

68 - F - 216 M

BRIDGE

ROAD #3

WILMOT TWP.

BA. 2920
Site 33-75

PETO ASSOCIATES LIMITED

68-F-216 M

SOIL FOUNDATION INVESTIGATION
BRIDGE ON WILMOT-TWP. ROAD #3
SITE 33-75
S. E. OF WELLESLEY

for

TOWNSHIP OF WILMOT
c/o MCCARGAR AND HACHBORN LTD.

Distribution:

4 cc Client
1 cc File

JOB NO. 68-F192

NOVEMBER, 1968



PETO ASSOCIATES LTD.
CONSULTING SOIL ENGINEERS
1287 Caledonia Rd. Toronto 19 - Ontario - Phone (416) 789-1126

JOB NO. 68-F192

November 7, 1968.

Township of Wilmot,
c/o McCargar and Hachborn Ltd.,
Consulting Engineers,
546 Belmont Avenue West,
P.O. Box 368,
Kitchener, Ontario.

Attention: Mr. E. G. Hachborn, P. Eng.

Dear Sir:

Re: Soil Foundation Investigation
Bridge on Wilmot-Twp Road #3
Site 33-75
S. E. of Wellesley.

The investigation was authorized by letter dated the 2nd October 1968 by Mr. E. G. Hachborn on behalf of the Client.

It is proposed to replace the existing structure with a 20 to 25 ft. span by 8 ft. high concrete box culvert, either rigid frame or a simple prestressed slab.

Two boreholes were located as shown on the accompanying site plan, see Figure 2; they were set out by our field technician who referred the ground elevations to a Temporary Bench Mark set up by the Consulting Engineer; this was a nail and flag in the root of the tree, east of existing bridge, north of road, station 0+83.5. The assumed elevation was 100.00.



The boreholes were put down by a 3½ inch diameter power operated auger using "H" casing to 15 ft. control caving between 6 and 12 ft.

The main soil stratum underlying the site is a grey compact to loose to coarse silt in a saturated condition. See Fig.1.

The stream bed is formed in this stratum, which arises at depths of 8 and 9 ft. below grade at holes 1 and 2 respectively and extends down to depths of between 23 and 20 ft. The "N" values at the two holes varied between 7 and 11 with an average value of 9.

With increasing depth, the silt stratum changes to a grey interbedded and saturated silty clay and silt in a stiff condition with "N" values of 27; both testholes were terminated in this stratum at 26 ft. 6 ins. below grade.

Overlying the main grey silt stratum and forming the banks of the creek, there was between 2 ft. 6 ins. and 3 ft. of fill consisting of mixed sand and gravel in a loose to compact and moist condition.

Below this and forming the creek banks, there is a brown to strong brown silty clay with pockets and seams of silt to clayey silt. In hole #1, at about 8 ft., the soil becomes a clayey sand containing some grits and fine gravel. This corresponds with a 12 inch seam of organic mixed sand and silty clay at depths of 7 to 8 ft. in hole #2. These sandy layers are believed to be the old stream bed, which has been eroded away by the creek between the testholes.

The "N" values in the creek bank stratum between 3 and 8 ft., vary between 6 and 9 with an average value of 7 and indicate a firm to stiff consistency in the stream banks.

Ground water was encountered at 7 ft. below grade in hole #1; this rose to 5 ft. 9 ins. after a period of 7 minutes and the hole caved at 6 ft. 10 ins.

In hole #2, water was encountered after the 10 ft. sample was recovered; here the water level rose to 7 ft. 5 ins. and the hole caved at 8 ft. 9 ins. after 5 minutes. After two hours, equilibrium level was reached at 5 ft. 8 ins. below grade.

These water levels correspond to elevations 96.1 and 96.4 at holes 1 and 2 respectively and compare with the elevation of the water, which at that time, was at elevation 96.1.

In order to advance the boreholes below these depths, 15 ft. of "H" casing was installed.

Following completion of the boreholes and withdrawal of the casing, the following details were recorded:

<u>BH #</u>	<u>Depth</u>	<u>Caved at</u>	<u>W.L. Depth</u>	<u>W.L. Elevation</u>
1	7	6'-10"	5'-9"	96.1 *
1	26'-6"	11'- 6"	9'-9"	92.1
2	26'-6"	10'- 6"	9'-3"	92.8
2	26'-6"	10'- 6"	5'-8"	96.4 after two hours *

*These represent equilibrium level and compare well with creek level at elevation 96.1.

