68-F-207 M

BRIDGE # 19

LOT 11, CONS. 11-12

YARMOUTH TWP.

BA 2768
Site 5-16

A.M. SPRIET AND ASSOCIATES LTD.,
CONSULTING ENGINEERS
LONDON ONTATIO.

Report on

SOIL INVESTIGATION

FOR

BRIDGE NO 19
LOT 11 CONCESSIONS 11-12

TOWNSHIP OF YARMOUTH

BY

DOMINION SOIL INVESTIGATION LIMITED.
369 Queens Avenue
LONDON ONTARIO
Reference No.8-1-L5.

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ENCLOSURES.

SUMMARY.

The natural subsoil below the creek bed consists of hard silty clay and very dense silty fine sand strata which are suitable for the support of spread footing foundations.

It is recommended that the footing grade be established at or below El.85.5 using a maximum net soil pressure of 10,000 p.s.f. for the design of the footings. Total settlement is estimated to be 0.5 inch.

Dewatering problems are discussed in the report.

1. INTRODUCTION.

In accordance with verbal authorization from A.M. Spriet & Associates Limited, Consulting Engineers, a soil investigation has been carried out in the Township of Yarmouth where it is proposed to replace an existing road bridge with a new structure.

The existing 74 foot span steel truss structure is situated on Lot 11, Concessions 11 and 12 of the Township where the road crosses Kettle Creek.

It is understood that the centre line of the new structure will be located about 160 feet to the west of the centre line of the existing bridge. The requirements of the project were discussed with Mr.W.E. Kelley 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 3 dynamic cone penetration tests, was carried out during the period January 10 to 12, 1968 at the locations shown on Enclosure 1. The holes were advanced 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.

The dynamic cone penetration tests were performed to obtain an indication of soil density and strata changes with depth.

Elevations were referred to a benchmark which was established by the client (nail in telephone pole, 100 feet west and 30 feet south of the centre of the existing bridge, El.100 feet).

111. SUBSURFACE CONDITIONS.

Detailed descriptions of the strata encountered in each borehole are given on the borehole logs, comprising Enclosures 2 and 4, 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.

The boreholes and dynamic cone penetration tests revealed an 18 foot thick layer of loose to compact fill&alluvial material which extends down to about El.90.

Borehole 1 penetrated a 4.5 foot thick layer of silty clay till below El.90, and the borehole was terminated in a very dense silty fine sand stratum at El.67.

Borehole 3 encountered the silty fine sand stratum at El.90 and was terminated in this stratum at El.61.

Grain size analyses of two typical samples of the silty fine sand are presented as grain size distribution curves on Enclosures 5 and 6.

IV. GROUNDWATER CONDITIONS.

The water levels in the boreholes reached equilibrium at an average El.95.6, which was about 5 feet above the ice level in the adjacent creek at the time the field work was carried out.

V. DISCUSSION AND RECOMMENDATIONS.

The natural subsoil below the creek bed consists of hard silty clay and very dense silty fine sand strata which are suitable for the support of spread footing foundations.

The creek bed extends down to El.89.5 therefore consideration should be given to a footing grade at or below El.85.5 to provide a 4 foot depth of cover for protection against frost action. The silty fine sand material at this elevation is highly susceptible to erosion therefore a hydrological study should be made to determine the maximum depth of scour prior to establishing the footing grade.

On the basis of the borehole results a maximum net soil pressure of 10,000 p.s.f. is appropriate for the design of footings at or below El.85.5, and furthermore this soil pressure incorporates a factor of safety of at least 3 against shear failure of the under lying soil.

Total settlement of footings mobilizing the above soil pressures is estimated to be 0.5 inch, and in view of the similar conditions encountered in the two boreholes no appreciable differential settlement is anticipated.

Construction.

A major problem in constructing footings in the prevailing soil conditions will be to control the groundwater and it is most important that proper dewatering procedures be used. There would be a tendency for the sides of an unprotected excavation to 'slough-in' and for the bottom of the excavation to heave or 'boil' when the water level is lowered.

The development of this condition must be prevented otherwise excessive weakening of the subgrade is likely to result. This may be acheived by carrying out the excavations inside a sheet pile enclosure which should penetrate to at least the same depth below the footing as the groundwater table is above the footing elevation. The sheeting may afterwards be left in place as a positive means of scour protection.

An alternative procedure would be to use a well-point system to lower the groundwater table below the footing grade during the construction period.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED.

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

CJWA/jb.,

APPENDIX A.

