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G.I.P-30 SEPT. 1976

GEOCRES No. 40I14-109

DIST. 2 REGION South western

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. _____

LOCATION LOTS 12 & 13

CONCESSION 13 YARMOUTH

TOWNSHIP.

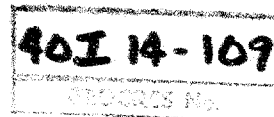
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE

MICROFILMED

B.A. 2269

A. M. SPRIET AND ASSOCIATES LTD.
264 WELLINGTON STREET,
LONDON ONTARIO.



Report on
SOIL INVESTIGATION
for
BRIDGE NO 10
LOTS 12 & 13, CONCESSION 13
TOWNSHIP OF YARMOUTH

by
DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 5-12-L12
January 6th, 1966.

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SUMMARY

The two borings revealed that the natural subsoil consists of hard glacial silty clay till which appears to extend to a considerable depth.

It is recommended that the structure be supported on spread footings at or below El. 86 using a maximum net soil pressure of 10,000 pounds per square foot. It is estimated that total settlement of the structure will not exceed 1-inch.

No unusual construction problems are anticipated.

I INTRODUCTION

Verbal authorization was received from A. M. Spriet & Associates, consulting engineers, to carry out a soil investigation at a site in the Township of Yarmouth where it is proposed to replace an existing road bridge with a new structure.

The existing steel-truss structure is located on Lots 12 and 13, Concession 13 of the Township where the road crosses Kettle Creek. It is understood that the proposed structure will have the same longitudinal and transverse centre lines as the existing bridge.

The purpose of this 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.

II FIELD WORK

The field work, consisting of 2 boreholes, was carried out on December 31, 1965, and January 1, 1966, at the locations shown on Enclosure 2. The holes were advanced by a continuous-flight powered-auger.

Standard Penetration Tests using a 2-inch outside diameter split-spoon sampler were performed at frequent intervals of depth, using a driving force 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 required to drive the sampler a further 12-inches was recorded as the standard penetration resistance (or 'N' value). This test determines the relative density of granular strata and gives an indication of the consistency of cohesive strata. It also enables samples to be obtained for classification purposes.

Dynamic cone penetration tests were performed adjacent to each borehole location to obtain an indication of soil density changes with depth.

The results of the field tests are presented on the Geotechnical Data Sheets, Enclosures 3 and 4. Elevations were referred to a benchmark which was given the arbitrary value, El. 100 feet (Nail in hydro-pole N-E corner of existing bridge).

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the Geotechnical Data Sheets, comprising Enclosures 3 and 4, and a general picture of the soil stratigraphy is given in the form of a Subsurface Profile on Enclosure 2.

Both boreholes penetrated a layer of loose to compact silty sand fill which is associated with the construction of the approaches to the existing bridge.

The natural soil was encountered at an average El. 92 and consists of silty clay containing a trace of fine gravel. The material is of glacial origin and is commonly known as Glacial Till. Owing to the clay content the soil exhibits considerable cohesion and should be regarded as a cohesive plastic material.

The consistency of the clay till is described as 'hard' as indicated by standard penetration test results ranging from 24 to 66 blows per foot.

IV GROUNDWATER CONDITIONS

Groundwater was encountered in the lower part of the sandy fill material in both boreholes and can be regarded as being in a 'perched' condition above the silty clay till.

V LABORATORY TESTS

A series of laboratory tests were performed on samples of the clay till stratum in which spread footings will bear, if such a design is used.

Atterberg Limit and moisture content tests were carried out on 2 samples as a means of classification and as a guide to the probable behaviour of the soil. These gave values of Liquid Limit of 26% and 28%; Plastic Limit of 13% and 12%; and Plasticity Index of 16% and 12% indicating that the soil is a clay of low plasticity and compressibility. The Liquidity Indices which relate the natural moisture content of the clay to the Atterberg Limits were 0 and 0.23 confirming the hard consistency obtained from the visual and tactile examination.

The results of the Atterberg Limit and moisture content tests are plotted graphically on the Geotechnical Data Sheet for each borehole.

VI DISCUSSION

The natural soil consists of hard silty clay till which appears to extend to a considerable depth.

The bed of the creek extends to El. 90.4, therefore allowing for scour it is recommended that footings should bear at or below El. 86. The footing depth should be decided after a hydrological study has been made to determine the maximum depth of scour. This level lies within the stratum of hard clay till and on the basis of the borehole results a maximum net soil pressure of 10,000 pounds per square foot is appropriate for the design of footings. Furthermore the footings will have a factor of safety of a least 3 against shear failure of the underlying soil.


