

REEKER BR.,

ONONDAGA TWP.

MIDDLE PORT

40P1-68



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40 P1-68
GEOCRES No.

REPORT ON SOIL CONDITIONS
RECONSTRUCTION OF REEKER BRIDGE
TOWNSHIP OF ONONDAGA
MIDDLEPORT, ONTARIO.

Ref. No. 74-3-K7

April 1974

Prepared for:
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Consulting Engineers
361 Elgin Street
Brantford, Ontario.

Distribution:

6 copies - J.D. Lee Engineering Limited
1 copy - Dominion Soil Investigation Limited (Toronto)
1 copy - Dominion Soil Investigation Limited (Kitchener)

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1.0 INTRODUCTION

Dominion Soil Investigation Limited has carried out a subsurface investigation for the proposed reconstruction of the Reeker Bridge on Big Creek in the Township of Onondaga.

Authorization to carry out the work was received in a letter dated March 20, 1974 from Mr. J.H. Cohoon, P. Eng of J.D. Lee Engineering Limited, Consulting Engineers for the project.

The purpose of the excavation was to disclose the subsurface conditions and make recommendations for the design and construction of the foundations.

2.0 METHOD OF INVESTIGATION

A total of 4 exploratory boreholes were put down at the locations shown on Dwg. No. 1. The boreholes were advanced to the sampling depths using a continuous flight power auger equipped with hollow-stem augers. Samples of the subsoil were recovered at 5 foot intervals using the Standard Penetration Test method. Several undisturbed samples of the cohesive soil were recovered using a thin-walled Shelby tube sampler and in-situ shear vane tests were done in the cohesive soil.



In two boreholes, bedrock was cored in the Bx (1-5/8") size for a depth of 10 feet.

Elevations have been referred to geodetic datum using a benchmark provided by the Consulting Engineers. The benchmark used is shown on Dwg. No. 1.

3.0 THE SITE

The existing single span steel frame bridge spans Big Creek a distance of 50 feet. The water level in Big Creek is 16 feet below the bridge deck.

The area is generally flat to slightly rolling and Big Creek has cut a deep U-shaped channel between the ridges or areas of higher elevation. There is no distinct alluvial valley and the embankments are quite steep to the north. To the south there is evidence of a wide valley with shallow embankments.

The existing abutments appear to have tilted toward the creek probably due to backfill pressure, and the bridge is in poor condition.

4.0 SUBSOIL CONDITIONS

Subsoil conditions as revealed in the four boreholes were quite uniform. Details of these conditions are given on Enclosures 2 to 5, the borehole logs and are presented in profile form on Dwg. No. 1. These conditions may be summarized briefly below.

- (i) FILL - 6 to 12 inches of granular fill overlying 4 to 8 feet of soft to stiff brown clayey silt fill was encountered in the boreholes. The fill layer was not distinct from the upper part of the natural soil except for grey clay inclusions in borehole 2 and remnants of root fibres in the upper level of the underlying natural soil.
- (ii) PEAT - in borehole 2, 6 feet of compact black peat was encountered beneath the fill extending to a depth of 14 feet (El. 723). Pieces of wood were encountered near 14 feet suggesting that an old foundation may be present within the existing backfill.
- (iii) CLAY - the natural stratum at the site is very soft to stiff brown to grey silty clay. The clay has a varved structure (lamination of clay, silt and very fine sand) and the results of the Standard Penetration tests gave N - values ranging from

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The upper zone was generally "stiffer" indicates a shallow crust overlying the firm stratum. The in-situ shear strengths ranged from 1400 to 2900 p.s.f. with values near 1500 psf most common and the sensitivity was of the order of 1.2.

The clay stratum extended to El. 687 where intact grey dolomitic limestone bedrock was encountered. Core recovery in the bedrock was over 90% and the recovered core showed only minor fracturing.

5.0 GROUNDWATER CONDITIONS

The free surface of the groundwater table was encountered at El. 730⁺ 8 feet above the level in Big Creek. The levels encountered are anticipated to be representative of a perched condition and the true level is near the level of the soil colour change: El. 725⁺.

