DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 40P11-13

DIST. 3 REGION SOUTHWESTERN

W.P. No.

CONT. No.

W. O. No.

STR. SITE No. 12-204

HWY. No.

LOCATION TWP. RD. & BAYFIELD RIVER, BRIDGE-369, TUCKERSMITH TWP, HURON CO.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED

B.M. ROSS & ASSOCIATES LIMITED
CONSULTING ENGINEERS
62 NORTH STREET
GODERICH ONTARIO
N7A 2T4

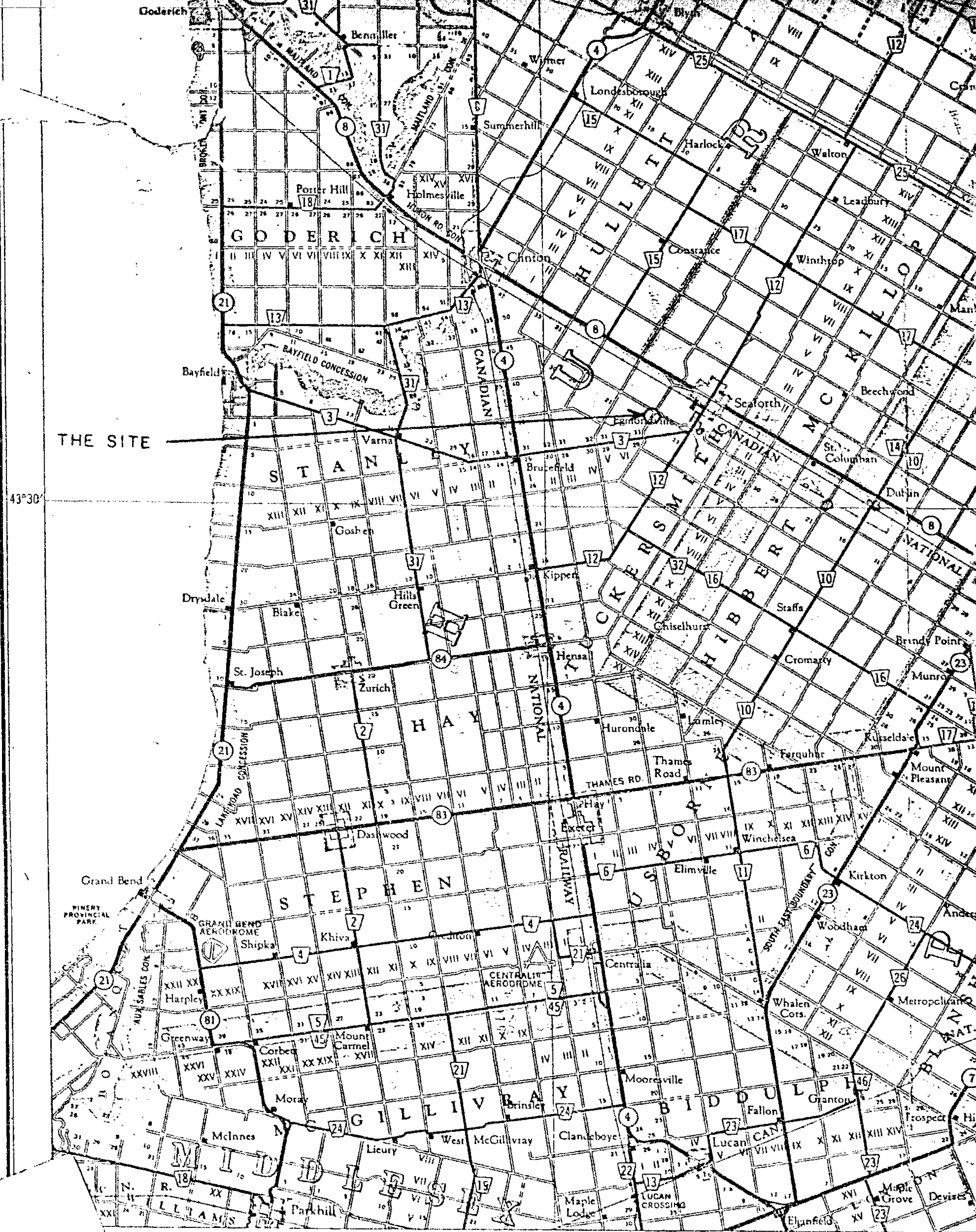
Report On SOIL INVESTIGATION for BRIDGE BR-369 LOT 15/16 SIDEROAD CONCESSION III H.R.S. TOWNSHIP OF TUCKERSMITH