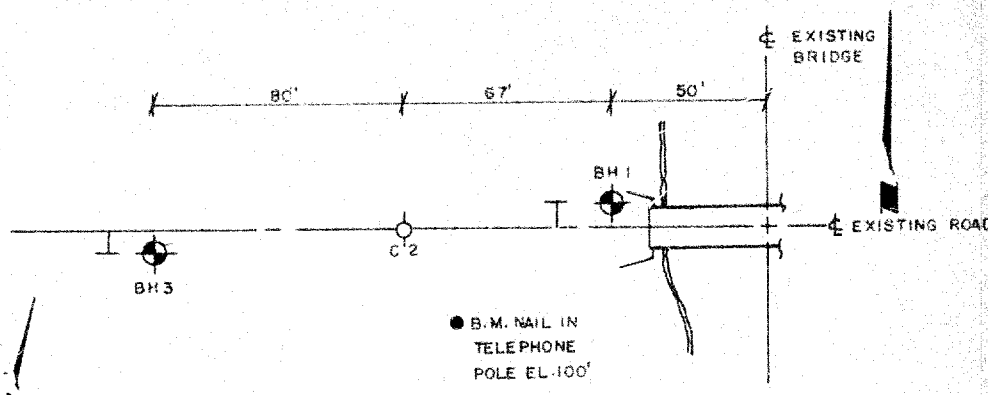
THE STANDARD PENETRATION TEST.

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.

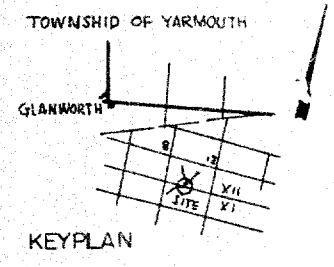
A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30 in. The tube is first driven an initial 6-inches to allow for the presence of disturbed material at the bottom of the borehole. The number 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.



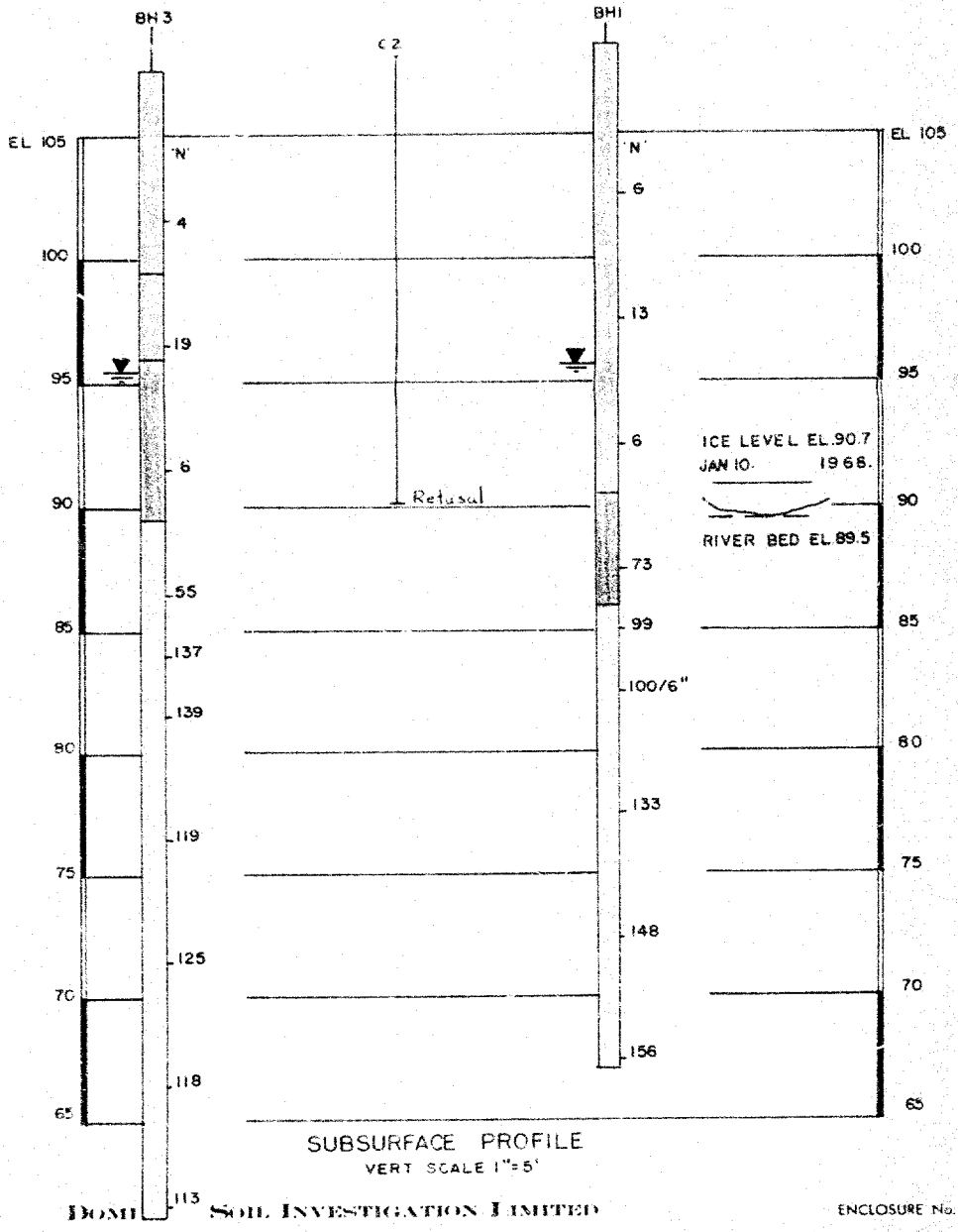
LOCATION OF BOREHOLES
SCALE 1"= 40'



