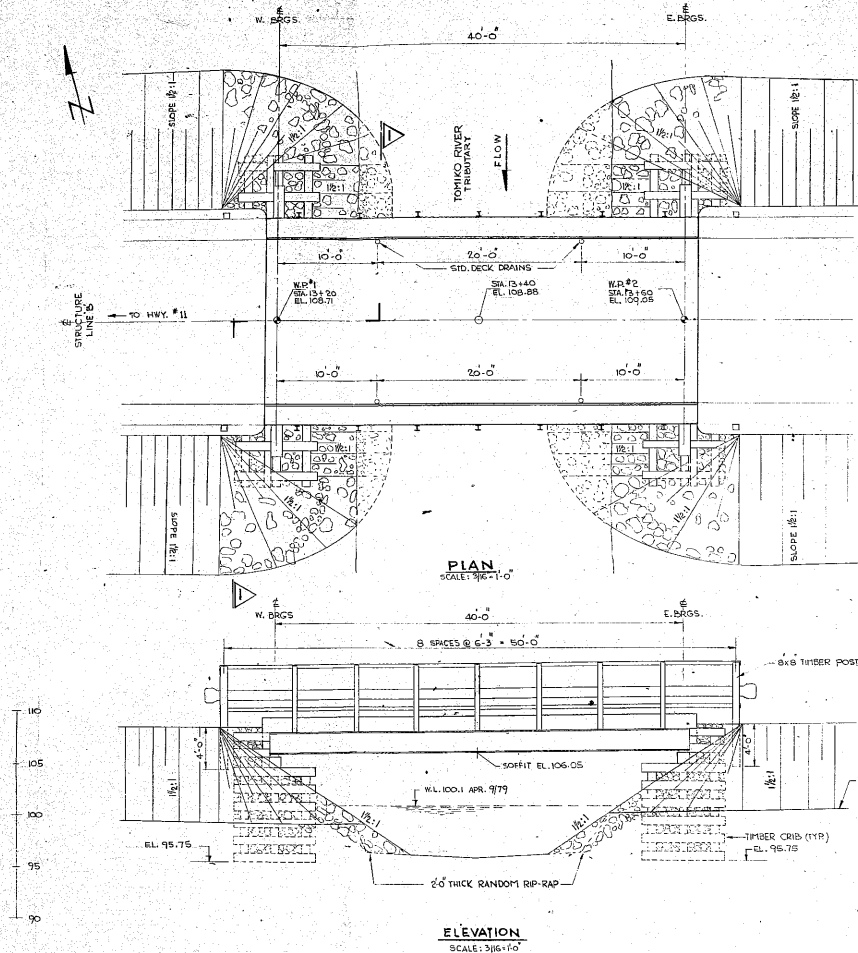
$\phi$  ANGLE OF SHEARING RESISTANCE  
 $\tau_f$  PEAK SHEAR STRENGTH  
 $\tau_R$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_e$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $\alpha, \beta$  STABILITY COEFFICIENTS  
 $A, B$  PORE PRESSURE COEFFICIENTS

**NOTE:** EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'_n$  = EFFECTIVE NORMAL STRESS

### HYDRAULIC TERMS

$h$  HYDRAULIC HEAD OR POTENTIAL  
 $q$  RATE OF DISCHARGE  
 $v$  VELOCITY OF FLOW  
 $i$  HYDRAULIC GRADIENT  
 $j$  SEEPAGE FORCE PER UNIT VOLUME  
 $\eta$  COEFFICIENT OF VISCOSITY  
 $k$  COEFFICIENT OF HYDRAULIC CONDUCTIVITY  
 $k_h$   $k$  IN HORIZONTAL DIRECTION  
 $k_v$   $k$  IN VERTICAL DIRECTION  
 $\alpha_v$  COEFFICIENT OF VOLUME CHANGE  
 $c_v$  COEFFICIENT OF CONSOLIDATION  
 $C_c$  COMPRESSION INDEX  
 $C_r$  RECOMPRESSION INDEX  
 $d$  DRAINAGE PATH DISTANCE  
 $T_v$  TIME FACTOR  
 $U$  DEGREE OF CONSOLIDATION  
 $O_c$  OVERCONSOLIDATION RATIO (OCR)

