#69-F-236 M

SITE 35-25

LOT 3, CONCESSIONS 2 AND 3

BRIDGE BR. 260

BA 2969
Site 35-25

DOMINION SOIL INVESTIGATION LIMITED

CONSULTING SOIL & FOUNDATION ENGINEERS

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39 BRENTFORD ROAD
KINGSTON 5, JAMAICA
WEST INDIES

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

Report on

SOIL INVESTIGATION

for

BRIDGE BR - 260

LOT 3 CONCESSIONS 2 & 3

TOWNSHIP OF ARTHUR

by

DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO.

Ref. No. 8-12-L10.

CONTENTS.

ENCLOSURES.

SUMMARY.

The two boreholes penetrated fill, peat, decomposed wood, and alluvial gravelly sandy silt deposits which extend to a depth of 3½ feet below the creek bed. Below this level the boreholes penetrated 13 feet into a glacial till stratum consisting of gravel in a matrix of very stiff sandy clayey silt.

It is recommended that the footings be supported within the upper part of the glacial till stratum using a maximum net soil pressure of 8000 p.s.f. for the design. Total settlement is estimated to be 1-inch or less.

No unusual construction problems are anticipated.

1. INTRODUCTION.

In accordance with authorization from B.M. Ross and Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Arthur where it is proposed to replace an existing road bridge with a new structure.

The existing structure is located at Lot 3 Concessions 2 & 3 of the Township where the road crosses a small creek.

It is understood that the proposed structure is a 25 foot span concrete rigid frame, and that it will be centered 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 site and to determine the relevant soil properties for the design and construction of the new foundations.

11. FIELD WORK.

The field work, consisting of 2 boreholes, and 2 dynamic cone penetration tests, was carried out on January 8, 9 & 10, 1969, at the locations shown on Enclosure 1. The

boreholes were advanced to the sampling depths by washboring methods and were lined with Bx size casing.

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.

Falling head permeability tests were performed inside the casing to determine the coefficient of permeability of the subsoil.

The field work was supervised by a soils engineer who also determined the ground surface elevations. These were referred to the low concrete of the existing bridge, which was taken as Geodetic El.1529.68 feet.

111. SUBSURFACE CONDITIONS.

Detailed descriptions of the strata encountered in each borehole are given on the borehole logs, comprising Enclosure 2, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 1. The following notes are intended only to amplify this data.

Underlying a 4½ foot thick layer of fill, the boreholes encountered peat, decomposed wood, and alluvial gravelly

sandy silt deposits, which extend to a depth of about 3½ feet below the creek bed, Below this level the boreholes penetrated a glacial till stratum consisting of gravel in a matrix of sandy clayey silt. Both boreholes were terminated in the till stratum at a depth of about 18 feet below the creek.

A grading analysis of a typical sample of the till is shown as a grain size distribution curve on Enclosure 3. Classification tests were performed on the sandy clayey silt portion of the till, giving the following results:-

Liquid Limit	17% to 23%
Plastic Limit	10% to 14%
Moisture Content	10% to 17%
Plasticity Index.	7 to 9
Liquidity Index.	0.33 to 0.14

The results of the falling head permeability tests indicate an average coefficient of permeability for the till material of 5×10^{-4} cm/sec.

IV. GROUNDWATER CONDITIONS.

The water levels in the boreholes reached equilibrium at an average El.1526.1, which was 5 inches above the ice level in the adjacent creek.

V. DISCUSSION & RECOMMENDATIONS.

The creek bed extends down to El.1523.5 therefore consideration should be given to a footing grade at or below El.1519.5 to provide a 4 foot depth of soil cover for protection against frost action.

Bearing Capacity.

The proposed footing grade lies within the glacial till stratum, and on the basis of the field and laboratory test results, a maximum net soil pressure of 8000 p.s.f. is appropriate for the design of footings. This soil pressure incorporates a factor of safety of at least 3 against shear failure of the underlying soil.

The adhesion between the footings and the underlying soil 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.

Settlement.

It is estimated that total settlement of footings mobilizing the maximum allowable soil pressure will be 1-inch or less, and in view of the similar conditions

encountered below the footing grade at the two locations, no appreciable differential settlement is anticipated.

Construction.

It may be assumed that dewatering of excavations will be carried out by normal pumping procedures from sumps dug below the footing grade, however the side slopes of the excavations will require to be shallow to prevent a 'flow' of soil and water into the excavations.

Yours very truly,
DOMINION SOIL INVESTIGATION LIMITED.

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

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

CJWA/jb.

APPENDIX 'A'.

