#66-F-268 M

ELGIN COUNTY

BRIDGE #39

(McNEIL BRIDGE)

LOT #15 CONC #11 #12

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LONDON ONTARIO

Report on

SOIL INVESTIGATION

for

ELGIN COUNTY BRIDGE NO. 39

(McNEIL BRIDGE)

LOT 15, CONCESSIONS 11 & 12

TOWNSHIP OF SOUTH DORCHESTER

65 F-2681

by

DOMINION SOIL INVESTIGATION LIMITED
369 Queens Avenue
LONDON ONTARIO

Reference No. 6-11-L18
November 29th, 1966.

CONTENTS

ENCLOSURES

SUMMARY

The two boreholes revealed the following general ground succession:- sand and gravel Road Ballast (1'-0" to 1'-6" thick); silty clay Fill (3'-0" to 12'-0" thick); and stiff to hard silty clay Till (22'-0" maximum penetrated).

It is recommended that the structure be supported on spread footing foundations at or below El. 89, using a maximum net soil pressure of 8000 p.s.f. Total settlement is estimated to be less than 1 inch.

No unusual construction problems are anticipated.

I INTRODUCTION

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

The existing structure, named McNeil Bridge, is located on Lot 15, Concessions 11 and 12, of the Township of South Dorchester, where County Road 50 crosses a tributary of Catfish Creek.

It is understood that the proposed structure is a concrete rigid frame and that the centre line will be the same as the existing bridge. The requirements of the project were discussed with Mr. A. M. Spriet, P. Eng., who supplied the foregoing information.

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 November 24 and 25, 1966, at the locations shown on Enclosure 2. The holes were advanced by washboring methods and were lined with Bx casing.

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.

The results of the field tests are presented on the Geotechnical Data Sheets, Enclosures 3 and 4. Elevations were referred to a nail in the south face of a hydro pole, 80 feet west of the centre line of the existing bridge, and on the north side of the road. The benchmark was given the assumed El. 100 feet.

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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 presented in the form of a Subsurface Profile on Enclosure 2.

The boreholes revealed the following general ground succession:-

		Thickness	
		Borehole 1	Borehole 2
(a)	Sand and gravel (Road Ballast)	1'- 6"	1'- 0"
(b)	Brown silty clay containing a trace of organics (Fill).	3'- 5"	12'- 0"
(c)	Brown silty clay, with traces of sand and fine gravel (Glacial Till). The consistency of this stratum changes from 'stiff' to 'hard' with depth as indicated by standard penetration test results ranging from 11 to 62 blows per foot.	22'- 0"	Penetrated 13'- 6"

IV GROUNDWATER CONDITIONS

Water levels were observed in the boreholes at an average El. 98.6 (i.e. about 3 feet above the water level in the creek at the time the field work was carried out).

V LABORATORY TESTS

A series of laboratory tests were performed on samples of the silty 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 33% and 37%; Plastic Limit of 14% and Plasticity Index of 19 and 23, indicating that the soil is a clay of low to medium plasticity and compressibility. The Liquidity Indices which relate the natural moisture content

Cont'd over....

of the clay to the Atterberg Limits were 0.1 and 0.2 indicating a 'stiff' consistency.

An unconfined compression test was carried out on a sample of the clay till to determine the undrained shear strength of the soil. The test gave a value of 5000 pounds per square foot confirming the 'hard' consistency indicated by the standard penetration test results.

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

VI DISCUSSION

The natural subsoil consists of 'stiff' to 'hard' silty clay till which will be suitable for the use of normal spread footing foundations.

The existing fill material extends to about El. 90 at borehole 2 location, and the refusal obtained in the standard penetration test at this elevation is attributed to the split-spoon sampler encountering the existing bridge footing. It will therefore be appropriate to construct the new footings within the hard silty clay till stratum at or below El. 89, and on the basis of the field and laboratory test results, a maximum net soil pressure of 8000 p.s.f. may be used in the design. The existing creek bed elevation is 93.0 feet, therefore the footings will have a sufficient depth of cover for frost protection. However, a hydrological study should be made to determine the maximum depth of scour prior to establishing the footing grade.

It is estimated that total settlement of the structure 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 silty 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 'stiff' to 'hard' cohesive till will present no unusual construction problems. The volume of seepage into excavations will be very small and should be collected in sumps dug below the footing grade and removed by pumping.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED

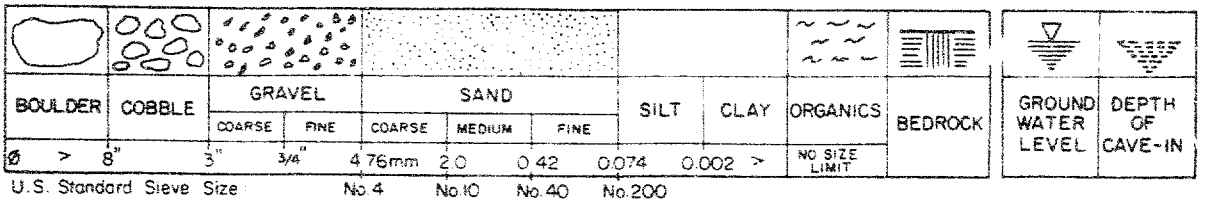
C.J.W. Atkinson, M.Sc., P.Eng.,
Branch Manager

CJWA:jms

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



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

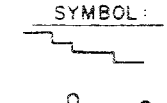
Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ø, 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 :



EXTRAPOLATED -N- VALUE

322

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 — UNCONFINED TEST $\bullet^{St}$

LABORATORY VANE TEST X^{St}

FIELD VANE TEST $+^{St}$

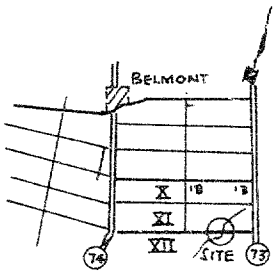
POCKET PENETROMETER TEST $\blacktriangledown^{St}$

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

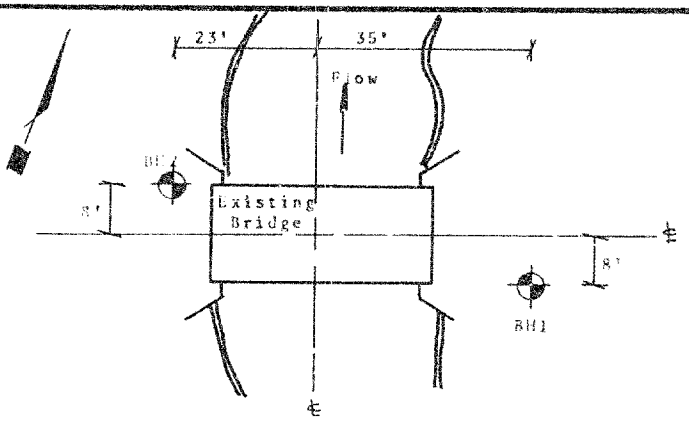
St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

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



KEY PLAN



LOCATION OF BOREHOLES

Scale 1-inch to 20 feet

LEGEND

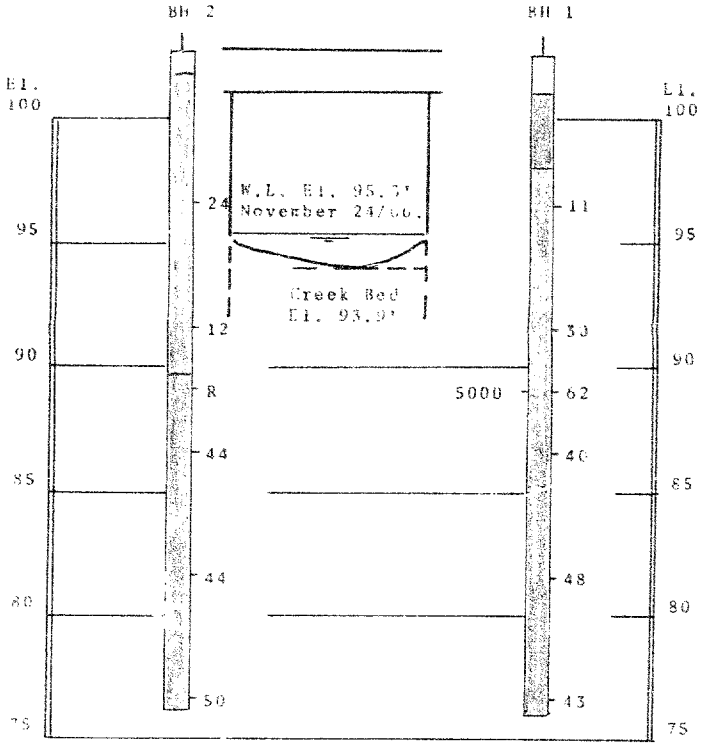
Sand and Gravel

Silty Clay Fill

Stiff to Hard
Silty Clay Till

Note: Figures to right of boreholes denote standard penetration resistance (blows per foot).

Figures to left of boreholes denote undrained shear strength (p.s.f.)



SUBSURFACE PROFILE

Vert. Scale 1-inch to 5 feet

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 1 . . .

OUR REFERENCE NO. 6-11618

CLIENT: A. M. Sprict & Associates, Ltd — METHOD OF BORING: Washboring — ENCLOSURE NO. 3

PROJECT: County Bridge No. 50 — DIAMETER OF BOREHOLE: Bx (3-inch)

LOCATION: Lot 15, Conc. IIG 12, S. Dorchester Twp. — DATE: November 24 & 25, 1966

DATUM ELEVATION: 100 feet, Nail in S. face of hydro pole, 0+80W, north side of road.

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N & Advancement of Sampler	PENETRATION RESISTANCE blows per foot 20 40 60 80 100 / SHEAR STRENGTH 100 lbs sq ft 10 20 30 40 50	CONSISTENCY water content % PL W LL 10 20 30 40	REMARKS
102.5	0.0	Ground Surface							
	1.5	Sand & Gravel							
100		Brown silty clay Fill, trace of organics.							W. L. El. 98.5
	4.3	Stiff		1	SS	11	○		
95		to							
		hard							
		brown		2	SS	30	○		
90		silty		3	SS	62	○	●	
		clay,							
		traces		4	SS	40	○		
85		of							
		sand		5	SS	43	○		
		and							
80		fine							
		gravel.							
	26.7	(Glacial Till)		6	SS	45	○		
		End of Borehole							

VERTICAL SCALE: 1 IN. TO 5 FT

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MADE CHD.

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

OUR REFERENCE NO. 6-11-148

CLIENT A. M. Sp ïet & Associates — METHOD OF BORING Washboring — ENCLOSURE NO. 4

PROJECT County Bridge No. 39 — DIAMETER OF BOREHOLE 3x (3-inch)

LOCATION Lot 15, Conc. 11 & 12, S. Dorchester Twp. — DATE November 24 & 25, 1966

DATUM ELEVATION 100 feet, Nail in S. face of hydro pole, 0+80W, north side of road.

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES % RECOVERY OF SAMPLE	PENETRATION RESISTANCE Blows per foot 20 40 60 80 100	SHEAR STRENGTH 100 lbs/sq ft 10 20 30 40 50	CONSISTENCY WATER CONTENT % PL W LL 10 20 30 40	REMARKS
102.7	0.0	Ground Surface								
	1.0	Sand & Gravel								
		Brown silty clay, trace of organics (Fill)		1	SS	24				W. L. El. 98.7
				2	SS	12				
	13.0			3	SS	Refusal				
		Hard brown silty clay, traces of sand and fine gravel (Glacial Till)		4	SS	44				
				5	SS	44				
				6	SS	50				
	26.5	End of Borehole								

VERTICAL SCALE 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE CHD