# OVERSIZE DRAWING



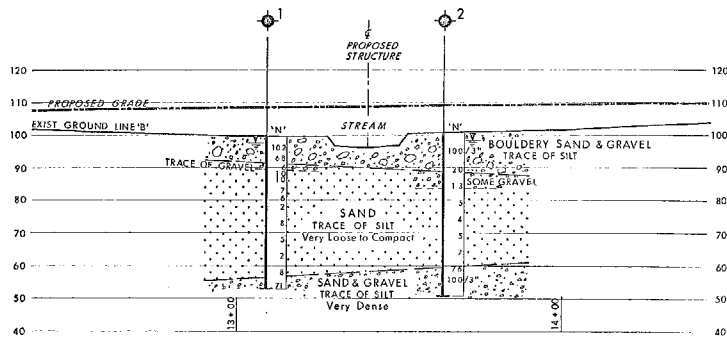
**BENCH MARK**  
 BM #1 ELEV. 100.00  
 N. + W. IN 1.0" WHITE  
 DITCH 30' LT. STA. 4400

DIST 13	CONT No	SHEET
WO	No 7241-80-11	
TOMIKO RIVER TRIBUTARY BRIDGE		
TWP. OF LYMAN LOT. 1 CON. IV		
GENERAL ARRANGEMENT		

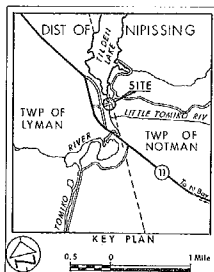
**NOTES:**  
 REINFORCING STEEL GRADE \_\_\_\_\_ 400  
 BARS MARKED WITH THE SUFFIX 'C' SHALL BE COATED BARS.  
 CLASS OF CONCRETE \_\_\_\_\_ 30 MPa  
 CLEAR COVER TO REINFORCING STEEL \_\_\_\_\_ 2"  
 TO ACHIEVE THE MINIMUM CLEAR COVER OF 2"  
 SPECIFIED THE TOP LAYER SHALL BE PLACED PRIOR  
 TO CONCRETING WITH A CLEAR COVER OF 1 1/2"  
 ± 1/2" TOLERANCE.

DRAWING NOT TO BE SCALED  
 1" = 3' INCHES ON ORIGINAL PLAN

DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING 11/10/44
DRAWING	CHECK	DATE 11/10/44

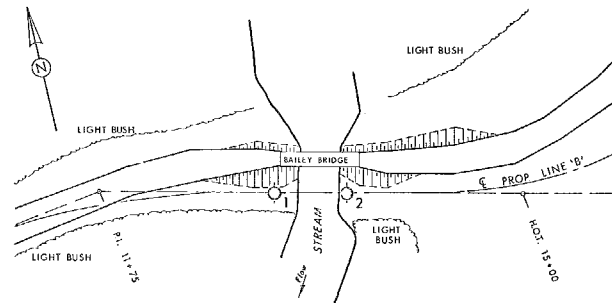


PROFILE LINE 'B'  
SCALE  
20 10 0 20 FT



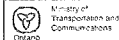
LEGEND			
	Bore Hole		
	Water Level at time of Investigation Nov 1979		
No	ELEVATION	STATION	OFFSET LINE 'B'
1	99.5	13+09	E
2	100.8	13+64	E

NOTE:  
ASSUMED BENCH MARK No 1 ELEV 100.00  
N & W IN 1.0" WHITE BIRCH 80' LT  
STA 4+00.



PLAN  
SCALE  
50 25 0 50 FT

Geocres No 311-49



# TOMIKO RIVER TRIBUTARY BRIDGE

DIST OF NIPISSING TWP OF LYMAN  
CON IV LOT 1 SITE No 43-233 DIST 13

WO 79-50066

Dwg No 7950066-A

REF. PLAN & PROFILE, RECEIVED July 31, 1979

DATE Dec 11, 1979