

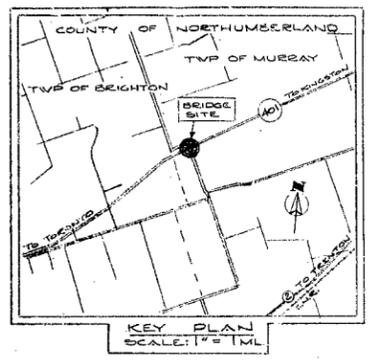
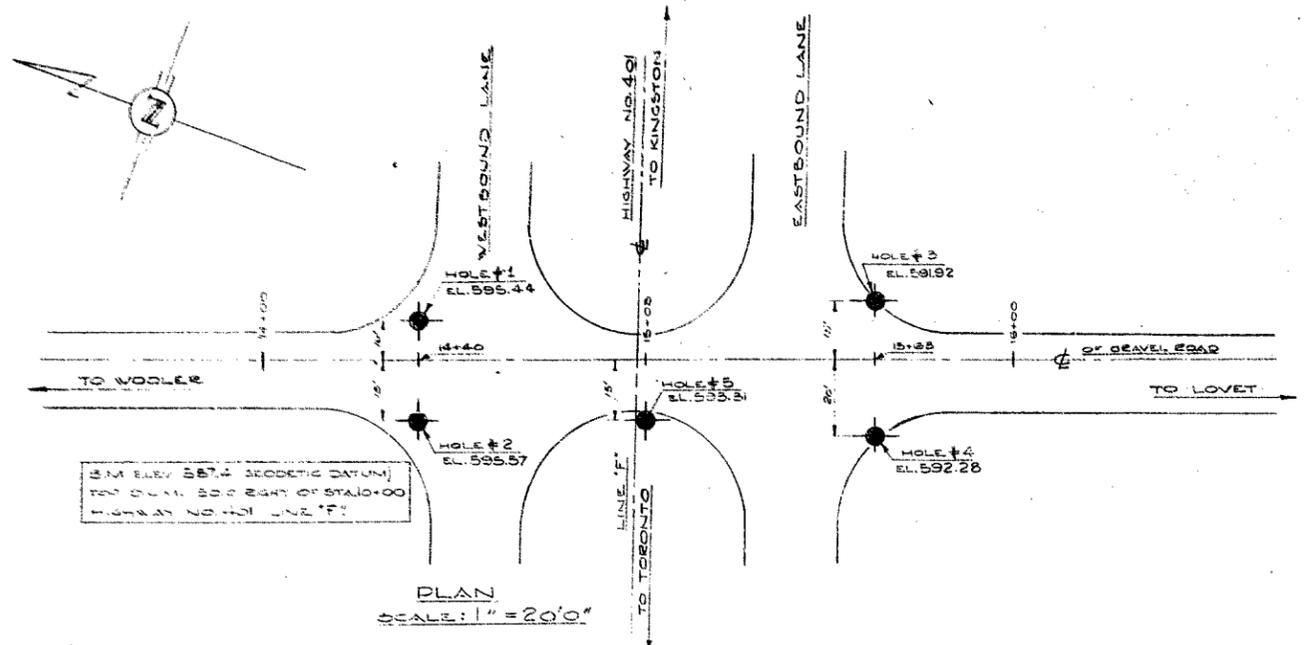
#60-F-261C

W.P. #65-59

HWY # 401

GRAVEL RD.

UNDERPASS



LEGEND.

● BOREHOLE.

○ BLOWS/FOOT.

PROFILES.

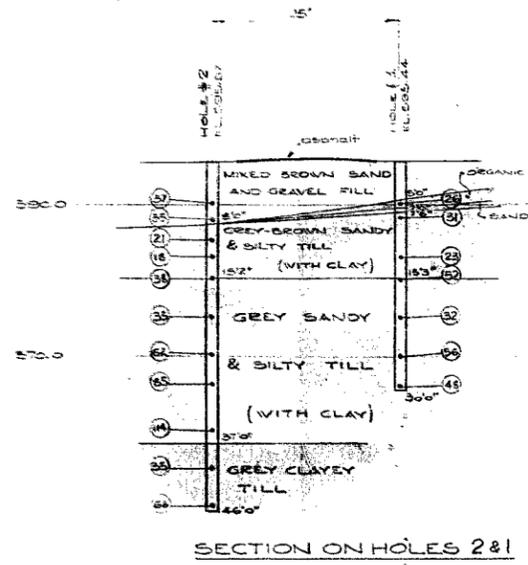
HORIZ. 1" = 10' 0"

VERT. 1" = 10' 0"

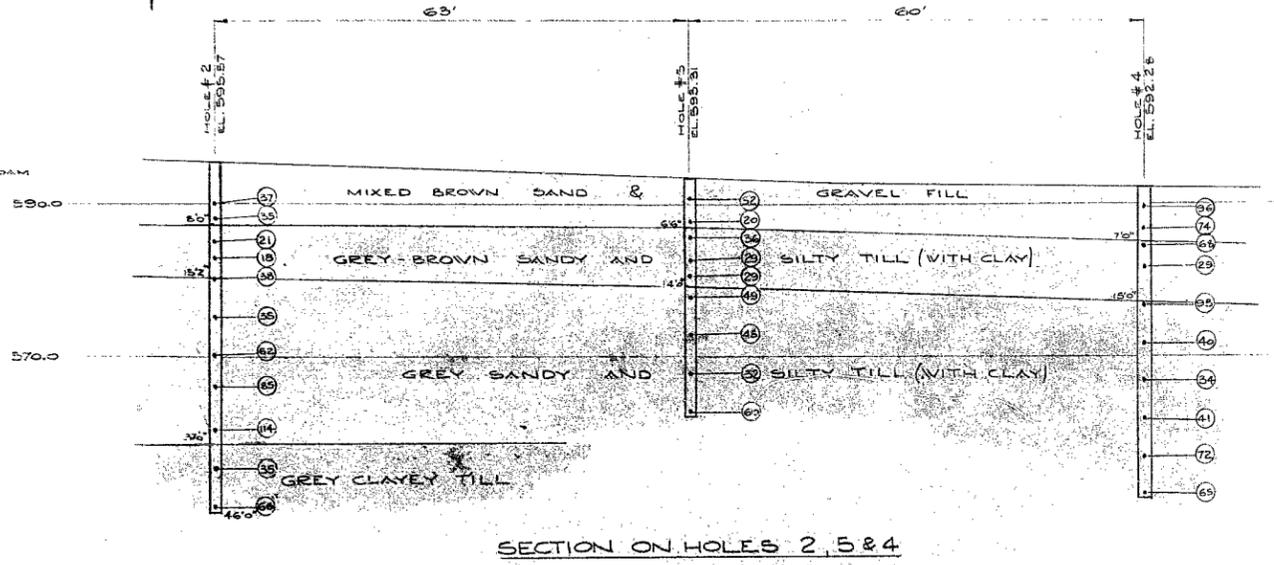
NOTES:

a) THE STRATIGRAPHY BETWEEN BOREHOLES IS INFERRED AND MAY ACTUALLY DIFFER FROM THAT SHOWN.

