

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31E-93

DIST. 11 REGION

W.P. No. 7629-81-00

CONT. No. 83-301

W. O. No.

STR. SITE No. 42-120

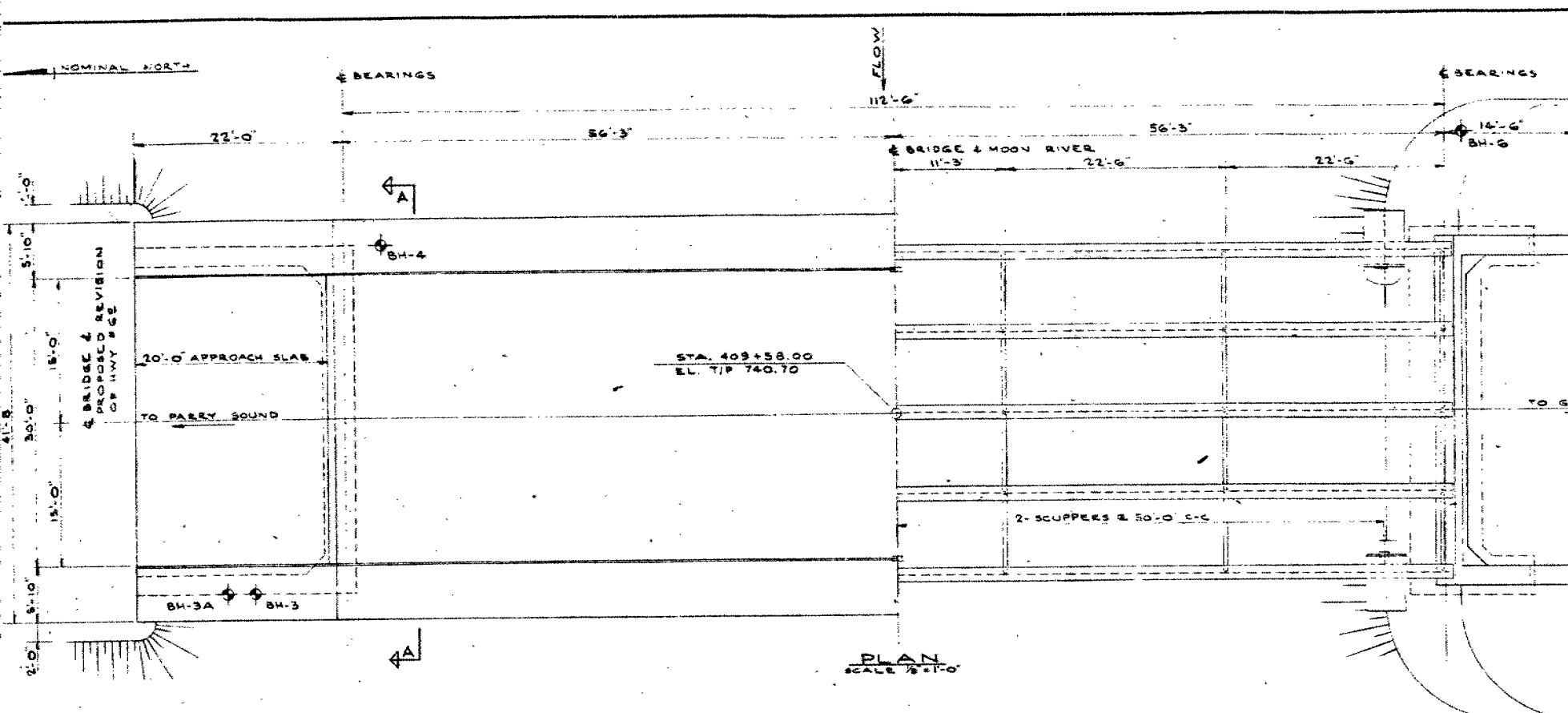
HWY. No. 169

LOCATION Retaining Wall South Bank
South Crossing, Moon River at
No. of PAGES - Balc