KEYPLAN

LEGEND

- SILT & CLAY, FILL
- HARD SILTY CLAY, TILL
- COMPACT COARSE SAND
- LOOSE SANDY SILT
- VERY DENSE FINE SAND



SUBSURFACE PROFILE
VERT SCALE 1"=5'

OUR REF. No. 8-1-L5

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ENCLOSURE No. 1

LOG OF BOREHOLE ...1.....

Our Reference Nº 8-1-LS

Enclosure Nº 2

CLIENT: A.M.Sprict & Associates Ltd.
PROJECT: Bridge No. 19
LOCATION: Township of Yarmouth
DATUM ELEVATION: Nail in tel. pole, El. 100 feet.

DRILLING DATA
Method: Washboring
Diameter: Bx(3-inch)
Date: January 10, 1968.

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 lbs/sq ft + FIELD VANE TEST ● COMPRESSION TEST	WATER CONTENT % PLASTIC LIMIT w_p NATURAL w LIQUID LIMIT w_l	REMARKS
108.6	0.0	Ground Surface								
		gravel								
		Brown sandy clayey silt (Fill)			1	SS	6	2-inch diameter cone		
					2	SS	13			
					3	SS	6			
90	18.0	Hard grey silty clay, trace of gravel (Glacial Till)			4	SS	73			
85	22.5	Very dense grey silty fine sand			5	SS	99			
					6	SS	100/6"			
					7	SS	153			
					8	SS	148			
					9	SS	156			
65	41.5	End of Borehole								

VERTICAL SCALE: 1 inch to 5 feet

MADE

CHECKED

DOMINION SOIL INVESTIGATION LIMITED

LOG OF BOREHOLE ..... CONE C2

Our Reference Nº 8-1-L5

Enclosure Nº 3

CLIENT: A.M.Sprict & Associates Ltd.
PROJECT: Bridge No. 19
LOCATION: Township of Yarmouth
DATUM ELEVATION: Nail in tel. pole, El. 100 feet

DRILLING DATA
Method:
Diameter:
Date:

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot	WATER CONTENT %	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL / GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	20 40 60 80 100 UNDRAINED SHEAR STRENGTH lbs/sq ft + FIELD VANE TEST ● COMPRESSION TEST	PLASTIC LIMIT w_p — NATURAL w — LIQUID LIMIT w_L	REMARKS
108.1	0.0	Ground Surface							
100									
95									
90	18.0								

LOG OF BOREHOLE ...3.....

Our Reference Nº 8-1-L5

Enclosure Nº 4

CLIENT: A.M.Spriet & Associates Ltd.
PROJECT: Bridge No. 19
LOCATION: Township of Yarmouth
DATUM ELEVATION: Nail in tel. pole, El. 100 feet.