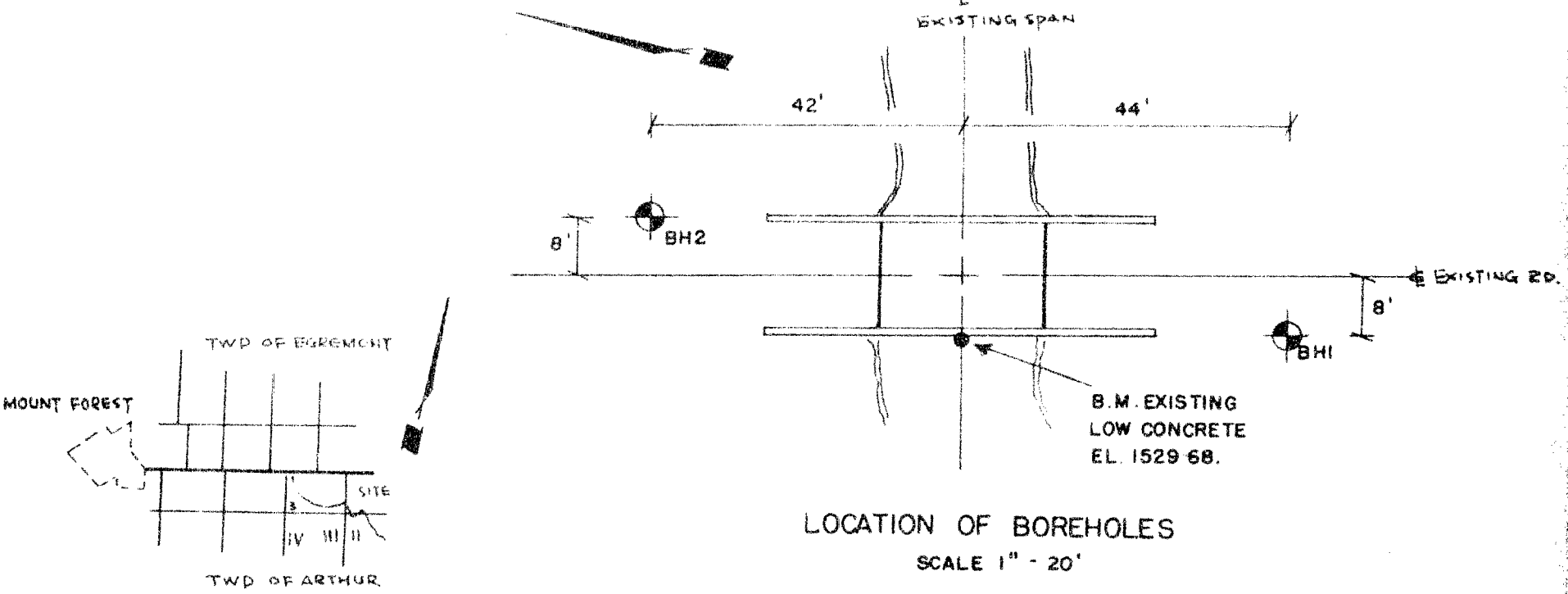
THE STANDARD PENETRATION TEST.

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 diamter 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.



LOCATION OF BOREHOLES

SCALE 1" - 20'