The ground conditions at this site are capable of supporting either the rigid box type culvert with the floor or bed slab founded at ± elevation 90.0, or the simple prestressed slab supported on strip footings founded at elevation 87.0. In either case, an allowable bearing value of 2 Kips per sq. ft. may be used for design purposes with a normal settlement tolerance of 1 inch.

The main problem arising at this site concerns the ground water control, which is necessary to permit excavation to be carried out below the present ground water level.

The non cohesive nature of the foundation soil will allow seepage pressures to destroy the bearing capacity of the subsoil if they are not effectively controlled during construction.

In order to achieve this, vacuum type well points installed in 8 to 10 inch diameter sand wicks using a sanding shell and wash boring or similar method will be necessary to ensure the well points are correctly installed and will work effectively. The sand used for the filter wicks should be sheet asphalt sand as specified in A.S.T.M. D-1073 and they should extend down to the lower boundary of the silt stratum at elevation ± 80 .

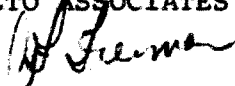
The foundation stratum is subject to scour and therefore rip rap or similar protection is recommended for the stream bed between the culvert walls; furthermore, the backfill around the section of the foundation walls below stream bed level should consist of weak concrete.

The backfill between the culvert and the road subgrade should be transitioned in accordance with the D.H.O. Standard D.D. 809 using sand cushion or Granular "B" material.

In conclusion, it is our opinion that the simple prestressed slab type of culvert is more compatible for the more difficult ground water conditions arising on this site.

Yours very truly,

PETO ASSOCIATES LTD.



C. F. Freeman, P. Eng.,
Chief Engineer.

CFF/jc

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 360 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS/FT.</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS/FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		
W.T.P.L. WETTER THAN PLASTIC LIMIT		D.T.P.L. DRIER THAN PLASTIC LIMIT		
A.P.L. ABOUT PLASTIC LIMIT				

TYPE OF SAMPLE

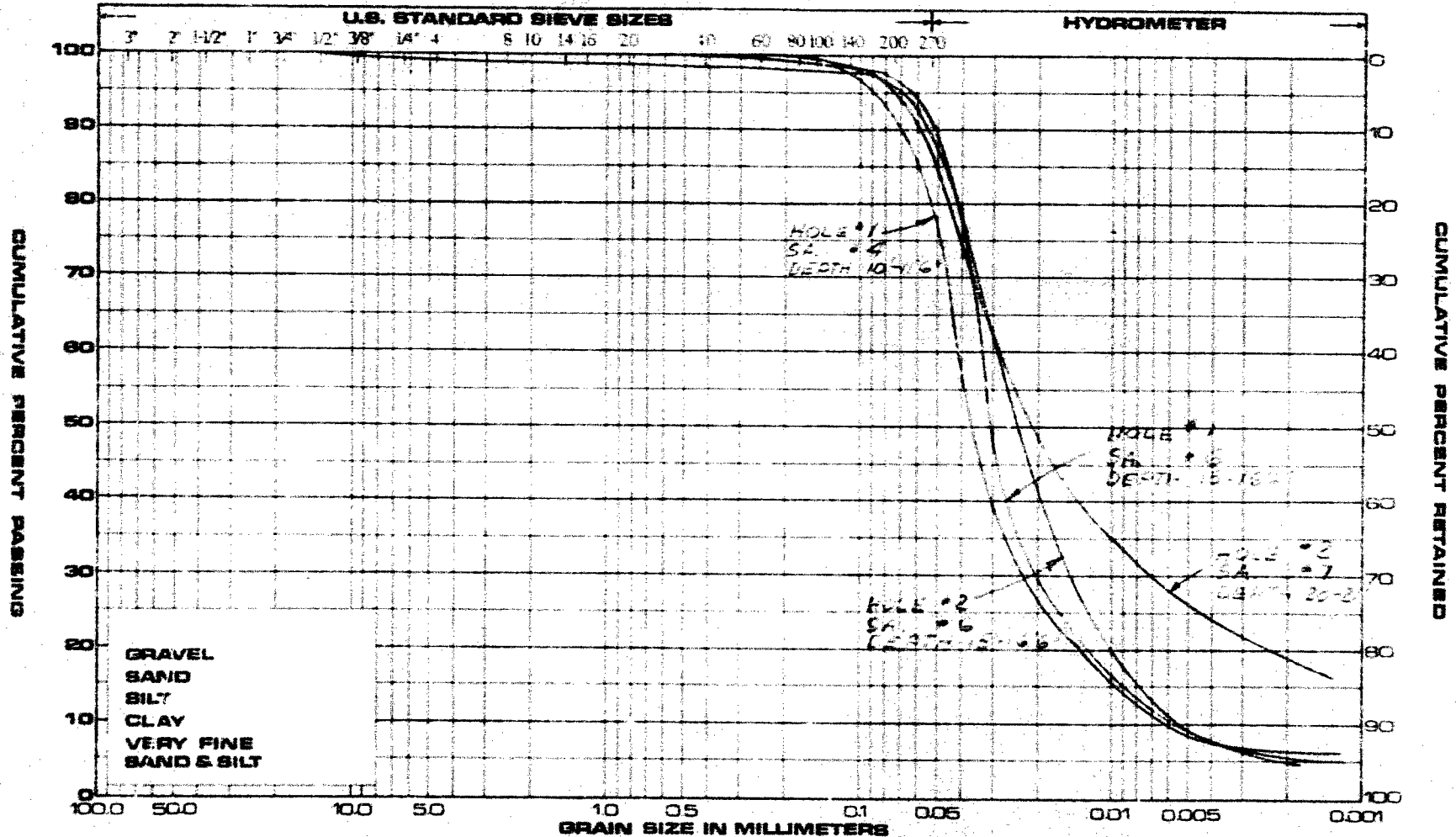
S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H	SAMPLE ADVANCED HYDRAULICALLY	
	P.M	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL		