DRILLING DATA
Method: Washboring
Diameter: Bx(3-inch)
Date: January 12, 1968

ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	SAMPLES NUMBER	TYPE	'N' Blows/Foot	REMARKS
107.6	0.0	**Ground Surface**						
		Brown clayey silt (Fill)			1	SS	4	
100	8.0	Compact coarse sand			2	SS	19	
	11.5	Loose sandy silt, with a trace of gravel			3	SS	6	
90	18.0	Very dense grey silty fine sand			4	SS	55	
					5	SS	137	
					6	SS	139	
					7	SS	119	
					8	SS	125	
					9	SS	118	
65					10	SS	113	
60	46.5	End of Borehole						

PENETRATION RESISTANCE Blows / Foot
20 40 60 80 100
UNDRAINED SHEAR STRENGTH lbs/sq ft.
+ FIELD VANE TEST ● COMPRESSION TEST

WATER CONTENT %
PLASTIC LIMIT w_P — NATURAL w — LIQUID LIMIT w_L

2-inch diameter cone

VERTICAL SCALE: 1 inch to 5 feet

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MADE CHECKED

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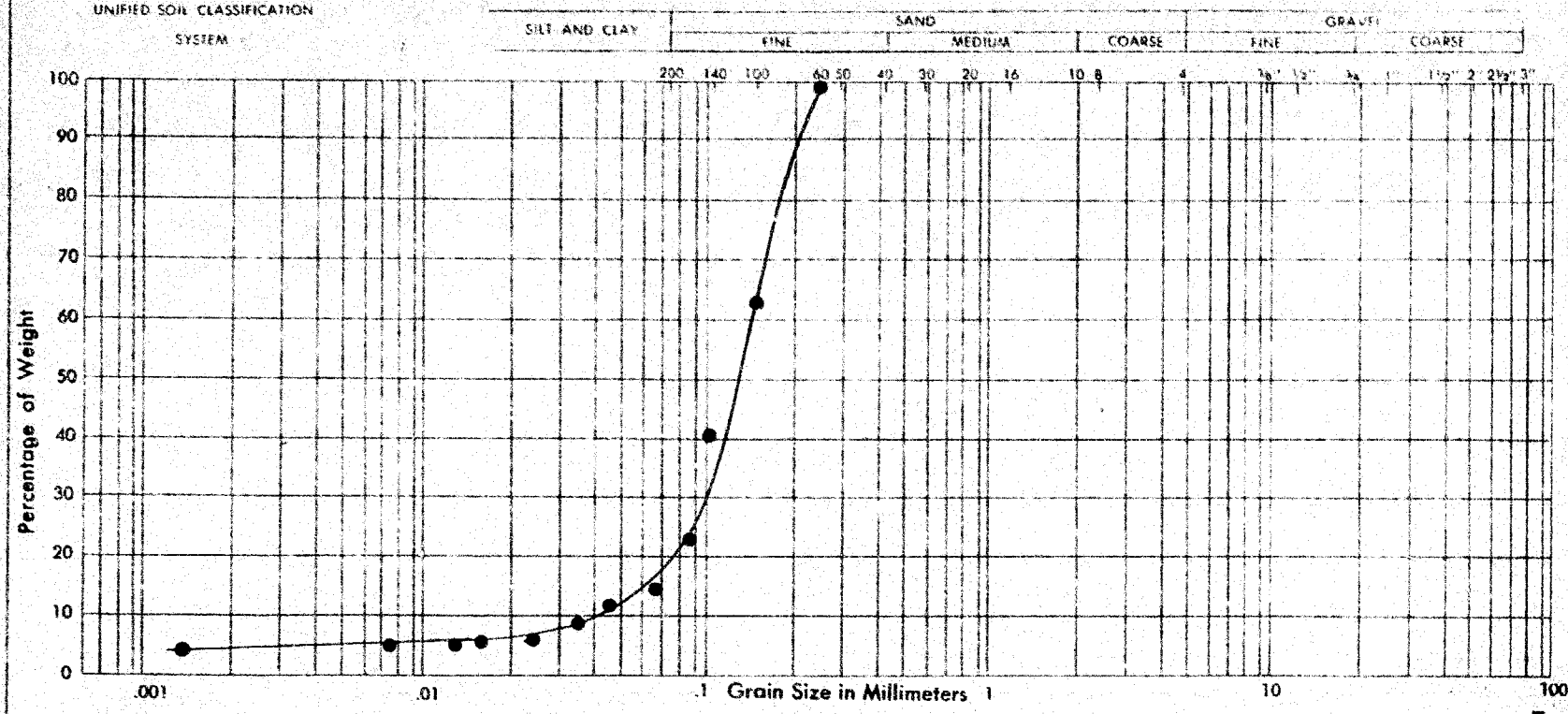
GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO 8-B-L5



PROJECT: Bridge 19

LOCATION: Twp of Yarmouth

BOREHOLE NO: 1

SAMPLE NO: 6

DEPTH OF SAMPLE: 26 feet

ELEVATION OF SAMPLE: 82.6 feet

COEFFICIENT OF UNIFORMITY 4

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

Fine sand with some silt

PLASTIC PROPERTIES:

LIQUID LIMIT % =

PLASTIC LIMIT % =

PLASTICITY INDEX % =

MOISTURE CONTENT % =

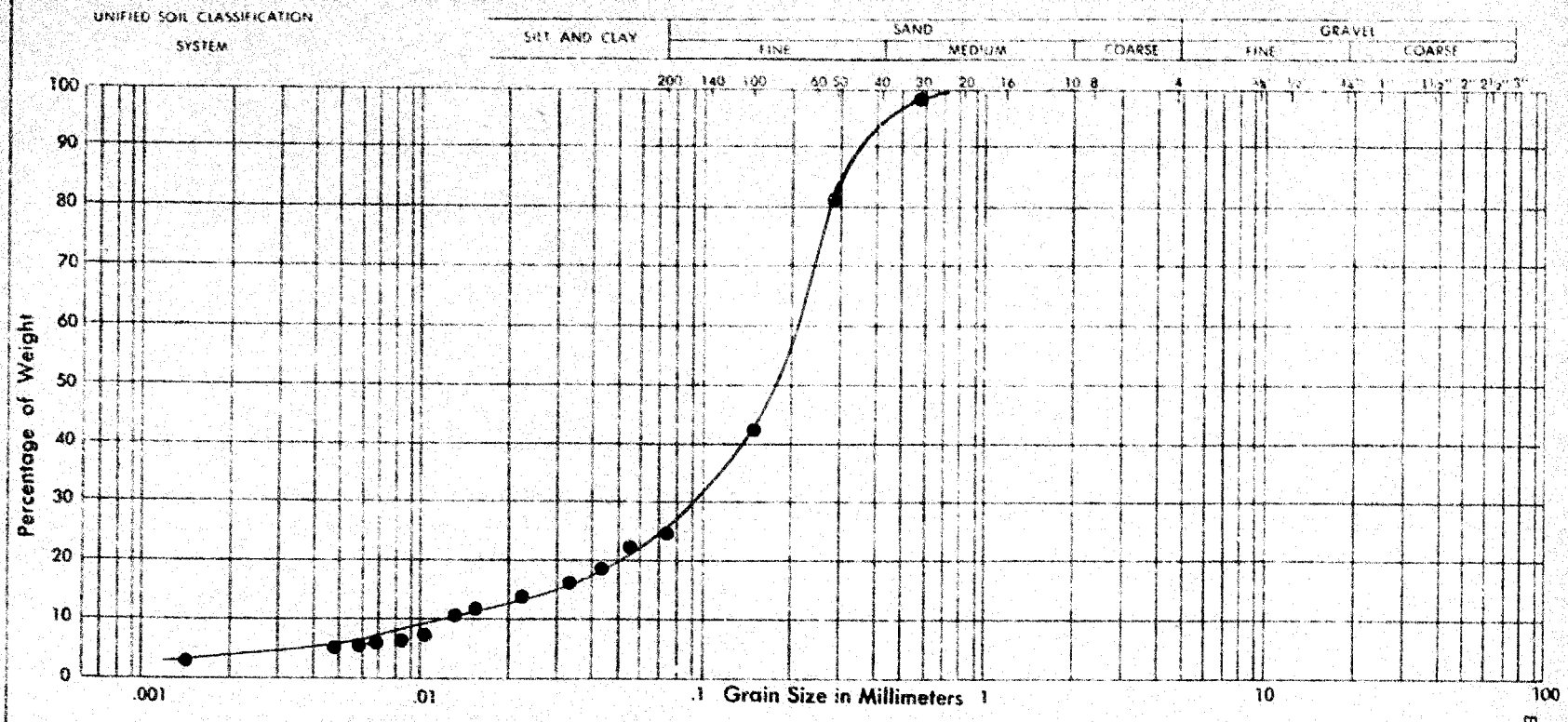
ACTIVITY =

Enclosure No. 5

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 8-1-L5



PROJECT: Bridge 19

LOCATION: Township of Yarmouth

BOREHOLE NO.: 3

SAMPLE NO.: 6

DEPTH OF SAMPLE: 26 feet

ELEVATION OF SAMPLE: 81.6 feet

COEFFICIENT OF UNIFORMITY 17

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

Silty fine sand

PLASTIC PROPERTIES:

LIQUID LIMIT % —

PLASTIC LIMIT % —

PLASTICITY INDEX % —

MOISTURE CONTENT % —

ACTIVITY —

Enclosure No. ●