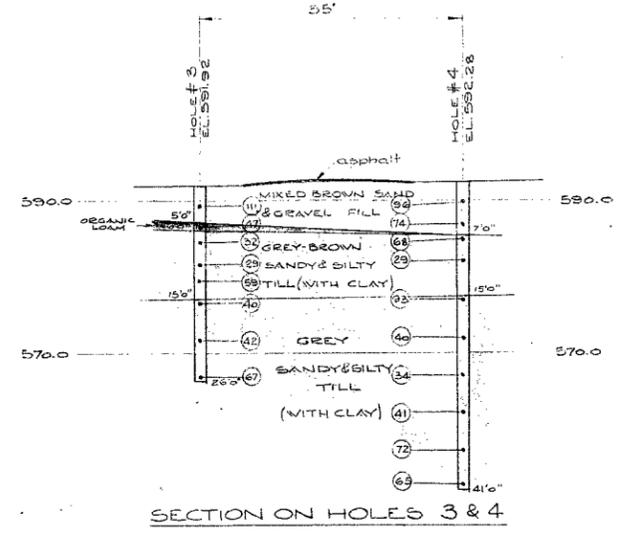
b) SEE BOREHOLE LOGS FOR COMPLETE SOIL DATA.



SECTION ON HOLES 2 & 1



SECTION ON HOLES 2, 5 & 4



SECTION ON HOLES 3 & 4



e.m. peto & associates Ltd.

SOIL SITE INVESTIGATION
AT
GRAVEL ROAD & HWY 401
FOR
DEPT. OF HIGHWAYS OF ONTARIO

OUR JOB No. 6064 DATE APP. 30
CLIENTS PLAN No. E-2747 SR. G. 1

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)

March 28, 1962.

DIFFERENTIAL SETTLEMENTS

Attention: Mr. Brian Richardson

Re: W.P. 65-59 Murray Twp. #1
Township Road Underpass,
Hwy. #401, District #7.

As the answer to your question: "What would the differential settlements between the pier and abutment footings be if the abutments are founded on spread footings placed on the well compacted granular fill?" -- we would like to make the following comments:-

The soil conditions at the site can be considered as quite uniform - i.e., the stratification relatively regular. Bedrock was not encountered up to the investigated depth of 46 ft. below ground level - i.e., up to elevation 548.57. All the encountered layers are dense to very dense, the number of blows per foot of the Standard Penetration Test being well over 30 on the average. The materials can be classified as basically granular, the clay content being very small. Geologically, the materials are described as tills. There is no doubt that the subsoil is quite heavily overconsolidated and settlements due to loads smaller than the preconsolidation load should be very small. We would therefore, conclude that the overall settlements due to a superimposed load of about 3.0 tons/sq.ft., would be in the order of up to 1 inch. Possible differential settlements would therefore be definitely within tolerable limits for continuous structures. However, the proposed structure is of a semi-continuous type which makes the problem of differential settlements even less serious.

We would recommend that a load of only 2.0 T/sq.ft. be used for the abutment footings as compared with the recommended 3.2 T/sq.ft. for the pier footings.

cont'd. /2 ...

Mr. A. M. Toys, Bridge Engr.
Attn: Mr. E. Richardson

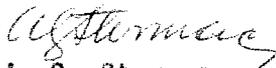
March 28, 1962

For a satisfactory performance of the bridge with abutment footings placed on the approach fills, it is essential that the required compaction of the approach fills be achieved.

Because it is simpler and easier to control and achieve such a requirement with granular material, such material is therefore preferable. It is sufficient if only a wide enough prism of granular material underneath the footings is constructed. The upper outer footing corner should not be less than 10 ft. from the 2:1 slope of the approach fill. This is to safeguard that the footing does not sit on a poorly compacted portion which is usually encountered close to the sloping surface of the fill.

Should there be any additional questions that you would like to discuss, please feel free to contact our Office.

AGS/MdeF


A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. Davis
F. DeVisser

Foundations Office
Gen. Files.

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)

March 23, 1962.
REVIEW OF PRELIMINARY DRAWING
No. D 5041-P1.

Attention: Mr. F. DeVisser.

Re: W.P. 65-59 Murray Twp. #1
Township Road Underpass,
Hwy. #401, District #7.

On the Preliminary Drawing No. D 5041-P1 - (general plan), the abutments are founded on steel 'H' piles, although in our covering letter to the Soils Report, dated April 13, 1960, we recommend large displacement piles, if piles at all are resorted to. It seems to us that the abutment footings could be placed on well compacted granular fill thus creating identical conditions for all the footings. The height of fill under the footings is only about 10 ft.

However, if piles are used, we would again recommend large displacement piles (steel tube piles) rather than 'H' piles. The piles should be driven at least 10 and not more than 20 ft. into the subsoil. A safe bearing load of 35 tons per pile, can be assumed.

AGS/MdeF

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Mr. B. Davis

Foundations Office
Gen. Files.



ONTARIO

DEPARTMENT OF HIGHWAYS

<i>Memo to</i>	<u>Mr. A. Stermac</u>	<i>Date</i>	<u>March 21, 1962</u>
	<u>Principal Foundation Eng.</u>	<i>Subject</i>	<u>W.P. 65-59 Murray Twp. #1</u>
	<u>Room 107, Lab. Bldg.</u>		<u>Township Road Underpass</u>
	<u>DOWNSVIEW</u>		<u>Hwy. #401, Dist. #7</u>
<i>From</i>	<u>Mr. F. DeVisser</u>		

Attached please find the preliminary bridge drawing for the subject structure.