by

Dominion Soil Investigation Limited
164 Newbold Court
London Ontario
N6E 1Z7

Ref: 76-1-L9

April 15, 1976



THE SITE
Goderich
Benmiller
Wingham
Londesborough
Blyth
Summerhill
Harlock
Walton
Porter Hill
Holmesville
Leadbury
GODERICH
Clinton
Constance
Winthrop
HULLETT
McKILLOP
TUCKERSMITH
Bayfield
BAYFIELD CONCESSION
Egmondville
Seaforth
Varna
Brucefield
STANLEY
St. Columban
Dublin
CANADIAN NATIONAL
43°30′
Goshen
Kippen
Drysdale
Blake
Hills Green
Chiselhurst
Staffa
HIBBERT
Hensall
Cromarty
Brindy Point
St. Joseph
Zurich
Munro
HAY
Hudondale
Lumley
Russeldale
Thames Road
THAMES RD.
Farquhar
Mount Pleasant
LAKE ROAD CONCESSION
Hay
Exeter
Dashwood
Winchelsea
USBORNE
Elimville
Grand Bend
PINERY PROVINCIAL PARK
STEPHEN
Kirkton
GRAND BEND AERODROME
Shipka
Khiva
Crediton
Centralia
CENTRALIA AERODROME
Woodham
Harpley
AUX SABLES CON.
Metropolitan
Whalen Cors.
Greenway
Corbett
Mount Carmel
Mooresville
Granton
McGILLIVRAY
BIDDULPH
Moray
Brinsley
Fallon
McInnes
Lieury
West McGillivray
Clandeboye
Lucan
Prospect
MIDDLESEX
Parkhill
Maple Lodge
LUCAN CROSSING
Elginfield
Maple Grove
Devizes
WILLIAMS

81°30′

C O N T E N T S

E N C L O S U R E S

I INTRODUCTION

In accordance with a letter of authorization, dated January 8, 1976, from B.M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Tuckersmith, where it is proposed to replace an existing bridge with a new structure. The existing structure is located on the Lot 15/16 Sideroad in Concession III H.R.S. of the Township, where the road crosses the Bayfield River.

The existing bridge is an single-span steel truss structure with a span of about 87 feet, and it is understood that the new structure will be an 86 foot span beam bridge on a 40 degree skew, centred on the existing bridge. The requirements of the project were discussed with Mr. K.G. Dunn, P. Eng., who supplied the foregoing information.

The purpose of the investigation was to reveal the subsurface conditions at the abutment locations, and to determine the relevant soil properties for the design and the construction of the new foundations.

II FIELD WORK

The field work, consisting of two sampled boreholes, was carried out on January 28 and February 5, 1976, at the locations shown on Enclosure 2. The holes were advanced to the sampling depths by a continuous-flight power auger machine, which was equipped with hollow-stem augers for soil sampling.

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', and the results are recorded on the borehole logs as 'N' values. The spilt-spoon samples were stored in air-tight containers which were transferred to our London laboratory for classification, testing and storage.

The field work was supervised by a soils technician, who also related the ground surface elevations to a local datum. The benchmark was taken as the low steel of the existing structure, which was established by the client as having a Geodetic El. 962.76 feet.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata, which were encountered in each borehole, are given on the borehole logs comprising Enclosures 3 and 4, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 2. The following notes are intended only to amplify this data.

Both boreholes encountered surface layers of fill which extend to a depth of 11.2 and 15.5 feet in boreholes 1 and 2 respectively. The fill generally consists of clayey silt, and in borehole 2 it is underlain by a thin layer of organic topsoil.