KEYPLAN

LEGEND

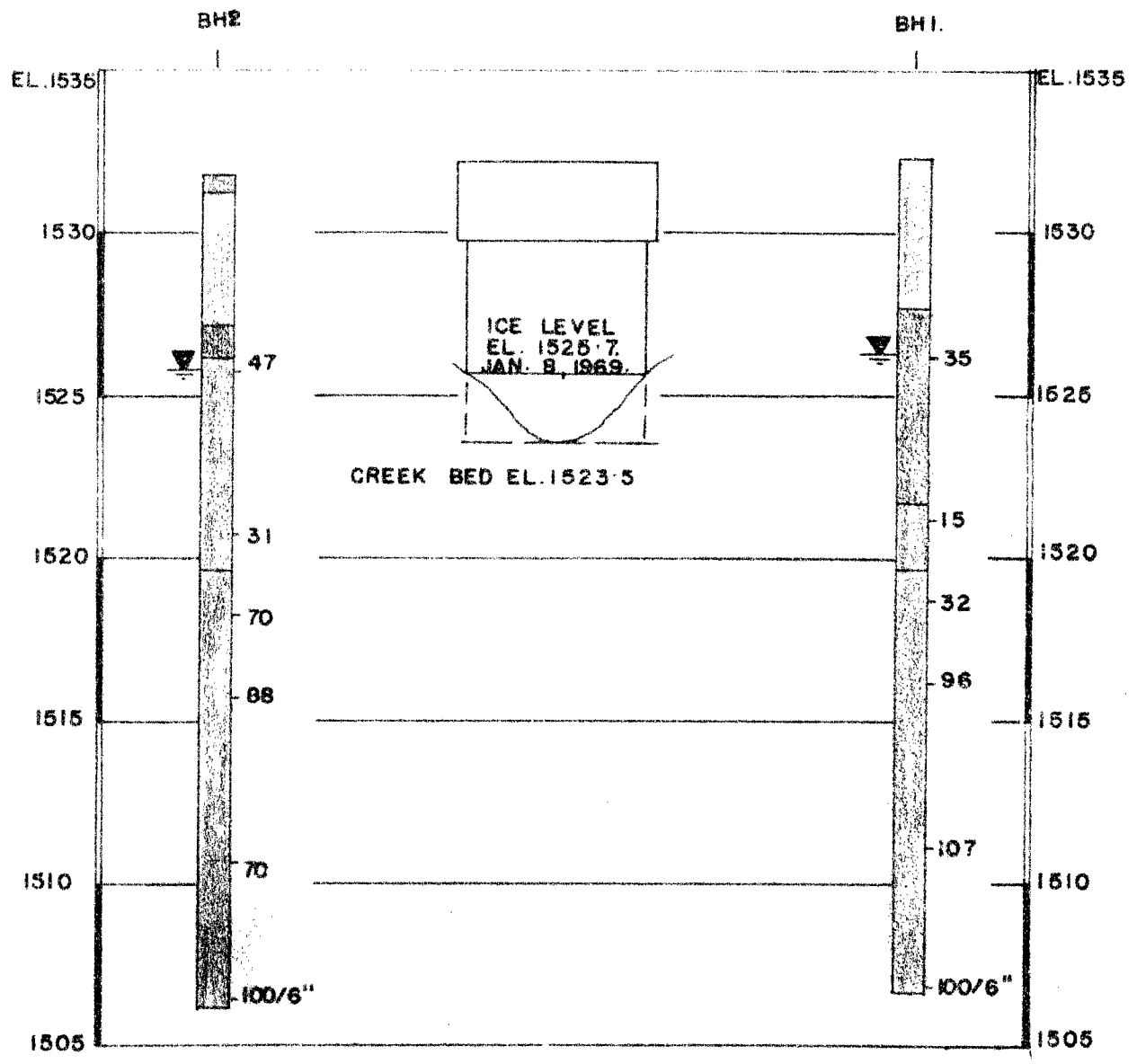
SANDY GRAVEL

SANDY CLAYEY SILT, FILL.

PEAT & DECOMPOSED WOOD.

COMPACT TO DENSE GRAVELLY SANDY SILT.

GRAVEL IN A MATRIX OF VERY STIFF SANDY CLAYEY SILT.



SUBSURFACE PROFILE

VERT. SCALE 1" - 5'

LOG OF BOREHOLE 1&2

Our Reference Nº 8-17-1.1b.

Enclosure Nº 2.

CLIENT: B.M.Ross & Associates Ltd.,
PROJECT: Bridge BR-260.
LOCATION: Township of Arthur.
DATUM ELEVATION: low concrete, El.1529.68 feet.

DRILLING DATA
Method: Washboring.
Diameter: Bx(3-inch)
Date: Jan 8,9 & 10,1969.

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' Blows/Foot	PENETRATION RESISTANCE Blows/Foot (20 40 60 80 100) / UNDRAINED SHEAR STRENGTH 100 lbs/sq.ft. + FIELD VANE TEST ● COMPRESSION TEST (10 20 30 40 50)	WATER CONTENT % PLASTIC LIMIT W_P NATURAL W LIQUID LIMIT W_L (10 20 30 40 60)	REMARKS
1532	0.0	Ground Surface						Borehole 1.		
		Sandy clayey silt (Fill).						2 inch dynamic cone		
1530	4.5	Peat.			1	SS	35			
	5.5	Pieces of slightly decomposed wood.								
25	9.0	Peat.								
	10.5	Brown gravelly sandy silt.			2	SS	15			Permeability Tests.
20	12.5	Gravel in matrix of very stiff sandy clayey silt.			3	SS	32			k= 3x10-4 cm/sec.
					4	SS	96			k=7x10-4 cm/sec.
15										
					5	SS	107			
10		(Glacial Till).								
	25.5	End of Borehole			6	SS	100/6"			
1531.7	0.0	Ground Surface						Borehole 2.		
	0.5	Sandy gravel.						2 inch dynamic cone		
1530		Sandy clayey silt (Fill)								
	4.5	Peat.			1	SS	47			
	5.5	Brown gravelly sandy silt, trace of organics.								
25					2	SS	31			
20	12.0	Gravel in matrix of very stiff sandy clayey silt.			3	SS	70			Permeability Test. k=5x10-4 cm/sec.
					4	SS	88			
15					5	SS	70			
10		(Glacial Till)								
	25.5	End of Borehole			6	SS	100/6"			
05										

VERTICAL SCALE: 1 inch to 5 feet

MADE: CHECKED:

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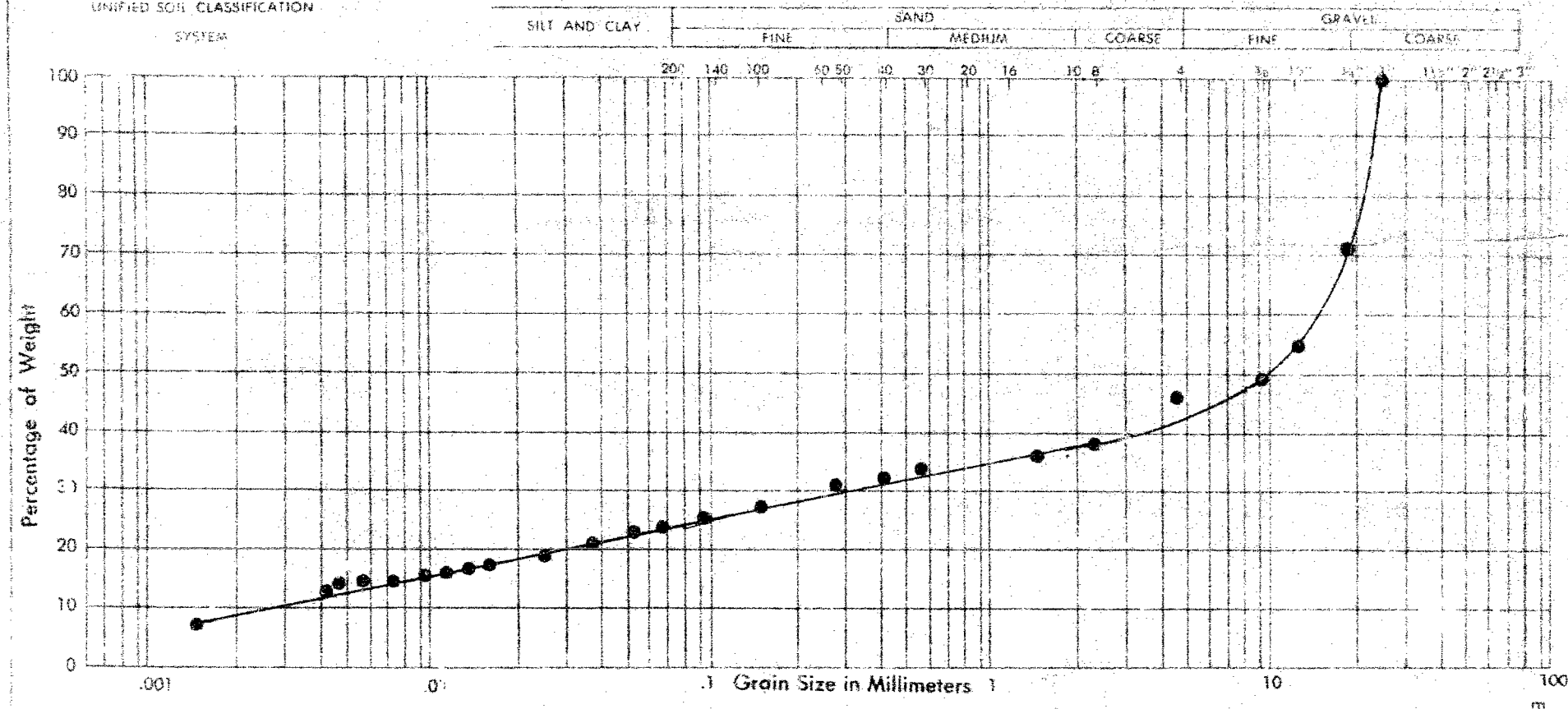
GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 8-12-210



PROJECT: Bridge BR-260

LOCATION: Twp. of Arthur.

BOREHOLE NO.: 1.

SAMPLE NO.: 4.

DEPTH OF SAMPLE: 15 feet.

ELEVATION OF SAMPLE: 1517 feet.

COEFFICIENT OF UNIFORMITY

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

Gravel with some sand, silt and a trace of clay.

PLASTIC PROPERTIES:

LIQUID LIMIT %

PLASTIC LIMIT %

PLASTICITY INDEX %

MOISTURE CONTENT %

ACTIVITY

Enclosure No.