If you have any comments, please let us know.

F. DeVisser

FDeV/m

F. DeVisser,
Bridge Location Engineer

Mr. S. McCombie,
Bridge Planning Engineer.
Materials & Research Section.

May 31, 1960.
REVIEW OF PRELIMINARY
BRIDGE LAYOUT.

Attention: Mr. F. De Visser.

Re: Proposed Crossing - Hwy. 401 & Gravel Rd.,
Lots 21 & 22, Con. 2, Twp. of Murray,
Northumberland County, District No. 7,
W.P. 65-59.

This Section has reviewed the preliminary bridge layout for the above site and concur with the proposed location for the footings.

Foundation recommendations, as outlined in our memo of April 13, 1960, are still valid.

If any further problems arise concerning this structure, please contact our Office.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
Per:

G. G. Cherrington
(G. G. Cherrington,
PROJECT FOUNDATIONS ENGR.)

GGC/MdeF
cc: Foundations Office
Gen. Files. ✓

Mr. A. M. Toys,
Bridge Engineer.
Materials & Research Section.

April 13, 1960.

FOUNDATION INVESTIGATION - by
E.M. Peto Associates, Limited.

Attention: Mr. S. McCombie.

Re: Proposed Crossing Hwy. 401 and Gravel Road,
Lots 21 & 22, Con. 2, Township of Murray,
Northumberland County, District No. 7,
W.P. 65-59.

Enclosed herewith is the report on the soil conditions existing at the above site, submitted by E. M. Peto and Associates, Ltd.

We agree with the conclusions and recommendations given in the above mentioned report, except that we do not find it necessary for the bearing capacity of footings wider than 4 ft. to be decreased below 3.2 T/sq.ft.

Although the stresses below a wider footing are transmitted to a greater depth the settlements, in this particular case, should not increase because the material at greater depth is denser and will therefore compress less.

For your convenience, we state here the necessary requirements and recommendations which you should follow in your future design work:-

1. Footings should be placed on top of the grey-brown sandy and silty layer at the approximate depth of 6' - 8' below G.L., i.e., at approx. elevations 587.5' at the North side, and 585.5' at the South side of the crossing. This recommendation is made in order to avoid an organic loam layer.
2. For footings of 4 ft. width or more, a nett bearing capacity of 3.2 T/sq.ft. is recommended. At such pressures, settlements will not exceed 1 inch.

- cont'd. /2 ...

3. Ground water could be encountered while excavating through the top sand-gravel layer.
4. Because of very favorable foundation conditions, spread footings can be used and there is no necessity to resort to piles. If piles, for some reason, have to be used, we recommend large shallow displacement piles driven into the sand-gravel layer.

If we can be of further assistance in connection with this project, please do not hesitate to contact our Office.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.

Per:

A. Sternac
(A. Sternac,
FOUNDATION OFFICE ENGR.)

AG/HdeF
Attach.

cc: Messrs. A. H. Toye (2)
H. A. Tregaskes
D. G. Ramsay
I. Campbell
C. F. Wetherall
P. Arkeon
A. Watt

Foundations Office
Gen. Files.

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:-

6064

1287 caledonia road,
TORONTO 19, ONTARIO.
RUssell 9-1128

April 11, 1960.

Soil and Foundation Engineering Department,
The Department of Highway of Ontario,
Parliament Buildings,
Toronto 2, Ontario.

Attention: Mr. E. Peaner, P. Eng.

re: Proposed Crossing Hwy. 401 and Gravel Road
Lots 21 and 22, Con. 2., Township of Murray,
Northumberland County - District No. 7,
V.P. 65-50

Dear Sirs:

In accordance with Mr. A. Butka's letter of instruction, dated March 30, 1960, we have pleasure in enclosing ten (10) copies of our report covering the soil site investigation for the proposed new overpass for the Gravel Road over Highway 401, as designated above. For your convenience, we summarize here very briefly our findings as given in some detail in the attached report:

1. The following soil strata were identified to the depth investigated:
 - a) Mixed brown sand and gravel fill to the 6 to 8 ft. depth. This fill is saturated, but is dense with an average N value of 34.
 - b) At test holes 1 and 3 only, a thin layer of 1 to 2 ft. thick of organic loam beneath the overlying fill. At test hole 1, there is a 6" seam of yellowish brown sand. This stratum is compact to dense, with N values of 26 to 31.
 - c) Grey brown sandy till underlying the fill (and the original topsoil at holes 1 and 3) to about the 14 or 15 ft. depth. This stratum is compact with N values averaging 27 or 28, although the average value appears a little lower at the North side of the crossing. This layer is only moist with moisture contents of 7 to 12%.

1.
 - d) Grey sandy till below the 14 or 15 ft. depth, to termination at all test holes but no. 2. This stratum was dense, with N values averaging at least 44. The soil was only moist with natural moisture contents of 7 to 8%.
 - e) Grey clayey till was noted at hole 2 only below the 37 ft. depth. The densities remained high and the m. c.'s low.

2. The sand and gravel fill was saturated at the time of the field investigation with the water table only 10" to 3'0" below surface at completion of the field work. The W. T. varied from elevation 582.6 to 588.1 at the North side, to 590.3 and 591.5 at the South side.

This water condition is perched on the underlying relatively impermeable grey-brown sandy till below the surface fill. It appears probable that this water condition will be non-existent in the dry summer months.

3. In our opinion, normal footings may be placed at almost any depth consistent with good design practice. The sand and gravel fill is even more compact than the underlying till. However, in view of the indication at two of the test holes of the original topsoil beneath the fill, we have recommended that the footings should preferably be placed into the top surface of the underlying grey-brown sandy till, 6 to 8 ft. below the existing grade. We have recommended limiting the bearing values to 3.2 tons per sq. ft. for footings up to 4 ft. in width, decreasing more or less proportionately to 2.8 tons per sq. ft. for footings 10 ft. wide or more. While the values given above may be considered conservative, they have been chosen with a view to minimizing any potential differential settlement between the opposite ends of the structure, since the N values for the bearing stratum at the North end of the structure are somewhat lower than the values obtained at the South side.

4. We do not believe that a pile foundation is a feasible consideration in view of the high soil densities at this site.

We trust that this report is complete and to your satisfaction. Should you require any additional advice in connection with this project, we shall be pleased to be of further service.