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6.0 DISCUSSION

Reeker Bridge will be replaced by a single span bridge along the present alignment. The water level in Big Creek is 16 feet below the bridge deck and the creek flows in a channel with steep, high embankments.

The site is underlain by surficial fill with some peat in borehole 2 extending to 14 feet. At depth firm to stiff silty clay was encountered with bedrock at a depth of 50 feet.

6.1 Foundations for Bridge.

The silty clay encountered to a depth of 50 feet has a low shear strength and is compressible. Spread footings are not considered feasible due to the magnitude of the settlement and the low allowable bearing pressure.

Therefore deep foundations bearing on the limestone bedrock are recommended and both piles and drilled caissons are feasible. Each will be discussed below.

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6.1.1. Pile Foundations

Due to the firm to stiff consistency of the clay, all types of piles would penetrate to bedrock. Timber piles are not considered economical because the driving length would be the same as for higher capacity steel H or tube piles and the safe working load of size 14 (12 inch diameter) timber piles is only 20 to 25 tons per pile.

The safe net working load for steel piles driven to rock is 10,000 psi of net steel area. Precast-concrete piles could be designed to develop their full structural capacities. The tip of the piles should be adequately protected to prevent damage when driven to bedrock. Some minor difficulty in driving can be expected near 15 feet in the vicinity of BH2 where pieces of wood were encountered.

Battered piles are recommended to resist unbalanced lateral pressures such as the lateral forces from the retained soil which caused the tipping of the existing abutments.

Pile caps should be formed beneath the anticipated depth of scour and frost.

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6.1.2 Drilled Caissons

Drilled caissons bearing in the bedrock could also be considered. A safe net bearing pressure of 20 Tons per square foot may be used for the design.

The caissons should have a minimum shaft diameter of 30 inches to permit inspection of the base. The caissons should be inspected for location and plumbness.

The clay possesses a moderate degree of stiffness but the presence of silt seams suggests that a full depth liner will be required to prevent minor cave-in. The clay has sufficient cohesive to permit the formation of small enlarged bases (bells) and the recommended maximum size is 48 inches.

6.2 Drainage

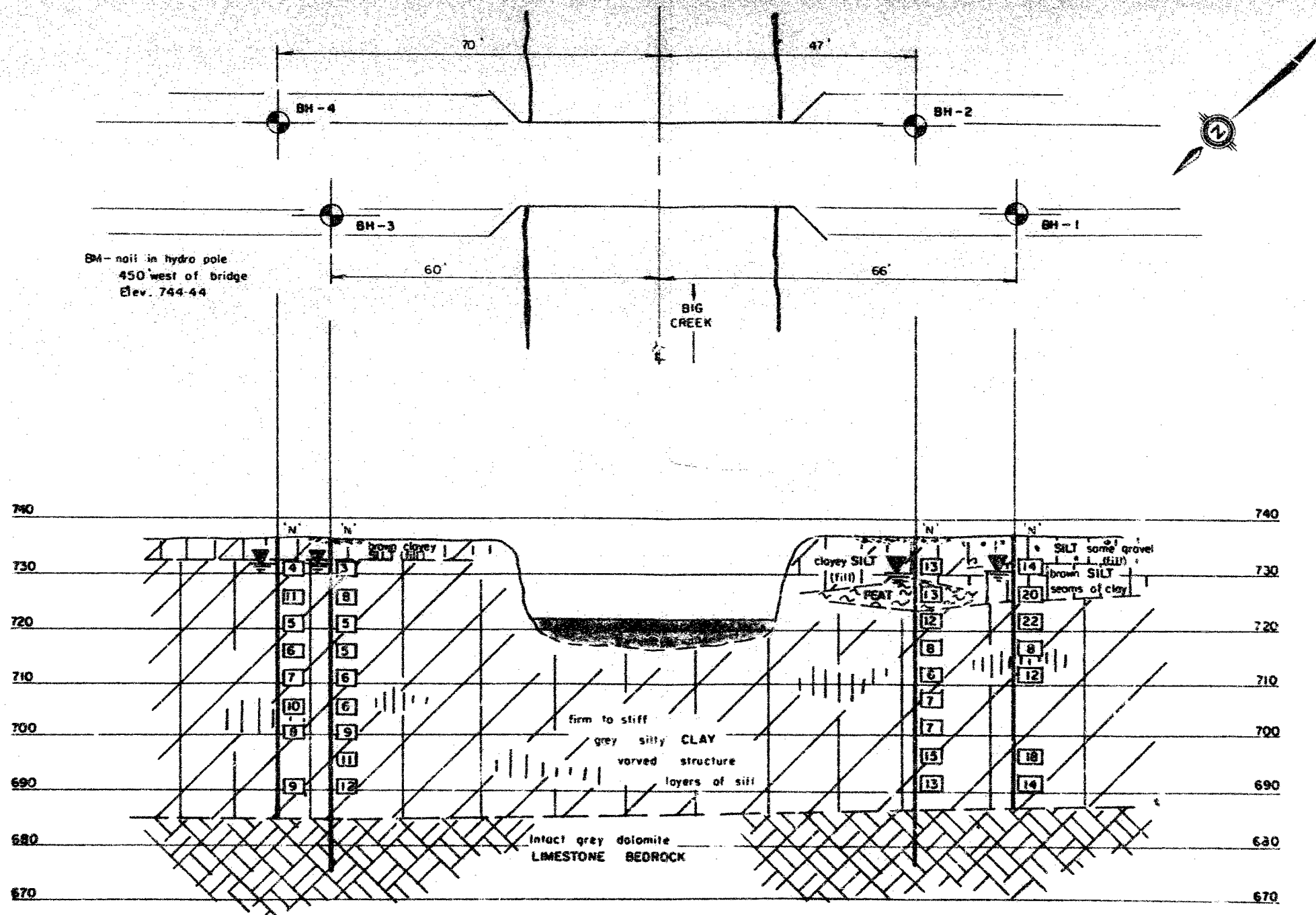
The backfill behind the abutments should be granular material and adequate drainage of the backfill should be provided through the abutments. Crushed stone should be placed around each drain to act as a filter.