It is estimated that total settlement will not exceed 1-inch and in view of the similar conditions encountered in the two boreholes, no appreciable differential settlement is anticipated.

The adhesion between the footings and the clay till may be taken as 2000 p.s.f. and the factor of safety against horizontal sliding of the abutments should be at least 1.5.

The hard cohesive impervious clay till should cause no unusual construction problems. Seepage should be accumulated in sumps dug below the footing grade and removed by pumping. The volume of seepage will be small. The soil is not unduly sensitive either to the effects of water or mechanical disturbance. The faces of temporary excavations into the till may be expected to stand vertically without bracing. That part of the excavation passing through fill should be braced or sloped at 1 to 1.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED


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



CJWA:jms

E n c l o s u r e s

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						
6"	> 8"	5"	3/4"	4.75mm	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
CAS 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.

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.

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
LL % Liquid limit
PL % Plastic limit
PI % Plasticity index
LI Liquidity index

γ^* Natural bulk density (unit weight)
 θ Void ratio
RD Relative density
 C_v Coeff. of consolidation
 m_v Coeff. of volume compressibility

k Coeff. of permeability
C Shear strength
 ϕ Angle of int. friction
C' Cohesion
 ϕ' Angle of int. friction
in terms of total stress
in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST
UNCONFINED TEST

LABORATORY VANE TEST
FIELD

POCKET PENETROMETER TEST

Strain of 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 %
Loose 15 - 35 %
Compact 35 - 65 %
Dense 65 - 85 %
Very dense 85 - 100 %

Very soft less than 250
Soft 250 - 500
Firm 500 - 1000
Stiff 1000 - 2000
Very stiff 2000 - 4000
Hard over 4000

GEOTECHNICAL DATA SHEET FOR BOREHOLE ... 1 ...

OUR REFERENCE NO. 5-12-L12

CLIENT: A. M. Spriet & Associates

PROJECT: Bridge No. 10

LOCATION: Twp. of Yarmouth

DATUM ELEVATION: 100 Feet

METHOD OF BORING: Washboring

DIAMETER OF BOREHOLE: 8x (3-inch)

DATE: December 31, & Jan. 1, 1965/66

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %				REMARKS
				NUMBER	TYPE	ft. or inches of Sample	20	40	60	80	100	<div><div><div><div></div><div>20</div></div><div><div></div><div>40</div></div></div><div><div></div><div>60</div></div><div><div></div><div>80</div></div><div><div></div><div>100</div></div></div>				
							SHEAR STRENGTH lbs. sq. ft.					<div><div><div><div></div><div>10</div></div><div><div></div><div>20</div></div></div><div><div></div><div>30</div></div><div><div></div><div>40</div></div></div>				
101.8	0.0	Ground Surface														
	1.0	Ballast														
		Loose to compact brown silty sand (Fill).														
95				1	SS	7										
				2	SS	22										
10.5				3	SS	36										
90		Hard grey silty clay, trace of fine gravel (Glacial Till)														
85				4	SS	49										
				5	SS	54										
80				6	SS	66										
				7	SS	52										
75	26.5	End of Borehole														

W. L.
E1.92.4

YOUR REFERENCE NO. 5-12-L12

GEOTECHNICAL DATA SHEET FOR BOREHOLE ... 2 ...

CLIENT: A. M. Spriet & Associates

PROJECT: Bridge No. 10

LOCATION: Twp. of Yarmouth

DATUM ELEVATION: 100 feet

METHOD OF BORING: Washboring

DIAMETER OF BOREHOLE: 6x (3-inch)

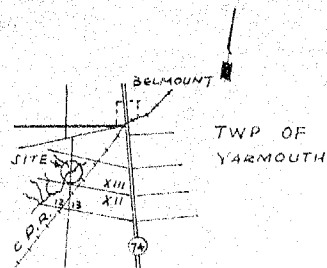
DATE: December 31, 1965

ENCLOSURE NO. 4




ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE Blows per foot					CONSISTENCY Water content %				REMARKS
				NUMBER	TYPE	ft or Advancement of Sampler	20	40	60	80	100	PL	W	LL		
101.3	0.0	Ground Surface														
	1.0	Ballast														
		Compact														
		brown														
95		silty														
	8.0	sand (Fill).		1	SS	8										
				2	SS	41										
		Hard														
90		grey		3	SS	45										
		silty														
		clay,														
85		trace		4	SS	59										
		of		5	SS	53										
		fine		6	SS	47										
80		gravel														
		silt seams														
		(Glacial Till).		7	SS	24										
75	26.5	End of Borehole														