Yours very truly,
 E. M. Peto ASSOCIATES LTD.

E. M. Peto
 E. M. Peto, P. Eng.

EMEP/vs
 Encs.

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

SOILS REPORT

for

GRAVEL ROAD OVERPASS - HWY 401

DISTRICT NO. 7 - W.P. 85 - 59

April, 1960

Job No. 8084

Client's Ref. No.

Date April 8th, 1960

Report on

SOIL SITE INVESTIGATION

GRAVEL ROAD OVERPASS - HWY. 401

DISTRICT NO. 7 - S. P. 65 - 69

for

DEPARTMENT OF HIGHWAYS OF ONTARIO.

INTRODUCTION:

We were instructed by letter dated March 30th, 1960 from Mr. A. Rutka, P. Eng., Acting Materials and Research Engineer, to carry out a foundation investigation at the above site, in accordance with the plans, profiles and verbal instructions given to our Mr. D. H. Mitchins on March 31st, 1960.

It was agreed that this work would be expedited. Providing no major soils problem was encountered during the field work, the soils report was promised for submission by April 12th, 1960, to the Department of Highways.

GENERAL INFORMATION:

1. The test hole locations were marked out and the field elevations recorded by our field engineer on April 4th, 1960. The field investigation work was carried out during the period April 4th to 8th inclusive, using our field crews and drill rig units #4 and #6, and for a limited time only, #5.
2. The details of the soil conditions, general description and densities, standard penetration test blows, natural moisture contents, water conditions, etc., encountered at each test hole are given on the individual borehole logs at the rear of the report.

The general site plan enclosed with the report shows the locations of the test holes. Test holes 3 and 4 were relocated 5 ft. to the South and 5 ft. to the East and West respectively from the original positions shown on the D. H. O. drawing to avoid interference with the traffic on Hwy. 401 Eastbound lane.

On part of the site plan, three profiles of the test holes have been drawn to demonstrate any inferred stratigraphy, and to facilitate comparison of the field test results.

GENERAL INFORMATION (Cont'd)

3. Dynamic cone probe tests were carried out at the locations adjacent to test holes 1 and 4. Both probes were terminated at virtual refusal approaching the Eff. depth. In view of the results obtained here and subsequently at these test holes, no further cone tests were carried out.

The results of the cone tests are included in tabular form in Appendix A.

4. Graphs of both the natural moisture contents and the standard penetration test blows per foot plotted against elevation have been included in Appendix A.

5. The field work was carried out under the continuous supervision of our field engineer in accordance with our standard procedure as described in Appendix B.

SITE AND GEOLOGY:

The site for the proposed overpass is located between lots 21 and 22 at Highway 401 in Concession II, Township of Murray in the County of Northumberland.

At the site, Highway 401 is flanked to the North by a 150 ft. ridge, and to the South by a gently southward sloping plateau. An existing excavation about 400 ft. to the North of the site reveals an unsorted silty and sandy till, similar to the material found at the test holes.

Geologically, the site appears to fall within the area of the physiographic region known as the Lake Iroquois sand plain. Immediately to the North is a drumlinized till plain. All of the soil revealed by this investigation has a glacial origin.

The anticipated sand soil was not found at the test holes, apart from a 6" layer at hole 1, and has either been removed during the construction of Highway 401, or was not deposited at this locality in the normal manner.

SOIL CONDITIONS:

Apart from a minor variation near the surface at test hole 1 three principal strata were identified, with indications of a fourth stratum at a depth at test hole 2. These strata are described as follows:

SOIL CONDITIONS: (Cont'd)

a) Mixed Brown sand and Gravel Fill

At all of the test holes, there is a stratum of generally dense sand and gravel which appears to be imported fill, ranging in thickness from 6 ft. to 8 ft. The N_{60} values varied between a low of 20 at 5 ft. depth at hole 5, to a high of 111 near the surface of hole 3. The scattered very high results are undoubtedly due to gravel interference with the sampling tube; the average N_{60} value is approximately 34.

The natural moisture contents varied irregularly from a low of 4.9% to a high of 16.5%. The lower results probably reflect the inclusion of gravel in the sample tins, while the higher values indicate the irregular seepage layers noted in this stratum. The samples were described visually as mostly wet to saturated.

b) Organic Loam and Yellowish Brown Sand

At test hole 1, there is a 3 ft. thick layer of organic loam between the 5 and 7 ft. depth. This layer overlays a 6 inch seam of yellowish brown sand.

At test hole 3, there is a 1 ft. thick layer of mixed dark brown clay loam (topsoil) at the 5 to 6 ft. depth, mixed with the overlying sand and gravel.

This layer is at least compact to dense, and does not appear to be highly organic in content. The natural moisture content of 22% at hole 1 reflects the clay content in this loam.

c) Grey Brown Sandy and Silty Till, i. e. with grits, pebbles and clay

Below the sand and gravel fill and the original surficial soils at holes 1 and 3, to depths of between 14 ft. and 15'3" below grade, the soil is a grey-brown sandy till. The bottom plane of this stratum falls slightly from approximately elevation 580 at the North end of the site, to between elevation 577 and 576 at the South end of the site. Thus this stratum is between 7'6" and 9 ft. thick and the bottom plane falls gently to the South, conforming to the grade of the existing surface.

The N_{60} values as obtained from the standard field penetration test varied irregularly between a low of 18 and 21 at hole 2 and a general high of about 36; several much higher N_{60} values are attributed to stone interference with the sampler. The average N_{60} value, excluding the abnormally high results, is about 27 or 28, and this stratum is therefore classified as compact to dense.

The samples were classified visually as moist or quite moist, with plasticities ranging from "slightly wetter than" to "drier than" the Plastic Limit. The natural moisture contents ranged between 7.2% and 12.3%, with most of the values being around 8 or 9%.

SOIL CONDITIONS: (Cont'd)

d) Gray Sandy Till

Below the 14 ft. to 15'3" depth at all five test holes, the soil became grey in colour, and was generally more dense. The soil appeared similar to the overlying stratum apart from the colour change, except that the till seemed more sandy with depth at hole 4. All of the holes were terminated in this stratum except test hole 2, where a slight change to a clay till appeared below the 37 ft. depth.