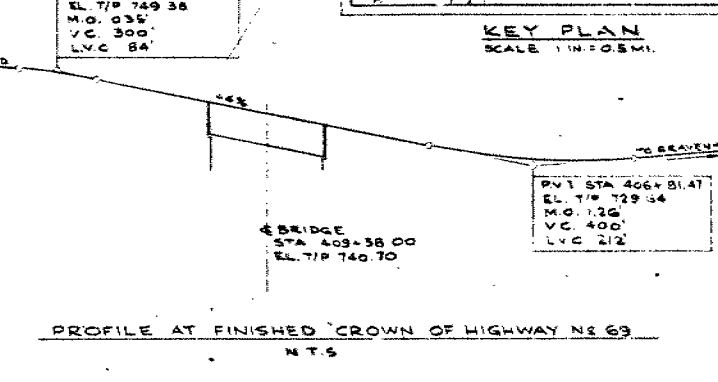
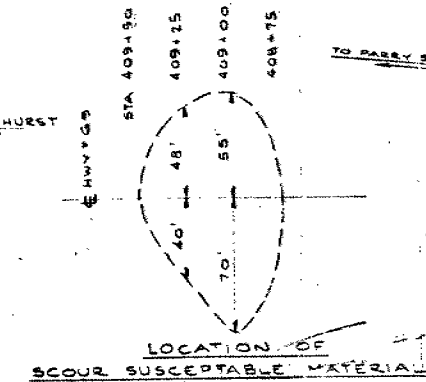
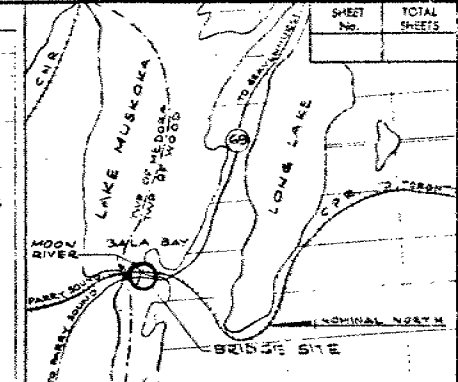
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

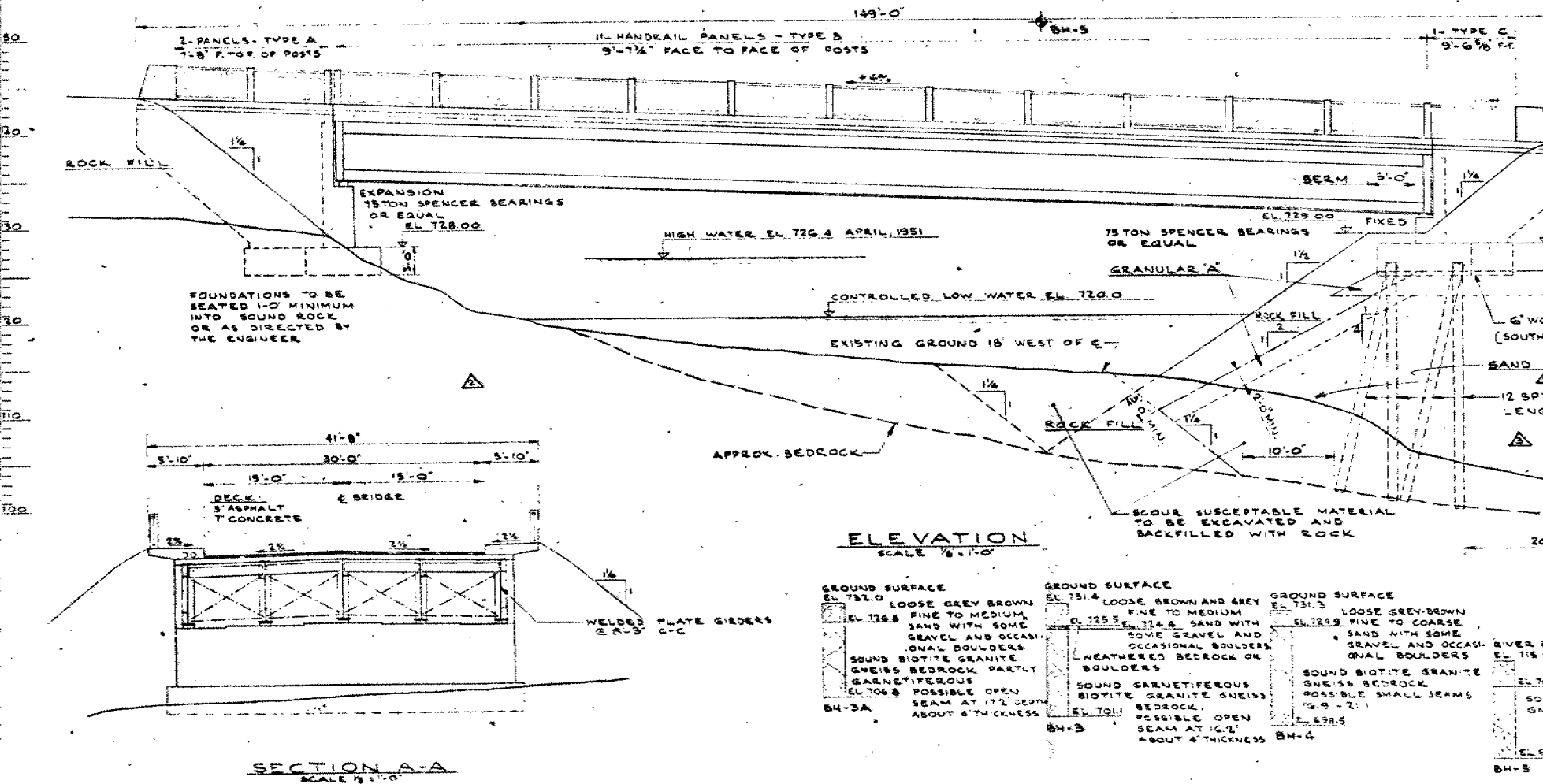
REMARKS:



REF DWG	TITLE
D4933-2	NORTH ABUTMENT DETAILS
D4933-3	SOUTH ABUTMENT DETAILS
D4933-4	STRUCTURAL STEEL DETAILS
D4933-5	DECK AND APPROACH SLAB DETAILS
D4933-6	REINFORCING STEEL SCHEDULE - FOOTINGS
D4933-7	REINFORCING STEEL SCHEDULE - ABUTMENTS
D4933-8	REINFORCING STEEL SCHEDULE - DECK
D4933-9	REINFORCING STEEL SCHEDULE - APPROACH SLABS
D4933-10	STANDARD HANDRAIL PANELS AND POSTS



- GENERAL NOTES:**
- ENGINEER - CONSTRUCTION MUST NOT BE COMMENCED ON THIS STRUCTURE UNTIL MONUMENTS TO FIX CONTROL POINTS HAVE BEEN ERECTED AND CHECKED BY THE ENGINEER.
 - GENERAL CONTRACTOR - THIS STRUCTURE TO BE BUILT IN ACCORDANCE WITH THE LATEST ISSUE OF D.H.O. FORM N29 AND THE SPECIAL PROVISIONS, EXTRA COPIES OF WHICH MAY BE OBTAINED FROM THE ENGINEER.
 - NO CONCRETE IS TO BE PLACED ABOVE BEARING SEAT ELEVATIONS UNTIL STRUCTURAL STEEL HAS BEEN ERECTED.
 - CONCRETE - IN FOUNDATIONS, ABUTMENTS, DECK AND APPROACH SLABS TO HAVE MINIMUM STRENGTH OF 3000 PSI AT 28 DAYS.
 - AN ADMIXTURE IS TO BE ADDED TO THE CONCRETE AS DIRECTED BY THE ENGINEER.
 - ALL EXPOSED EDGES TO HAVE 1" CHAMFER.
 - CONSTRUCTION JOINTS SHALL BE MADE ONLY AT THE LOCATIONS SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER, AND THE SEQUENCE OF PLACING CONCRETE MUST BE APPROVED BY THE ENGINEER.
 - REINFORCING STEEL - THE CLEAR COVER TO REINFORCING STEEL SHALL BE 3" FOR SURFACES IN CONTACT WITH SOIL, 1 1/2" IN DECK, AND 2" FOR ALL OTHER SURFACES.
 - STRUCTURAL STEEL - FOR STRUCTURAL STEEL NOTES SEE DRAWING D4933-4.
 - BEARING SEATS - THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR FINISHING THE BRIDGE SEATS DEAD LEVEL TO THE PROPER ELEVATIONS FOR THE STRUCTURAL STEEL. BRIDGE SEATS SHALL BE FINISHED TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF PLUS OR MINUS 1/8 INCH.
 - PIILING - LENGTH OF PILES GIVEN ON PLANS ARE FOR TENDER PURPOSES ONLY. ACTUAL PILE LENGTH TO BE DETERMINED IN FIELD BY THE ENGINEER.
 - MAXIMUM LOAD PER PILE - 60 TONS. PILE HAMMER TO DELIVER MINIMUM ENERGY OF 15,000 FT-LBS PER BLOW. FINAL RESISTANCE TO BE AS APPROVED BY THE ENGINEER.
 - BORING DATA - THE COMPLETE SOIL INVESTIGATION REPORT FOR THIS STRUCTURE MAY BE EXAMINED AT THE BRIDGE OFFICE AND FOUNDATION OFFICE, DOWNSVIEW, AND AT THE JIMTOWNE DISTRICT OFFICE.
 - THE DEPARTMENT DOES NOT GUARANTEE THE ACCURACY OF THIS REPORT OR THE ABRIDGED VERSION SHOWN ON THESE PLANS.



GROUND SURFACE	GROUND SURFACE	GROUND SURFACE	GROUND SURFACE	GROUND SURFACE	GROUND SURFACE
EL 728.0	EL 728.0	EL 728.0	EL 728.0	EL 728.0	EL 728.0
LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS	LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS	LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS	LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS	LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS	LOOSE GREY BROWN FINE TO MEDIUM SAND WITH SOME GRAVEL AND OCCASIONAL BOULDERS
SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS	SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS	SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS	SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS	SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS	SOUND BIOTITE GRANITE GNEISS BEDROCK PARTLY GARNETIFEROUS
EL 708.5	EL 708.5	EL 708.5	EL 708.5	EL 708.5	EL 708.5
POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS	POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS	POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS	POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS	POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS	POSSIBLE OPEN SEAM AT 172 DEPTH ABOUT 4" THICKNESS
BH-3A	BH-3A	BH-3A	BH-3A	BH-3A	BH-3A

BORE HOLE LOG
VERTICAL SCALE 1" = 20'
FOR LOCATION OF BORE HOLES SEE PLAN

10.7.64	AD	3 SAND CUSHION & GRANULAR A AT ABUT ADDD
9.6.64	AD	3 PILING NOTE ADDED
8.3.64	AD	3 NOTE RE OPEN SEAM REMOVED
5.11.63	AD	3 SAND CUSHION, REVISED TO WORKING SLAB
DATE	BY	DESCRIPTION
MORRISON, HERSHFIELD, MILLMAN & HUGGINS, LTD. CONSULTING ENGINEERS		
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION		
MOON RIVER BRIDGE AT BALA		
KING'S HIGHWAY No. 69		DIST. No. 11
DISTRICT OF MUSKOKA		
TWP. WOOD		LOT 33 CON. 7
GENERAL ARRANGEMENT		
APPROVED	SITE NO. 24-20	W.P. No. 187-61
DESIGN	R.C.A. CHECK	J.T.G.
DRAWING	A.P. CHECK	R.C.A.
DATE	Oct 23	LOADING
		H-20
		S-16
		DRAWING No.
		D4933-1

Contract Drawings for Moon River
@ Bala. Hwy 169.

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 83 - 301



Ministry of
Transportation and
Communications

INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations and Symbols
3 - 9	Foundation Investigation Report For W.P. 7629-81-00, Site 42-120 South Bank Retaining Wall Moon River at Bala

NOTE: For purposes of the contract this report supersedes all other foundation reports prepared by or for the Ministry in connection with the above-mentioned project.

'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 350 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

DENSENESS: 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. \bar{C}_{IU} = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
W S WASH SAMPLE
S T SLOTTED TUBE SAMPLE
B S BLOCK SAMPLE
C S CHUNK SAMPLE
T W THINWALL OPEN
T P THINWALL PISTON
O S OSTERBERG SAMPLE
F S FOIL SAMPLE
R C ROCK CORE
P H T.W. ADVANCED HYDRAULICALLY
P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ 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
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_c, N_q, N_γ BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e 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 = $w_L - w_p$
 L_L LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 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

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_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
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 α_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)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

FOUNDATION INVESTIGATION REPORT

For

W.P. 7629-81-00, Site 42-120

Retaining Wall, South Crossing of Moon River

Hwy. #169, District 11

INTRODUCTION

This report contains the results of a subsurface investigation for the design of the proposed retaining wall. The field work was performed during the period from 81 12 07-18, utilizing a diamond drill, BX and AX casing, BX and AX core barrels, and raft-mounted wash-boring techniques. This investigation consisted of 3 boreholes (B.H. No. 1, No. 2, No. 3). Borehole No. 4 was completed during the original investigation for the structure (W.P. 187-61).

This report supersedes previous correspondence.

SITE DESCRIPTION

The site is located along the south bank of the south crossing of the Moon River at Bala, in Wood Township, District of Muskoka, near the junction of Hwy. 169 and Hwy. 660.

Physiographically, the area is located in the Canadian Shield.

The site is located downstream from the controlled outlet (waterfall) of Bala Bay, Lake Muskoka. Severe scouring along the south bank of the river has caused undermining problems at the upstream end of the south abutment footing of the existing M.T.C. bridge.

SUBSURFACE CONDITIONS

The Record of Borehole Sheets (Appendix), illustrate the conditions at the borehole locations. The locations and elevations of the borings, along with estimated stratigraphical profiles based on the borehole data are shown on Sheet No. 4-1 of the contract drawings.

From the CPR structure to approximately Sta. 0+90, (along control line) the bedrock is exposed or under embankment fill. From Sta. 0+90 to the M.T.C. structure the bedrock is overlain by river bed deposits of boulders, some sand and gravel, trace of silt and clay. This deposit increases in thickness to the southwest.

The bedrock, sound biotite granite gneiss, slopes to the southwest. Bedrock elevations at the borehole locations are indicated below:

B.H. No. 1	714.5'
B.H. No. 2	708.5'
B.H. No. 3	706.8'
B.H. No. 4	703.7'



D. H. Dundas

D. Dundas, P. Eng.
Project Foundations Engineer

K. G. Selby


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

APPENDIX

RECORD OF BOREHOLE No 1

6

W P 7629-81-00 LOCATION Sta: 0+89, 69 Lt. Control Line ORIGINATED BY D. D.
 DIST 11 HWY 169 BOREHOLE TYPE BX Casing, Coring COMPILED BY O. J.
 DATUM Geodetic DATE 81 12 09 CHECKED BY D. D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			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	W _p	W	W _L		
720.0	River Surface																
0.0	Water																
714.8	River Bed																
5.2	Boulders																
	Bedrock sound		1	RC	95Z												
	biotite granite		2	RC	100Z												
705.8	gneiss																
14.2																	

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

W P 7629-81-00 LOCATION Sta: 0+66, 69 Lt. Control Line ORIGINATED BY D. D.
DIST 11 HWY 169 BOREHOLE TYPE BX Casing, Coring COMPILED BY O. J.
DATUM Geodetic DATE 81 12 10, 14 CHECKED BY D. D.



[illegible]

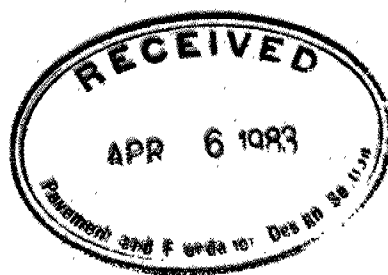
+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 4 (originally BH 6 in Geocon Ltd. report of 63 01 02 for WP 187-61)

W P 7629-81-00 LOCATION Sta: 0+72.46 Lt. Control Line
DIST 11 HWY 169 BOREHOLE TYPE AX Casing, Coring
DATUM Geodetic DATE 62 12 05

ORIGINATED BY Geocon Ltd.
COMPILED BY A. E. L.
CHECKED BY F. J. E.

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
720.0	Previous River Surface																
0.0	Previous water																
716.0	Previous river bed																
4.0	Boulders some sand and gravel trace of silt and clay (interpreted)		1	RC			710										
			2	RC													
703.7																	
16.3	Bedrock sound biotite granite gneiss		3	RC AX	100%		700										
							690										
683.2																	
36.8	End of Borehole						680										
		</															



ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 7629-81-00 DIST 11

HWY 169 STR SITE 42-120

Retaining Wall, South Crossing of Moon River

DISTRIBUTION

S. McCombie (2)
B. MacKinnon
G. Ricker
D. J. Armatage (2)
C. Grebski
B. J. Giroux
R. Hore

L. Argo (Cover only)
J. Anderson (Cover only)
T. J. Kovich (Cover only)

Files

FOUNDATION INVESTIGATION REPORT

For

W.P. 7629-81-00, Site 42-120

Retaining Wall, South Crossing of Moon River

Hwy. #169, District 11, Bala

INTRODUCTION:

This report contains the results of a subsurface investigation for the design of the proposed retaining wall. The field work was performed during the period from 81 12 07-18, utilizing a diamond drill, BX and AX casing, BX and AX core barrels, and raft-mounted wash-boring techniques. This investigation consisted of 3 boreholes (BH No.1, No.2, No.3). Borehole No.4 was completed during the original investigation for the structure (W.P.187-61).

This report supersedes previous correspondence.

SITE DESCRIPTION

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Physiographically, the area is located in the Canadian Shield.

The site is located downstream from the controlled outlet (waterfall) of Bala Bay, Lake Muskoka. Severe scouring along the south bank of the river has caused undermining problems at the upstream end of the south abutment footing of the existing MTC bridge.

SUBSURFACE CONDITIONS

The Record of Borehole Sheets (Appendix), illustrate the conditions at the borehole locations. The locations and elevations of the borings, along with estimated stratigraphical profiles based on the borehole data are shown on Drawing No. 76298100-A.

From the CPR structure to approximately STA: 0+90, the bedrock is exposed or under embankment fill. From STA: 0+90 to the MTC structure the bedrock is overlain by river bed deposits of boulders, some sand and gravel, trace of silt and clay. This deposit increases in thickness to the southwest.

The bedrock, sound biotite granite gneiss, slopes to the southwest. Bedrock elevations at the borehole locations are indicated below:

BH No. 1	714.5'
BH No. 2	708.5'
BH No. 3	706.8'
BH No. 4	703.7'

DISCUSSION AND RECOMMENDATIONS

The retaining wall should be founded on sound bedrock. This will involve excavation of any surface materials (mostly boulders). The wall may be constructed in sections using a prefabricated form. If desired, footings of tremie concrete may be initially constructed in place, and then anchored by drilling through the concrete and dowelling into the bedrock.

For any excavations near the existing abutment footing, the integrity of the structure and its foundations should be maintained by suitable protective measures.

Design Data

Earth pressures should be computed as per Subsection 6.6.1.2.2 of the O. H. B. D. C. For this non-yielding foundation condition, the at-rest coefficient of earth pressure will apply, with $K_0=0.5$ for granular backfill material.

Backfill should be composed of free-draining granular material.

A suitable system of drains should be provided for the retaining wall.

For frost protection, cover should be 6 feet.

A tremie design is recommended for any portions of the wall constructed underwater.

For sliding safety, to achieve resistance to lateral forces either

- i) key the wall a minimum of 2.0 feet into the bedrock, or
- ii) dowel into bedrock, a minimum of 3.0 feet where footings are located directly on bedrock, and a minimum of 6.0 feet where dowels must also pass through tremie concrete. As a design example, 2 inch diameter dowel installed as recommended will provide a shearing resistance of approximately 5 tons per dowel.

Settlements will be negligible.

For bearing capacity, net safe pressure = up to 50 tsf.

For the purposes of the O. H. B. D. C. factored bearing capacity at U.L.S. = 75 t. s. f. Bearing Capacity at S. L. S. Type II will not govern design.

MISCELLANEOUS

The field work for this project was carried out under the supervision of Mr. D. H. Dundas, Project Foundations Engineer. This report was written by Mr. Dundas and reviewed by Mr. K. G. Selby, Senior Foundations Engineer. The equipment used was owned and operated by Atcost Soil Drilling Inc.

D. H. Dundas
D. H. Dundas, P. Eng.
Project Foundations Engineer



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

A P P E N D I X



Ministry of
Transportation and
Communications

RECORD OF BOREHOLE No 1

W P 7629-81-00 LOCATION Sta: 0+89.69 Lt. ORIGINATED BY D. D.
DIST 11 HWY 169 BOREHOLE TYPE BX Casing, Coring COMPILED BY O. J.
DATUM Geodetic DATE 81 12 09 CHECKED BY D. D.

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
720.0	River Surface																
0.0	Water																
714.8	River Bed																
5.2	Bedrock sound biotite granite gneiss		1	RC BX	95%		710										
705.8			2	RC	100%												
14.2							700										

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

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



W P 7629-81-00 LOCATION Sta: 0+66, 69 Lt. ORIGINATED BY D. D.
DIST 11 HWY 169 BOREHOLE TYPE BX Casing, Coring COMPILED BY O. J.
DATUM Geodetic DATE 81 12 10, 14 CHECKED BY D. D.

[illegible]

+3, x5 : Numbers refer to Sensitivity

15 \pm 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



W P 7629-81-00 LOCATION Sta: 0+22, 73 Lt. ORIGINATED BY D. D.
DIST 11 HWY 169 BOREHOLE TYPE BX and AX Casing, Coring COMPILED BY O. J.
DATUM Geodetic DATE 81 12 15 - 17 CHECKED BY D. D.

[illegible]

+3, x5: Numbers refer to Sensitivity



20
15 ϕ 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Communications
Ontario

RECORD OF BOREHOLE No 4 (originally BH 6 in Geocon Ltd. report of 63 01 02 for WP 187-61)

W P 7629-81-00 LOCATION Sta: 0+72.46 Lt. ORIGINATED BY Geocon Ltd.
DIST 11 HWY 169 BOREHOLE TYPE AX Casing, Coring COMPILED BY A. E. L.
DATUM Geodetic DATE 62 12 05 CHECKED BY F. J. E.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH							
720.0	Previous River Surface														
0.0	Previous water														
716.0	Previous river bed														
4.0	Boulders some sand and gravel trace of silt and clay (interpreted)		1	RC			710								
			2	RC											
703.7															
16.3	Bedrock sound biotite granite gneiss		3	RC AX	100%		700								
							690								
683.2															
36.8	End of Borehole						680								

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

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 350 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

DENSENESS: 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. $\bar{C}U$ = 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 CHUNK 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

μ COEFFICIENT OF FRICTION
 δ 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
 ω SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e 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 = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of 2.0 } \mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_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
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = 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
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_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)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO PR-D-206 (Form 10-75-10)

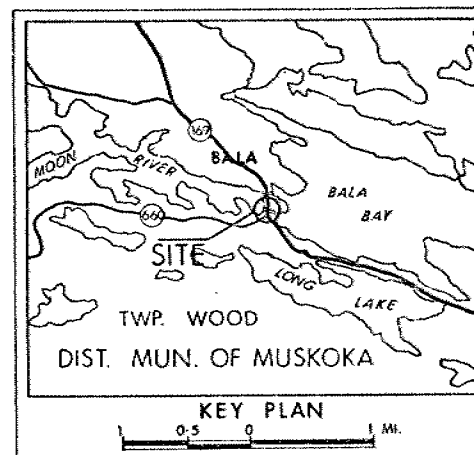
CONT No
WP No 7629-81-00

MOON RIVER RETAINING WALL

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊗ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ↓ WL at time of investigation 8112

No	ELEVATION	STATION CONTROL LINE	OFFSET CONTROL LINE
1	720-0	0+89	69' LT.
2	720-0	0+66	69' LT.
3	720-0	0+22	73' LT.
4	720-0	0+72	46' 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.

REVISIONS	DATE	BY	DESCRIPTION

GEORES No 31E-93
HWY No 169 DIST 11
SUBMITTAL CHECKED DATE 82 02 05 SITE 42-120
DRAWNOL J. CHECKED APPROVED DWG 76298100-A