W. L.
El. 94.3
Dec. 31,
1965.

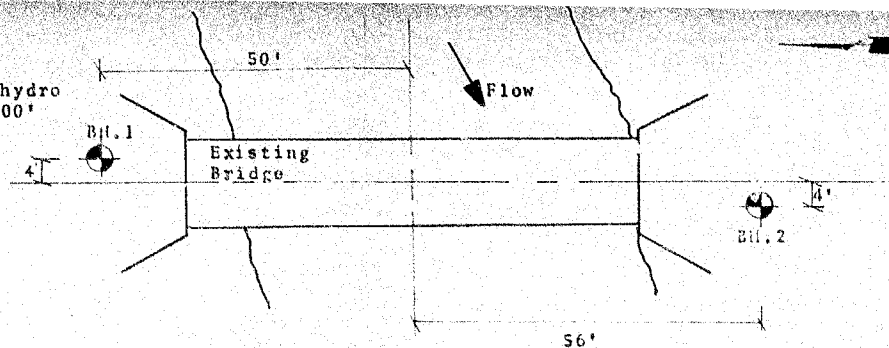
W. L.
El. 94.3
Dec. 31,
1965.



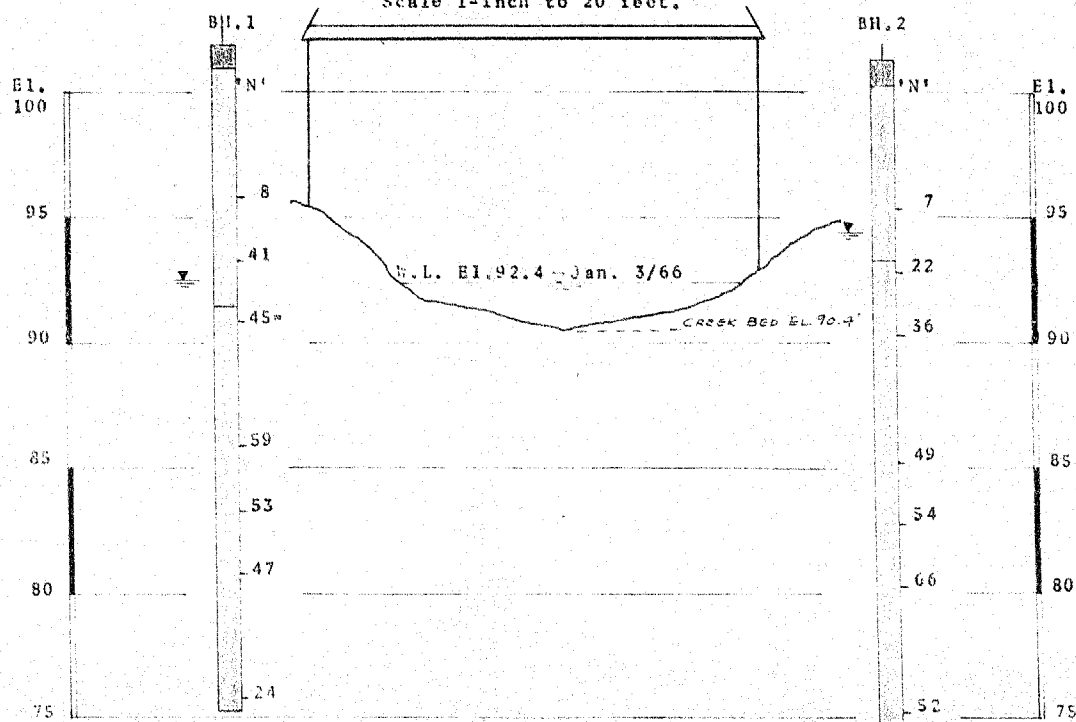
KEY PLAN

-  Ballast
-  Silty Sand Fill
-  Silty Clay Till

BM. Nail in hydro pole. El. 100'



LOCATION OF BOREHOLES
Scale 1-inch to 20 feet.



SUBSURFACE PROFILE

Vert. Scale 1-inch to 5 feet