The density remained comparatively high everywhere in this stratum. As might be anticipated in a till, there was a considerable scatter of N_c value results, ranging from a low of 32 (Holes 1 and 5) to high values in excess of 60. Discarding the very high results, the N_c value appears to average about 44. The stratum is therefore classified as "dense."

The natural moisture contents ranged narrowly between 6.8% and 9.4%. Most of the samples obtained were classified visually as moist and either at, or drier than, the Plastic Limit. This tends to indicate a Plastic Limit of about 10% for this soil.

e) Gray Clayey Till

At test hole 2 only, the soil below the 37 ft. depth appeared much more clayey and has been classified as a clay till. The densities remained high. The natural moisture content was still only 8.8% at the 41 ft. depth, although the sample was classified as wetter than the Plastic Limit.

WATER CONDITIONS:

The final water table readings are all attributed to the wet to saturated condition of the surface fill to the 6 to 8 ft. depth. This condition is undoubtedly due to the melting snow which was saturating the ground at the time of the investigation. The adjacent road drainage ditches were filled with water at the time.

No water table readings have therefore been shown on the soil profiles. Water filled the test holes after sampling at the 2- 3 ft. depth in each case; however, the test holes stood open without casing during sampling in the top 5 feet and no "quick" condition appeared.

CONCLUSIONS AND RECOMMENDATIONS:

1. In view of the generally dense soil conditions encountered at and below the normal footing depths, it has been considered unnecessary to carry out any laboratory testing of the samples, apart from the determination of the natural moisture contents.
2. The foundations for the proposed structure may be carried on normal footings placed at almost any depth below grade, assuming provision of the usual protection against frost penetration, based on the indicated soil strengths. However, the presence of the organic loam topsoil at the 5 to 7 ft. depth at test hole 1, and to a lesser extent at test hole 3, makes it advisable to carry the footings down to the top surface of the grey brown sandy till between 6'6" and 8'0" below existing grade, i. e. to elevation 587.5 at the North side of the site and to elevation 585.3 at the South side of the crossing.

Based on the average "N" value of 27 for this stratum, the allowable bearing value ranges from 3.2 tons per sq. ft. for footings up to 4 ft. wide, decreasing to 2.6 tons per sq. ft. for footings up to 10 ft. wide. These values are based on "Peck, Hanson, Thornburn" non cohesive soil tables and are designed to limit the theoretical settlement to a maximum of 1 inch. Shear failure is not considered a limiting criterion in this case.

The soil actually has some cohesion. Using Terzaghi's cohesive soil tables the allowable bearing values with a factor of safety of at least three against any shear failure would be from 3.2 to 4.2 tons per sq. ft. In view of the lower than average "N" values obtained at test holes 1 and 2, we would prefer to recommend the use of the lower bearing values of 2.6 to 3.2 tons per sq. ft.

3. Settlement of the completed structure, using the suggested bearing values given above, should be less than the theoretical maximum of 1 inch. Since the soil "N" values are somewhat lower at the North side of the Hwy. 401, as compared to the South side of the crossing, any settlement which does occur should develop to a greater extent at the North side.
4. We do not believe that a pile foundation is either required or practical at this site. Displacement piles could not be driven without pre-boring, and augering in the till soils would be difficult, and steel H piles would be driven only with extreme difficulty.

CONCLUSIONS AND RECOMMENDATIONS (Cont'd)

5. The sand and gravel fill is fully saturated at the present time. Any excavation for footings placed at the bottom of this fill at this time of the year will encounter water to the 6 to 8 ft. depth.

In view of the relatively dense state of the fill, use of cut-off sheet piling driven into the underlying grey brown till is not recommended. We believe that it will be more practical to widen the corners of the excavation and to pump from local sumps to keep the water out of the general excavation.

It appears reasonable to assume that this water condition is seasonal and is due to the snow melt-water at the present time. Thus, in the dry months of the year, no water may exist at this site.

No water condition was noted in any of the test holes below the surficial fill, nor do the relatively low natural moisture contents indicate the presence of any water table or water source at depth.

6. There is no indication of any problem in connection with the placement of the approach embankment to the North and to the South of the crossing.

E. M. PETO ASSOCIATES LTD.,

C. F. Freeman

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

EMP:sb

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name Gravel Road - Hwy. 401 Job No. 6064 Borehole No. 1
 Client Dept. of Highways of Ontario Casing BX Boring Date April 4th - 6th, 1960
 Elevation Clients Compiled By U. J. V. Checked By P. M. A.

SAMPLE CONDITION

-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBESAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- C. SOIL SHEAR STRENGTH LBS/SQ.FT.
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0'0"						
			505.44		1	C.S.			
Sand & Gravel Fill	Mixed brown				2	C.S.			Wet
			5'0"						
Silty loam topsoil		Compact	590.44		3	S.S.	26	22.0	
Fine to coarse clayey sand changing to a silty and sandy till (Clay content)	Grey Brown	Compact to Dense	7'0" 587.94		4	S.S.	31	8.4	Wet Layer of brown sand 7'-7'6"
			10'0"						
Sandy and silty till (Stones)	Grey Brown	Extremely Dense			5	S.S.	100/9"	7.2	Moist. Stone in sampler.
Silty and sandy till (clay content)	As above	Compact			6	S.S.	23	9.0	Quite moist (Sl. W. T. F. L.)
			15'3"						
Sandy till (very grifty) with stones	Grey	Dense to Very dense	580.19		7	S.S.	52	7.4	Moist. (used wash water to expedite work below 16')
			20'0"						
As above (more fines)	Grey	Compact to Dense			8	S.S.	32	8.0	moist about F. L.
			25'0"						
As above	Grey	Very dense			9	S.S.	56	8.4	Moist about P. L.
			30'0"						
As above	As above		585.44		10	S.S.	48	7.5	Moist about P. L.

HOLE TERMINATED AT 30 ft.

Water level readings

Date	Time	Casing Depth	Hole Depth	Depth to Water Level	Remarks
April 6	11:35 a. m.	15'	30'	7'7"	Hole not bailed after pulling rods.
	11:45	15'	30'	5'2"	
	11:55	15'	30'	4'1"	
	4:00 p. m.	NH		2'10"	

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name Gravel Road and Hwy. 401 Job No. 6064 Borehole No. 2
 Client Dept. of Highways of Ontario Casing BX Boring Date April 4th and 5th, 1960
 Elevation Client's Compiled By U. J. V. Checked By P. M. A.

