

CONESTOGO

RIVER BRIDGE.

LOT 1, CON. 12+13

PEEL TWP.

40 P 15 - 20

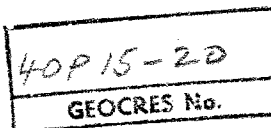


DOMINION SOIL INVESTIGATION LIMITED

CONSULTING SOIL & FOUNDATION ENGINEERS

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REPORT ON SUBSURFACE INVESTIGATION
CONESTOGO RIVER BRIDGE REPLACEMENT
LOT 1, CONCESSIONS 12 & 13
TOWNSHIP OF PEEL

Ref. No. 74-8-K15

October 1974

Prepared for:
Township of Peel,
c/o Kelley & Smart Limited,
Consulting Engineers,
13 Spetz Street,
Kitchener, Ontario.

Distribution:

- 6 copies - Kelley & Smart Ltd.,
- 1 copy - Dominion Soil Investigation Limited (TORONTO)
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§

1.0 INTRODUCTION

Dominion Soil Investigation Limited has been retained by Kelley & Smart Limited to conduct a subsurface investigation at the Conestogo River Bridge Replacement in the Township of Peel. Authorization to proceed with the work was received in a letter dated August 28, 1974 from Mr. W.E. Kelley, P. Eng., of Kelley & Smart Limited Consulting Engineers for the project.

The purpose of the investigation was to disclose the subsurface conditions at the site and make recommendations for the design and construction of the proposed bridge.

2.0 METHOD OF INVESTIGATION

The field work consisted of four exploratory boreholes put down at the locations shown on Drawing No. 1 of this report. Two of the boreholes were advanced from the bottom of the stream bed and two were done through the existing abutment fill. The boreholes were advanced to the sampling depths using a continuous flight hollow stem power auger and samples of the subsoil were recovered at 2½ and 5 foot intervals of depth in each borehole using the Standard Penetration Test Method. The samples recovered were returned to our laboratory for analysis and classification.

S

Elevations have been referred to a temporary benchmark established by the Consulting Engineers for the project. The benchmark used was the top of the existing concrete curb at the south east end of the bridge, having a given elevation of 100.0 feet, reference to local datum.

3.0 THE SITE

The site of the proposed bridge replacement is at the crossing of the Conestogo River and the road allowance between Concessions 12 and 13 in the Township of Peel. The site is located approximately 1 mile north-east of the village of Drayton. The existing bridge, which is a single span steel truss with a span of 115 feet, which crosses the Conestogo River which flows through the meandering valley channel cut through a wide flood plane. The bottom of the stream generally consists of gravel and the depth of water was approximately 12 inches at the time of the investigation.

The sides of the present channel are almost vertical being 4 feet in height. There is evidence of flooding in the vicinity of the bridge.

4.0 SUBSOIL CONDITIONS

The subsoil conditions encountered in the boreholes done at this site varied in the surficial soil deposits. At depth

the soil was quite uniform. Details of the subsoil conditions encountered in each borehole are shown on the individual borehole logs of Enclosures 2 to 5 inclusive and are illustrated graphically on the subsurface profile of Drawing No. 1. These conditions may be summarized briefly as follows,

- (i) FILL - Beneath the ground surface (elevation 100.0) at the bridge abutments 14 to 15 feet (EL 85) of compact sand and silt fill was encountered. 'N' values within the fill ranged from 8 to 21 blows per foot (higher values were caused by gravel). The fill contained some debris.
- (ii) SAND & GRAVEL -The river bottom consists of silty sand and gravel and this sand stratum was also encountered in the boreholes done at the abutments. The thickness of the stratum ranged from 3 to 6 feet and 'N' values within the sand and gravel ranged from 20 to over 100 blows per foot.
- (iii) SILT TILL -Beneath the sand and gravel, very dense grey silt till was encountered. The till varied from clayey to sandy silt and 'N' values ranged

31 to over 100 blows per foot. All boreholes were terminated within the silt till, the deepest penetration being $31\frac{1}{2}$ feet below ground surface.

5.0 GROUNDWATER CONDITIONS

As the boreholes were either in the river or very near to the river, the groundwater level is the same in the boreholes as the river level at the time of the investigation. This appears to be due to the direct connection with the river through the pervious sand and gravel stratum.

6.0 DISCUSSION

The existing single span steel truss bridge over the Conestogo River is to be replaced with a three span concrete structure. The existing channel beneath the bridge will be widened to increase the flow opening. The two piers will be located in the stream bed and the horizontal and vertical alignment will remain unchanged. The proposed footing elevation is 74.5 feet, 25½ feet below the bridge deck.

6.1 Bearing Capacity & Settlement

The proposed structure can be supported on spread footings cast at elevation 74.5 feet where the subsoil is very dense grey silt till. A safe net bearing pressure of 10 K.S.F. is recommended for the design of the foundations.

The footings will be subjected to a lateral pressure due to water and ice forces and a coefficient friction between the silt till and the foundation may be assumed as 0.35. The factor of safety against sliding should be 1.5 and should friction not be adequate, the passive restraint of this soil should be utilized by installing a key. ($K_p = 3.0, \gamma = 130$ pcf)

The total settlement is expected to be less than 1 inch and differential settlements will be negligible due to the uniformly

high relative density encountered at the proposed foundation depth. The depth of the footing proposed will provide adequate protection against scour and frost.

6.2 Excavation & Dewatering

Excavations in the creek filled bed will be up to 8 feet deep and at the abutments will be up to 25 feet deep. Excavations for the water table where a stratum of pervious sand and gravel was encountered, will require extensive dewatering. Gravity sumps and pumping will probably not handle the in-flow of water expected, and well-points are probably not practical for this project. It is therefore suggested that the excavation be enclosed in tight sheeting which should penetrate into the silt till stratum to provide a cut-off. Only a slight seepage is expected from the silt till.

Excavations above the water table and fill should be sloped at $1\frac{1}{2}$ horizontal to 1 vertical. Excavations in the sand and gravel will be supported by sheeting which should be designed to resist the lateral earth pressure including surcharge using a coefficient of active pressure, $K_a=0.30$ and the unit weight of soil, $\gamma = 130$ pcf.

6.3 Backfilling

The excavated sand and gravel will be suitable for re-use as backfill. In order to prevent an accumulation of water behind

the abutments, drains through the abutments should be provided. The drains should effectively drain the backfill to the full depth and screens on the outlets should be provided.

It is proposed to construct the embankments at $1\frac{1}{2}$ horizontal to 1 vertical, and the embankments will be built partly of fill. Embankments of 2 horizontal to 1 vertical are suggested and should be protected by rip-rap or sand placed slabs up to the high water level.

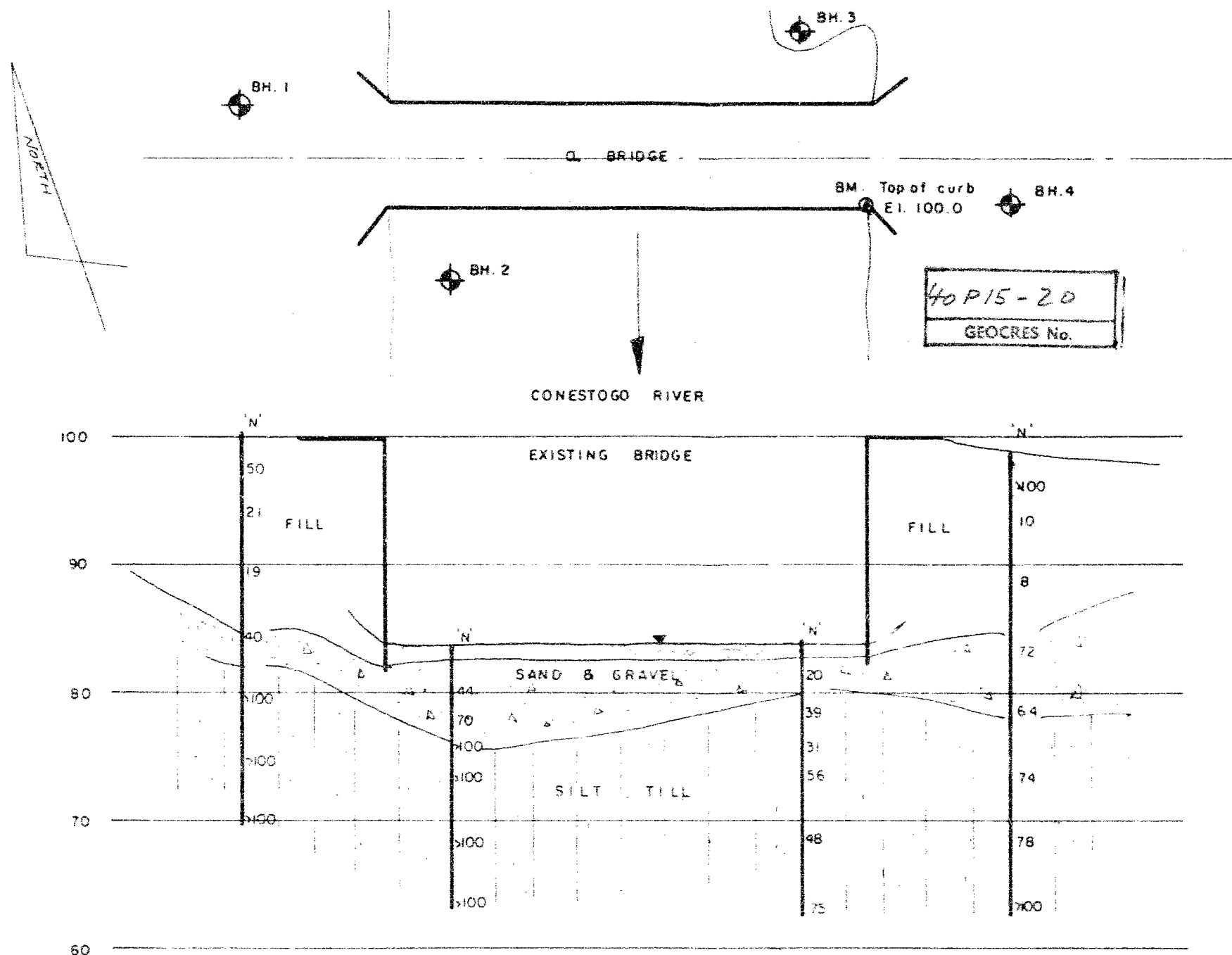
DOMINION SOIL INVESTIGATION LIMITED.

J.B. England

J. Byron England, P. Eng.,
Kitchener Branch Manager



JBE*dr



BOREHOLE LOCATION PLAN & SUBSOIL PROFILE

SCALE
 HOR. 1" = 30'
 VERT. 1" = 10'

Prep. By LWM

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURESOIL COMPONENTS AND GROUND WATER CONDITIONS

											Ground Water Level	
BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANIC	BEDROCK		Depth of Cover-in
		coarse	fine	coarse	medium	fine						
Ø	< 8"	4"	3/4"	4-76mm	2-0	0-42	0-074	0-002	<	no size limit		

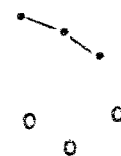
SAMPLE TYPES

AS	Auger Sample	SS	Split Spoon Sample
RC	Rock Core	TP	Piston, thin walled tube sample
%	Recovery	TW	Open, thin walled tube sample

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-1: to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot

SYMBOLSOIL PROPERTIES

W%	Water content	k	Coeff. of permeability
LL%	Liquid limit	C	Shear strength — in terms of total stress
PL%	Plastic limit	φ	Angle of int. friction — in terms of total stress
γ	Natural bulk density (unit wt.)	C'	Cohesion — in terms of effective stress
Cv	Coeff. of consolidation	φ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH

— DERIVED FROM —

TRIAXIAL

UNCONFINED

LABORATORY

FIELD

POCKET
PENETROMETER
TEST

COMPRESSION TEST

VANE TEST

St



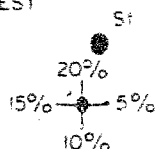
St

X

+

St

Strain at failure is represented by direction of stem



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

LOG OF BOREHOLE.....I.....

Our Reference No. 74-8-K15

Enclosure No. 2

CLIENT: Kelley & Smart Limited
PROJECT: Conestogo River Bridge
LOCATION: Conc 12 & 13, Drayton
DATUM ELEVATION: Local

DRILLING DATA

Method: Augering
Diameter: 6"
Date: September 30, 1974.

