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W.P. No.

CONT. No.

W. O. No. 73-F-205M

STR. SITE No. 12-238

HWY. No.

LOCATION SILVER CREEK BRIDGE

Lot 9 CONCESSIONS 2/3, H.R.S.

[illegible]

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

40P11 - 11

DOMINION SOIL INVESTIGATION LIMITED

CONSULTING ENGINEERS

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B.M. ROSS AND ASSOCIATES LTD.
CONSULTING ENGINEERS
GODERICH ONTARIO

Report On 73-F-205
SOIL INVESTIGATION
for
SILVER CREEK BRIDGE
LOT 9 CONCESSIONS 2/3, H.R.S.
TOWNSHIP OF TUCKERSMITH

STR. SITE 12-238 DISF3

40P11-11
GEOCRES No.

by

Dominion Soil Investigation Limited
1220 Trafalgar Street
London Ontario

Ref: 73-2-L5

April 24, 1973

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I INTRODUCTION

In accordance with a letter of authorization dated February 8, 1973, from B. M. Ross and Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Tuckersmith, where it is proposed to replace an existing road bridge with a new structure. The existing concrete deck on steel beam structure is located at Lot 9, Concessions 2/3, H.R.S., of the Township, where the Concession road crosses Silver Creek.

It is understood that the new structure will be located about 40 feet downstream from the existing bridge to allow for realignment of the road. 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 locations of the new abutments, and to determine the relevant soil properties for the design and construction of the foundations.

II FIELD WORK

The field work, consisting of two boreholes, was carried out on February 16 and March 17, 1973, at the locations shown on Enclosure 2. The holes were advanced to the surface of the bedrock by a continuous flight power auger machine, which was equipped with hollow-stem augers, and the bedrock was proved in borehole 2 to a depth of 4 feet using Axt diamond drilling equipment.

Standard penetration tests were performed throughout the overburden, as detailed in Appendix 'A', and the results are recorded on the borehole logs as 'N' values. The split-spoon samples were stored in air-tight containers and transferred to our London laboratory for classification and testing.

The core sample of bedrock, which was obtained from borehole 2, was transferred to a core box in the same sequence as it was extracted and then transported to the laboratory for inspection.

The field work was supervised by a soils engineer, who also determined the ground surface elevations. These were referred to the top of the road at the centre line of the existing bridge which was established by the client as having a Geodetic El. 993.25 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.

Borehole 1 encountered a surface layer of sandy topsoil overlying a silty sand deposit which extends to a depth of 4 feet. The sand was underlain by successive layers of 'firm' brown clayey silt and 'loose' to 'compact' silt and fine sand which extend down to the surface of the inferred bedrock at El. 974.2.

Borehole 2 encountered a surface layer of silty and peaty topsoil, 3 feet thick, overlying a 'loose' to 'dense' silt stratum which contains seams of sand and gravel. The 'loose' to 'dense' relative density is indicated by 'N' values ranging from 5 to 36 blows per foot. A one foot thick layer of sandy gravel was penetrated below the silt stratum, and the gravel overlies sound limestone bedrock which was encountered at El. 973.7. A 95% recovery was obtained from a 4 foot long core of the bedrock.

IV GROUNDWATER CONDITIONS

Equilibrium water levels were observed in boreholes 1 and 2 at El. 983.5 and El. 983.3 respectively. The water level in the adjacent creek was observed at El. 983.1 on March 17, 1973.

V DISCUSSION AND RECOMMENDATIONS

It has been shown that limestone bedrock underlies the site at a depth of about 6½ feet below the existing creek bed, and that the existing overburden consists

of silt and fine sand in which a layer of clayey silt and seams of sand and gravel were encountered.

Footings should be located on sound limestone bedrock, and a maximum allowable bearing pressure of 40,000 p.s.f. may be used for the design. The coefficient of friction between the rock and the concrete may be taken as 0.5, and the factor of safety against sliding should be at least 1.5. Additional sliding resistance may be generated by means of a key into the rock. Resistance to overturning of the abutments may be obtained by the use of dowels grouted into the bedrock.