 UNDISTURBED	SAMPLE CONDITION	SAMPLE TYPE	ABBREVIATIONS
 FAIR		A.S. AUGER SAMPLE	V.T. IN SITU VANE SHEAR TEST
 DISTURBED		C.S. CASING SAMPLE	C. SOIL SHEAR STRENGTH LBS/SQ.FT.
 LOST		S.S. 2" STANDARD SPLIT TUBE SAMPLE	W.L. WATER LEVEL IN CASING
		S.L. SPLIT BARREL WITH LINERS	W.T. GROUND WATER TABLE IN SOIL
		S.T. THIN-WALLED SHELBY TUBE SAMPLE	W.T.P.L. WETTER THAN PLASTIC LIMIT
		W.S. WASH SAMPLE	D.T.P.L. DRIER THAN PLASTIC LIMIT
		R.C. ROCK CORE	

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No and Condition	Sample Type	No. of Blows per Ft	Natural Moisture Content	WATER LEVELS & REMARKS
			0'0"						
Sand and gravel	Mixed brown		595.57		1	C.S.			Wet (Fill to 8 ft.)
As above	As above	Extremely Dense			2	S.S.	80/5***	10.5	Wet *Refused on stone; hole moved 2' South and restarted.
As above	As above		5'0"		3	C.S.			Wet
As above	As above	Dense			4	S.S.	37	15.7	Moist
		Dense	8'0"			S.S.	35		
Silty, sandy till (clay content)	Grey brown		587.57		5	A.S.			Moist
As above	As above	Compact	10'0"		6	S.S.	21	10.2	Quite moist, about P.L.
As above	As above	Compact			7	S.S.	18	9.9	Quite moist, about P.L.
			15'2"						Getting denser at 15'2"
As above	Grey	Dense	580.40		8	S.S.	38	9.0	Moist, slightly D. T. P. L. Starting to use wash water at 16'0"
			20'0"						
As above	Grey	Dense			9	S.S.	35	7.9	Moist, slightly D. T. F. L.
			25'0"						
As above (more sand)	Grey	Very dense			10	S.S.	62	7.5	Moist (Harder below 27'10"0)
			30'0"						
Sandy till	Grey	Extremely Dense			11	S.S.	85		Moist
			35'0"						Seam of Med. - coarse sand 33'10" to 35 ft.
Sandy till (very gritty and stone fragments)	Grey	Extremely Dense	37'0"		12	W.S. S.S.	114		Moist
			558.57						Less dense at 37 ft.
			40'0"						
Clayey till	Grey	Dense			13	S.S.	35	8.8	W. T. F. L.
		V. Dense	46'0"			S.S.	66		
			548.57						

TEST HOLE TERMINATED AT 46'0"

Water Level Readings

Date	Time	Casing Depth	Hole Depth	Depth to Water Level	Remarks
Apr. 5	6:00 p. m.	37'	45'	9'10"	After removing rods.
	6:10	37'	45'	7'10"	
	6:25	37'	45'	6'2"	
Apr. 6	8:00 a. m.	Nil	32'11"	2'6"	(Hole caved at 32'11")

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name Gravel Road - Hwy. 401 Job No. 6064 Borehole No. 3
 Client Dept. of Highways of Ontario Casing BX (4" pipe to 5') Boring Date April 5th - 6th, 1960
 Elevation Clients Compiled By U. J. V. Checked By P. MA.

SAMPLE CONDITION

 UNDISTURBED
 FAIR
 DISTURBED
 LOST

SAMPLE TYPE

A.S. AUGER SAMPLE
 C.S. CASING SAMPLE
 S.S. 2" STANDARD SPLIT TUBE SAMPLE
 S.L. SPLIT BARREL WITH LINERS
 S.T. THIN-WALLED SHELBY TUBE SAMPLE
 W.S. WASH SAMPLE
 R.C. ROCK CORE

ABBREVIATIONS

V.T. IN SITU VANE SHEAR TEST
 C. SOIL SHEAR STRENGTH LBS/SQ.FT.
 W.L. WATER LEVEL IN CASING
 W.T. GROUND WATER TABLE IN SOIL
 W.T.P.L. WETTER THAN PLASTIC LIMIT
 D.T.P.L. DRIER THAN PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface.			0'0"						
			591.92			C.S.			Water seepage 7" to 12"
Sand and gravel fill	Mixed Brown	Extremely Dense			1	S.S.	111	7.5	Quite moist.
			5'0"			C.S.			
Mixed sand and gravel and Clay loam topsoil (Fill)	Mixed grey brown and Dk. Brown	Dense	6'0"		2	S.S.	47	12.2	Quite moist
Silty and sandy till grits and pebbles with clay. stones	Grey Brown	Compact to Dense	585.92		3	S.S.	32	8.8	W. T. F. L. Quite moist.
		Compact to Dense	10' 0"			S.S.	29		
Silty and sandy till with clay grits and pebbles	Grey brown	Very dense			4	S.S.	59	9.5	Quite moist.
Ditto	Grey	Dense	15'0"		5	S.S.	40	8.8	Started to use wash water at 13 ft. Moist.
		Dense	576.92			S.S.	42		
			20'0"			S.S.			
As above, very gritty	Grey	Very dense	26'0"		6	S.S.	67	9.0	Moist.
			565.92						
HOLE TERMINATED AT 26 ft.									Final W. F. reading 0'10" from surface, before moving off site.

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name Gravel Road and Hwy. 401 Job No. 6064 Borehole No. 4
 Client Dept. of Highways of Ontario. Casing BX and 4" Boring Date April 4th and 5th, 1960
 Elevation Client's Compiled By U. J. V. Checked By P. M. A.

 UNDISTURBED	SAMPLE CONDITION	A.S. AUGER SAMPLE	SAMPLE TYPE	V.T. IN SITU VANE SHEAR TEST	ABBREVIATIONS
 FAIR		C.S. CASING SAMPLE		C. SOIL SHEAR STRENGTH LBS/SQ.FT.	
 DISTURBED		S.S. 2" STANDARD SPLIT TUBE SAMPLE		W.L. WATER LEVEL IN CASING	
 LOST		S.L. SPLIT BARREL WITH LINERS		W.T. GROUND WATER TABLE IN SOIL	
		S.T. THIN-WALLED SHELBY TUBE SAMPLE		W.T.P.L. WETTER THAN PLASTIC LIMIT	
		W.S. WASH SAMPLE		D.T.P.L. DRIER THAN PLASTIC LIMIT	
		R.C. ROCK CORE			

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Natural Moisture Content	WATER LEVELS & REMARKS
Ground surface			0'0"						
Sand and gravel	Mixed Brown		592.28		1	C.S.			Wet
As above	As above	Extremely Dense			1	S.S.	96	4.9	Water seepage 7" to 12"
As above	As above					C.S.			Wet (frozen 3'4" to 4'5")
As above	As above		5'0"						
As above some silty clay	As above	Very dense			2	S.S.	74	6.0	Quite moist to wet (Slight seepage 5' to 7')
Silty sandy till (Clay Content)	Grey Brown	Very dense	585.28		3	S.S.	68	7.9	Moist D. T. P. L.
			10'0"						
As above	As above	Compact to dense			4	S.S.	29	9.6	Moist D. T. P. L.
			15'0"			SS	71*		* Driving stone (using wash water below 13 ft)
As above (Stones)	Grey	Extremely Dense	577.28		5	S.S.	93	8.3	Moist D. T. P. L.
			20'0"						
		Dense				S.S.	40	9.4	
			25'0"		6	W.S.			
As above	Grey	Dense			7	S.S.	34	8.2	Moist - about plastic limit.
			30'0"						
as above (fragments of stones)	Grey	Dense			8	S.S.	41	6.8	Moist D. T. P. L.
			35'0"						
As above (more sand)	Grey	Very dense			9	S.S.	72	8.3	Moist.
			41'0"						
As above	Grey	Dense	41'0"		10	S.S.	65		Moist
			551.28						

HOLE TERMINATED AT 41 ft. 0 ins.

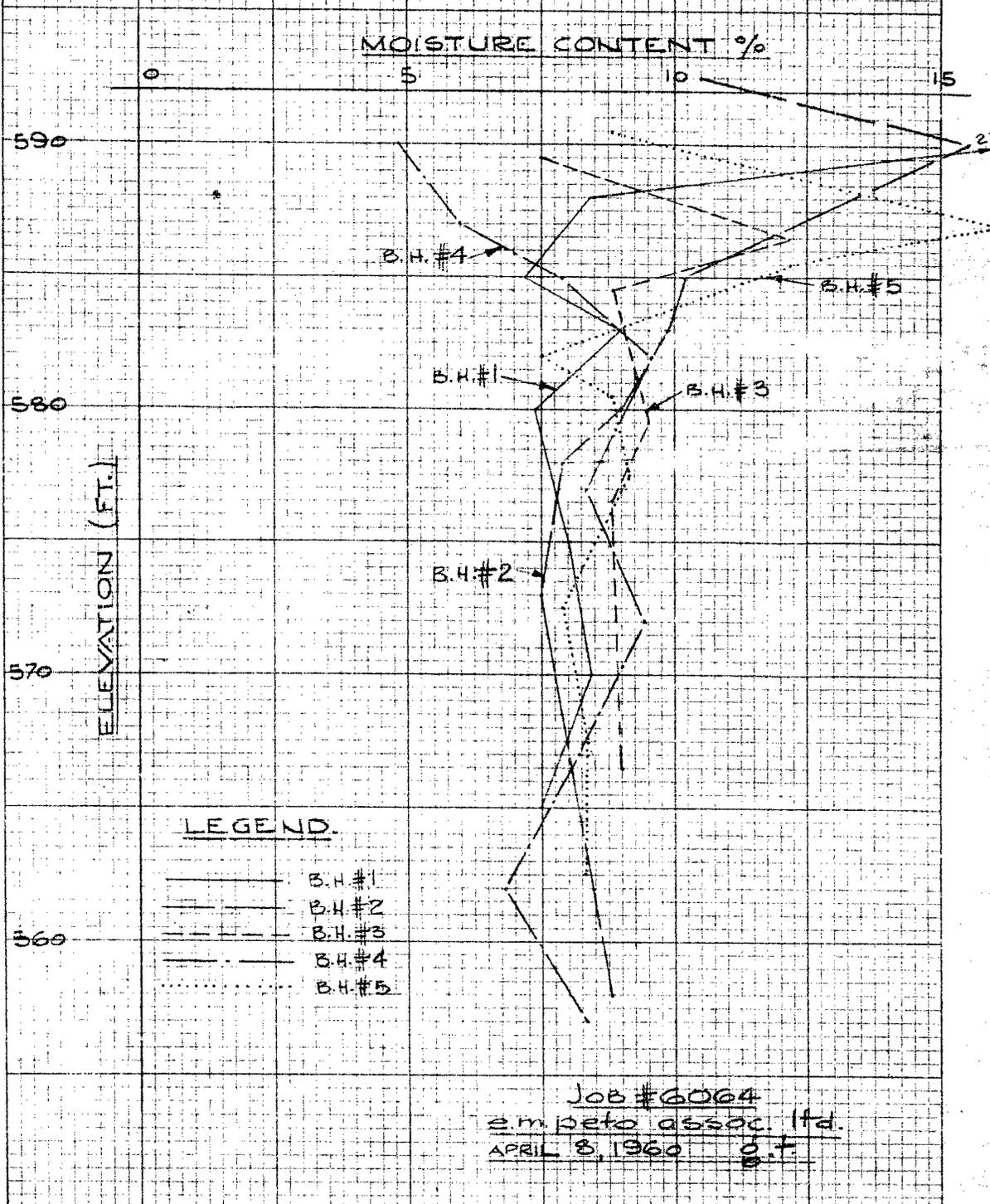
Water Level Readings.

Date	Time	Casing Depth	Hole Depth	Depth to Water Level	Remarks
April 4					Surface water seepage and very slight seepage from 14'2"
April 5	2:37 p.m.	15'	41'	14'2"	
	2:39	15'	41'	13'7"	
	2:45	15'	41'	8'1"	
	2:52	15'	41'	5'1"	
	2:57	15'	41'	3'10"	
	3:07	15'	41'	2'5"	
	3:17	15'	41'	1'10"	
	3:45	Nil	5'5"	3'10"	
April 6	8:00 a.m.	Nil	4'5"	0'10"	

ASBESTOS

GROUPS

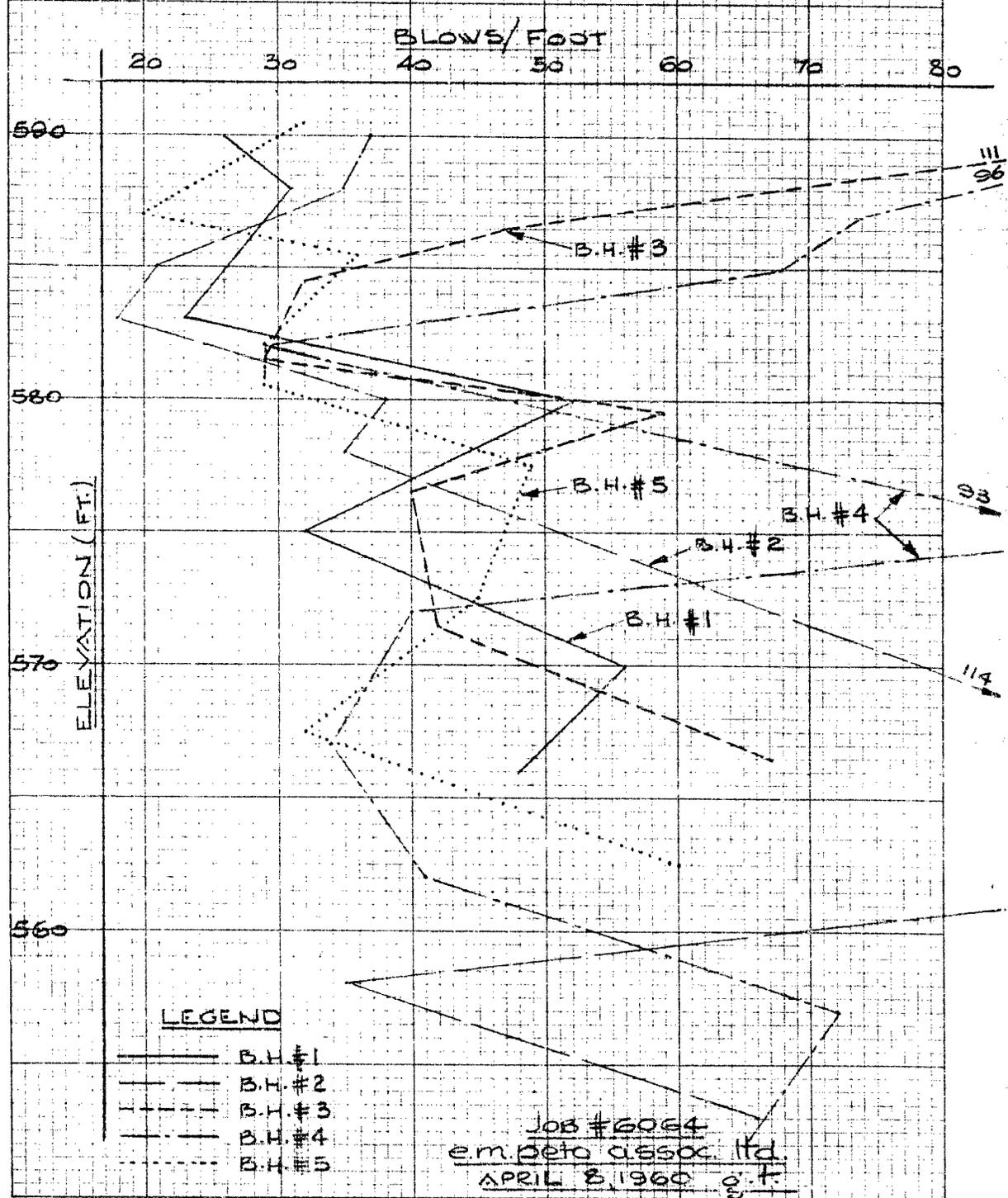
NATURAL MOISTURE CONTENT VS. ELEVATION.



K&E
 10 X 10 TO THE INCH 359-5G
 KEUFFEL & ESSER CO. MADE IN U.S.A.

Job #6064
 empeta assoc. lfd.
 APRIL 8, 1960 G.F.

STANDARD PENETRATION TEST RESULTS vs. ELEVATION.



LEGEND

- B.H. #1
- B.H. #2
- · - · - · B.H. #3
- B.H. #4
- B.H. #5

JOB #6094
 em.peto assoc. ltd.
 APRIL 8, 1960 g.t.

PROBE TEST RESULTS

Job No. 6064

Depth	Below Grade	Surface Elev.	Probe 1 595.4 ±	Probe 4 592.3 ±
0	1		6	12
1	2		58	44
2	3		75	201
3	4		96	256
4	5		26	524
5	6		15	256
6	7		30	81
7	8		33	40
8	9		67	37
9	10		91	40
10	11		46	49
11	12		48	34
12	13		39	146
13	14		52	28
14	15		125/10	283/10 100/1"

PH Associates Inc.

METHOD OF OPERATION

The field investigation work is carried out by means of a skid-mounted diamond drill rig.

Standard sampling procedures are followed. Casing is driven and cleaned, either by tubes or by wash water.

Samples are recovered ahead of the casing at frequent intervals, with either a 2 inch or 3 inch O. D. split barrel sampling tube, Shelby tube, or split barrel sampling tube fitted with brass liners and special sharp cutting nose.

The standard penetration test results are recorded when sampling with the regular 2 inch O. D. split barrel sampler, these being the number of blows of a 140 pound hammer falling 30 inches, required to drive the sampling tube a distance of one foot into undisturbed soil.

The Dutch cone probe test is made by driving the drill rods into the ground with a 2-1/4" - 90° cone tip. The number of 4200 inch pound blows per foot of penetration are recorded, as in the standard penetration test.

Where required, "in situ" shear strength tests are made ahead of the casing, using modified Acker vane test equipment.

Disturbed samples are visually classified in the field, sealed in sample jars, and are re-examined, and tested as necessary, in the soils laboratory. Undisturbed samples are returned to the laboratory for later examination and testing, as required.

The test holes are bailed at the end of the day and on completion. Subsequent water level readings are taken for the duration of the field work. Water pressure readings are recorded when Artesian water conditions are encountered. Moisture content samples are recovered at frequent intervals to assist in the soil classification and the interpretation of water table results.