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PARTICLE SIZE DISTRIBUTION

FIGURE 1

UNIFIED	GRAVEL		SAND			SILT & CLAY			
			COARSE	MEDIUM	FINE				
M.T.	STONES	GRAVEL	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	CLAY
U.S. BUREAU	GRAVEL		COARSE	MED	FINE	SILT		CLAY	

JOB NAME Wilmot Creek Bridge JOB NO. 68F192 HOLE NO. 2 SAMPLE NO. 7
DEPTH 20'-21'6" REMARKS Grey silt



PETO ASSOCIATES LTD.

RECORD OF BOREHOLE NO. 1

CONSULTING SOIL ENGINEERS

JOB NO. 68F192

JOB NAME Bridge on Wilmot Twp. Rd. #3

TECHNICIAN DM

BORING DATE Oct. 17/68

CLIENT Township of Wilmot

ENGINEER OFF

GROUND ELEV. 101.9

BOREHOLE TYPE 3/4 Auger - N. Casing to 15'

TYPED BY JC

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT STANDARD PENETRATION TEST BLOWS/FOOT					LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _P WATER CONTENT _____ W			REMARKS
DEPTH ELEV.	DESCRIPTION	LEGEND	NUMBER	TYPE	BLOWS/FOOT	10	20	30	40	50	W _P	W	W _L	
						SHEAR STRENGTH C _u LB/SQ. FT.					WATER CONTENT % 10 20 30			
10'0"	FILL. mixed sand & gravel													
2'6"														
	CLAY. brown si. clay mixed with fine sand and silt, moist, some seams of clayey sand, becoming V. Sandy occ. grit		1	SS	9									
			2	SS	6									
9'0"			3	SS	8									
	SILT. grey coarse silt & trace of fine sand with organic specks saturated loose to compact		4	SS	7									
			5	SS	7									
			6	SS	8									
20'0"														
	CLAY. greyish brown very silty clay pockets & seams of very fine sands & silts, M.W.T.P.L. becoming drier		7	SS	10									
26'6"			8	SS	27									
	BH terminated at 26'6"													

▼ 5'9"

After 7' sample water at 6'6"

3 mins 6'2"

5 mins 5'11"

7 mins 5'9"

cave at 6'10"

15' casing

After pulling casing cave at 11'6"

water 9'9"



