

MEMORANDUM

File

TO: Mr. A. G. Stermac
Principal Foundation Engineer
Room 107, Lab. Bldg.

FROM: J. B. Curtis

DATE: July 27, 1962

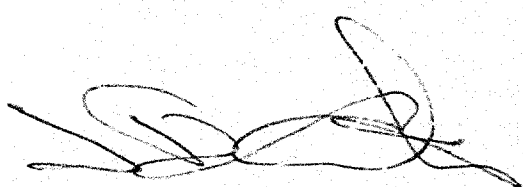
OUR FILE REF.

IN REPLY TO

SUBJECT: Indian River Bridge at Pembroke
Hwy. 41 District ~~8~~ *10! Banquet*
Cont. 62-83
W.P. 253-60

Smith Curtis
Please be advised that the above structure has been
awarded as of July 11, 1962.

I believe you were interested in the pile driving pro-
posed for this ~~date~~ because of the artesian condition. Would
you kindly contact the District for construction dates etc.



JBC/et

J. B. Curtis,
Bridge Location Engineer.

cc. N. D. Smith

Contacted Mr. Wigle - District Engineer

Tuesday 7 Aug - Start construction

pile driving date - by teletype in due course

Kyle 2/8/62

Mr. A. M. Toye,
Bridge Engineer.

Materials & Research Section.

September 6, 1960.

FOUNDATION INVESTIGATION REPORT

by: E. M. Peto Associates, Limited.

Attention: Mr. S. McCombie.

Re: Proposed Indian River Crossing,
Pembroke Ontario, Hwy. No. 41,
W.P. 253-60 -- District 10.

This memo accompanies the foundation report submitted by E. M. Peto & Associates for the above noted site.

The Foundation Section has reviewed the contents of this report and submit the following comments:-

1. We concur with the Consultants' conclusions that spread footings should not be used at the site.
2. Footings for piers and/or abutments should be pile-supported. Small displacement type 'H' piles are recommended. Refusal to pile penetration will be reached at or slightly above bedrock elevation shown in the soil stratigraphy drawing in the report.
3. The free-draining granular nature of the subsoil is such that standard embankment fill sections using 2:1 slopes can be safely constructed.

If we can be of further assistance in connection with the design of this structure, please contact our Office.

LGS/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
E. A. Tregaskes
D. G. Ramsay
J. Ford
C. E. Robertson
J. E. Gruspier
A. Watt
Foundations Office
Gen. Files.

L. G. Soderman
L. G. Soderman,
PRINCIPAL FOUNDATIONS ENGINEER

1:48 PM 1:59

DOWN BANC 8 AUG 20/62 1:48 PM U R G E N T

MR A STERMAC PRINC FOUNDATIONS ENGR MAT AND RES SECT
RE CONT 60-83 INDIAN RIVER BRIDGE HWY 41 PEMBROKE
PILE DRIVING OPERATIONS FOR ABOVE NOTED STRUCTURE WILL
COMMENCE IN THE MORNING OF THURSDAY, AUGUST 23/62.
V WHEELER FOR W G WIGLE DIST ENGR

Ver

e. m. peto associates ltd.

YOUR REFERENCE:-

OUR REFERENCE:- 60168

1287 caledonia road,

TORONTO 19, ONTARIO.

RUssell 9-1126

August 29, 1960

Department of Highways of Ontario,
Foundation & Engineering Branch,
Parliament Buildings,
Toronto 2, Ontario.

Attention: Mr. A. Rutka,
Acting/ Material & Research Engineer.

Dear Sirs:

Re: Foundation Investigation
Proposed Indian River Crossing
at Pembroke, Ontario
Highway # 41
W.P. 253-60 - District 10

We have pleasure in forwarding herewith 10 copies of the foundation and engineering report on this site. This investigation was carried out in accordance with instructions given in your letter dated July 20th, 1960.

Details of the soil and ground water conditions together with the foundation recommendations are given in detail in the main report. Here, for your convenience, we summarize our findings as follows:

1. The main stratum overlying this site virtually from ground surface, except where the existing embankment has been constructed, consists of a saturated silty fine sand with grits and pebbles (sandy till) in a saturated and very loose to loose condition. At one location, below a depth of 38 ft. to the bedrock surface approximately at a depth of 50 ft., the material becomes dense to extremely dense but this appears to be an isolated condition.

Underlying the saturated sandy till material, a dark grey to light grey banded granite gneiss bedrock was encountered at depths of approximately 41 to 51 ft. below grade and depending on location. Artesian water conditions were encountered above bedrock and certainly at bedrock elevation at the 3 testholes and the probe holes put down at this site.

2. In view of the foregoing conditions, the site is not considered as suitable for a normal spread footing type of foundation and for this reason a piled type of footing has been recommended, and to this end the use of steel-H

piles is considered suitable, particularly since the underlying soil contains random boulders.

3. The rock cores recovered from the investigation have not been subjected to compression tests, but in view of the fissures noted in one of the cores and the softer nature of some of the rock core, a bearing value of 40 tons per square foot has been recommended, instead of a considerably higher value normally used for this type of rock.
4. It is understood that the existing embankment will be raised approximately 5 ft. and widened as a result, and in view of the granular nature of the underlying soil, it is not considered that such a relatively shallow embankment will introduce any stability problem here, although some settlement of an immediate nature can be anticipated during the course of construction of the embankment.
5. Certain recommendations in regard to the removal of the organic surficial soil overlying the site have been made, and these details are given in the main report.

We believe the report to be complete within your terms of reference, however, should you have any points you wish to raise in connection with the contents thereof, we shall be pleased to discuss these at your convenience.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.

EMP/ajm

DEPARTMENT OF HIGHWAYS OF ONTARIO

FOUNDATION INVESTIGATION
PROPOSED INDIAN RIVER CROSSING
PEMBROKE, ONTARIO
HIGHWAY # 41

W. P. 253 - 60 - DISTRICT 10

August, 1960

Job No. 60168

Client's Ref. No.

Date August 29, 1960

Report on

FOUNDATION INVESTIGATION
PROPOSED INDIAN RIVER CROSSING
PEMBROKE, ONTARIO
HIGHWAY # 41

W. P. 253 - 60 - DISTRICT 10

for

DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

This investigation was carried out under authority of your letter dated July 20th, 1960, during the period July 28th to August 21st, 1960. The object of the investigation was to determine the soil and ground water conditions with a view to making recommendations as to the suitable type of foundation for the proposed structure.

GENERAL INFORMATION:

Details of the procedure normally followed in carrying out the soil investigation, together with that followed in the report, are given in Appendix A.

Details of the standard penetration test results versus elevation are given in Appendix B.

The only laboratory tests carried out were Mechanical Analyses, details of which may be found in Appendix C.

Natural moisture contents plotted against elevation have not been included in this case since the ground was virtually saturated from existing grade downwards, except in the case of hole 2 where an existing embankment was penetrated initially. All elevations given on the drawing and referred to in the report are related to a T.B.M. which was a cross on the northwest end of the 2'0" concrete walk, 36'0" right of Station 1176+15. The elevation of this T.B.M. was taken to be 412.32. The elevation of the water level in the Indian River at the time of the investigation, in the vicinity of probe hole 5, on August 11th, 1960, was 384.2.

A considerable amount of difficulty was encountered with the Artesian water condition existing at the site entailing the plugging of the holes and the probe holes and at probe hole 5, 15 ft. of 4 inch casing was left in the ground and plugged.

The details of the boreholes and probe holes put down are as follows:

Bore Hole	Probe Hole	Ground Elevation	Refusal Depth	Refusal Elevation	Diamond Drilling Length	Terminal Depth
1		388.4	44'8"	343.7	9'10"	54'6"
2		398.0	51'4"	346.7	12'11"	64'3"
3		387.7	29'1"-41'3"	346.4	7 " and 10'0 1/2"	51'5"
	1	388.3	47'6"	340.8		
	2	results not included (see note below)				
	3	388.3	42'2"	346.1		42'2"
	4	384.6	36'7"	348.0		36'7"
	5	384.7	39'6 1/2"	345.2		39' 6 1/2"
	6	396.4	32'8 1/2"	363.7		32'8 1/2"
	7	390.7	39'5 1/4"	351.3		39'5 1/4"

The following comments are made in regard to the various boreholes and probe holes.

- (a) Probe hole 2 refused at a depth of 11'3" probably on the footing of the existing bridge and was redriven at a new location nearby, but the results have been omitted since the probe went off line, through boulder interference and the results are not representative.
- (b) Probe hole 4 refused at 6'10" and was redriven nearby.
- (c) Probe hole 5 refused at 1'9" and was redriven nearby. The additional drilling shown for borehole 3 was due to refusal on a boulder at 29'1" which was subsequently drilled to a depth of 29'8", i.e 7 inches.

SITE AND GEOLOGY:

The site is located southwest of Pembroke at the junction of the Indian River and the Queen's Highway # 41. (Boundary Street). The boreholes and probes flank both approaches to the river.

The existing structure is typified by narrow shoulders approaching a concrete and steel 50 ft. span bridge, in a poor state of repair. A culvert directs water down an existing valley parallel to the highway, 20 ft. south of the west abutment. The remaining countryside is relatively flat, with the greatest contour difference being adjacent to the river. The river is approximately 5 ft. deep.

The PreCambrian bedrock has undergone glacial change, with the resulting deposition of glacial till. The Champlain Sea then inundated the area leaving deposits of marine clay surrounding higher islands of glacial material. Final emergence of the land upon the retreat of the salt water sea, left the topography free to be weathered by local stream action and atmospheric conditions.

SITE AND GEOLOGY: - Cont'd

The underlying bedrock of banded granite gneiss exhibits stringers of pegmatite, which were probably injected during ancient orogenic movements. The rock at the present time appears stable and sound, although it should be remembered that the site lies within the highly faulted Ottawa lowlands, and a mild earth tremor centered around Cornwall, was registered in 1943.

SOIL CONDITIONS:

Four main strata of material were encountered on this site. These were:

- (a) Mixed fill
- (b) Surficial soils
- (c) Silty fine sand with grits, pebbles and stones (sandy till)
- (d) Bedrock

(a) Mixed Fill

This stratum was encountered at hole 2 only, between ground surface and a depth of 11 ft. From ground surface to a depth of 3 ft. it was a grey-brown medium sand with gravel and pockets of minor organic content. From 3 ft. to 11 ft. it was a grey-brown slightly clayey sand with gravel content. The upper layer was in a compact condition with an "N" value of 14, whilst the main lower portion of the fill was in a loose condition with "N" values ranging between 3 and 9 with an average value of 5. The upper sand layer was moist with a natural moisture content of 5.2%, whilst the lower mixed layer was described as quite moist to moist with an average moisture content of 17%.

(b) Surficial Soils.

This stratum was encountered at each of the three testholes at the following depths:

- Hole 1 from ground surface to 2 feet
- Hole 2 from 11ft. to 12'10" - thickness 1'10"
- Hole 3 from ground surface to 7 feet.

The average thickness was 3'7". From the soil profile it can be seen that the thickness between holes 1 and 2 is fairly constant, increasing at hole 3, and the lower surface of the layer dips generally in the direction of hole 1 through hole 2 toward hole 3. It was a grey-brown or brownish-grey material which at hole 1 was described as clayey silt with fine sand and pebbles, whilst at hole 2 it was a clayey sand with grits and pebbles, and at hole 3 it was a silty to very silty fine sand to medium sand with a layer of organic silt occurring between depths of 2 and 3 ft. At holes 1 and 3 there was varying organic content; generally it was a very loose to loose condition with "N" values ranging from 2 to 8, although a very high value of 90 was recorded at hole 2, however, this has been disregarded

SOIL CONDITIONS:(b) Surficial Soils - Cont'd

since it was considered to be due to stone interference with the sampler. Near the surface at holes 1 and 3 it was moist or wetter than the Plastic Limit, whilst with depth at hole 3 it became wet to saturated. A similar condition was noted at hole 2 where this material was encountered.

(c) Silty Fine Sand.

Apart from the underlying bedrock this stratum was the main stratum encountered on this site. It occurred at each hole at the following depths:

Hole 1 from 2 ft. to 44'8" - thickness 42'8"

Hole 2 from 12'10" to 51'4" - thickness 38'6"

Hole 3 from 7 ft. to 41'3" - thickness 34'3"

Thus the average thickness is 38'6" and it increases from hole 3 through hole 2 toward hole 1. The material was a grey silty fine sand with grits, pebbles and stones with varying clay content and random boulders. Generally, it was in a very loose to loose and wet to saturated condition with "N" values rarely exceeding 10, except below a depth of 35 ft. in hole 2 where the "N" values showed a sharp increase and ranged between 58 and 90, excluding a very high value of 217 at a depth of 45 to 46 ft., which was probably due to stone interference. The stratum contained numerous water bearing seams and two such seams were clearly identified as sand layers occurring at 32 to 33 ft. in hole 1, and 38 to 41 ft. 6 ins. in hole 2. In addition, at hole 3 between depths of 25 ft. and 27 ft., a clay silt seam with fine sand, grits and pebbles was noted, and at a depth of 29'1" a small limestone boulder was encountered which was drilled and entailed moving the hole three feet west in order to advance the hole below this depth. Ground water conditions are dealt with in detail in a subsequent section but it may be noted here that Artesian water conditions were encountered below a depth of 25 ft. in hole 1 whilst similar conditions were encountered above the rock surface at holes 2 and 3. Generally, ground water conditions were adverse shortly following the penetration of this stratum, and quick conditions can be expected below depths of 15 to 20 ft.

(d) Bedrock.

Bedrock was encountered at each testhole and diamond drilled for a length of 10 ft. The depth at which it was encountered at each hole was as follows:

Hole 1 at a depth of 44'8" - elevation 343.7

Hole 2 at a depth of 51'4" - elevation 346.7

Hole 3 at a depth of 41'3" - elevation 346.4

The bedrock is broadly described as a light and dark grey banded granite gneiss. The details of the rock core at each test hole are as follows;

SOIL CONDITIONS:

Bedrock - Cont'd

Hole 1, the first run from 44'8" to 49'2", contained 10 inches of pink pegmatite with the remainder banded gneiss, the colour here was dark grey with light grey bands. The recovery was 3 ft. of core or 67%. The second run from 49'2" to 54'6" was a dark grey with light grey bands, banded gneiss with quartz stringers. The core recovery was 3'9" or 70%.

Hole 2, the first run from 51'4" to 56'4", was a banded granite-gneiss with pegmatite stringers. The colour was light grey with dark grey bands. The recovery was 100%. The second run from 56'4" to 61'2" gave a recovery of 3 ft. or 62%. From 57'4" to 57'8" was similar to the first run. From 57'8" to 61'2" was a softer banded gneiss, which carried a fracture, filled with mud, at 57'8". The third run from 61'2" to 64'3", gave a recovery of 84% and it was a banded gneiss with pegmatite stringers.

Hole 3, first run from 41'4 1/2" to 46'5", recovery 100%. Second run from 46'5" to 51'3", recovery 4'4" or 87%. The material was grey biotite granite gneiss, very siliceous in spots.

In addition to the information obtained from the rock cores in regard to the bedrock elevation, a series of probe holes were put down at the locations indicated on the drawings and the details of the penetration test results are given in tabular form in the Appendices. The depth of bedrock surface based on refusal at each of these probe holes was as follows:

Probe Hole #	Depth to Bedrock	Bedrock Elevation
1	47'6"	340.8
2	51'4"	346.7 (Result from BH#2
3	42'2"	346.1 and not from probe)
4	36'7"	348.0
5	39'6 1/2"	345.2
6	32'8 1/2"	363.7
7	39' 5 1/4"	351.3

These assumed profiles of bedrock surface have been shown on the drawing supporting the report.

WATER CONDITIONS:

A series of notes on the water level readings taken during the investigation are given in the Appendices and based on these results the following conclusions have been drawn:

1. Quick conditions developed in each testhole at depths varying between 18'6" at hole 1, 20 ft. at hole 2, and 25 to 30 ft. at hole 3.

WATER CONDITIONS: - Cont'd

2. At hole 1, the water was under Artesian pressure from a depth of 25 ft. and rose to a height of 5'6" above existing grade or to elevation 398.5. At holes 2 and 3, the Artesian condition occurred virtually at rock surface and at hole 2 the water level rose to 10 inches above grade or elevation 398.8 whilst at hole 3 it rose to a height of 7'3 1/2" above grade or elevation 395.0.
3. Conditions at these two latter holes tended to suggest the possibility of water coming from the rock, however, it is not considered that this actually occurred. It is thought this effect was due to the casing not being drilled into the rock surface sufficiently far to ensure complete cut-off of the water under pressure lying above the bedrock. At hole 2 only, where it was possible to carry out a series of daily readings over a period of 10 days, the water level in the testhole with the casing withdrawn was finally established at a depth of 4'10" and the hole had collapsed to a depth of 21 ft.

CONCLUSIONS AND RECOMMENDATIONS:

1. The existing river bottom shown on the DHO survey profile of the bridge crossing is at elevation 380, therefore without taking into consideration the question of scour on the footings it is evident that for normal spread footings the foundation elevation would have to be in the order of 374 or 376 in order to provide reasonable frost protection to the bridge footings. On the basis of this assumption normal spread footings are not considered a suitable foundation for the following reasons.
 - (a) The soil conditions are extremely loose at every hole, except hole 2 below a depth of 35 ft.
 - (b) The ground water table is above the footing elevation and in view of this condition such ground bearing strength as would normally be available under dry conditions would be subject to a large reduction factor to provide for the ground water conditions.
 - (c) Footings settlements although of an immediate nature would be large and probably differential in extent.
 - (d) From a construction aspect excavation and ground water control will present considerable problems.
2. For the foregoing reasons it would appear that the most suitable form of foundation at this site would be a pile footing, although even in this instance some site problems can be anticipated in connection with (i) random boulder content, (ii) the penetration of the extremely dense layer which appears to exist below a depth of 38 ft. in hole 2, (iii) the Artesian water condition which exists at depth on this site. This latter condition may lead

CONCLUSIONS AND RECOMMENDATIONS: - Cont'd

2. - Cont'd

to the tendency for the piles to uplift during driving although this is not considered to be a serious problem.

3. Following completion of the driving there is the possibility of ground water being forced up under pressure along the interface between the piles and the soil and for this reason it is considered that a suitable granular material with filtering characteristics should be placed below the pile cap and around the piles at this point. The grading requirements for this filtering material should comply with the grading of a well-graded concrete sand and the thickness of the layer below the pile cap should not be less than 6 inches, and around the piles it would be preferable if the thickness was increased to 12 inches.
4. Due to the random boulder content together with the extremely dense sandy till layer in the area of hole 2 below a depth of 38 ft. it is considered that steel-H piles with reinforced tips are the most suitable type of pile for use on this site, with a bearing value on the rock of 40 tons per square foot.
5. The proposed embankment approaches are to be increased, we understand, by approximately 5 ft. above the existing grade and this small increase together with the generally granular characteristic of the underlying soil does not, we believe, present any stability problem with regard to these embankments, although some settlement of an immediate nature will inevitably take place during the construction period.
6. It is considered that it would be good practice to remove the organic surficial soils, particularly in the area of holes 3 and 1, to the depth indicated on the borehole logs, where possible, although some difficulty in regard to ground water conditions may be anticipated in this connection particularly during wet weather conditions. Where for practical site reasons it is not possible to remove the whole of this material, at least the layer of organic silt encountered at a depth of 2 ft. in the area of hole 3 should be removed. Compaction near existing grade will be virtually impossible without lowering the ground water table, for this reason it is suggested that the material used to replace the excavated surficial soils should be a well-graded granular material in order to provide for lateral drainage, and to eliminate the compaction problem as far as possible.

E. M. PETO ASSOCIATES LTD.,



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

CFF/ajm

APPENDIX A

STANDARD PROCEDURE

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 augers, 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 inch dia. x 60° 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 (or pumped out) during the work as necessary, 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.

Borehole logs are prepared giving details of the soil description and condition as recorded in the field. These logs form the basis of the soil profile, which indicates the general stratigraphy assumed to exist between the boreholes as represented by the borehole logs.

The boreholes are normally set out by the Field Engineer, who also records the ground elevations referred to a temporary bench mark or known reference point. If the Client has been responsible for setting out the boreholes and recording their ground elevations this is stated in the preamble to the report.

A plan is drawn up from drawings supplied by the Client or his representatives, showing the locations of the boreholes and the T. B. M. where applicable.

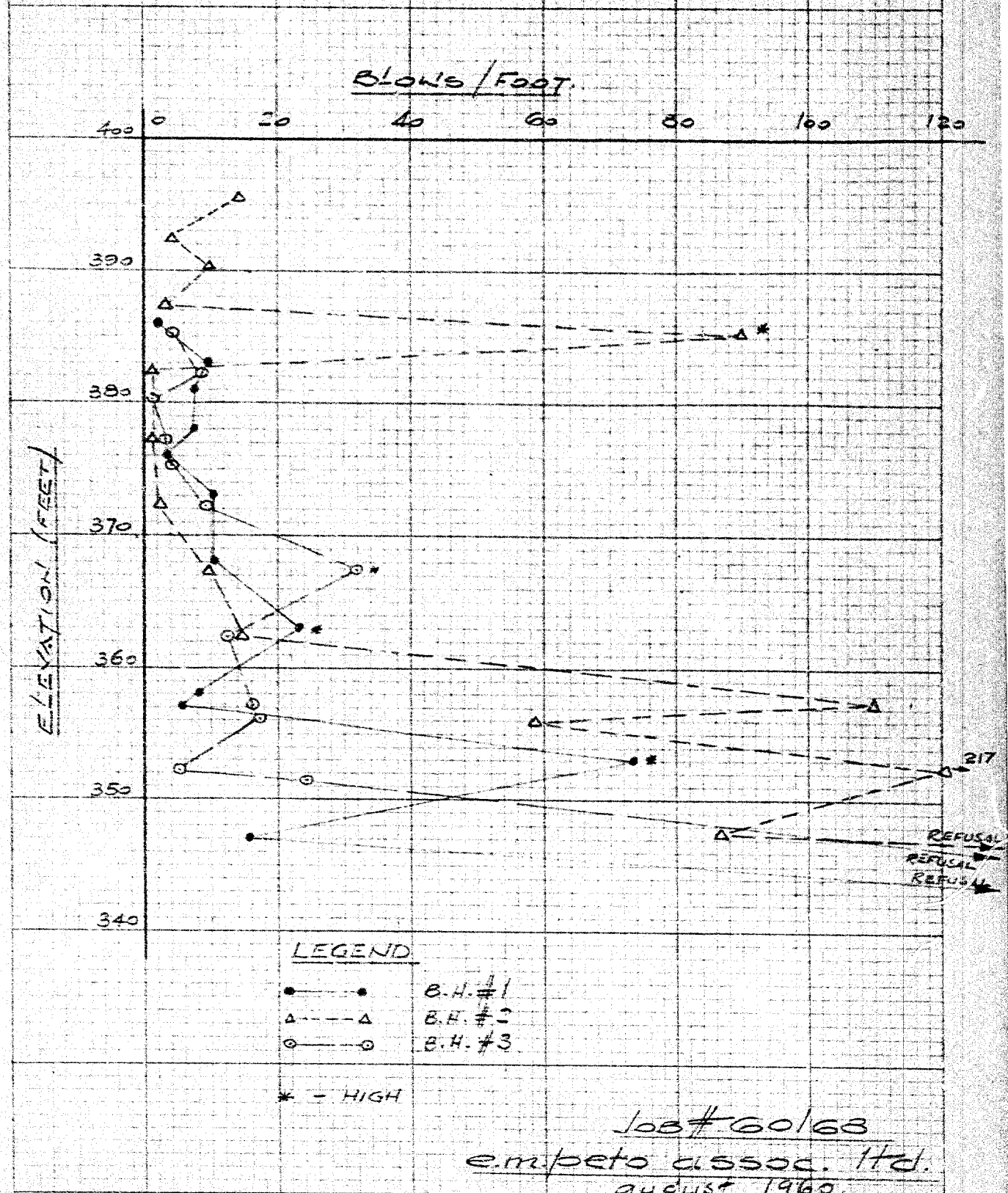
Normally, the standard penetration blows and the natural moisture contents are plotted against elevation as a graph, and these graphs form part of the appendices, together with laboratory test result details, ground water readings and other soil characteristics which can be best illustrated in graphical form.

Thus the appendices comprise:

- Appendix A Standard Procedure
- Appendix B Field Test Results
- Appendix C Laboratory Test Results (where applicable)
- Appendix D Ground Water Readings (where applicable)
- Appendix E Soil Characteristics versus elevation
(where applicable)

APPENDIX B
FIELD TEST RESULTS

STANDARD PENETRATION VS. ELEVATION.



e. m. peto associates ltd.
 DRILLER'S DAILY FIELD RECORD SHEET

Name of job **Indian River W.P. 253-60**

Date **Aug. 3, 1960**

Probehole no. **P1**

Order no. **60168**

Location:

Drill Rig No.

CONC PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	4	25 - 26	9	50 - 51		75 - 76	
1 - 2	3	26 - 27	11	51 - 52		76 - 77	
2 - 3	2	27 - 28	9	52 - 53		77 - 78	
3 - 4	3	28 - 29	9	53 - 54		78 - 79	
4 - 5	9	29 - 30	9	54 - 55		79 - 80	
5 - 6	32	30 - 31	9	55 - 56		80 - 81	
6 - 7	9	31 - 32	19	56 - 57		81 - 82	
7 - 8	9	32 - 33	42	57 - 58		82 - 83	
8 - 9	6	33 - 34	48	58 - 59		83 - 84	
9 - 10	14	34 - 35	17	59 - 60		84 - 85	
10 - 11	11	35 - 36	42	60 - 61		85 - 86	
11 - 12	9	36 - 37	73	61 - 62		86 - 87	
12 - 13	11	37 - 38	37	62 - 63		87 - 88	
13 - 14	11	38 - 39	34	63 - 64		88 - 89	
14 - 15	11	39 - 40	40	64 - 65		89 - 90	
15 - 16	8	40 - 41	30	65 - 66		90 - 91	
16 - 17	9	41 - 42	50	66 - 67		91 - 92	
17 - 18	11	42 - 43	44	67 - 68		92 - 93	
18 - 19	15	43 - 44	34	68 - 69		93 - 94	
19 - 20	14	44 - 45	37	69 - 70		94 - 95	
20 - 21	14	45 - 46	54	70 - 71		95 - 96	
21 - 22	12	46 - 47	137	71 - 72		96 - 97	
22 - 23	10	47 - 48	132	72 - 73		97 - 98	
23 - 24	10	48 - 49	Refusal	73 - 74		98 - 99	
24 - 25	8	49 - 50		74 - 75		99 - 100	

DRILLER'S DAILY FIELD RECORD SHEET

Name of job... **Indian River W.P. 253-60**Date... **Aug. 10, 1960**Probehole no... **P3**Order no... **60168**

Location:

Drill Rig No... **7**COSE PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	4	25 - 26	9	50 - 51		75 - 76	
1 - 2	4	26 - 27	10	51 - 52		76 - 77	
2 - 3	3	27 - 28	8	52 - 53		77 - 78	
3 - 4	5	28 - 29	4	53 - 54		78 - 79	
4 - 5	4	29 - 30	19	54 - 55		79 - 80	
5 - 6	20	30 - 31	22	55 - 56		80 - 81	
6 - 7	8	31 - 32	9	56 - 57		81 - 82	
7 - 8	5	32 - 33	20	57 - 58		82 - 83	
8 - 9	5	33 - 34	12	58 - 59		83 - 84	
9 - 10	5	34 - 35	12	59 - 60		84 - 85	
10 - 11	4	35 - 36	17	60 - 61		85 - 86	
11 - 12	4	36 - 37	13	61 - 62		86 - 87	
12 - 13	11	37 - 38	17	62 - 63		87 - 88	
13 - 14	5	38 - 39	11	63 - 64		88 - 89	
14 - 15	4	39 - 40	9	64 - 65		89 - 90	
15 - 16	3	40 - 41	8	65 - 66		90 - 91	
16 - 17	3	41 - 42	23/10"	66 - 67		91 - 92	
17 - 18	4	42 - 43	100/2"	67 - 68		92 - 93	
18 - 19	5	43 - 44	100/0"	68 - 69		93 - 94	
19 - 20	16	44 - 45	Refusal at 42 2"	69 - 70		94 - 95	
20 - 21	6	45 - 46		70 - 71		95 - 96	
21 - 22	5	46 - 47		71 - 72		96 - 97	
22 - 23	6	47 - 48		72 - 73		97 - 98	
23 - 24	2	48 - 49		73 - 74		98 - 99	
24 - 25	9	49 - 50		74 - 75		99 - 100	

DRILLER'S DAILY FIELD RECORD SHEET

Name of job..... **Indian River W.P. 253-60**Date..... **August 6, 1960**Probehole no..... **P4**Order no..... **60168**

Location:

Drill Rig No..... **7**CONE PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	2	25 - 26	9	50 - 51		75 - 76	
1 - 2	8	26 - 27	9	51 - 52		76 - 77	
2 - 3	5	27 - 28	9	52 - 53		77 - 78	
3 - 4	3	28 - 29	12	53 - 54		78 - 79	
4 - 5	2	29 - 30	12	54 - 55		79 - 80	
5 - 6	3	30 - 31	23	55 - 56		80 - 81	
6 - 7	4	31 - 32	63	56 - 57		81 - 82	
7 - 8	2	32 - 33	74	57 - 58		82 - 83	
8 - 9	2	33 - 34	78	58 - 59		83 - 84	
9 - 10	2	34 - 35	93	59 - 60		84 - 85	
10 - 11	5	35 - 36	74	60 - 61		85 - 86	
11 - 12	2	36 - 37	30/1"	61 - 62		86 - 87	
12 - 13	4	37 - 38	100/4"	62 - 63		87 - 88	
13 - 14	6	38 - 39	100/2"	63 - 64		88 - 89	
14 - 15	17	39 - 40		64 - 65		89 - 90	
15 - 16	16	40 - 41	Terminated at 36 7"	65 - 66		90 - 91	
16 - 17	11	41 - 42		66 - 67		91 - 92	
17 - 18	12	42 - 43		67 - 68		92 - 93	
18 - 19	12	43 - 44	Refusal at 36 7"	68 - 69		93 - 94	
19 - 20	11	44 - 45		69 - 70		94 - 95	
20 - 21	33	45 - 46		70 - 71		95 - 96	
21 - 22	27	46 - 47		71 - 72		96 - 97	
22 - 23	11	47 - 48		72 - 73		97 - 98	
23 - 24	10	48 - 49		73 - 74		98 - 99	
24 - 25	8	49 - 50		74 - 75		99 - 100	

DRILLER'S DAILY FIELD RECORD SHEET

Name of job.....**Indian River W.P. 253-60**.....

Date...**August 8th, 1960**.....

Probehole no.....**P5**.....

Order no. **60168**.....

Location:

Drill Rig No.....**7**.....

CONE PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	2	25 - 26	8	50 - 51		75 - 76	
1 - 2	1	26 - 27	12	51 - 52		76 - 77	
2 - 3	2	27 - 28	9	52 - 53		77 - 78	
3 - 4	5	28 - 29	12	53 - 54		78 - 79	
4 - 5	3	29 - 30	17	54 - 55		79 - 80	
5 - 6	1	30 - 31	60	55 - 56		80 - 81	
6 - 7	0	31 - 32	58	56 - 57		81 - 82	
7 - 8	13	32 - 33	30	57 - 58		82 - 83	
8 - 9	10	33 - 34	47	58 - 59		83 - 84	
9 - 10	17	34 - 35	210	59 - 60		84 - 85	
10 - 11	14	35 - 36	182	60 - 61		85 - 86	
11 - 12	14	36 - 37	101	61 - 62		86 - 87	
12 - 13	20	37 - 38	170	62 - 63		87 - 88	
13 - 14	15	38 - 39	226	63 - 64		88 - 89	
14 - 15	44	39 - 40	Refusal at 39' 6-1/2"			89 - 90	
15 - 16	23	40 - 41		65 - 66		90 - 91	
16 - 17	17	41 - 42		66 - 67		91 - 92	
17 - 18	15	42 - 43		67 - 68		92 - 93	
18 - 19	15	43 - 44		68 - 69		93 - 94	
19 - 20	45	44 - 45		69 - 70		94 - 95	
20 - 21	6	45 - 46		70 - 71		95 - 96	
21 - 22	6	46 - 47		71 - 72		96 - 97	
22 - 23	7	47 - 48		72 - 73		97 - 98	
23 - 24	9	48 - 49		73 - 74		98 - 99	
24 - 25	8	49 - 50		74 - 75		99 - 100	

DRILLER'S DAILY FIELD RECORD SHEET

Name of job... **Indian River Bridge W.P. 253-60**Date... **Aug. 14th, 1960**Probehole no... **6**Order no... **60168**

Location:

Drill Rig No... **7**CONE PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	9	25 - 26	20	50 - 51		75 - 76	
1 - 2	10	26 - 27	17	51 - 52		76 - 77	
2 - 3	17	27 - 28	18	52 - 53		77 - 78	
3 - 4	18	28 - 29	23	53 - 54		78 - 79	
4 - 5	14	29 - 30	22	54 - 55		79 - 80	
5 - 6	8	30 - 31	41	55 - 56		80 - 81	
6 - 7	4	31 - 32	91	56 - 57		81 - 82	
7 - 8	4	32 - 33		57 - 58		82 - 83	
8 - 9	23	33 - 34	Refusal at 32' 8-1/2"			83 - 84	
9 - 10	19	34 - 35		59 - 60		84 - 85	
10 - 11	23	35 - 36		60 - 61		85 - 86	
11 - 12	16	36 - 37		61 - 62		86 - 87	
12 - 13	16	37 - 38		62 - 63		87 - 88	
13 - 14	15	38 - 39		63 - 64		88 - 89	
14 - 15	14	39 - 40		64 - 65		89 - 90	
15 - 16	12	40 - 41		65 - 66		90 - 91	
16 - 17	12	41 - 42		66 - 67		91 - 92	
17 - 18	13	42 - 43		67 - 68		92 - 93	
18 - 19	13	43 - 44		68 - 69		93 - 94	
19 - 20	17	44 - 45		69 - 70		94 - 95	
20 - 21	18	45 - 46		70 - 71		95 - 96	
21 - 22	25	46 - 47		71 - 72		96 - 97	
22 - 23	18	47 - 48		72 - 73		97 - 98	
23 - 24	14	48 - 49		73 - 74		98 - 99	
24 - 25	24	49 - 50		74 - 75		99 - 100	

DRILLER'S DAILY FIELD RECORD SHEET

Name of job..... **Indian River Bridge, W.P. 253-60**Date..... **Aug. 14th, 1960**Probehole no..... **7**Order no..... **60168**

Location:

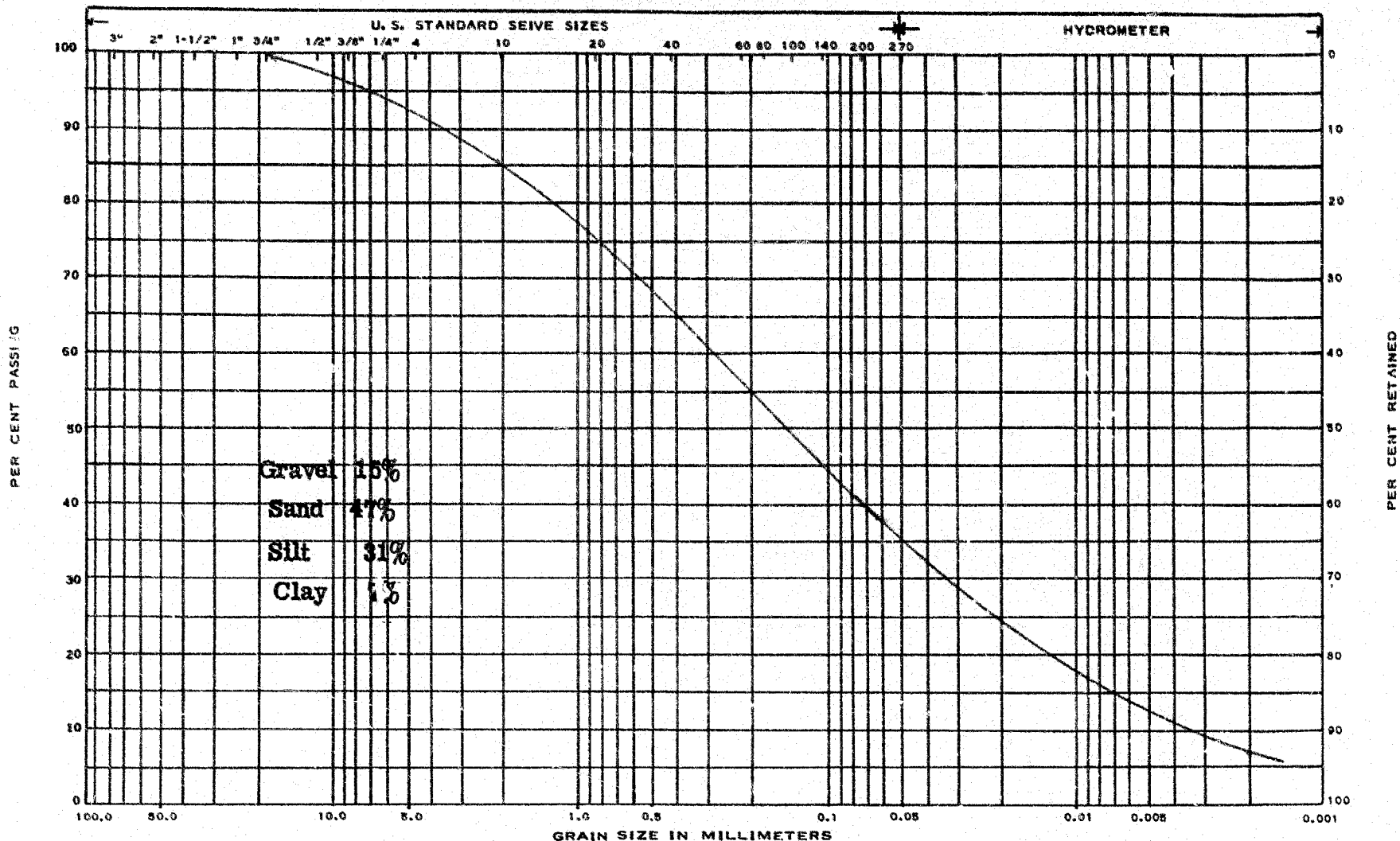
Drill Rig No..... **7**CONE PENETRATION TEST

Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows	Depth from to	No. of blows
0 - 1	9	25 - 26	77	50 - 51		75 - 76	
1 - 2	4	26 - 27	32	51 - 52		76 - 77	
2 - 3	7	27 - 28	35	52 - 53		77 - 78	
3 - 4	10	28 - 29	31	53 - 54		78 - 79	
4 - 5	5	29 - 30	30	54 - 55		79 - 80	
5 - 6	6	30 - 31	32	55 - 56		80 - 81	
6 - 7	4	31 - 32	24	56 - 57		81 - 82	
7 - 8	12	32 - 33	19	57 - 58		82 - 83	
8 - 9	4	33 - 34	29	58 - 59		83 - 84	
9 - 10	4	34 - 35	27	59 - 60		84 - 85	
10 - 11	4	35 - 36	31	60 - 61		85 - 86	
11 - 12	4	36 - 37	72	61 - 62		86 - 87	
12 - 13	3	37 - 38	122	62 - 63		87 - 88	
13 - 14	5	38 - 39	183	63 - 64		88 - 89	
14 - 15	32	39 - 40	Refusal at 39' 5-1/4"			89 - 90	
15 - 16	18	40 - 41		65 - 66		90 - 91	
16 - 17	14	41 - 42		66 - 67		91 - 92	
17 - 18	13	42 - 43		67 - 68		92 - 93	
18 - 19	18	43 - 44		68 - 69		93 - 94	
19 - 20	9	44 - 45		69 - 70		94 - 95	
20 - 21	13	45 - 46		70 - 71		95 - 96	
21 - 22	15	46 - 47		71 - 72		96 - 97	
22 - 23	23	47 - 48		72 - 73		97 - 98	
23 - 24	22	48 - 49		73 - 74		98 - 99	
24 - 25	27	49 - 50		74 - 75		99 - 100	

APPENDIX C
LABORATORY TEST RESULTS

e. m. peto associates ltd.

Toronto 18, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
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MASS. INST. OF TECH. CLASSIFICATION

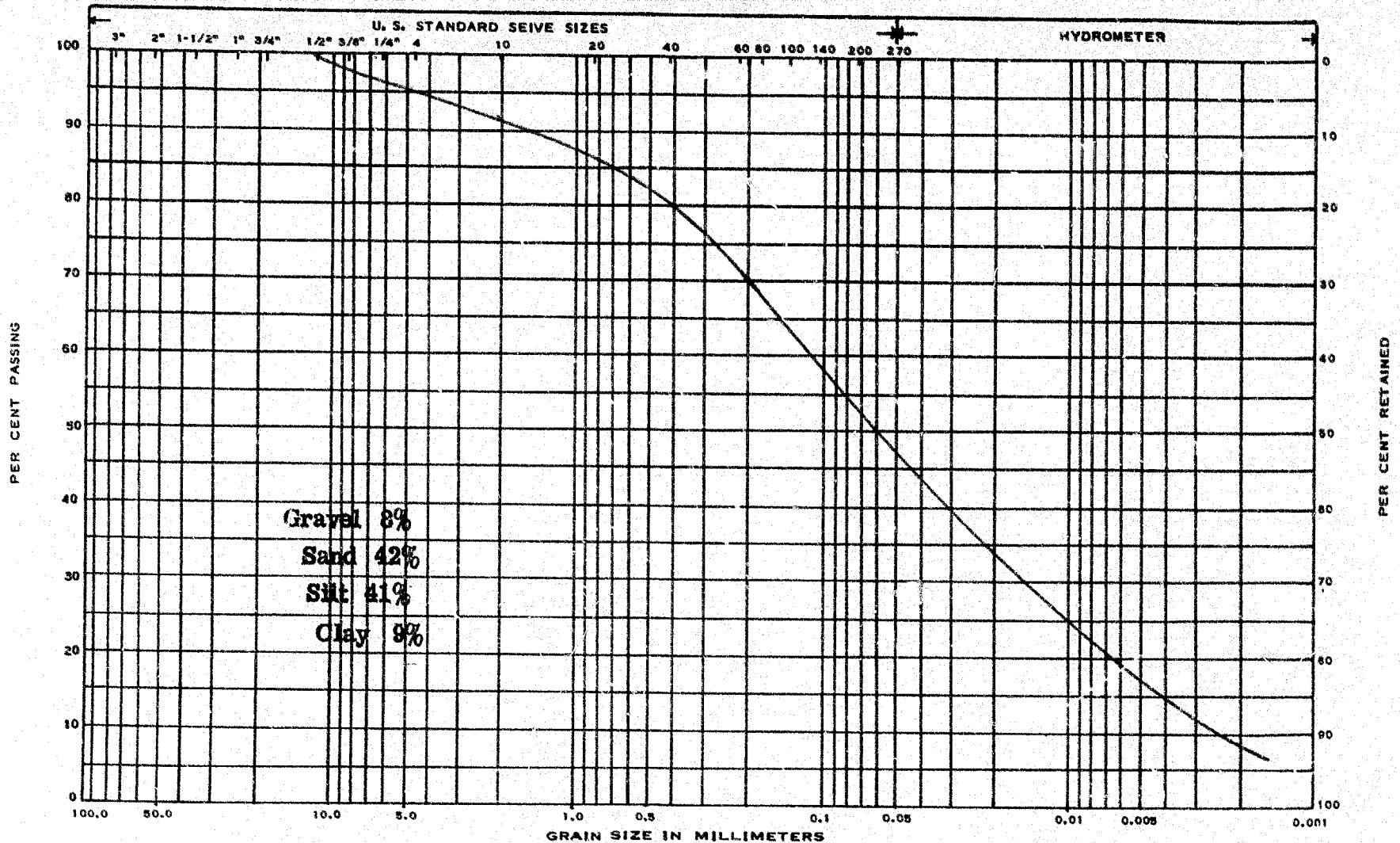
JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 1 SAMPLE NO. 6

DEPTH 10'-11" ELEVATION _____ REMARKS Sandy till

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
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MASS. INST. OF TECH. CLASSIFICATION

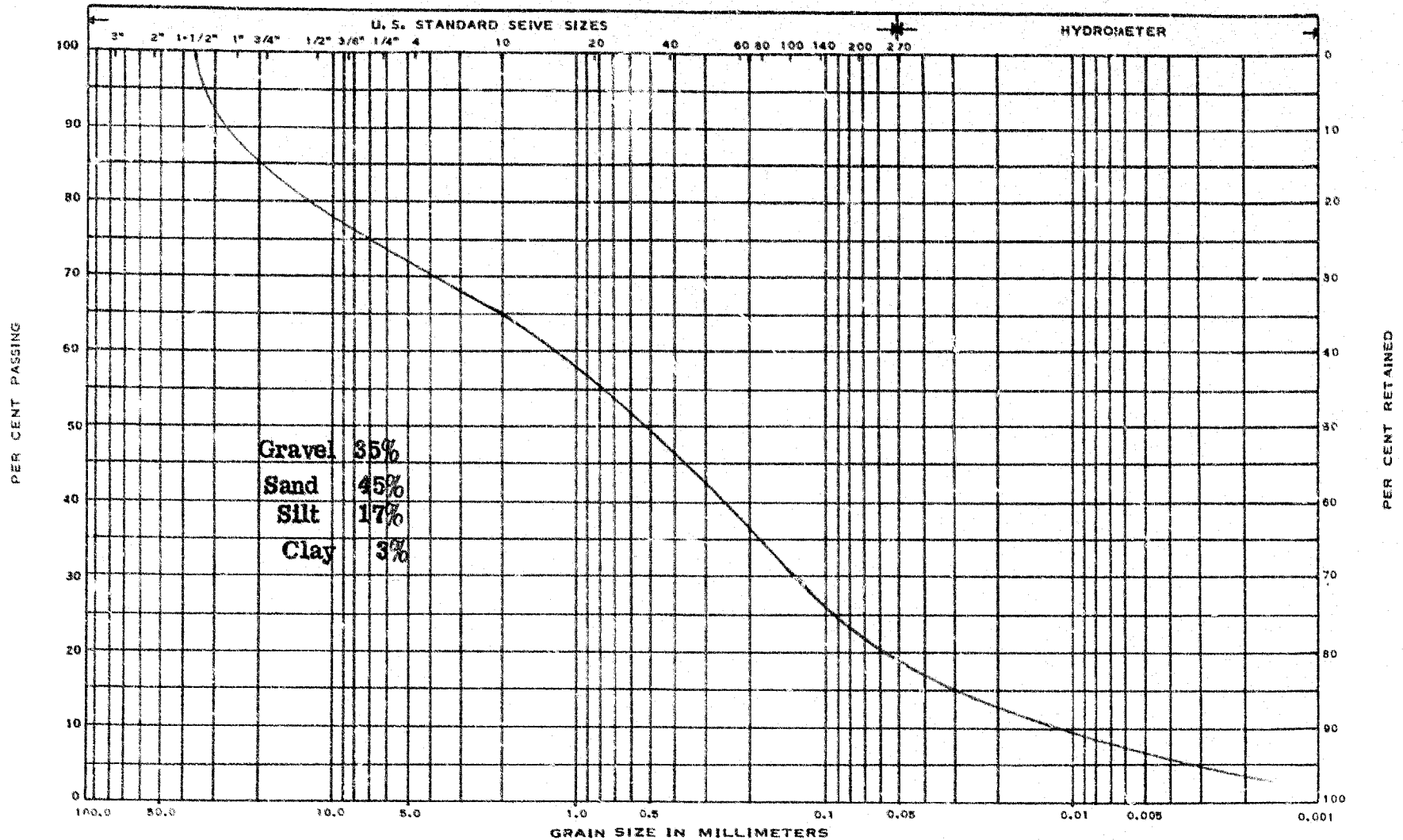
JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 1 SAMPLE NO. 9

DEPTH 20'-21' ELEVATION _____ REMARKS Sandy fill

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.

Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
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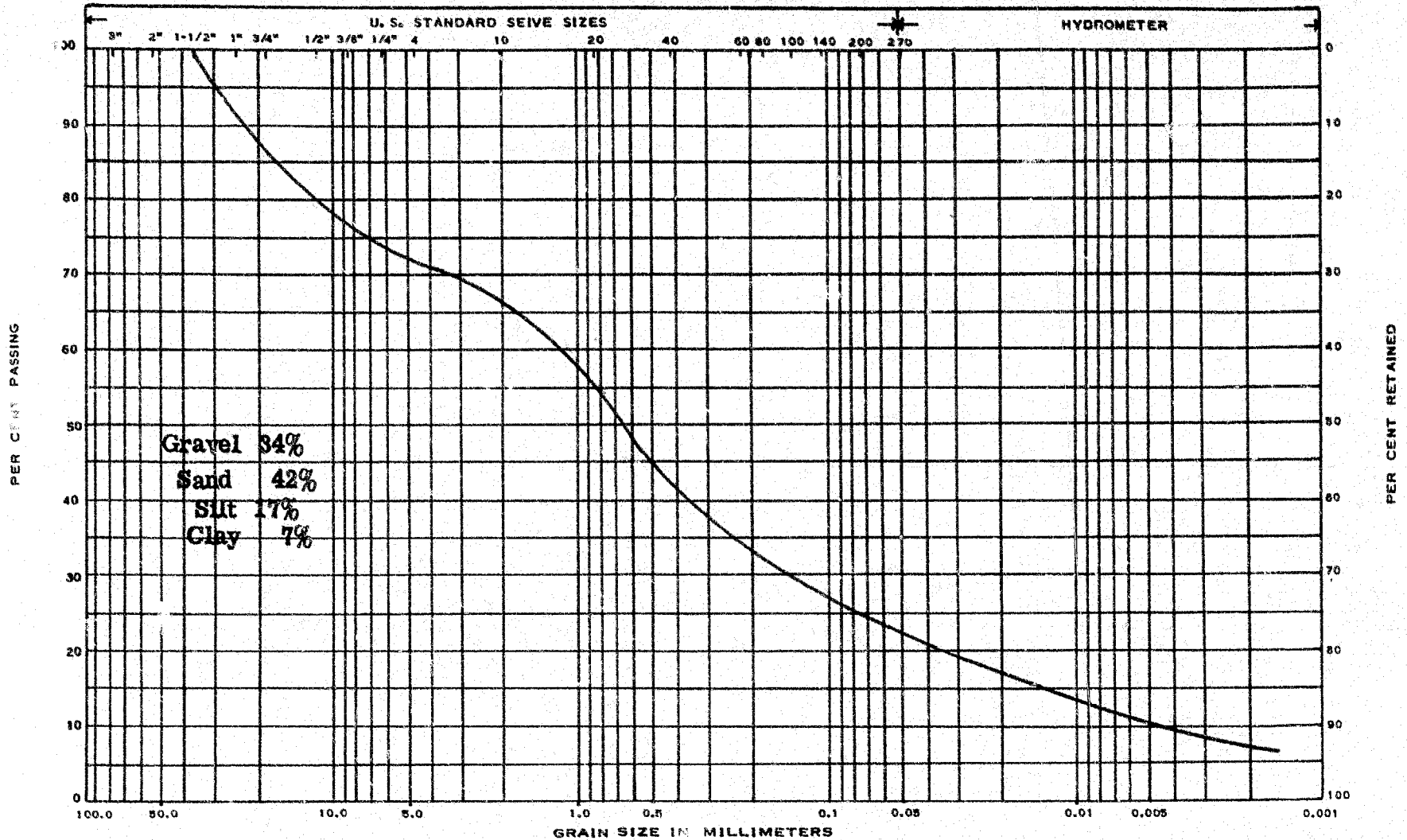
MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 1 SAMPLE NO. 12

DEPTH 35'-36' ELEVATION _____ REMARKS Silty gravelly sand.

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
Toronto 19, Ontario



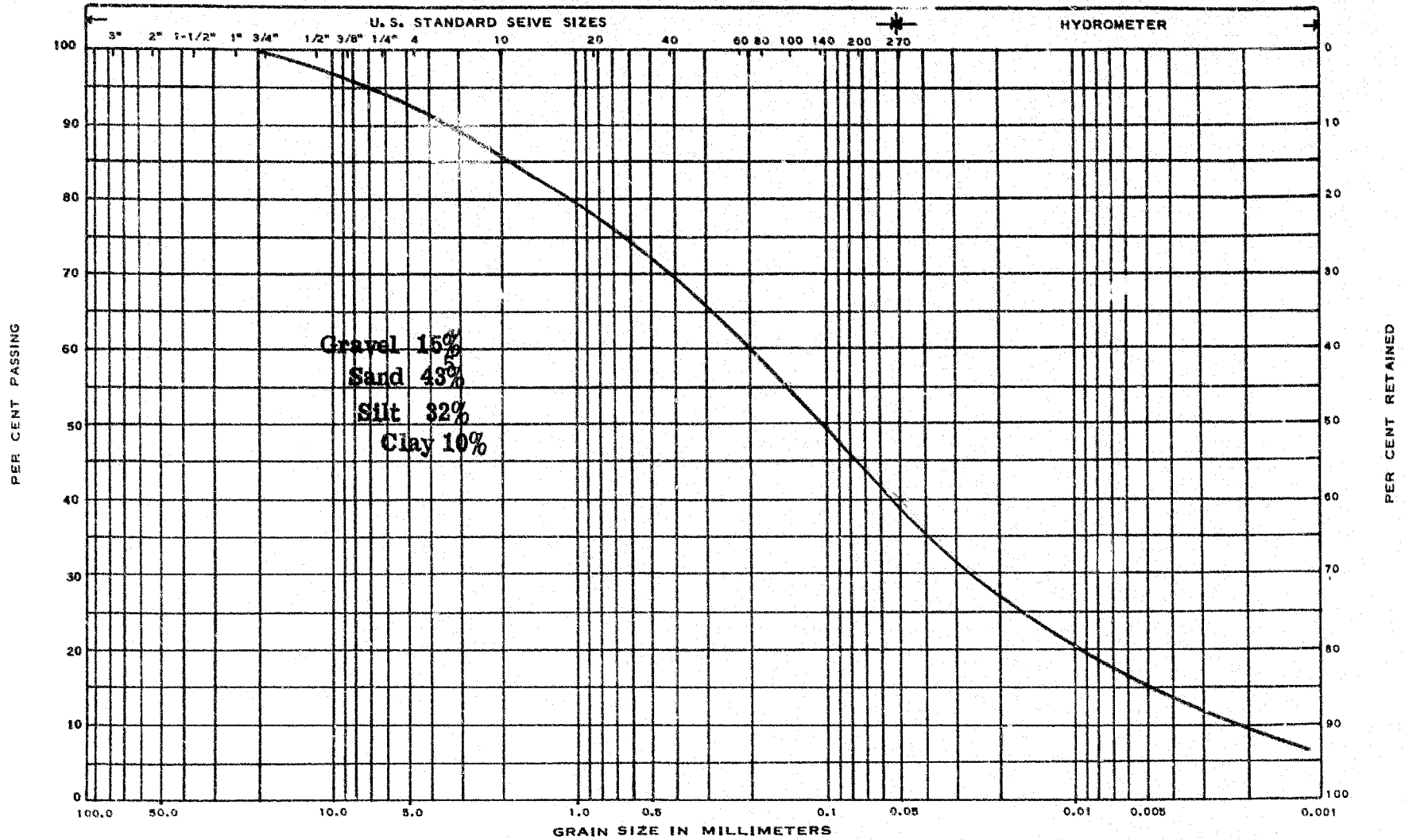
STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 2 SAMPLE NO. 4 & 5
DEPTH 5'-7' ELEVATION _____ REMARKS (Mixed Fill) Silty gravelly sand.

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
Toronto 19, Ontario



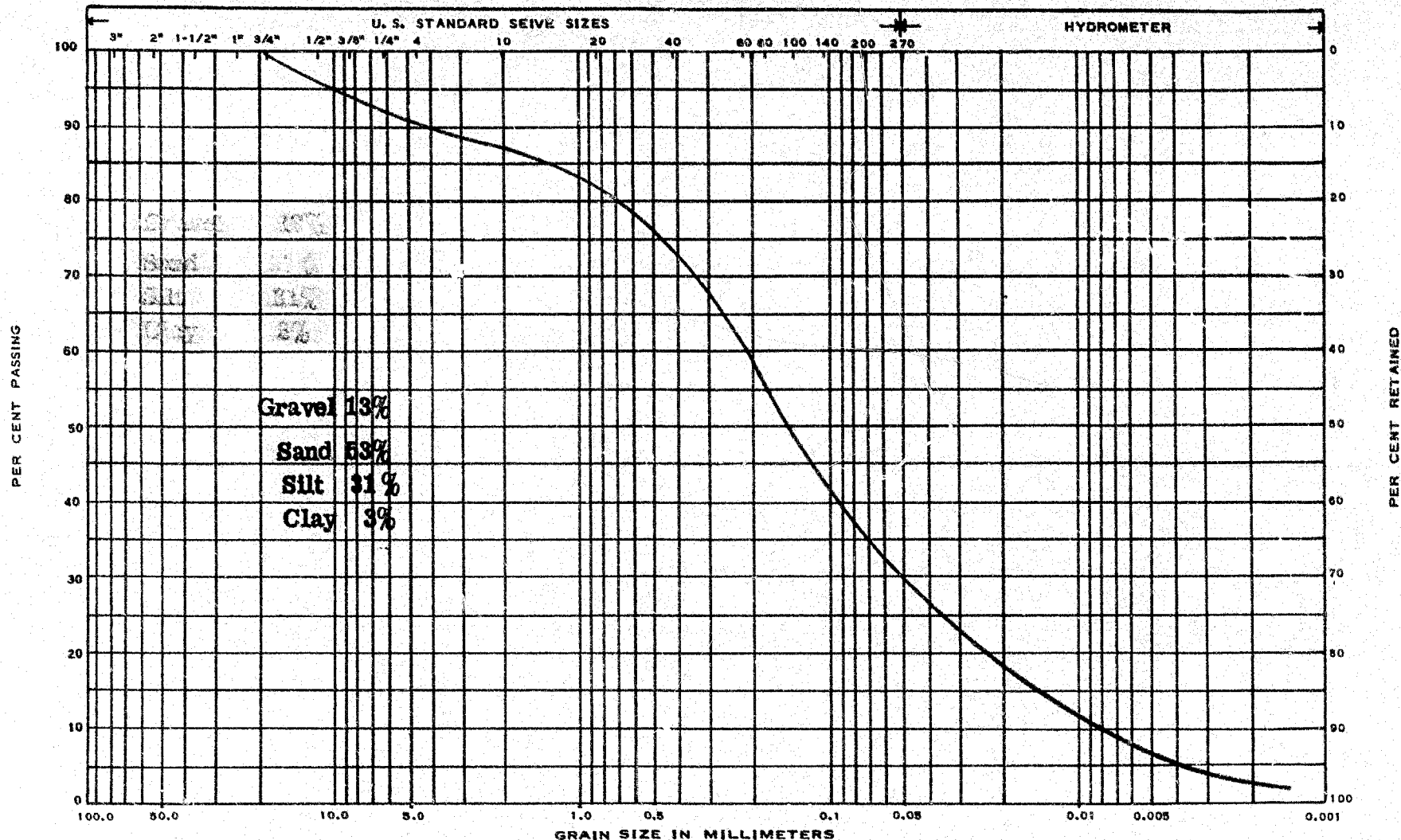
STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 2 SAMPLE NO. 8
DEPTH 15'-16' ELEVATION _____ REMARKS Sandy till

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
Toronto 19, Ontario



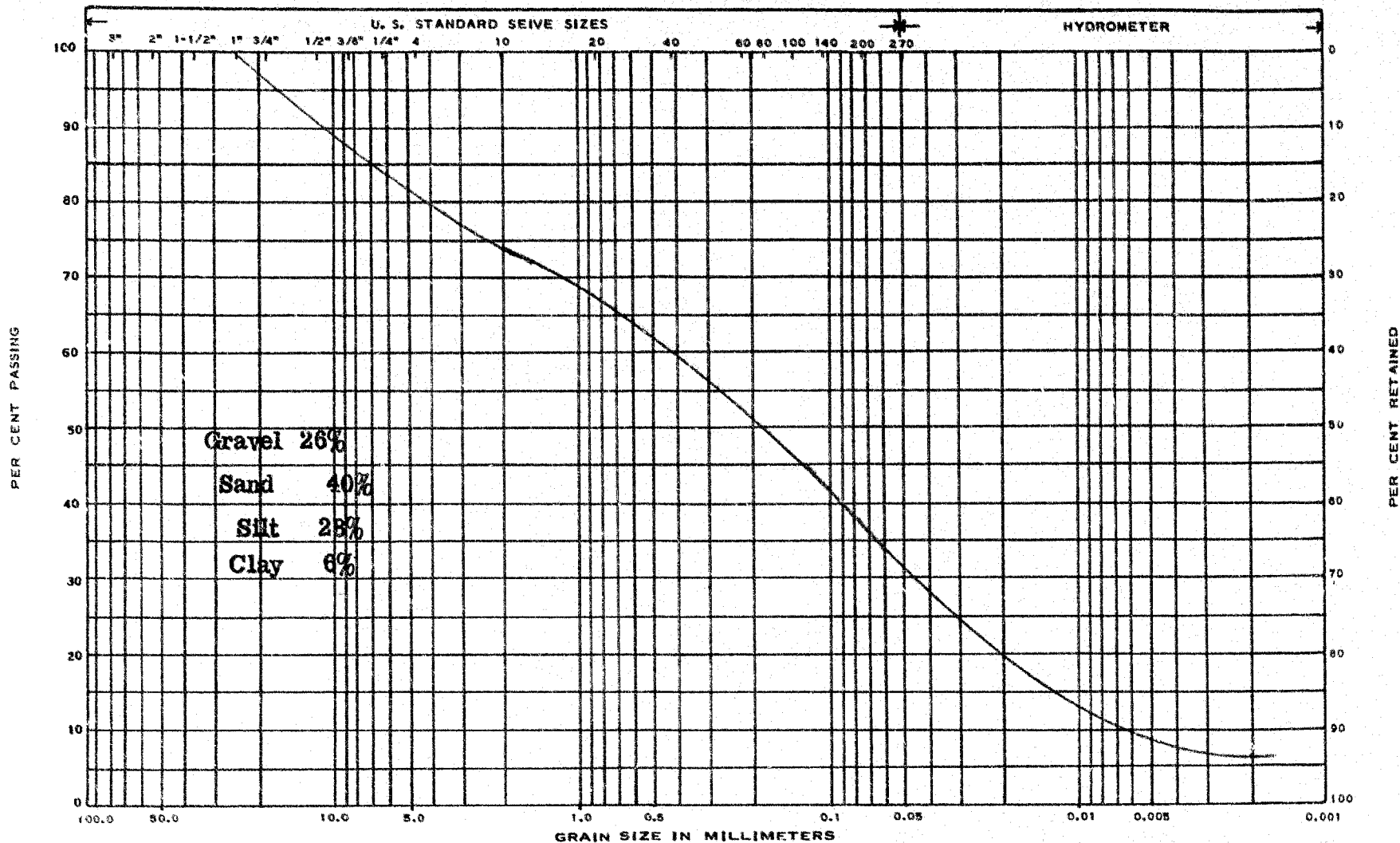
STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 2 SAMPLE NO. 17
 DEPTH 50' 3" - 51' 3" ELEVATION _____ REMARKS Sandy till

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
Toronto 19, Ontario



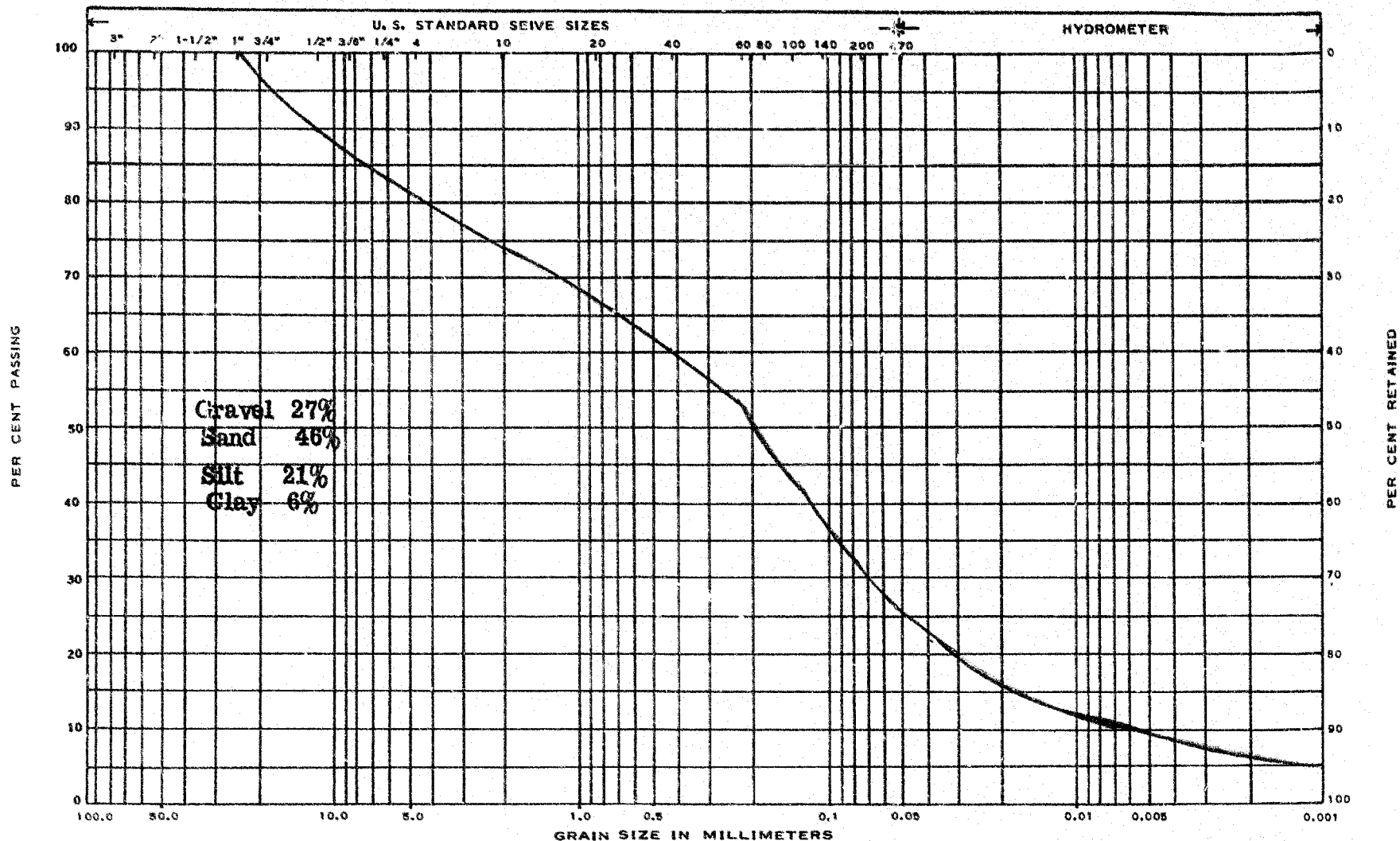
STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 3 SAMPLE NO. 6
 DEPTH 10'-11' ELEVATION _____ REMARKS Sandy till

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
Toronto 19, Ontario



STONES	GRAVEL	COARSE SAND	MED. SAND	FINE SAND	COARSE SILT	MED. SILT	FINE SILT	CLAY
--------	--------	-------------	-----------	-----------	-------------	-----------	-----------	------

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Indian River Bridge JOB NO. 60168 HOLE NO. 3 SAMPLE NO. 9
 DEPTH 20'-21' ELEVATION _____ REMARKS Sandy till

GRAIN SIZE DISTRIBUTION

APPENDIX D
GROUND WATER READINGS

WATER READINGS

The following is a series of notes based on the detailed water readings taken at each testhole during the course of the investigation.

Hole 1

- (1) Hole was dry to 18'6" but kept collapsing up to the end of the casing from a depth of 4'8".
- (2) A quick condition developed overnight, and wet sand backed up the casing from a depth of 18'6" with the hole cased to 12'6", and the water level was approximately 9 ft. below grade.
- (3) With the casing at 20 ft. and attempting to clean out the hole dry from 16 ft., the water level stabilized at 6 ft. below grade, and sand backed up the casing to the depth of 10'4".
- (4) With the hole open to 21 ft. and cased to 20 ft., the water level was 10'2". The hole was then bailed to 18'9" and the water level rose 1 inch only in five minutes, to a depth of 18'8".
- (5) With the hole at 26 ft. and cased to 25 ft., the water level rose to 2'5" below grade and sand backed up to 24'9" in eight minutes. The hole was then bailed to 21'3", and after 39 minutes the water level was at ground level and sand had backed up to 23'4". After a further 15 minutes water was flowing slowly over the top of the casing 5'6" above ground level and the sand had backed up to 22'8".
- (6) With the hole at 32 ft. and cased to 30 ft., water was flowing over the top of the casing 3 inches above ground level and the sand had backed up the casing to 29'4". The hole was then bailed to 10'6" below grade and after eight minutes the water was flowing over the top of the casing 3 inches above ground level at a rate of approximately 1/2 gallon per minute and sand had backed up to 29'1".
- (7) With the hole at 36 ft. and cased to 35 ft., the water level was stabilized at 10 ft. 1 1/2 inches above ground level, elevation 398.5.
- (8) With the casing at 40 ft., a very active water condition was encountered when the split spoon was driven to 40'6", the water level rising to 5'2" above ground level in 30 seconds. The Artesian head was finally stabilized at 8'8 1/2" above ground level and the hole was then opened to 40'6". This was cut off by driving the casing to 41'2". Artesian water however, was encountered again with the casing at 44'8", i.e. on assumed bedrock. When rock coring to 54'6" was completed and the casing still at 44'8" the water level was established at 6'7" above ground level.

Hole 2

- (1) With the hole uncased to 11 ft., the hole collapsed initially at 10 ft. and then at 3 ft.
- (2) With the hole at 16 ft. and cased to 15 ft., water level was established at 14'3 1/2". After an overnight period the hole collapsed to 15'2".
- (3) With the hole at 20 ft., and cased to 21 ft., water level was at 5'9", the hole collapsed at 20'1". The hole was then bailed to 17'11" and sand backed up the casing to 19'7" with the water level at 17'10".
- (4) With the hole at 27'6" and cased to 25 ft., water level was at 10'3" after two minutes. The hole was then bailed to 25'9" and water level rose to 23'7" in 45 minutes and the hole collapsed to 26'8".
- (5) With the hole at 32'7" and cased to 30 ft. water level was at 7'10"; the hole was then bailed to 30 ft. and water level rose to 1'7" below grade in 63 minutes and the hole collapsed to 30'9".
- (6) With the hole at 39 ft. and cased to 35 ft., water level rose to 1'0" below grade overnight and the sand had backed up the casing to 33'3".
- (7) With the hole at 42'6" and cased to 40 ft., the water level was steady at 12'2". The hole was then bailed to 38 ft. and after 10 minutes the water level dropped to 38'10" and the hole collapsed to 41'8".
- (8) With the hole at 45'6" and cased to 45 ft., the water level was at 12'1" below grade. The hole was then bailed to 43'5" returning to 42'2" in ten minutes, the hole was open to 45'6".
- (9) With the hole at 51 ft. and cased to 50 ft., the water level was at 15 ft. below grade. It was then bailed to 41'6" and in two minutes rose to 17'4". After an overnight period it rose to 2 inches above ground level and the hole was open to 50'2".
- (10) With the hole at 51'7" and cased to 51'4" (on rock), the water level was 6 in. above ground level. After 25 minutes it dropped to 7'6" below grade and in a further 8 minutes rose to 6'10". As rock coring proceeded the water level rose to 8 inches above ground level and with the hole at 64'3" and cased to 51'4" the water rose to 10 inches above ground level in 14 minutes, elevation 398.8.
- (11) As the casing was withdrawn to 21 ft. the hole collapsed to 40'6" and the water level fluctuated between 1 inch and 2'1" below grade, at which point the hole had collapsed to 25'5".
- (12) With the casing withdrawn to 18 ft., the water level was established at 4'6". The hole was then bailed to 14'7" and in 8 minutes the water level rose to 13'4". After an overnight period the water level was at 6'3" and the hole was open to 24'8".

Hole 2 - Cont'd

- (13) With the casing withdrawn water level dropped to 7 feet.
- (14) Over a ten day period the water level was stabilized at 4'10" and the hole collapsed to 21 ft.





Hole 3

- (1) With the hole uncased to 6 ft., the water level rose to 3'2" and the hole collapsed to 3'9".
- (2) With the hole at 8 ft. and cased to 7 ft., the ground was wet and the hole collapsed to 6'11".
- (3) With the hole at 11 ft. and cased to 9 ft., the water level rose to 5 ft. The hole was then bailed to 7'6" and the water level rose to 7 ft. in 6 minutes and the hole collapsed to 9'10".
- (4) With the hole at 16 ft. and cased to 14 ft., the water level rose to 5 ft., the hole was then bailed to 12'8" and in 25 minutes the water level rose to 11'6". Overnight the water level ~~fell~~ to 2'10" and the hole collapsed to 14'4".
- (5) With the hole at 21 ft. and cased to 19'6", the water level was established at 5'8" below grade and the hole collapsed to 19'8". The hole was then bailed to 16'6" and the water rose to 15'11" in seven minutes with the hole open to 19'8".
- (6) With the hole at 26 ft. and cased to 25 ft., the water level rose to 7'3" below grade. The hole was then bailed to 23'6" and the water level remained there for 5 minutes, the hole being open to 25 ft.
- (7) With the hole at 32 ft., and cased to 30ft. the water level was at 6'10" and the hole had collapsed to 29'11". The hole was then bailed to 23'10"; and in 37 minutes the water level rose to 10'8" and sand backed up the casing to 27'11".
- (8) With the hole at 41 ft. and cased to 35 ft. and following withdrawal of the rods the water level rose to ground level in one minute. After 22 minutes the water level was at 4'8" above ground level and the hole was open to 37'9". The following morning, following commencement of rock coring, the water level rose to 7'3 1/2" above ground level, elevation 395.9 The time taken for this water level to rise was 25 minutes.

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

Job Name Indian River & Hwy. #41 Job No. 60169 Borehole No. 1
Client D.H.O. Casing BX Boring Date Aug. 3, 4 & 5/60
Elevation Geodetic Compiled By U.J.V. Checked By C.F.F.

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.	WATER LEVELS & REMARKS	Blasts/ft
			0'0"						
Clay silt with fine sand & pebbles with org. content	Brownish-Gr.		388.4	1	X	c.s.		W.T.P.L.	4
	"		2'0"	2	X	c.s.		W.T.P.L. (more clay)	3
Silty fine sand odd grit and pebbles	Grey	V. loose		3	X	s.s.	2	Q.M. (W.T.P.L.)	2
			5'0"					At 3 ft. turning wet to saturated	9
As above with grits & pebbles & minor clay	"	Loose to compact		4	X	s.s.	9	Wet (sl. plastic)	32
"	"	Loose		5	X	s.s.	7	Wet (sl. plastic)	9
			10'0"						6
Silty fine sand, as above	"	"		6	X	s.s.	7	Wet to saturated	14
"	"	V. loose		7	X	s.s.	3	Wet to saturated	11
			15'0"					No free water in hole to 18'6"	11
"	"	Loose to compact		8	X	s.s.	10	Wet	8
			20'0"			2"s.l.		Starting to use wash at 16 ft.	9
									11
As above, minor clay	"	"		9	X	s.s.	10	Wet	15
			25'0"					2" layer of silty clay	14
								Gravelly layer at 21'	12
								Slight seepage	10
As above, less clay	"	Compact		10	X	s.s.	22/10	Wet artesian water	8
More gravelly coarse sand							1 1/2"	and sand	9
			30'0"					Backing up 2'4"	11
								*High stone interference	9
V. silty fine to med. sand with grits & pebbles	"	Loose		11	X	s.s.	8	Artesian water & sand backing up 8"	9
		V. Loose	32'0"				5	Wet to saturated	11.7
		to loose	33'0"					Layer of coarse sand	42
			35'0"					32-33 ft.	48
Silty fine sand with grits pebbles & stones, minor Cl. Very silty & clayey patches	"	V. dense		12	X	s.s.	74*	Q.M. (sl. plastic)	6.6
			40'0"					Artesian water	73
								*High due to driving stone	37
									34
Med. to fine sand with grits, pebbles & stones & minor silt content	"	Compact		13	X	s.s.	15	Saturated Artesian water	8.3
			44'6"						30
10" pink pegmatite remainder dk. grey banded gneiss with Lt. gr. bands						R.C.		Drilled recovered 3'0" core (67%)	54
			50'0"					Longest unbroken piece 6" (peg.) 8" (gneiss)	137
Banded gneiss with quartz stringers	"					R.C.		Drilled recovered 3'9" core for 70% recovery	232/6"
			54'6"					Longest unbroken piece 8"	

Hole terminated at 54'6"

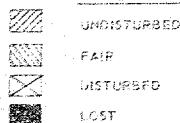
Artesian conditions occur below 25 ft. W.T. 5'6" above grade. Above 25' ground wet to saturated. Quick conditions can be expedited from 8' with W.L. at 9'. Maximum artesian conditions recorded gave a W.T. 10' above grade or elevation 398.5 from 30 ft.

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

BOREHOLE LOG

Job Name Indian River & Hwy. #41 Job No. 00108 Borehole No. 2
Client D.H.D. W.P. 253-50 Casing BY Boring Date July 28, 29, 30, Aug. 1 & 2
Elevation Geodetic Compiled By U.J.V. Checked By C.F.F.

SAMPLE CONDITION



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 (feet)	Log	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVEL & REMARKS	Dutch cone blows 1 ft.
			0'0"					Mixed fill to 11'0"	
Mud. sand with siltye grav. Grey-brown			1'9.3	1	1	S.S.		Moist Hair roots	3
Pockets minor org. content				2	2	S.S.			6
Med. sand with gravel		Compact	3'0"	3	3	S.S.	14	Moist	5
			5'0"						8
Slightly clayey sand with gravel		Soft to firm		4	4	S.S.	4		5
"		Firm to stiff		5	5	S.S.	9	Moist	4
As above		V. loose	11'0"	6	6	S.S.	3	M. Moist	4
Clayey sand with grits & pebb. (stone)	Grey brown	V. hard	12'40"	7	7	S.S.	90*	Water encountered at 6'0"	6
V. silty fine sand with Grits & peb. some clay	Grey	V. loose		8	8	S.S.	1	W.T.P.L. at 11'0"	13
"				9	9	2"s.l. pushed	14.3	Colour change at 12' 10"	10
"			20'0"					*High due to driving	10
"		V. loose		10	10	S.S.	1	Sat. stone	14
"								Slight water seepage	11
As above, minor clay		V. loose	25'0"	11	11	S.S.	2	Used wash water from 18 ft.	10
"								Sat. water bearing sand backing up casing 5"12	11
"		Loose to compact	30'0"	12	12	S.S.	9	Water seepage	13
"								Wet to sat.	15
"								Water bearing	22
"								2"s.l. pushed	60
Silty fine to med. sand with grits & peb. (till)		Compact	35'0"	13	13	S.S.	14	Sat. water bearing sand backing up casing 1'9"	29
"			38'0"					Turning dense at 38' 52"	145
Med. to fine sand with grits & pebbles.		Extremely dense	41'6"	14	14	S.S.	90	Wet, water seepage	353
Silty fine to med. sand with grits & pebbles		V. dense		15	15	S.S.	58		345
"			45'0"					Q.M. Boulder at 44'10"	
"		Extremely dense		16	16	S.S.	217	V.M. (wash water) s.s. lost but c.s. recovered. Water Seepage	
As above									
As above with minor clay & v. silty partings		Extremely dense	51'4"	17	17	S.S.	86	M. water bearing	
6" sand & gravel layer above rock									
Banded granite gneiss with light Grey with pegmatite stringers	Dark grey with light Grey bands		55'0"					51'4"-56'4" drilled 100% core recovery	
								Longest unbroken piece 10"	
Fracture filled with clay at 57'8"			57'0"					56'4"-61'2" drilled recovered 3'9" (62%)	
Banded gneiss with pegmatite stringer (softer than above)	Dark grey with light Grey bands		60'0"			R.C.		Longest unbroken piece 7" in harder granite 3" in softer gneiss 61'2"-64'3" drilled	
								Recovered 2'7" (82%) led	
			64'3"					Longest unbroken piece 2"	

Hole terminated at 64'3"

Artesian water at rock surface rising to 10 inches above grade elevation 393.8
W.L. From 20 ft. at 5'0". Conditions deteriorate with depth.

BOREHOLE LOG

Job Name Indian River W.P. 253-09

Job No. 60168

Borehole No. 3 & 3A (3'W)

Client D. H. O.

Casing BX

Boring Date Aug. 30, 11, 12/60

Elevation Geodetic.

Compiled By U. J. V.

Checked By C.F.F.

SAMPLE CONDITION

SAMPLE TYPE

ABBREVIATIONS

 UNDISTURBED

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

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

 FAIR

DISTURBED

LOST

SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS & REMARKS	Dutch cone 4/ft.
Silty fine to med. sand with clayey patches & minor org. cont.	Greybrown	V. loose	0'0"		1	c.s.		M.	4
Silty fine sand - minor org. content	"	V. loose	387.7		2	c.s.		M. pockets of silt	3
Organic silt	"	to loose	5'0"		3	s.s.	4	M. to Q.M.	5
V. silty med. to fine sand org. content	Mixed grey br. & grey	Loose	7'0"		4	s.s.	8	Wet to sat.	8
Silty fine sand with grits, pebbles & stones minor clay content	Grey	V. Loose	10'0"		5	s.s.	12	Wet to sat. Started to use wash water 8 ft.	5
As above, no stones	"	"	15'0"		6	s.s.	3	Wet to saturated	4
As above more grits & pebs. some clay	2	V. loose to loose	15'0"		7	s.s.	4	Gravelly & stoney from 13 ft.	11
As above, more clay		Loose to compact	20'0"		8	s.s.	9	Wet to saturated	4
V. silty fine to med. sand with grits, pebbles & minor clay	"	do.	20'0"		9	s.s.	12*	Wet to sat. * High due to stone interference	5
Clay silt with fine sand grits & pebbles	"	do.	25'0"		10	s.s.	12	W.T.P.I. (Q.M.)	10
Limestone boulder	"	do.	27'0"		11	r.c.		Hit boulder diamond drilled recovery	9
Silty fine to med. sand with grits & pebbles & stone	"	do.	29'1"		12	s.s.	16*	3rd core	22
Fine to med. sand with silty patches	"	Compact	35'0"		13	s.s.	5	Wet to saturated Below 32' results obtained from B.H. 3A	20
Biotite Granite Gneiss	Grey		40'0"		14	r.c.	24	*High from stone inter- Rds. dropped ferencel3 under own wt. from 37 to 39'	17
			46'5"		15	r.c.		Getting denser at 40' Wet to sat. turning Refusal at 41'3"	18
			51'5"		16	r.c.		1st run 41'4 1/2" to 46'5" Recovery 5 ft.-100% Grey biotite granite Very siliceous (gneiss in spots. Longest unbroken piece 6". 2nd run as above 46'5" to 51'3". Recovery 4'4"-87%	19
Hole terminated at 51'5"									
Saturated conditions from 6 ft., W.L. at 3'2"									
Artesian conditions above rock. W.T. 7' 3 1/2" above grade or elevation 395.0									

#60-F-262C

W.P. #253-60

Hwy #41

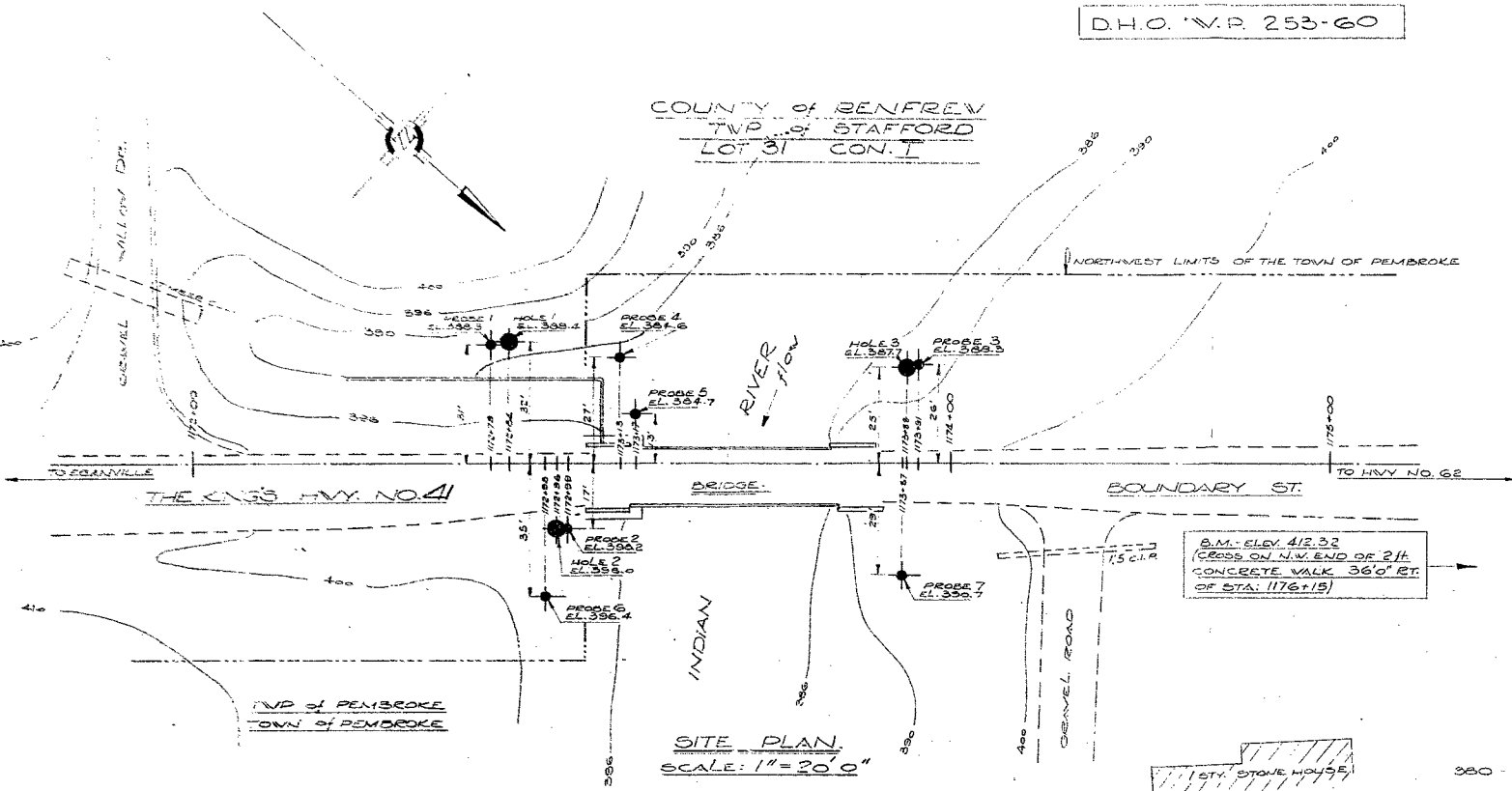
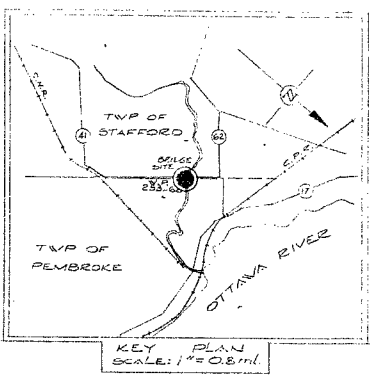
INDIAN RIVER

CROSSING

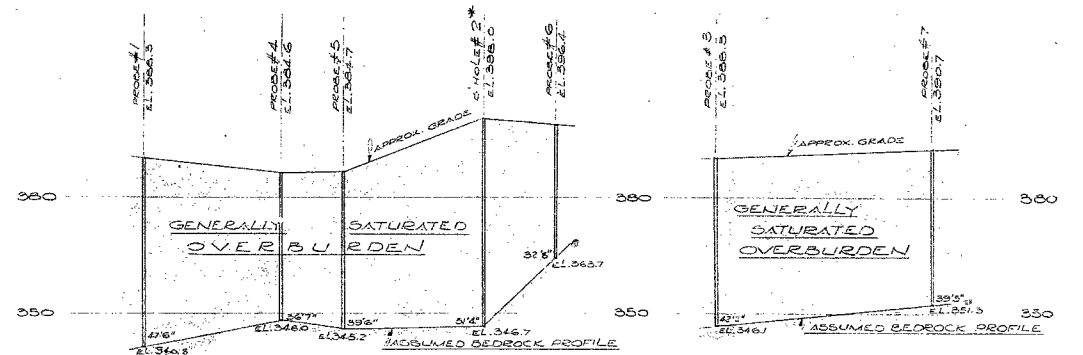
PEMBROKE

D.H.O. W.P. 253-60

COUNTY OF BENFREW
TWP. OF STAFFORD
LOT 31 CON. I

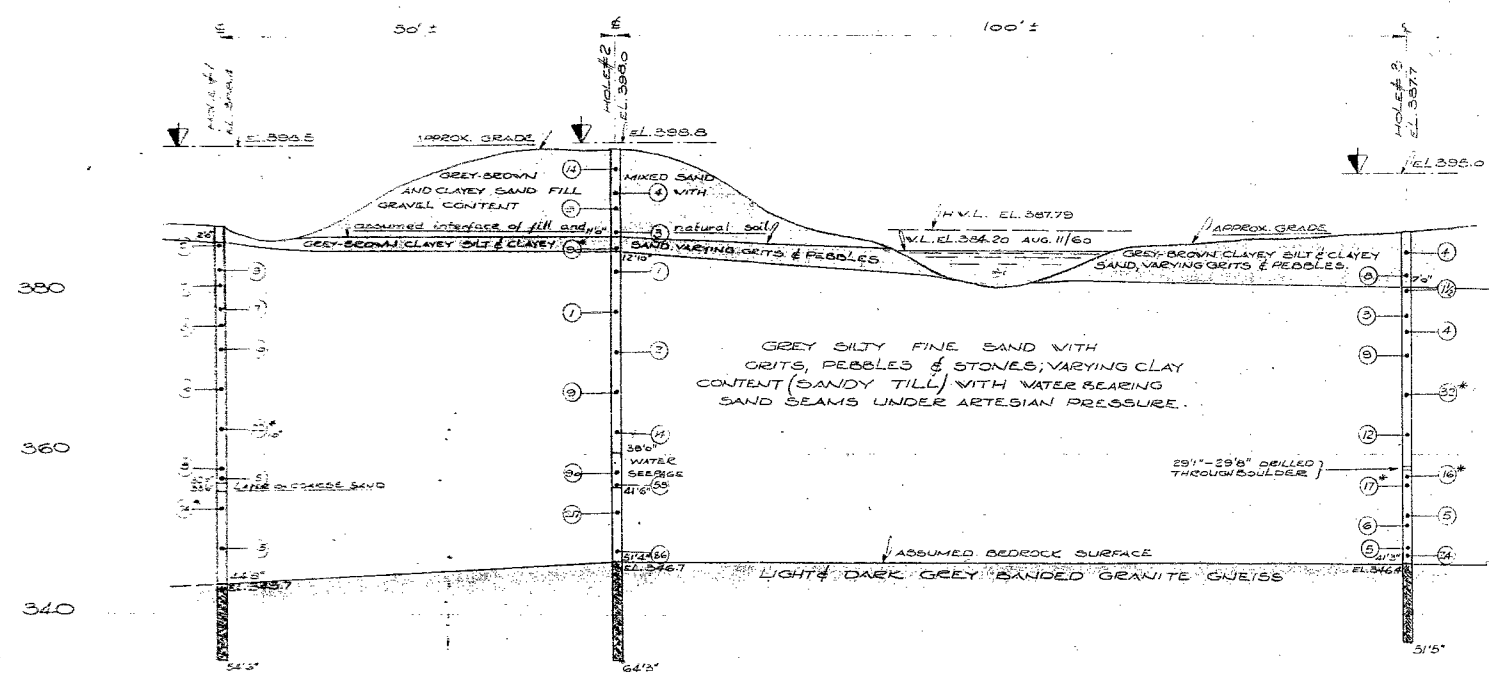


SITE PLAN
SCALE: 1" = 20' 0"



SECTION ALONG PROBES 1, 4, 5 & 6. SECTION ALONG PROBES 3 & 7.
(* RESULTS ON PROBE #2 HAVE BEEN IGNORED)

NOTE: HORIZONTAL & VERTICAL SCALES FOR SECTIONS (SHOWN ABOVE) - 1" = 20' 0"



SOIL PROFILE THROUGH HOLES 1, 2 & 3.

SCALE: HOR. & VERT. 1" = 10' 0"

* NOTE: THESE VALUES CONSIDERED TO BE MISLEADINGLY HIGH DUE TO STONE INTERFERENCE.

NOTES:

- 1) SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.
- 2) THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN ESTIMATED AND MAY DIFFER FROM THAT SHOWN.

LEGEND.

- BOREHOLE.
- BLOWS/FOOT.
- MAXIMUM V.L. OBTAINED DURING INVESTIGATION (GENERALLY V.L. VARIABLE WITH DEPTHS OF HOLES; SEE REPORT FOR DETAILS).
- PROBE HOLE.



e.m. peto & associates Ltd.

SOIL SITE INVESTIGATION
AT
INDIAN RIVER BRIDGE
FOR
DEPT. OF HIGHWAYS OF ONTARIO
OUR JOB No. 60168 DATE: AUG. 1960
CLIENTS PLAN No. W.P. 253-60 PER. G.T.