The settlement of the structure will consist entirely of elastic deflection of the bedrock, and it is estimated that total settlement will not exceed 0.25 inch.

It is important that the rock surface should be thoroughly cleaned and roughened when the concrete is poured, all loose fractured and weathered material being removed.

The silt and fine sand material will have a tendency to 'slough-in' when the excavation is being carried out, and it is recommended that allowance be made for the use of sheeting if the excavation cannot be carried out by normal open cut methods. Seepage of water into the excavations may be controlled by normal pumping procedures providing that the creek is diverted from the construction area.

Yours very truly,

DOMINION SOIL INVESTIGATION LTD.

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

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

CJWA:eg

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-ins. 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-in. 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

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

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ϕ, 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.

SYMBOL: 322

EXTRAPOLATED -N- VALUE

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 COMPRESSION TEST — UNCONFINED TEST — LABORATORY VANE TEST — FIELD VANE TEST — POCKET PENETROMETER TEST

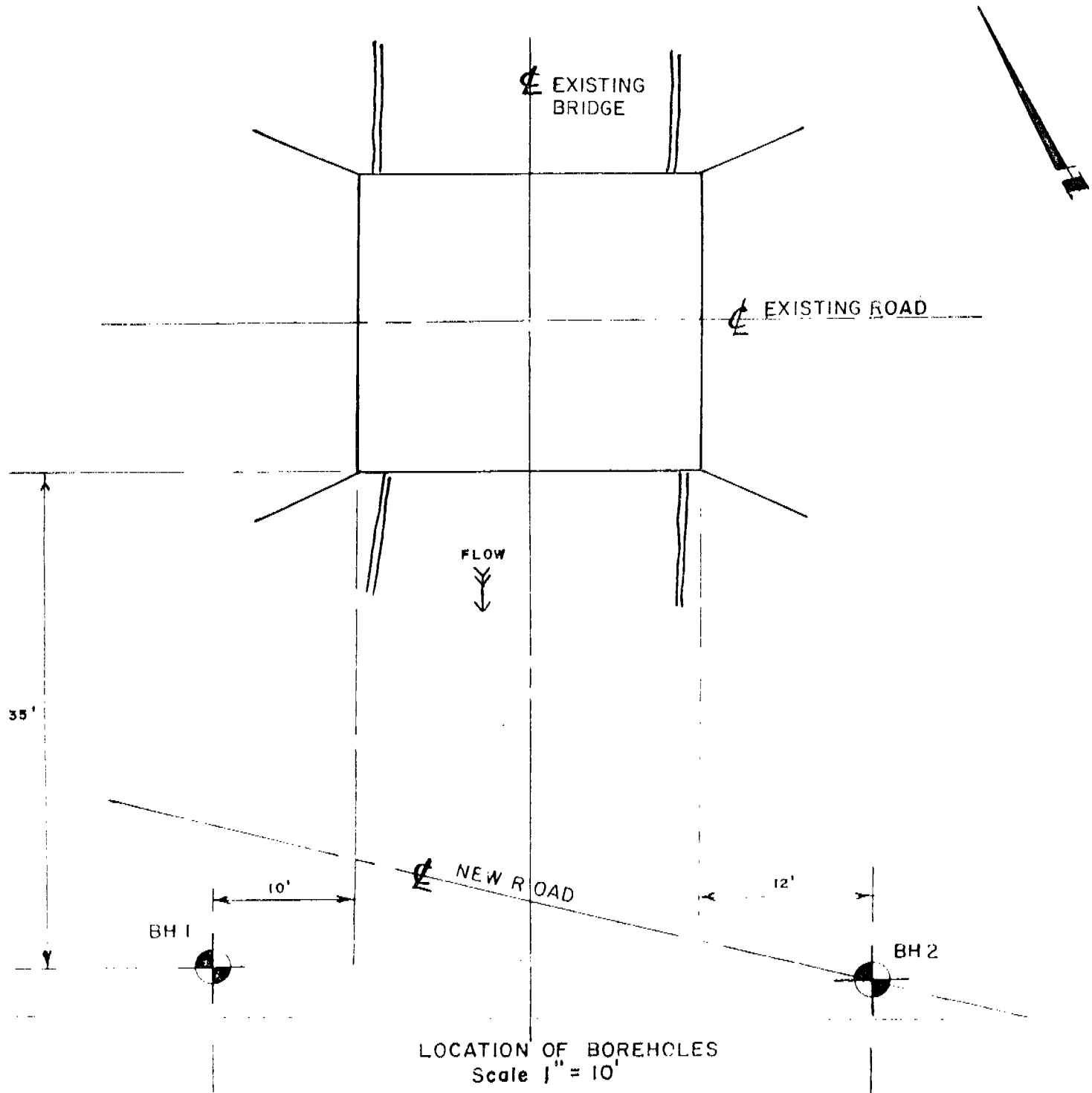
St

Strain at failure is represented by direction of stem: 20%, 15%, 5%, 10%

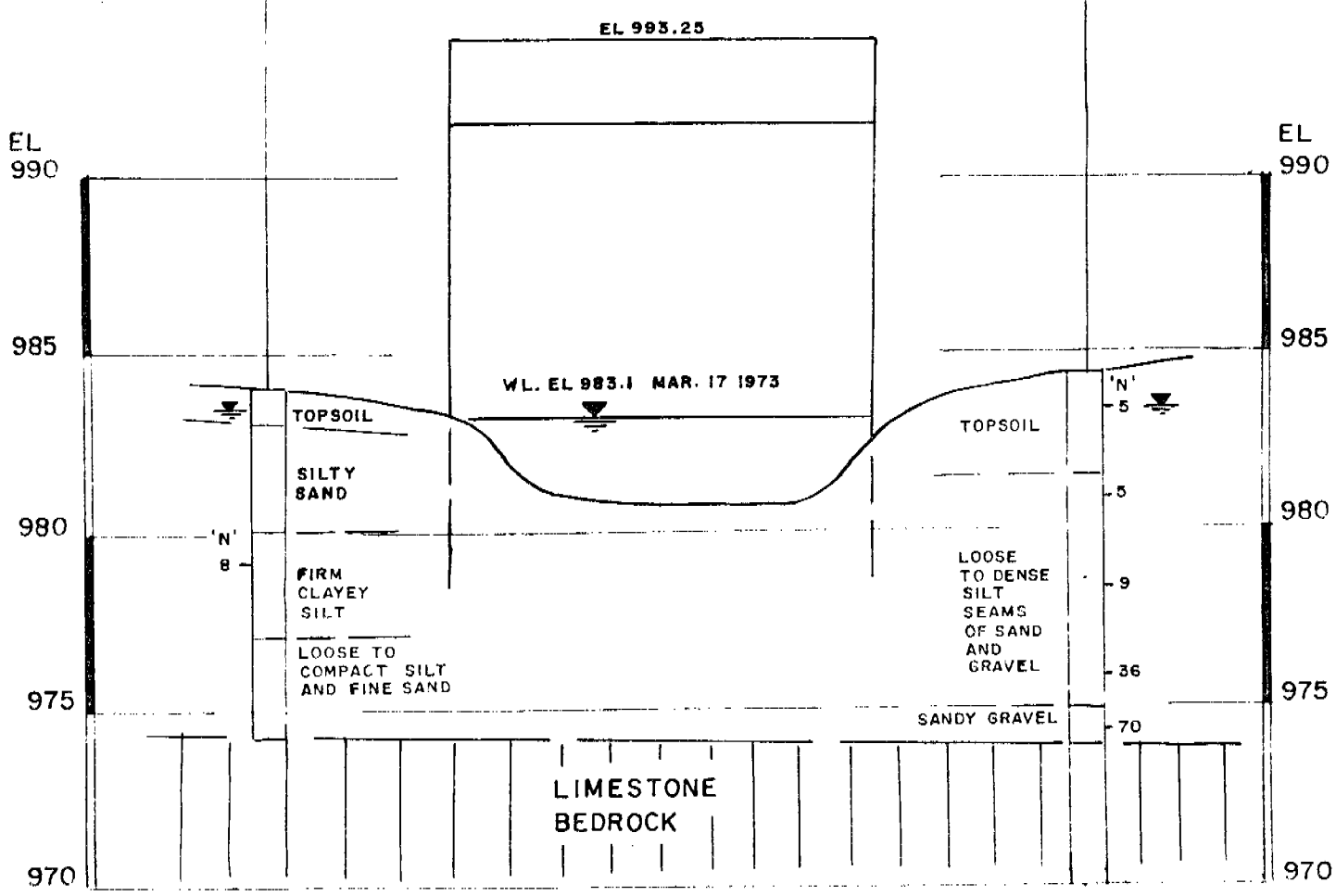
St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS	C lbs/sq ft
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000



LOCATION OF BOREHOLES
Scale 1" = 10'



SUBSURFACE PROFILE

LOG OF BOREHOLE 1

Our Reference № 73-2-L5

Enclosure № 3

CLIENT: B.M. Ross and Associates Limited,
PROJECT: Bridge BR-306,
LOCATION: Township of Tuckersmith
DATUM ELEVATION: Nail in hydro pole, Sta 0+50, El. 1033.06

DRILLING DATA

Method: Hollow-stem auger.
Diameter: 8-inch
Date: February 16, 1973

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	TYPE	'N' Blows / Foot	PENETRATION RESISTANCE Blows / Foot (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH lbs/sq.ft. + FIELD VANE TEST ⊖ COMPRESSION TEST (20 40 60 80 100)	WATER CONTENT % PLASTIC LIMIT W_P NATURAL W LIQUID LIMIT W_L (10 20 30 40 50)	REMARKS
984.0	0.0	Ground Surface								
	1.0	Sandy Topsoil								
		Brown silty sand.								
980	4.0	Firm brown clayey silt.			1	SS	8	⊖		
	7.0	Loose to compact brown silt and fine sand.								
975	9.8	End of Borehole								Refusal to further penetration by auger or sampler at depth of 9.8 feet. Inferred Bedrock.
970										

VERTICAL SCALE: 1 inch to 5 feet

MADE: CHECKED:

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE .....2.....

Our Reference № 73-2-L5

Enclosure № 4

CLIENT: B.M. Ross and Associates Limited,
PROJECT: Bridge BR-306,
LOCATION: Township of Tuckersmith
DATUM ELEVATION: Nail in hydro pole, Sta 0+50, El. 1033.06.

DRILLING DATA

Method: Hollow-stem auger.
Diameter: 8-inch
Date: March 17, 1973.

SUBSURFACE PROFILE					SAMPLES			PENETRATION RESISTANCE Blows / Foot (20 40 60 80 100)	UNDRAINED SHEAR STRENGTH lbs/sq.ft. + FIELD VANE TEST ● COMPRESSION TEST (20 40 60 80 100)	WATER CONTENT % PLASTIC LIMIT Wp — NATURAL W — LIQUID LIMIT WL (10 20 30 40 50)	REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot				
984.3	0.0	Ground Surface									
		Silty and peaty Topsoil.			1	SS	5				
	3.0				2	SS	5				
980		Loose becoming dense brown silt, seams of sand and gravel.			3	SS	9				
					4	SS	36				
975	9.5	Sandy gravel.			5	SS	70				
	10.6	Lime stone Bedrock.			6	Axt	95%				
970	14.6	End of Borehole									

VERTICAL SCALE: 1 inch to 5 feet

MADE: CHECKED:

DOMINION SOIL INVESTIGATION LIMITED