DOMINION SOIL INVESTIGATION LIMITED.

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



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Borehole Location Plan and Inferred Subsoil Profile

40PI-68
GEOCRE No.

scale hor & vert: 1" = 20'

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 Cave-in
Ø < 6"		coarse	fine	coarse	medium	fine					no size limit	
		4"	3/4"	4-7.5mm	20	0.42	0.075					

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: 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
PL%	Plastic limit	φ	Angle of int. friction
γ	Natural bulk density (unit wt.)	c	Cohesion
Cv	Coeff. of consolidation	φ'	Angle of int. friction
			in terms of total stress
			in terms of effective stress

UNDRAINED SHEAR STRENGTH

— DERIVED FROM —

TRIAXIAL

UNCONFINED

LABORATORY

FIELD

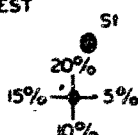
POCKET
PENETROMETER
TEST

COMPRESSION TEST

VANE TEST

S_t

Strain at failure is represented by direction of stem



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

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

Our Reference No 74-3-K7

Enclosure No 2

CLIENT: J.D. Lee Engineering Limited
PROJECT: Reconstruction of Pecker Bridge
LOCATION: Township of Onondaga
DATUM ELEVATION: G.S.C.

DRILLING DATA

Method: Augering
Diameter: 6 1/2"
Date: April 2, 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	W _p	W		W _L	
								UNDRAINED SHEAR STRENGTH									lbs./sq. ft.
								+ FIELD VANE TEST * COMPRESSION TEST									
								500	1000	1500	2000	2500					
737.5	0	GROUND SURFACE															
736.5	10	SAND & GRAVEL FILL															
		Brown SILT some gravel FILL															
732.5	20	Very stiff brown SILT seams of clay			1	SS	14	0									
	10																
					2	SS	20	0									
725.0	125																
	5	Firm to stiff brown silty CLAY varved structure with layers of silt			3	SS	22	0									
	20				4	SS	8	0									
	22				5	SS	12	0									
	30				6	TW											
	35				7	TW											
	40				8	SS	16	0									
	45				9	SS	14	0									
687.0	50.5	END OF BOREHOLE			10	SS	>100										

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: LWM CHECKED: JBE

LOG OF BOREHOLE.....2.....

