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W. O. No. \_\_\_\_\_

STR. SITE No. 12-185

HWY. No. \_\_\_\_\_

LOCATION PROP. NEW BR-360, CO. OF  
HURON, GREY TWP., CON. 6 LOT 35.

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. \_\_\_\_\_

REMARKS: DOCUMENTS TO BE UNFOLDED  
BEFORE MICROFILMED



# DOMINION SOIL INVESTIGATION LIMITED

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40P11-15  
GEOCREs No.

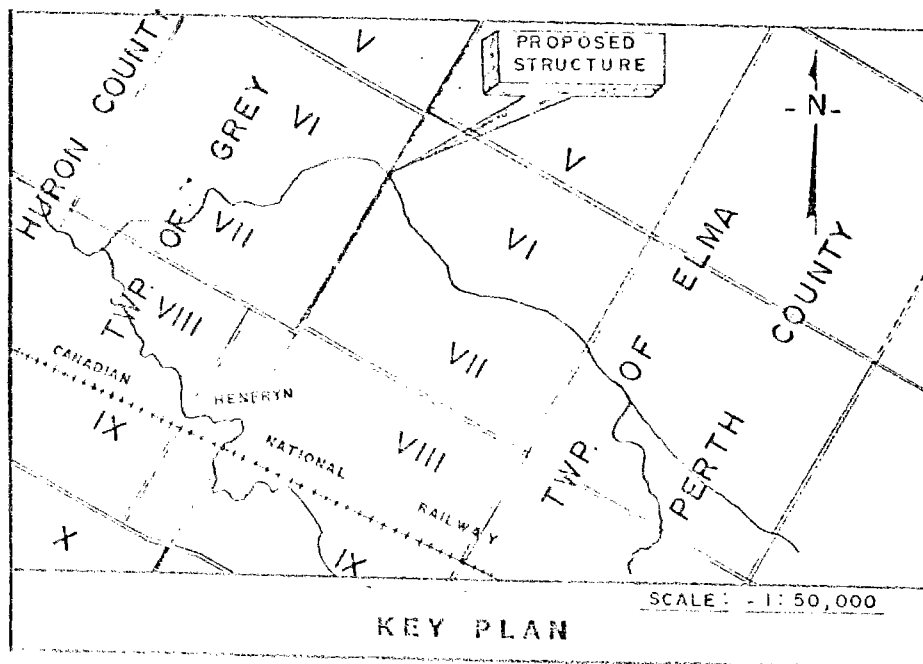
Report On  
SOIL INVESTIGATION  
for  
PROPOSED NEW BRIDGE BR-360  
LOT 35, CONCESSION 6  
TOWNSHIP OF GREY  
COUNTY OF HURON

STRUCTURE SITE No. 12-11-75

by

Dominion Soil Investigation Limited  
164 Newbold Court  
London Ontario

Ref: 75-7-L3  
August 19, 1975





## C O N T E N T S

	<u>PAGE</u>
I INTRODUCTION . . . . .	I
II FIELD WORK . . . . .	II
III SUBSURFACE CONDITIONS . . . . .	III & IV
IV GROUNDWATER CONDITIONS . . . . .	IV
V DISCUSSION AND RECOMMENDATIONS . . . . .	IV - VI

Appendix 'A' - The Standard Penetration Test

## E N C L O S U R E S

	<u>No.</u>
LIST OF SYMBOLS, ABBREVIATIONS & NOMENCLATURE . . .	1
LOCATION OF BOREHOLES & SUBSURFACE PROFILE . . .	2
BOREHOLE LOGS . . . . .	3 & 4

§i

I

INTRODUCTION

In accordance with a letter of authorization from B.M. Ross & Associates Limited, Consulting Engineers, a soil investigation has been carried out on the County line between Huron and Perth Counties, where it is proposed to replace an existing bridge with a new structure.

The existing structure is located at Lot 35, Concession 6 of the Township of Grey in the County of Huron, and it consists of a concrete deck on steel beam construction.