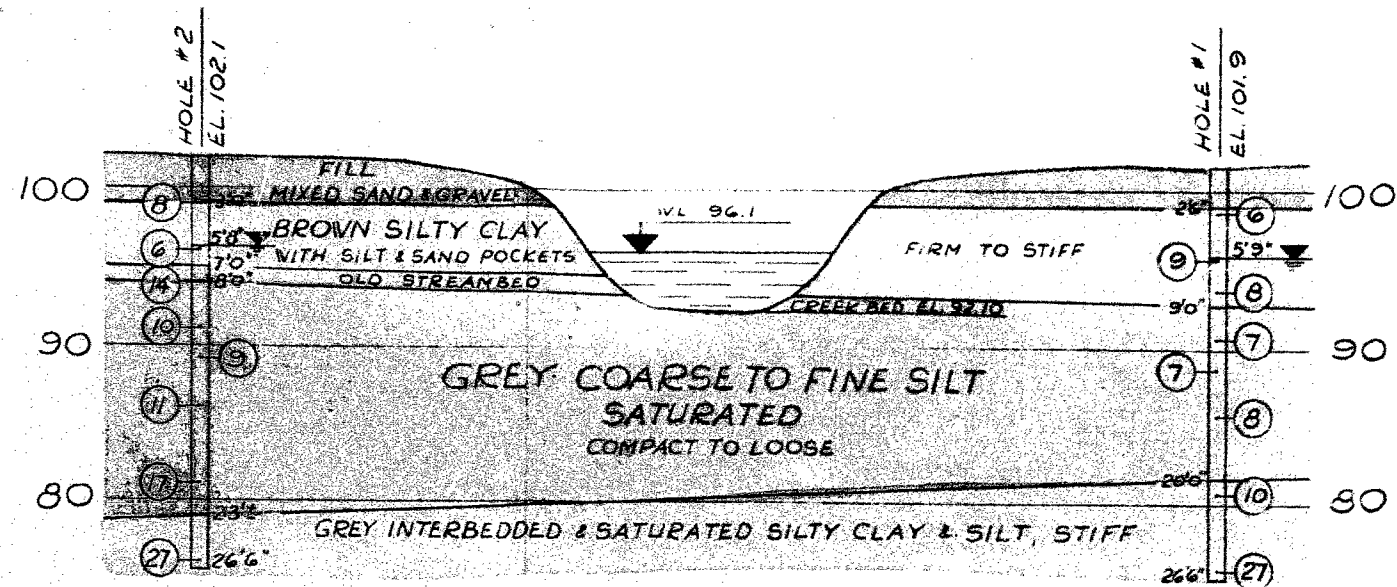
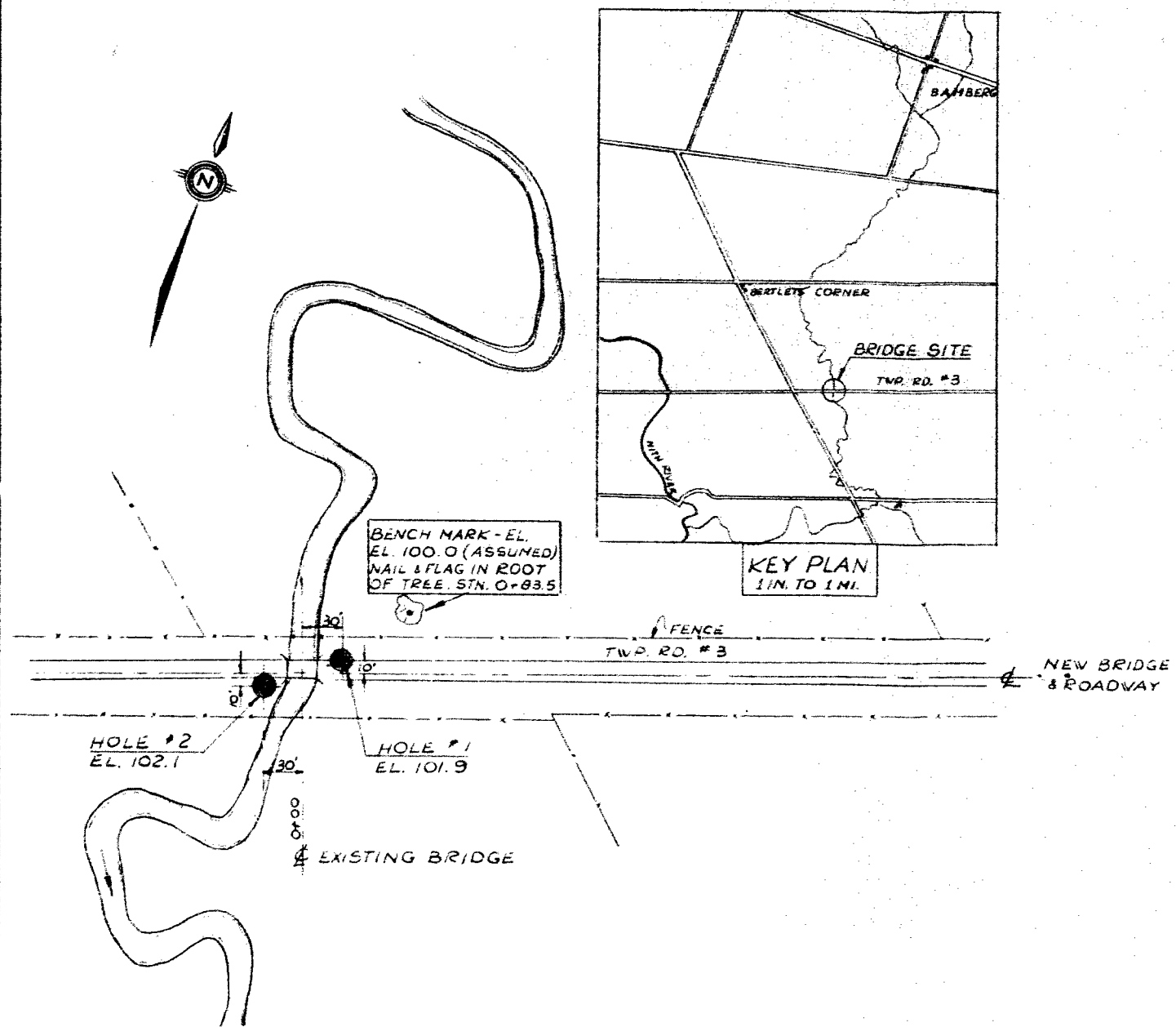
P&T ASSOCIATES LTD.