The native subsoil consists of glacial silty clay till which extends to the limits of the boreholes at depths of 20.0 and 23.5 feet for boreholes 1 and 2 respectively. From 17.0 to 20.0 feet in borehole 1 the silty clay was observed to be more gravelly, and a grain size analysis of a typical sample of the silty clay taken at a depth of 15 feet in borehole 1 is shown as a grain size distribution curve on Enclosure 5. Due to the clay content the glacial till is regarded as a plastic and cohesive material, and its consistency is described as 'very stiff' based on 'N' values ranging from 10 to 31 blows per foot. Atterberg Limit tests were performed on two samples of the glacial till giving values of Liquid Limit of 14.8 and 19.4%, Plastic Limit of 13.0 and 12.7%, and Plasticity Index of 1.8 and 6.7% These values indicate that the silty clay has a low plasticity and compressibility, and the natural moisture content values ranging from 9.4 to 11.4% confirm the very stiff consistency obtained from visual and tactile examination.

Both boreholes were terminated when refusal to further penetration of the split-spoon or augers was encountered, and the refusal levels were El. 944.6 and El. 942.4 in boreholes 1 and 2 respectively. This would indicate a boulder formation or possibly bedrock surface.

IV GROUNDWATER CONDITIONS

After completion of the drilling water levels were observed at El. 954.1 and El. 960.3 in boreholes 1 and 2 respectively. The ice surface on the adjacent river was observed at El. 956.5 at the time the field work was carried out, and for construction purposes it may be assumed that the prevailing water table is closely connected with the river level at any particular time.

V DISCUSSION AND RECOMMENDATIONS

The investigation has shown that the soil profile consists of generally impervious fill materials which extend to depths of 11.2 and 15.5 feet below the ground surface. These materials are associated with the construction of the approaches to the existing bridge, and they are underlain by a native glacial silty clay till stratum which has a very stiff consistency. The silty clay till is a competent material for the support of spread footing foundations, which should be located at a minimum depth of 4 feet below the river bed for protection against frost action, and on the basis of the borehole results a maximum allowable soil pressure of 6000 p.s.f. is appropriate for the design of spread footing foundations located within the silty clay till stratum.

Total settlement of footings up to 15 feet in width is estimated to be 1-inch or less, and due to the uniform nature of the silty clay subsoil, no appreciable differential settlement is anticipated.

The adhesion between the footings and the underlying subsoil may be taken as 0.35 or 35% of the vertical load, whichever is the lower value, and the factor of safety against horizontal sliding of the abutments must be at least 1.5.

When carrying out the excavations some seepage may be anticipated from silt and sand seams, however it is expected that this will be controlled by pumping from sumps located outside the footing area.

Particular care should be taken to prevent softening or freezing of the subgrade once it has been exposed, and it is recommended that the footing concrete be poured as soon as possible after excavation and inspection of the subgrade to minimize disturbance.

The abutments must be backfilled with approved granular backfill in accordance with the requirements of the Ministry of Transportation and Communications, and it must be compacted to at least 95% of its maximum standard Proctor dry density to prevent differential settlement of the finished road surface.

REGISTERED PROFESSIONAL ENGINEER
C. J. W. ATKINSON
PROVINCE OF ONTARIO

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

C.J.W. Atkinson, M.Sc., P. Eng.,
Branch Manager.

CJWA/cs

APPENDIX 'A'

THE STANDARD PENETRATION TEST

In order to determine the relative density of non-cohesive soils, such as sands and gravels, the standard penetration test has been adopted. The test also gives an indication of the consistency of cohesive soils.

A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30 inches. The tube is first driven an initial 6 inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows (N) required to drive the sampler a further 12 inches is recorded. The sample tube is one originally developed by Raymond Concrete Pile Company in the United States, where a sufficient number of tests have been made in conjunction with field investigations to show that the results, although essentially empirical, may be applied to foundation design.

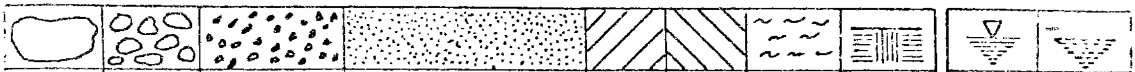
For Sands:-

Values of 'N'	Density
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very Dense

Enclosure No. 1.

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
Ø > 8"	3"	3/4"	4.76mm	2.0	0.42	0.074	0.002 >		NO SIZE LIMIT			

U.S. Standard Sieve Size: No.4 No.10 No.40 No.200

SAMPLE TYPES.

AS Auger sample
CS Sample from casing
ChS Chunk sample
RC Rock core
% Recovery
SS Split spoon sample
TP Piston, thin walled tube sample
TW Open, thin walled tube sample
WS Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure

Washwater returns
Washwater lost

PENETRATION RESISTANCES.

SYMBOL:

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ø, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia. split spoon sampler 1 foot into the ground, expressed in blows per foot.

EXTRAPOLATED -N- VALUE 322

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL / UNCONFINED COMPRESSION TEST: ◎ O St

LABORATORY / FIELD VANE TEST: X St + St

POCKET PENETROMETER TEST: St

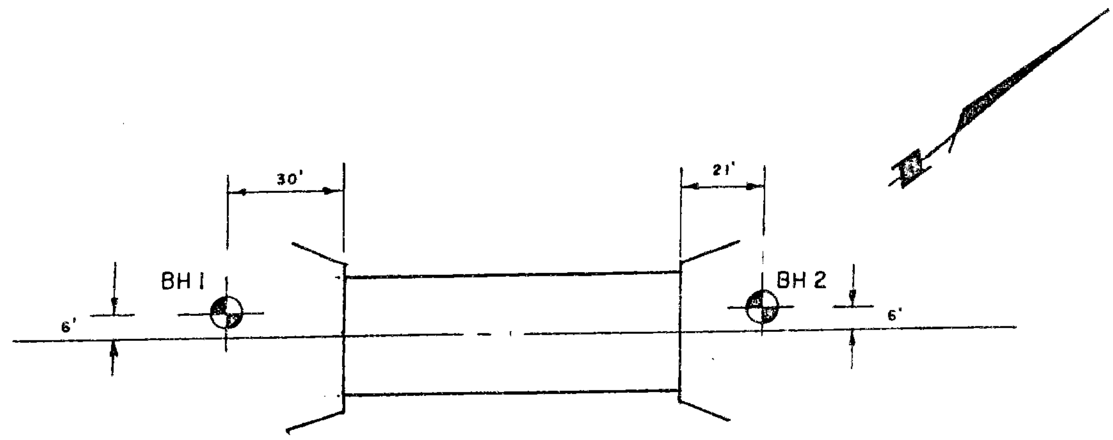
Strain at failure is represented by direction of stem: 20% (up), 5% (right), 10% (down), 15% (left)

St : sensitivity = shear strength in undisturbed state / shear strength in remoulded state

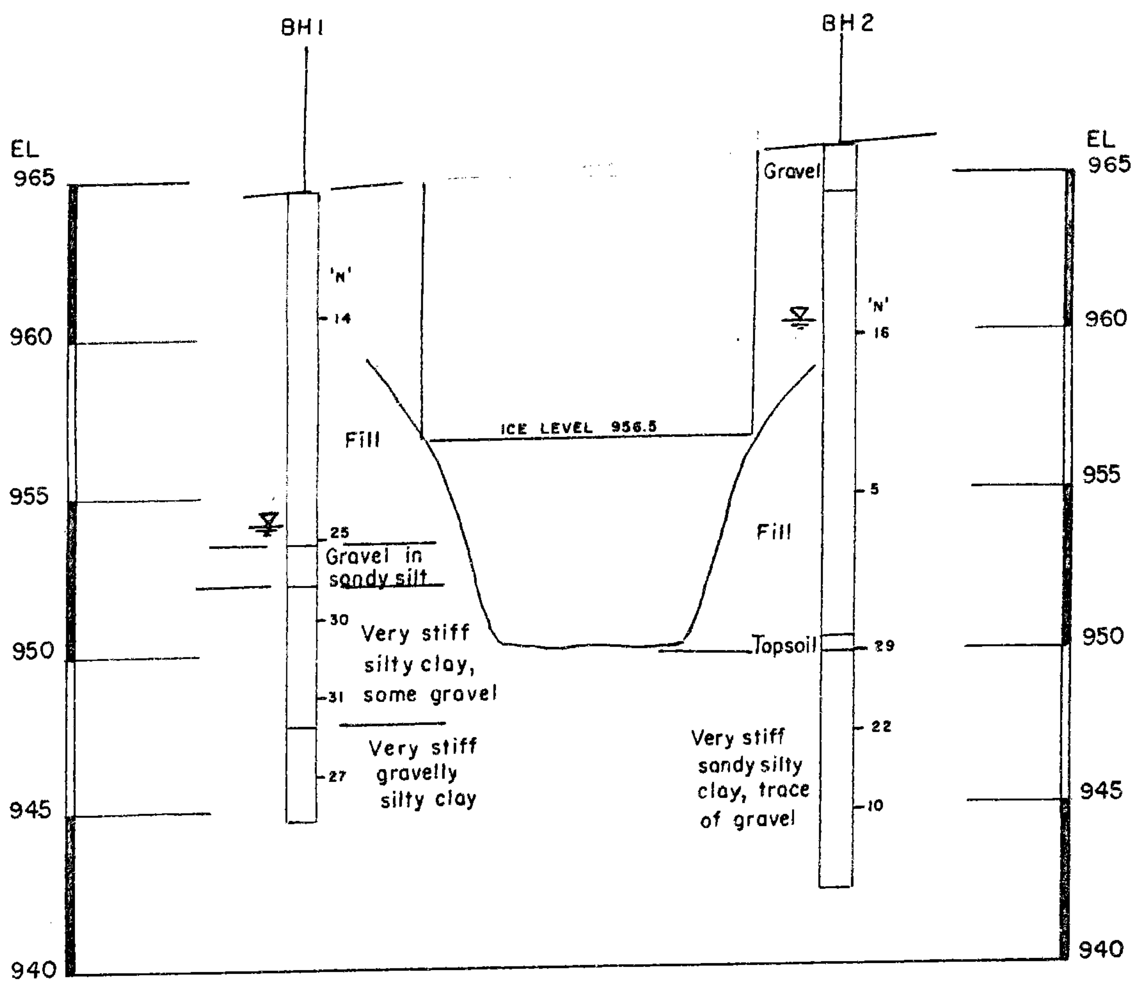
SOIL DESCRIPTION.

COHESIONLESS SOILS:	RD:
Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

COHESIVE SOILS	C lbs/sq ft
Very soft	less than 250
Soft	250 - 500
Firm	500 - 1000
Stiff	1000 - 2000
Very stiff	2000 - 4000
Hard	over 4000



SITE PLAN
Scale 1" = 40'



SUBSURFACE PROFILE
Scale Hor. 1" = 40'
Vert. 1" = 5'

CLIENT: B.M. Ross and Associates Ltd.,

PROJECT: Bridge BR-369

LOCATION: Township of Tuckersmith,

DATUM ELEVATION: low steel, El. 962.76 feet.

Encl. No: 3

DRILLING DATA

Method: Auger

Diameter: hollow-stem

Date: January 28, 1976

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	TYPE	'N' Blows/Foot	PENETRATION RESISTANCE Blows/ft. 20 40 60 80 100 / Undrained Shear Strength p.s.f. + Field vane test ◦ Compression test	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
964.6	0.0	Ground Surface									
960		Brown clayey silt, some sand and gravel. Fill			1	SS	14				
955				▼	2	SS	25				
	11.2	Gravel in sandy silt matrix									
	12.5	Very stiff grey silty clay, some gravel.			3	SS	30		12.7	10.2	19.4
950					4	SS	31			9.4	
	17.0	Very stiff gravelly silty clay.			5	SS	27				
945	20.0	End of Borehole						Split-spoon refusal at El. 944.6. Hammer bouncing			

N°: 76-1-L9 ... BOREHOLE ....

Encl. N° 4

CLIENT: B.M. Ross and Associates Ltd.
PROJECT: Bridge BR-369,
LOCATION: Township of Tuckersmith,
DATUM ELEVATION: low steel, El. 962.76 feet.

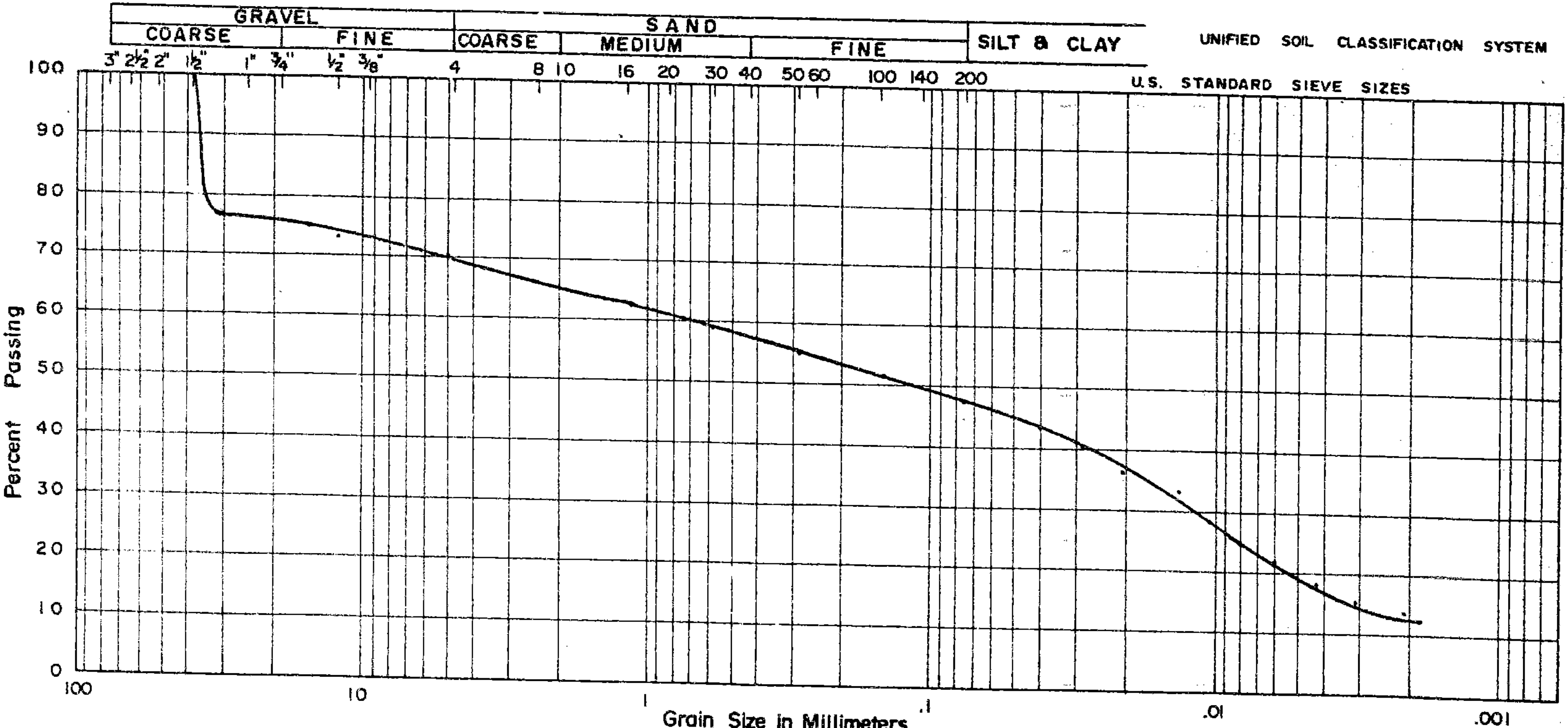
DRILLING DATA
Method: Auger
Diameter: hollow-stem
Date: January 28, 1976

Elevation Ft.	Depth Ft.	Description	Symbol	Ground Water	Sample Number	Type	'N' Blows/Foot	Penetration Resistance (Blows/ft. 20 40 60 80 100) / Undrained Shear Strength p.s.f. (+ Field vane test, ● Compression test)	Plastic Limit %	Natural Water %	Liquid Limit %
965.9	0.0	Ground Surface									
		Gravel									
	1.5	Brown sandy clayey silt, some gravel. Fill		▼							
960					1	SS	16	⊙			
955					2	SS	5	⊙			
950	15.5	Topsoil, wood			3	SS	29	⊙		10.2	
	16.0	Very stiff grey sandy silty clay, trace of gravel.									
					4	SS	22	⊙	13.0	11.4	14.8
945					5	SS	10	⊙		11.6	
	23.5	End of Borehole						Auger refusal at El. 942.4			

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 76-1-L9



PROJECT: Bridge BR-369

LOCATION: Township of Tuckersmith

BOREHOLE Nº: 1

SAMPLE Nº: 4

DEPTH: 16'

ELEVATION: 949'

COEFFICIENT OF UNIFORMITY:

COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

Sandy Silty Clay, some gravel

PLASTIC PROPERTIES

LIQUID LIMIT	% =	
PLASTIC LIMIT	% =	
PLASTICITY INDEX	% =	
MOISTURE CONTENT	% =	

ENCLOSURE Nº 5