Our Reference No. 74-3-K7

Enclosure No. 3

CLIENT: J.D. Lee Engineering Limited
PROJECT: Reconstruction of Pecker Bridge
LOCATION: Township of Onondaga
DATUM ELEVATION: G.S.C

DRILLING DATA

Method: Augering & Pock Coring
Diameter: 6 1/2" & 8" R x
Date: April 3, 1974

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %			REMARKS	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL		LIQUID LIMIT
								UNDRAINED SHEAR STRENGTH + FIELD VANE TEST	STRENGTH lbs/sq. ft.				W _p	W		W _L
								• COMPRESSION TEST								
737.0	0	GROUND SURFACE														
736.5	0.5	GRANULAR FILL														
	5	Stiff brown and grey clayey SILT (FILL)			1	SS	13	0								
729.0	8.0	Compact black PEAT wood			2	SS	13	0								
723.0	14.0				3	SS	12	0								
	20	Stiff Silty CLAY varved structure layers of silt			4	SS	8	0								
	25				5	SS	6	0								
	30				6	SS	7	0								
	35				7	SS	7	0								
	40				8	SS	15	0								
	45				9	SS	13	0								
686.5	50.5	Intact grey dolomitic LIMESTONE BEDROCK			10	RC	90% Rec.									
	55				11	RC	90% Rec.									
676.5	60.5	END OF BOREHOLE														

Auger refusal
on wood, hole
moved 5 feet
and redrilled

Auger refusal on wood, hole moved 5 feet and redrilled

VERTICAL SCALE: 1 inch to 6 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: LWM CHECKED: JBE

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

Our Reference No. 74-3-K7

Enclosure No. 4

CLIENT: J.D. Lee Engineering Limited
PROJECT: Reconstruction of Reeker Bridge
LOCATION: Township of Onondaga
DATUM ELEVATION: G.S.C.

DRILLING DATA
Method: Augering & Rock Coring
Diameter: 6 1/8" x 8x
Date: April 5, 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	W _p	W		W _L
								UNDRAINED SHEAR STRENGTH + FIELD VANE TEST								
736.9	0	GROUND SURFACE														
736.4	0.5	736.4														
		Brown clayey SILT (FILL)														
732.4	4.5	Very soft to stiff silty CLAY			1	SS	3	0								
	10				2	SS	8	0								
	15	brown grey			3	SS	5	0								
	20	varved structure layers of silt			4	SS	5	0								
	25				5	SS	6	0								
	30				6	SS	6	0								
	35				7	SS	9	0								
	40				8	SS	11	0								
	45				9	SS	12	0								
585.7	51.2	Intact grey dolomitic LIMESTONE BEDROCK			10	RC	98% Rec									
	55				11	RC	100% Rec.									
575.7	61.2	END OF BOREHOLE														

VERTICAL SCALE: 1 inch to 6 feet

LOG OF BOREHOLE....4.....

Our Reference No. 74-3-K7

Enclosure No. 5

CLIENT: J.D. Lee Engineering Limited,
PROJECT: Reconstruction of Reeker Bridge,
LOCATION: Township of Onondaga
DATUM ELEVATION: G.S.C.

DRILLING DATA

Method: Augering
Diameter: 6½"
Date: April 4, 1974

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %			REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N'	Blows / Foot				PLASTIC LIMIT	NATURAL	LIQUID LIMIT	
								20	40	60	80	100			
								UNDRAINED SHEAR STRENGTH							
								+ FIELD VANE TEST							
								1000	1500	2000	2500	3000			
736.9	0	GROUND SURFACE													
		Brown clayey SILT (FILL)													
732.9	4.0				1	SS	4	0							
	5	Very soft to stiff silty CLAY													
	10				2	SS	11	0							
	15	varved structures layers of silt			3	SS	5	0							
	20				4	SS	6	0							
	25				5	SS	7	0							
	30				6	SS	10	0							
	35				7	SS	8	0							
	40				8	SS	-								
	45				9	SS	9	0							
685.4	51.5	END OF BOREHOLE													

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: LWM CHECKED: JBE