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS		
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	Blows / Foot					PLASTIC LIMIT	NATURAL		LIQUID LIMIT	
								20	40	60	80	100					
								UNDRAINED SHEAR STRENGTH									
								+ FIELD VANE TEST					COMPRESSION TEST				
<div><div>W_p</div><div>W</div><div>W_L</div></div>																	
1003	0	GROUND SURFACE															
		Granular Fill															
983	20	Compact to			1	SS	50										
	5	dense brown															
940	63	silty SAND (FILL)			2	SS	21										
		Compact															
		dark brown															
	10	SILT			3	SS	19										
		trace sand															
		(FILL)															
853	15	Dense brown			4	SS	40										
		silty SAND															
		some gravel															
823	180	Very Dense			5	SS	>100										
	20	grey SILT															
		TILL															
	25	embedded sand			6	SS	>100										
	30				7	SS	>100										
700	303	END OF BOREHOLE															

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: DL

CHECKED: *[Signature]*

LOG OF BOREHOLE2.....

Enclosure No. 3

Our Reference No. 74-8-K15.

CLIENT: Kelley & Smart Limited
PROJECT: Conestogo River Bridge
LOCATION: Conc 12 & 13, Drayton
DATUM ELEVATION: Local

DRILLING DATA

Method: Augering

Diameter: 6½

Date: September 30, 1974.

SUBSURFACE PROFILE		SAMPLES			PENETRATION RESISTANCE Blows/Foot					WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Ft.	20	40	60	80	100	
								UNDRAINED SHEAR STRENGTH + FIELD VANE TEST					
83.8	0	WATER SURFACE											
82.8	1.0	water											
		Dense to											
		very dense			1	SS	44		0				
	5	brown SAND											
		& GRAVEL			2	SS	70			0			
76.8	7.0	Very dense			3	SS	>100				0		
	10	grey SILT			4	SS	>100				0		
		TILL											
	15	embedded sand			5	SS	>100				0		
	20												
63.1	20.7	END OF BOREHOLE			6	SS	>100				0		

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: DL

CHECKED: gal.

LOG OF BOREHOLE3.....

Enclosure No.4....

Our Reference No. 74-8-K15
 CLIENT: Kelley & Smart Limited
 PROJECT: Conestogo River Bridge
 LOCATION: Conc 12 & 13, Drayton
 DATUM ELEVATION: Local

DRILLING DATA

Method: Augering
 Diameter: 6½
 Date: September 30/74.

SUBSURFACE		PROFILE		SAMPLES			PENETRATION RESISTANCE Blows/Foot					WATER CONTENT %			REMARKS				
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows/Ft.	20	40	60	80	100	PLASTIC LIMIT	NATURAL		LIQUID LIMIT			
								UNDRAINED SHEAR STRENGTH p.s.f.											
								+ FIELD VANE TEST ● COMPRESSION TEST											
								W _P			W			W _L					
84.1	0	WATER SURFACE																	
83.2	0.9	water																	
80.6	3.5	Compact SAND & GRAVEL			1	SS	20												
	5	Hard grey clayey SILT			2	SS	39												
		TILL			3	SS	31												
	10				4	SS	56												
	15	Dense to very dense grey sandy SILT TILL			5	SS	48												
	20				6	SS	75												
62.6	21.5	END OF BOREHOLE																	

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

DRAWN: DL

CHECKED: *gsl*

LOG OF BOREHOLE 4

Our Reference No 74-8-F15

Enclosure No 5

CLIENT: Kelley & Smart Limited
PROJECT: Conestogo River Bridge
LOCATION: Cons 12 & 13, Inayton
DATUM ELEVATION: Local

DRILLING DATA

Method: Augering
Diameter: 6"
Date: September 30, 1974.

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	Blows / Foot					PLASTIC LIMIT W _p	NATURAL W		LIQUID LIMIT W _L
								20	40	60	80	100				
								UNDRAINED SHEAR STRENGTH + FIELD VANE TEST COMPRESSION TEST								
98.5	0	GROUND SURFACE														
96.5	2.0	Granular Fill	A													
		Compact SAND & GRAVEL (FILL)	B		1	SS	>100						0			
93.0	5.5	Compact dark brown SILT & SAND, debris (FILL)	C		2	SS	10	0								
					3	SS	8	0								
84.5	14.0	Very dense yellowish brown SAND & GRAVEL	D		4	SS	92				0					
78.0	20.0	Hard grey clayey SILT (TILL)	E		5	SS	64			0						
					6	SS	74			0						
68.0	30.0	Very dense grey brown sandy SILT TILL	F		7	SS	78			0						
					8	SS	>100						0			
62.5	36.5	END OF BOREHOLE														

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: DL

CHECKED: JMK