It is understood that the proposed structure is a 75 foot span prestressed concrete beam bridge with a new centre line about 9 feet to the north of the existing centre line. 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 new footing locations, 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 July 14, 1975, 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 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 split-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, and it was established by the client as having a value, El. 1166.16 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 a surface layer of sand and gravel which form the existing travelled road surface, overlying fill materials which consist of silty fine sand containing traces of organics and wood. A layer of gravel was encountered immediately below the fill material, and it revealed a thickness of 1 to 1½ feet.

The natural soil profile consists of 'very dense' sandy clayey silt till at the south abutment location, and 'hard' clayey silt and silty clay overlying 'very dense' sandy clayey silt till at the north abutment location. The 'very dense' relative density of the sandy clayey silt till is indicated by 'N' values ranging from 51 blows per foot to 50 blows for a 3 inch

penetration of the sampler. The 'hard' consistency of the clayey silt and silty clay materials is indicated by 'N' values ranging from 41 to 100 blows per foot, which were confirmed by undrained shear strength values of 2600 and 6680 p.s.f. The natural moisture content of the sandy clayey silt till was determined to range from 9.2% to 23.0%, and the natural moisture content of the clayey silt and silty clay is typified by two moisture content determinations of 11.3% and 14.8%.

## IV

GROUNDWATER CONDITIONS

Water levels were observed at El. 1151.7 and El. 1151.1 in boreholes 1 and 2 respectively, and the water level in the adjacent stream was observed at El. 1151.6. It may therefore be assumed that the prevailing groundwater level is closely tied to the stream level at any particular time.

## V

DISCUSSION AND RECOMMENDATIONS

The investigation has shown that the stream bed coincides with the sand and gravel layer, which is underlain by 'very dense' sandy clayey silt till and



'hard' clayey silt and silty clay materials. The footing grade should be established at a minimum depth of 4 feet below the creek bed for protection against heave due to frost action, and on the basis of the borehole results a maximum allowable soil pressure of 5 tons per square foot is appropriate for the design of footings at or below El. 1146.5.

The recommended soil pressure incorporates a factor of safety of 3 against shear failure of the underlying soil, and total settlement of footings 10 feet in width is estimated to be 0.5 inch or less. In view of the uniform soil conditions revealed by the boreholes, no appreciable differential settlement is anticipated.

The adhesion between the footings and the sandy clayey silt or clayey silt subsoil may be taken as 2000 p.s.f. 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.

The native subsoil is unsuitable for use as backfill behind retaining walls, therefore free-draining granular material will be required to comply with the

requirements of the Ministry of Transportation and Communication. The bulk density of the granular fill may be assumed to be 130 p.c.f., and the coefficient of active earth pressure equal to 0.4.

No unusual construction problems are envisaged in carrying out excavations into the relatively impervious sandy clayey silt till and impervious clayey silt and silty clay deposits. Seepage will be confined to the upper layers of silty fine sand fill and sand and gravel, and it should be accumulated in sumps dug outside the footing area prior to being removed by pumping. The footing grade should be protected from freezing or softening after it has been exposed, and the footing concrete should be poured as soon as possible after the excavation has been completed to minimize disturbance of the subgrade.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



CJWA:eg

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

## 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
> 8"	3"	COARSE	FINE	COARSE	MEDIUM	FINE	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.

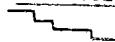
DYNAMIC PENETRATION RESISTANCE : to drive a 2"  $\phi$ , 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot

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

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

SYMBOL



322

## SOIL PROPERTIES.

W % Water content	$\gamma$ Natural bulk density (unit weight)	k Coeff. of permeability
LL % Liquid limit	e Void ratio	C Shear strength
PL % Plastic limit	RD Relative density	$\phi$ Angle of int friction
PI % Plasticity index	Cv Coeff. of consolidation	C' Cohesion
LI Liquidity index	m <sub>v</sub> Coeff. of volume compressibility	$\phi'$ Angle of int friction

## UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

TRIAXIAL COMPRESSION TEST

UNCONFINED TEST

LABORATORY

VANE TEST

FIELD

POCKET PENETROMETER TEST

Strain at failure is represented by direction of stem

20%  
15%  
10%  
5%

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

## SOIL DESCRIPTION.

COHESIONLESS SOILS :

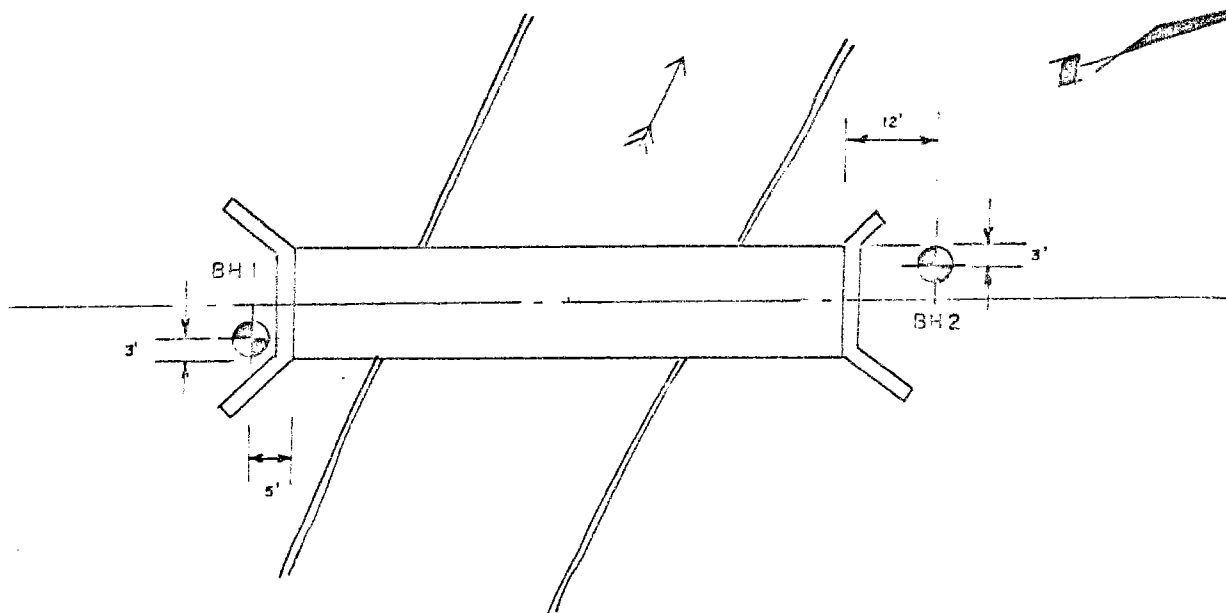
RD :

Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

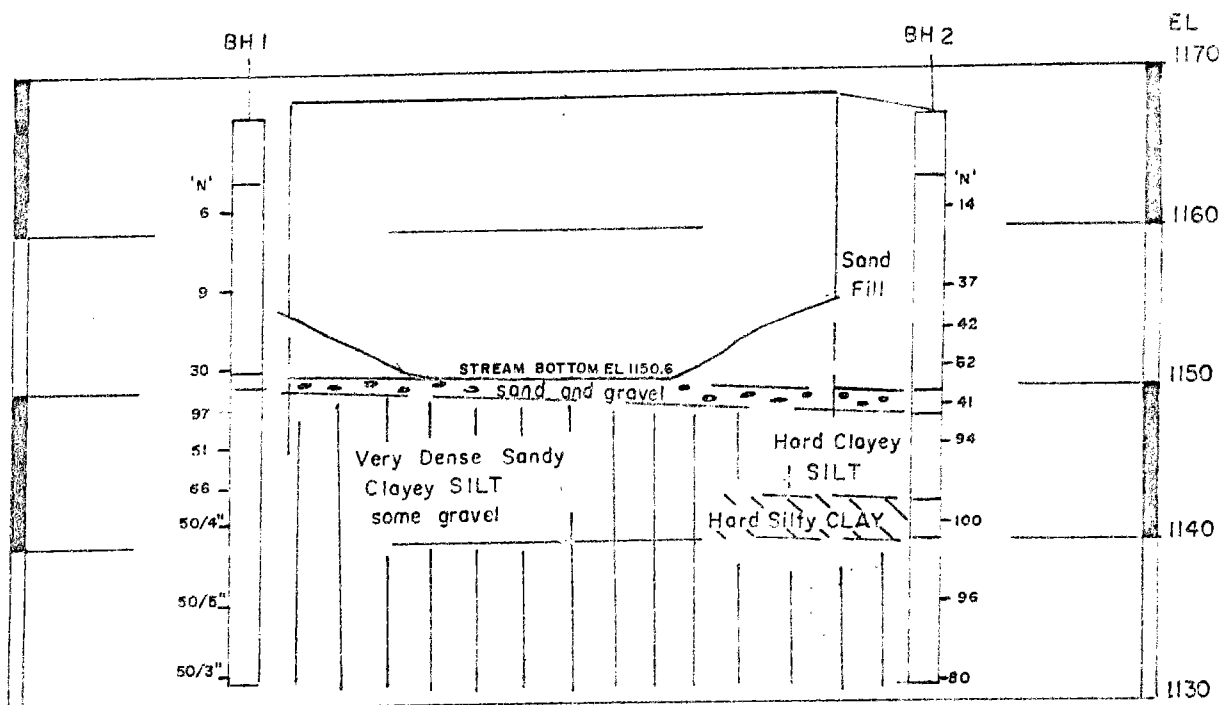
COHESIVE SOILS

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



LOCATION OF BOREHOLES  
Scale 1"=20'



SUBSURFACE PROFILE  
Hor. Scale 1"=20'  
Vert. Scale 1"=10'

REF NO: 75-7-L3

## LOG OF BOREHOLE 1...

Encl. No. 3

CLIENT: B.M. Ross &amp; Associates Ltd.,

PROJECT: Proposed Bridge BR-360

LOCATION: County of Huron.



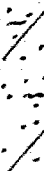



DATUM ELEVATION: low steel, El. 1166.16 feet

## DRILLING DATA

Method: Auger

Diameter: 4½ inch

Date: July 14, 1975

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					Blows/ft.									
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N'	Blows/foot	20	40	60	80	100	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %					
									Undrained Shear Strength								100 p.s.f.				
									+ Field vane test								or Compression test				
									20	40	60	80	100								
1672.00		Ground Surface																			
65	4.0	Sand and gravel.																			
60		Brown silty fine sand.			1	SS	6	o							22.6						
55		Fill.			2	SS	9	o							15.2						
50	16.0	Sand and gravel			3	SS	30		o												
45	17.0	Very dense grey sandy clayey silt, some gravel.			4	SS	97					o			9.2						
					5	SS	51			o					12.0						
					6	SS	66				o				14.2						
40					7	SS	50/4"							→	13.0						
35					8	SS	50/5"							→	8.0						
30	58	End of Borehole			9	SS	50/3"							→	23.0						

MADE:

CHECKED:

Date: July 14, 1975.

Ground Surface							
65	Sand and gravel.						
4.0	Brown silty fine sand wood	1	SS	14			
60							
55		2	SS	37			
	Fill brown grey	3	SS	42			
50	Gravel	4	SS	62			
45	Hard grey clayey silt	5	SS	41			14.8
41.5		6	SS	94			
40	Hard grey silty clay	7	SS	100			11.3
35	Very dense grey sandy clayey silt, some gravel.	8	SS	96			
30	End of Borehole	9	SS	80			10.9