RECORD OF BOREHOLE NO. 2

CONSULTING SOIL ENGINEERS

JOB NO. 68F192 JOB NAME Bridge on Wilmot Township Road #3 TECHNICIAN DM
 BORING DATE 17 Oct. 68 CLIENT Township of Wilmot ENGINEER CEE
 GROUND ELEV. 102.1 BOREHOLE TYPE 3 1/2" Auger II Casing to 15' TYPED BY JC

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION BLOWS/FOOT STANDARD PENETRATION TEST BLOWS/FOOT					LIQUID LIMIT _____ W _L PLASTIC LIMIT _____ W _p WATER CONTENT _____ W			REMARKS
DEPTH ELEV.	DESCRIPTION	LEGEND	NUMBER	TYPE	BLOWS/FOOT	10	20	30	40	50	SHEAR STRENGTH C _u LB/SQ. FT.			
0'0"	FILL. mixed sand and gravel													
3'0"	CLAY. brown silty clay with strong brown pockets of silt slightly WTPDL		1	SS	8									9' cave water 8' after 10' sample 5 mins. cave 8'9" water 7'5".
7'0"	Old stream bed		2	SS	6									
8'0"	SILT. Grey SILT saturated, compact, odd silt & clay seam and trace of fine sand		3	SS	14									
			4	SS	10									
			5	SS	9									
			6	SS	11									15' casing after 15' sample
			7	SS	17									
23'4"	CLAY. Grey inter-layered silty clay and silt, stiff		8	SS	27									hole caved in to 14'5" after completion.
26'6"	BH terminated at 26'6"													After pulling casing cave 10'6" water 9'3"
														After 2 hrs. water at 5'8"



LEGEND

- BOREHOLE
- (10)— BLOWS/FOOT
- ▼ WATER LEVEL

NOTE

SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.

NOTE: The actual soil stratification has been verified from data obtained at the borehole locations only. The inferred contacts shown are based on geological evidence and these may vary from those shown between borings.



FIG. 2

TOWNSHIP OF WILMOT
% McCARGAR & HACHBORN, CONS. ENGINEERS

BRIDGE ON WILMOT
TOWNSHIP ROAD #3 (SITE 33-75)
NEAR WELLESLEY/ONTARIO

PREPARED BY
PETO ASSOCIATES LTD.

JOB NO. 68 F192	DATE OCT 1968	DRW. BY K.K.	CHECKED BY [Signature]
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DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT