

6.1-20 SEPT. 1976

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P7-40

W. P. No. 187-58

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

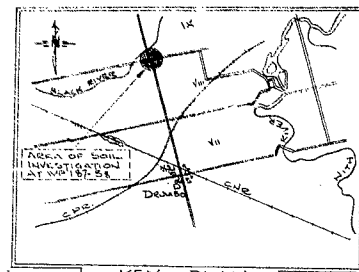
HWY. No. 401

LOCATION CO. RD., DRUMBO

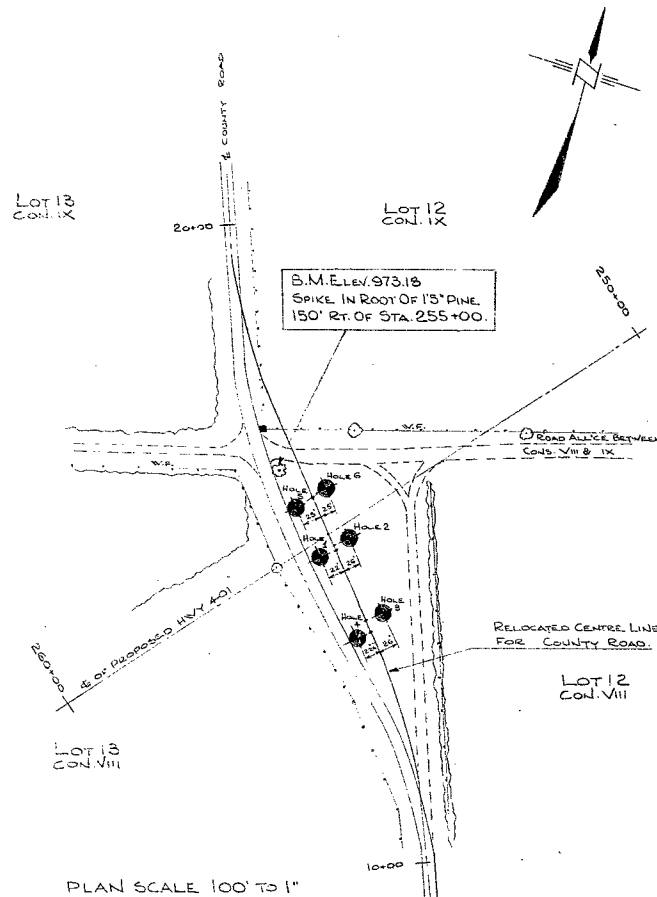
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. ONE

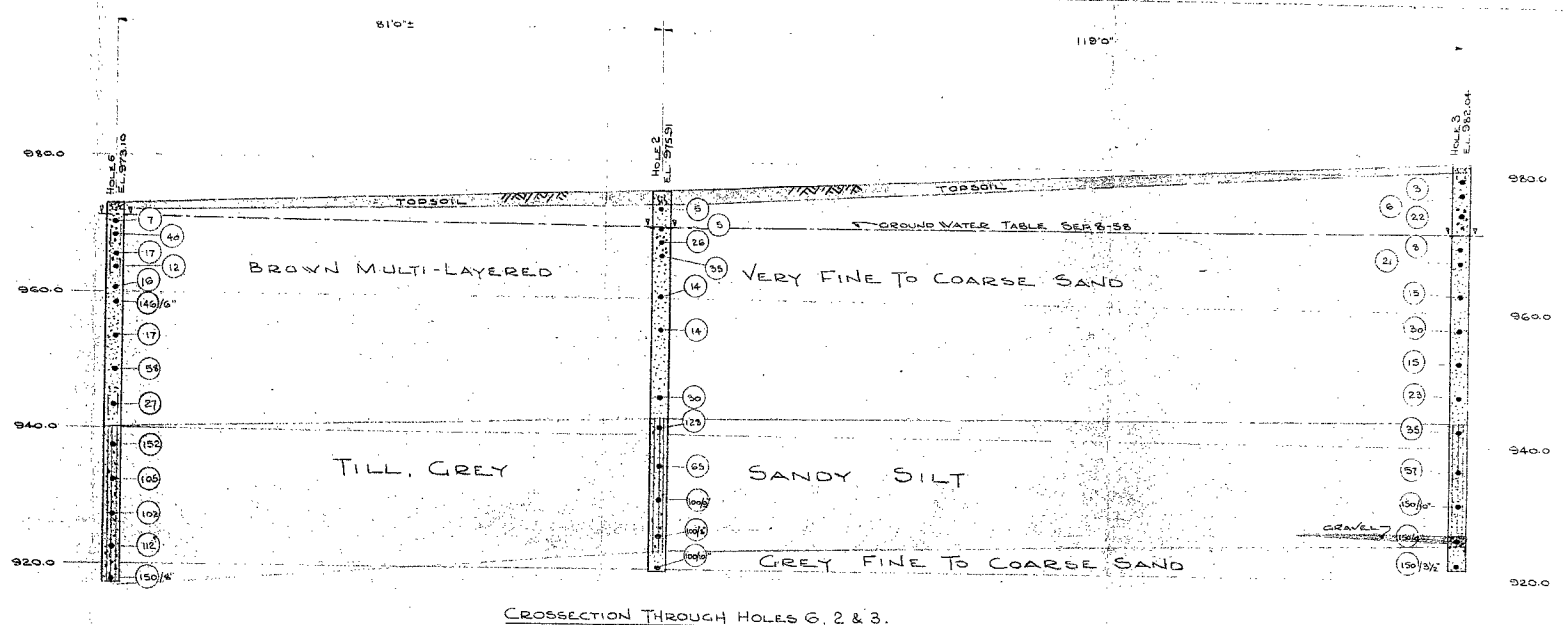
REMARKS: _____



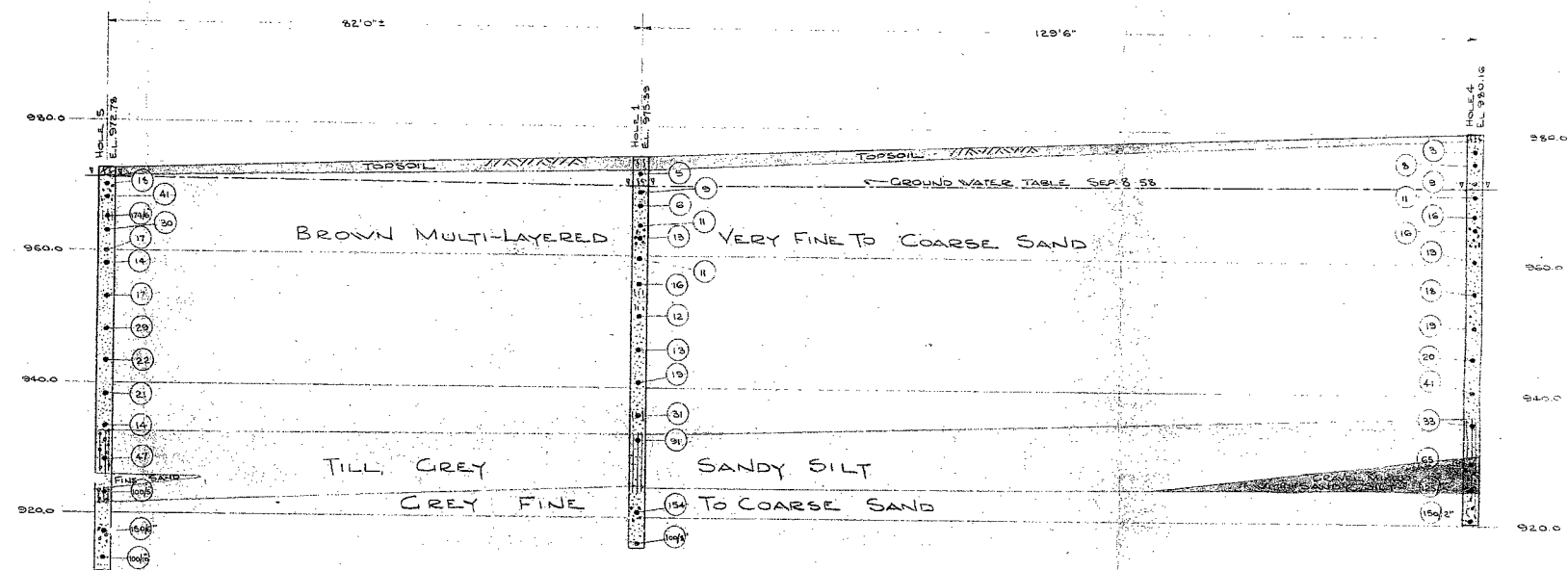
KEY PLAN
OF BATHURST (SHEET 40P)
& WOODSTOCK (SHEET 40P)
SCALE 1 IN. TO 100 FT.



HOLE NO.	ELEVATION	CHAINAGE (COUNTY ROAD)
1	975.33	14+76.5
2	975.91	14+81
3	982.04	13+62
4	966.16	13+47
5	972.78	15+60
6	973.10	15+60
7	974.01	15+00



CROSSSECTION THROUGH HOLES 6, 2 & 3.



CROSSSECTION THROUGH HOLES 5, 4 & 1.

- LEGEND
- TEST HOLE.
 - ⊖ BLOWS/FOOT.

PROFILES
SCALE HOR. 10' TO 1"
VERT. 10' TO 1"

NOTE: PLEASE SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.

NOTES: THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. A LINEAR VARIATION IN SOIL STRATIGRAPHY HAS BEEN ASSUMED BETWEEN BOREHOLES, AND THIS MAY ACTUALLY DIFFER FROM THAT SHOWN.



e.m. peto & associates ltd.
SOIL SITE INVESTIGATION
AT
HWY 401 UNDERPASS - COUNTY ROAD
DRUMBO
FOR
DEPARTMENT OF HIGHWAYS OF ONTARIO
OUR JOB No. 58102 DATE: SEP. 5-58
CLIENTS PLAN No. WD 127-58 PER: G.T.

40P7-40
GEORES No.

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 40P7-40

W.P. No. 187-58

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

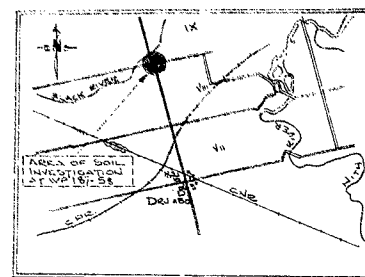
HWY. No. 401

LOCATION CO. RD., DRUMBO

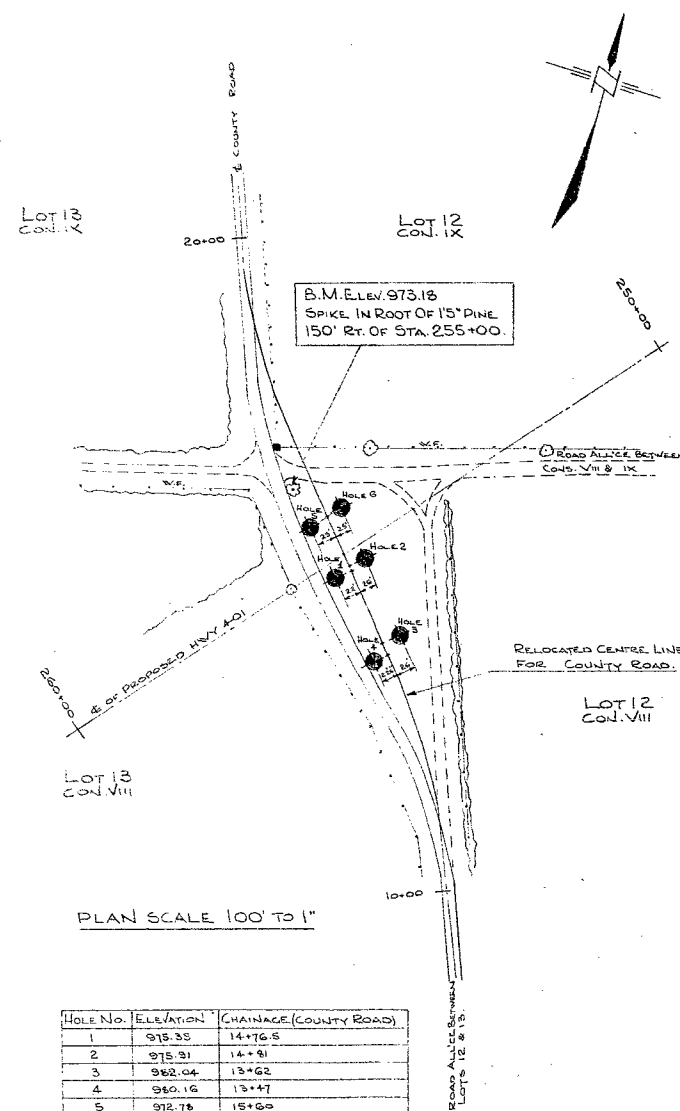
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. ONE

REMARKS: _____

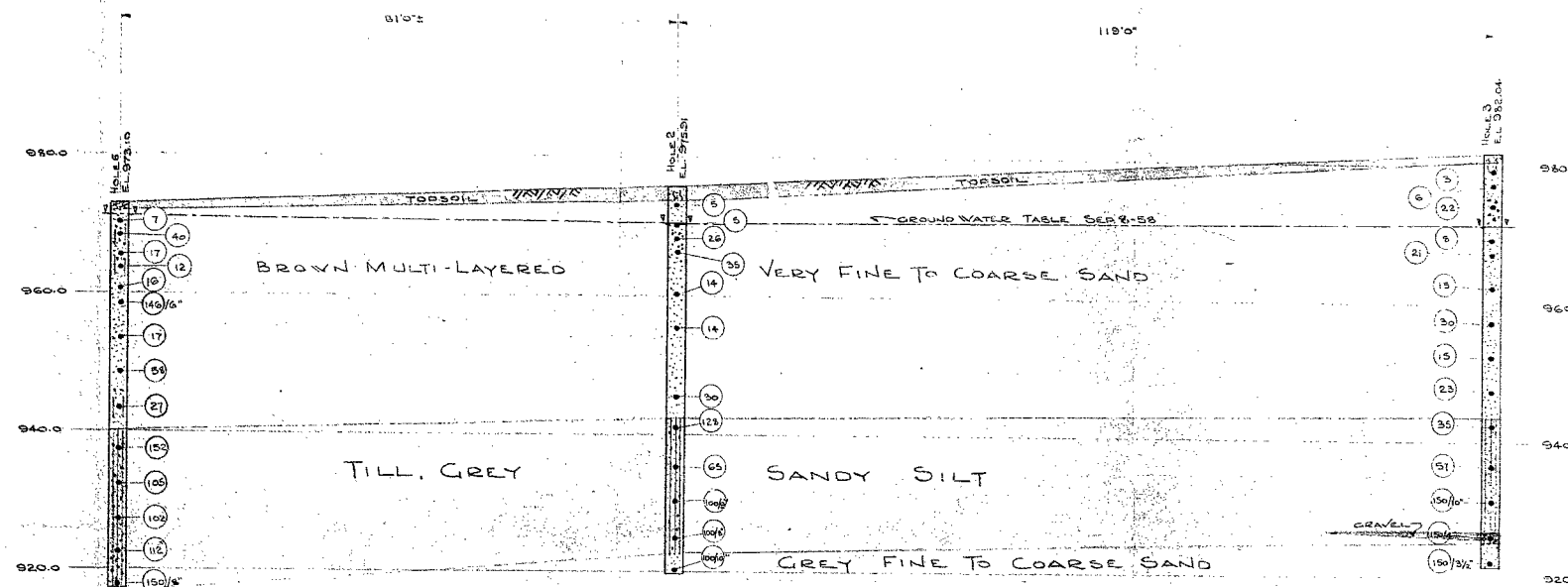
G1-20 SEPT. 1976



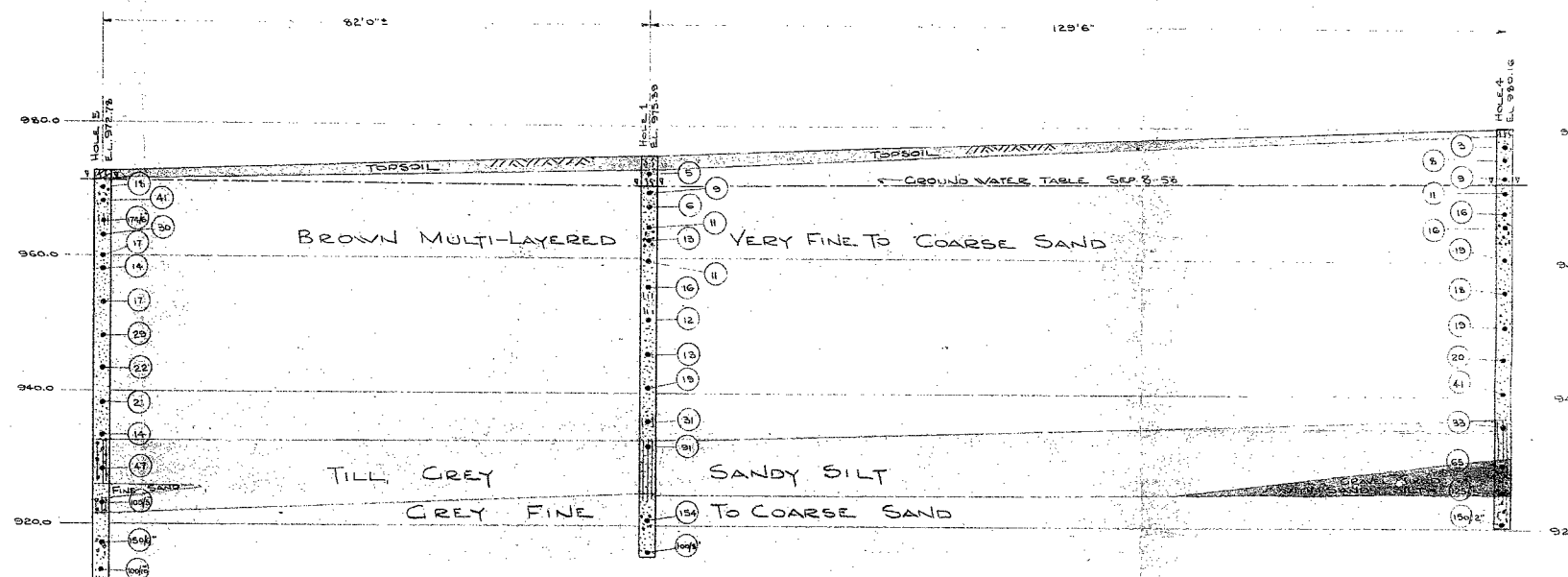
KEY OF PLAN
STATIONED (SHEET 407)
& WOODSTOCK (SHEET 407)
SCALE 1" = 100'



HOLE NO.	ELEVATION	CHAINAGE (COUNTY ROAD)
1	975.35	14+76.5
2	975.91	14+81
3	982.04	13+62
4	980.16	13+47
5	972.78	15+00
6	973.10	15+00
7	973.10	15+00



CROSSSECTION THROUGH HOLES 2 & 3.



CROSSSECTION THROUGH HOLES 5, 4 & 1.

PROFILES

SCALE HOR. 10' TO 1"
VERT. 10' TO 1"

LEGEND

- TEST HOLE
- ⊖ BLOWS/FOOT

NOTE: THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. A LINEAR VARIATION IN SOIL STRATIGRAPHY HAS BEEN ASSUMED BETWEEN BOREHOLES, AND THIS MAY ACTUALLY DIFFER FROM THAT SHOWN.

NOTE: PLEASE SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.



40P7-40
GEORES No.

e.m. peto & associates ltd.

SOIL SITE INVESTIGATION
AT
HWY 401 UNDERPASS - COUNTY ROAD
DRUMBO
FOR
DEPARTMENT OF HIGHWAYS OF ONTARIO
OUR JOB No. 52102 DATE SEP 9-58
CLIENTS PLAN No. VPD 187-58 PER C.T.

40P7-40
GEORES No.

e. m. peto associates ltd.

YOUR REFERENCE:- W. P. 187-58

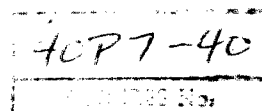
OUR REFERENCE:- 58102

850 roselawn avenue.

TORONTO, ONTARIO.

RUssell 1 - 4955.

September 12th, 1958.



The Department of Highways of Ontario,
280 Davenport Road,
Toronto, Ontario.

Attention: Mr. J. C. McAllister

Re: Soil Site Investigation,
Hwy. 401 Underpass - County Road, Drumbo

Dear Sirs:

BLENHEIM TWP. BRIDGE NO 4

In reference to your verbal request we are forwarding herewith four (4) copies of our report covering this investigation for your attention.

We have considered the site conditions in detail in the attached soils report. Here for your convenience is a summary of our findings and recommendations.

1. The topsoil is a 1 to 2 feet thick layer of reddish brown or dark brown sandy silty loam mixed with organic matter.

Below the topsoil and to the varying depth of 33 to 44 feet a multi layered light brown to brown very fine to coarse sand is located.

Below the brown sand and to the depth of 50 to 55 feet a layer of well consolidated grey sandy silt till mixed with a varying amount of gravel is encountered.

Below the till there is a very dense layer of grey fine to coarse sand. All holes except #3 were terminated in this material.

2. The ground water table was found at El. 971 at the time of the investigation. It falls gently towards the Black River. The free water level in the Black River was at El. 968.6.
3. The soil was loose above El. 970 with an average standard penetration of 6.3 blows per foot. Between El. 970 - 950 it was compact with average standard penetration of 15.2 blows per foot. Below El. 970 it was increasing with depth, from 15.2 at El. 970 to 54 at El. 930.
4. Using spread footings a suitable foundation elevation is El. 970.
5. The allowable bearing capacity for spread footings with a minimum surcharge of 4 ft. and with footings of minimum width of 10 feet is 1.0 tons per square foot and for footings of minimum width of 5 feet is 0.5 tons per square foot. The given values are based on a safety factor of minimum 3 and settlement not exceeding 1 inch under static conditions.
6. The excavation will be partly done in water, the water inflow may loosen up the surface on which the foundation is placed, furthermore spread footing foundation tends to concentrate the vibrations in the soil causing settlement in excess of one inch.
7. Based on the above considerations it is our opinion that a pile foundation is to be preferred to spreading footings.
8. The foundation load should be carried down by piles into the very dense grey sandy silt till, if possible, to El. 930.
9. Any type of displacement pile can be used, as it seems desirable to penetrate into the till which process means heavy driving requirements and thus the use of timber piles would not be advisable. It is possible to use steel "H" piles, but this type of pile is not warranted by the soil conditions at the site.
10. In order to insure uniform support in the heterogenous material it will be necessary to specify the set of 8 - 10 blows for the last inch with standard heavy duty pile driving hammer.

11. The safe side slopes of the embankment are 1-1/2 horizontal on 1 vertical, assuming controlled construction practice (optimum moisture, maximum density). There is no danger of base failure.
12. The topsoil should be removed for a depth of one foot before placing the fill.
13. For computing the active pressure on the retaining wall structure, and assuming the fill is a well compacted granular material, the lateral earth pressure coefficient " K_a " suggested.

a) for unyielding structure is $K_a = 0.70$

b) for yielding structure is $K_a = 0.27$

The suggested value for the angle of wall friction $\delta = 0.75\phi = 26^\circ$.

14. Some of the sands in the soil profile are frost susceptible. The ground water table is near to the ground surface. There is a possibility that at some location in this general area the frost susceptible soil will be near the subgrade and it can be a potential cause of frost heave.

We hope that we have covered all the technical matters arising from this investigation. However, should you require any additional advice or amplification of our recommendations, we shall be pleased to be of further service.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,



E. M. Peto, P. Eng.

GYs:sb

40P7-40
GEOCRES No.

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

HWY. 401 UNDERPASS - COUNTY ROAD, DRUMBO

W. P. 187-58

SOILS REPORT

by

e. m. peto associates ltd.

Toronto, Ontario.

September, 1958

Job No. 58102

Client's Ref. No. W.P. 187-58

Date Sept. 12, 1958.

Report on

SOIL SITE INVESTIGATION

HWY. 401 UNDERPASS - COUNTY RD., DRUMBO

W.P. 187-58, Drumbo, Ontario

for

THE DEPARTMENT OF HIGHWAYS OF ONTARIO

INTRODUCTION:

In accordance with the verbal instructions received from Mr. J. C. McAllister on August 29th, 1958, a soil investigation was carried out at the site of the proposed County Road Overpass over Highway 401, near Drumbo, Ontario.

The object of the investigation was:-

- a) To determine the soil profile at the site.
- b) To make recommendations for the type of foundation most suited to the soil condition.
- c) To determine the allowable bearing capacity of the soil at the elevation of the proposed foundation structure.
- d) To observe and report any unusual circumstances which may influence the alignment of the road and the design of the structure.

PROGRAMME OF WORK:

August 28th, 1958: Location and reconnaissance of site by the Field Engineer.

August 29th, 1958: Field Engineer staked out boreholes. Crew and equipment moved from Toronto to the site.

August 30th, 1958: Driving borehole #1.

September 1st, 1958: Driving borehole #2.

September 2nd, 1958: Driving borehole #3.

September 3rd, 1958: Driving borehole #4 and general check of water levels.

September 6th, 1958: Driving borehole #6.

September 7th, 1958: Starting borehole #5.

September 8th, 1958: Completion of borehole #5 and final check of water levels. Crew and equipment moved back to Toronto.

GENERAL INFORMATION:

1. Our standard sampling procedures were followed. These are described in Appendix II.
2. Six boreholes were driven.
 - Borehole #1 to the depth of 60 feet.
 - Borehole #2 to the depth of 56 feet.
 - Borehole #3 to the depth of 60 feet.
 - Borehole #4 to the depth of 60 feet.
 - Borehole #5 to the depth of 61.5 feet.
 - Borehole #6 to the depth of 56 feet.

GENERAL INFORMATION: (Cont'd)

3. Laboratory tests were made on representative samples to determine the natural moisture content and density, index properties and whenever it was possible the strength of the various layers in the soil profile. The results of these investigations are given in the report under the section entitled "Laboratory test results" and in Appendix I.
4. A site plan showing the soil test hole locations together with two soil profiles through boreholes #5, 1, 4, and #6, 2, 3 and detailed individual borehole logs are included.
5. The ground surface elevations are referred to D.H.O. bench mark, spike in root of 1.5 ft. diameter pine 115.0 ft. right of Sta. 225 + 50, elevation 973.18.

SITE AND GEOLOGY:

The area under investigation is covered by grass, it is gently sloping in a general Northerly direction. It is enclosed by the Drumbo-Washington Road on the West and by the Gravel Concession Road #IX on the North, and by a gravel slip road connecting these on the East. North-West from the site there is a small watercourse named the Black River.

The site is located on the boundary of the physiographic region known as the Ingersoll moraine and the spillways of the Thames and Grand Rivers. Accordingly, the soil consists of varying density sandy till and river bottom material.

SOIL CONDITIONS:

The soil condition is fairly uniform through the site. In general, below the thin topsoil (1-2 feet) a 40 foot thick layer of sand is located, which changes to a sandy silt till of about 10 feet in thickness. The sandy silt till is underlain by material of varying texture consisting of sand, gravel and rock fragments.

SOIL CONDITIONS: (Cont'd)

Topsoil

The topsoil is a one to two foot thick layer of reddish brown or dark brown sandy silty loam mixed with organic matter. It is loose and moist.

Brown Sand

Below the topsoil and to depths varying from 33 to 44 feet a multi-layered light brown to brown very fine to coarse sand is located.

The sand is loose above elevation 970, it is compact to elevation 950 and below this elevation it is gradually increasing in density with depth.

Above the ground water table the sand is slightly moist to moist with natural moisture contents between 3% to 7%. Below the ground water table the sand is saturated. The differences in the moisture contents of the recovered samples are all indications of the textural variation of the soil.

Till

Below the brown sand, to the depth of 50 to 55 feet a layer of well consolidated grey sandy silt mixed with varying amounts of gravel is found.

In borehole #5 at 47 to 49 feet depth a pocket of grey brown sand was encountered. In borehole #6 the gravel and rock fragment content increased with depth. The borehole was terminated in this material at 56 feet.

The till is hard, the standard penetration values obtained ranged between 33 blows per foot to 100 blows per five inch penetration. The higher value given above was predominating.

In general the natural moisture content was below the plastic limit of the material, but as the soil was very well consolidated, it was saturated.

SOIL CONDITIONS: (Cont'd)

Grey Sand and Gravel

Below the till there is a very dense layer of grey fine to coarse sand. All holes except #6 were terminated in this material. In borehole #3 from 55 to 56 feet depth and in borehole #4 from 50 to 55 feet depth pockets of grey gravel mixed with sandy silt were found.

The sand and gravel was very dense. All the standard penetration values were higher than 100 blows per foot of penetration.

The samples recovered were moist to saturated.

WATER CONDITIONS:

The general surface and subdrainage of the area is toward the Black River.

The following water level observations were made in the six boreholes:

Borehole #1

On August 30th, 1958, at 7:00 p.m. the depth of hole was 60 feet, and the casing was at 54 feet. The water in the hole was at 5'7". At this time the hole was filled up with water. After 2 minutes the water level was down at 5'7" depth. At 7:30 p.m. the water level was at 5'6" depth.

On September 1st, 1958, after pulling the casing the water level in the hole was at 5 feet depth. At 7:00 p.m. it was at 4'7".

Borehole #2

On September 1st, 1958, at 3:30 p.m. the depth of hole was 56 feet and the depth of casing 40 feet. The hole was bailed out to 19'6". At this depth the water was flowing into the hole faster than it could be bailed. The depth of water in the hole was,

after 5 minutes 10'8"
10 minutes 10'2"
15 minutes 9'0"

On September 2nd, 1958, at 7:30 a.m. the water level was at 5'4" depth. After pulling the casing it was at 5'5".

WATER CONDITIONS: (Cont'd)

Borehole #3

On September 2nd, 1958, at 5:30 p.m. the depth of hole was 60 feet, the casing was at 44 feet. The hole was bailed to 37'5". At this depth the water was flowing in the hole faster than it could be bailed. The depth of water in the hole was,

after 5 minutes 30'6"
10 minutes 21'8"
15 minutes 18'10"

After pulling the casing the hole was dry to the depth of 11'2".
On September 3rd, 1958, at 7:30 a.m. the hole was caved in at the depth of 10'6".

Borehole #4

On September 3rd, 1958, the depth of hole was 60 feet and the depth of casing 54 feet. The hole was bailed to 48'6" at this depth sand burst into the casing. The depth of water in the hole was,

after 5 minutes 44'6"
10 minutes 40'0"
15 minutes 36'8"
40 minutes 21'4"

After pulling the casing the hole caved in at 8'6".

Borehole #5

On September 8th, 1958, the depth of hole was 61.5 feet and the casing was at 54 feet. The hole was bailed to 16'4", at this depth water was flowing in faster than it could be bailed. The depth of water in the hole was,

after 5 minutes 5'4"
10 minutes 4'0"
15 minutes 3'5".

After pulling the casing the water was at 1'5" depth.

reportfor The Department of Highways of Ontario Sheet No. 7.

WATER CONDITIONS: (Cont'd)

Borehole #6

On September 6th, 1958, the depth of hole was 56 feet and the casing was at 43 feet. The water was bailed at 7:30 p.m. to the depth of 20'6". At this depth the water was flowing into the hole faster than it could be bailed. The depth of water in the hole was,

after 5 minutes 8'7"
10 minutes 5'8".

On September 7th, 1958, the water was at 2'3" depth and on September 8th, 1958, it was at 1'9" depth.

Based on these observations the following ground water levels were established in the six boreholes:

Borehole #1 the water in the hole was at 4'7" depth.
Borehole #2 the water in the hole was at 5'5" depth.
Borehole #3 the water in the hole was at 10'6" depth.
Borehole #4 the water in the hole was at 8'6" depth.
Borehole #5 the water in the hole was at 1'5" depth.
Borehole #6 the water in the hole was at 1'9" depth.

The average elevation of the ground water table at the time of the boring operation was at elevation 971 gently sloping toward the Black River.

On September 4th, 1958, the free water level in the Black River was at elevation 968.60 and the bottom of the river was at elevation 967.52. These measurements were made at the bridge on the County Road about 600 feet North of the site.

LABORATORY TEST RESULTS:

Standard Penetration Tests

An average penetration profile is given in the Appendix I. The sand is loose above elevation 970 with an average standard penetration of 6.3 blows per foot. Between elevation 950 and 970 the sand is compact and the average standard penetration is 15.2. Below elevation 950 the standard penetration values are increasing with depth and at about elevation 930 all the penetration values were higher than 100 blows per foot of penetration.

Mechanical Analysis

Mechanical analyses were made on representative samples of the brown sand, till and grey sand layers for the proper identification and classification of the material. The results of these tests are given in a graphical form in Appendix I and in a tabular form below.

Sample Description	Borehole	Depth	Gravel [*]	Sand [*]	Silt [*]	Clay [*]	Classifi- cation
a) Brown sand, medium some fine	#1	12'0"-13'6"		97	3		A-3
b) Light brown fine sand.	#1	24'0"-25'0"		85	15		A-2--
c) Light grey silty vf sand, grits and pebbles.	#1	54'0"-55'0"	23	39	32	6	A-4-3
d) Grey sand, medium some coarse.	#1	59'0"-59'8"		98	2		A-3
e) Brown sand fine to vf, some silt	#2	20'0"-21'0"		69	27	4	A-4
f) Grey till, sandy silt, some gravel	#2	35'0"-36'0"	25	32	29	14	A-4-3
g) Grey till, sandy silt, some gravel	#2	45'0"-46'0"	17	35	32	15	A-4-3
h) Light brown sand, medium, some coarse	#4	9'0"-10'6"	4	62	4		A-3

*M. I. T. Classification.

report

for The Department of Highways of Ontario

Sheet No. 9.

LABORATORY TEST RESULTS:**Mechanical Analysis (Cont;d)**

The sand samples a, b, d, e, and h, are poorly graded, the grey sand sample c and the till, samples f and g are well graded.

Atterberg Limits

In order to determine the degree of plasticity and the classification of the grey sandy silt till, the plastic and liquid limit was determined on three samples of this material.

<u>Borehole</u>	<u>Depth</u>	<u>L. L.</u>	<u>P. L.</u>	<u>P. I.</u>	<u>% Pass. #200 Sieve</u>	<u>Classification^x</u>
# 1	43'0"-44'0"	16.5	10.8	5.7	~ 53	A-4-3
# 2	40'0"-41'0"	16.3	10.8	5.5	~ 53	A-4-3
#2	50'0"-50'8"	15.2	11.3	3.9	~ 53	A-4-3

^xRevised U.S. Public Roads Administration Classification System.

Liquid limit charts are included, see Appendix L.

The till is low plasticity and compressibility.

Field Density Tests.

In four instances liner samples were obtained from the brown sand stratum for the determination of the in situ density of the material and on five samples taken by the split spoon sampler from the till volumetric analyses were performed in the laboratory. The following results were obtained.

<u>Soil</u>	<u>Borehole</u>	<u>Depth</u>	<u>Moisture Content %</u>	<u>Wet dens. p. c. f.</u>	<u>Dry dens. p. c. f.</u>	<u>Degree of Sat. %.</u>
Sand	1	18'6"-19'6"	20.2	130.0	108.0	100.0
	2	13'0"-13'6"	20.5	134.5	111.5	100.0
	2	24'6"-25'0"	20.3	134.3	111.6	100.0
	3	9'6"-10'6"	7.8	115.0	106.9	38.0
Till ^x	1 & 2	35'0"-50'8"	7.6	150.0	139.5	100.0

^x Average of five tests.

report

for The Department of Highways of Ontario Sheet No. 10.

LABORATORY TEST RESULTS:Field Density Tests (Cont'd)

The first three samples were taken from below the ground water table, consequently they were saturated 100%. The sample from borehole #3 was taken from above the ground water table, reflects this fact the degree of saturation which was found to be 38%. The samples from the till were saturated.

Triaxial Compression Test

It appeared to be necessary to provide the designer with a definite value of internal friction " ϕ " of the brown sand strata. A conservative " ϕ " value was obtained, using remoulded samples of the poorly graded yellowish brown very fine sand compacted to the field density at 11.3% of moisture content.

The samples were tested under 30, 60 and 80 psi minimum principal pressures using the quick drained triaxial compression test technique.

The three Mohr circles obtained and the Mohr envelope is given in the Appendix I together with the physical properties of the samples.

An internal friction value of $\phi = 35^{\circ}$ was obtained.

ENGINEERING CONSIDERATIONS:

1. At the time of the investigation the ground water table was at elevation 971, near to the ground surface. There was a 2.5 feet drop in water level between the ground water level of the site and the free water level of the Black River.

It can be expected that in spring the ground water elevation will be considerably higher and this level can be estimated from the flood level of the Black River.

2. There are two possible alternatives for the foundation structures.
 - a) Spread footings founded on the compact brown sand.
 - b) Bearing piles carrying the load from the super-structure down to the grey sandy silt till.

ENGINEERING CONSIDERATIONS: (Cont'd)

3. Using spread footings as the foundation structure, the base elevation of the foundation structure should be in the compact brown sand. It can be seen from the standard penetration profile that this limiting condition restricts the foundation elevation at or below El. 970.

As the ground water table is high it is advisable to keep the foundation elevation as near to the surface as the soil condition and frost penetration allow, to minimize the water difficulties during construction.

Taking into account these considerations together with the geometry of the two intersecting road profiles the most advantageous foundation elevation for spread footings is elevation 970.

At this elevation the allowable bearing capacity of the submerged sand, taking into account the minimum surcharge of 4 feet is,

for footing, minimum width 10 ft. 1.0 tons per square foot.

for footing, minimum width 5 ft. 0.5 tons per square foot.

The above bearing capacities are based on a factor of safety of 3 and settlement not exceeding one inch under static conditions.

It should be pointed out here that the use of spread footings, will tend to concentrate the vibration from the superstructure to the sand, which may cause settlement in excess of one inch which value was given for ordinary static conditions.

Part of the excavation will be done under water, which is a construction problem and added expense in itself; furthermore the inflowing water may loosen the sand surface, right at, and below the foundation which may be the cause for additional settlement.

report

for The Department of Highways of Ontario Sheet No.12

ENGINEERING CONSIDERATIONS:

3. (Cont'd)

The depth of frost penetration should be given careful consideration and the proposed foundation elevation should be adjusted if the records of the Department indicate a depth of frost penetration, at the specific location of the overpass, greater than five feet, since the ground water level foundation together with the potential frost susceptible soil present, may cause frost heave.

4. If the superstructure will not tolerate differential settlement the foundation load should be carried down into the very dense grey sandy silt till if possible to elevation 930.0.

From examination of the penetration profile it is evident that the till has different bearing values in different holes even at the same elevation. In order to ensure uniform support it will be necessary to specify the set of 8 - 10 blows for the last inch with standard heavy duty pile driving hammers. Any type of displacement pile can be used.

It will be necessary to penetrate into the till, which will need heavy driving, consequently the use of timber piles is not advisable. On the other hand the use of steel "H" piles is possible but not warranted by the soil condition.

5. The profile of Hwy. 401, supplied by the Department shows a maximum fill of 25 feet at the overpass. We thought that it is necessary to provide the Department with factual information regarding the safe slope of the embankment and physical constants governing the design of the abutment as an earth retaining structure.

In order to obtain a conservative estimate of the internal friction value of the granular material a series of quick drained triaxial compression tests were performed on the yellowish brown very fine sand (borehole #1, depth 18'6" - 19'6") the poorest material found at the site below the topsoil. The samples were compacted at a moisture content 11.3% (approximated optimum moisture content) to the field dry density of 106 p.c.f. An internal friction value $\phi = 35^\circ$ was obtained. For the details of the test see Appendix I.

ENGINEERING CONSIDERATIONS:

5. (Cont'd)

If the fill is composed of granular material and compacted to the maximum density slope 1-1/2 horizontal to 1 vertical can be used. There is no danger of base failure. It will be necessary to remove the one foot of topsoil before placing the fill.

6. The active pressure exerted on the retaining structure will depend on the rigidity of the structure assuming the placement of the fill is controlled (optimum moisture, maximum density).

If the outward displacement of the wall is assumed to be 0.1% of its height, the active pressure exerted by the wall can be computed using $\phi = 35^\circ$ and the relationship

$$\begin{aligned} p_a &= K_a \cdot w \cdot h. \\ \text{where } K_a &= \tan^2 (45 - \phi/2) \\ w &= 125 \text{ p.c.f.} \\ h &= \text{depth in ft. where the active pressure } p_a \\ &\quad (\text{p.s.f.}) \text{ is to be determined.} \end{aligned}$$

Alternatively if the wall is rigid and will not yield viz. a rigid frame structure, $K_a = 0.7$ should be used. The friction angle between the wall and sand can be taken as $0.75 \phi \approx 26^\circ$.

Drains should be provided in the wall slightly above the lower ground surface level if there is any danger of hydrostatic pressure "build up", which can endanger the stability of the embankment.

7. It may be worth while to point out that some of the sands in the stratified profile are frost susceptible. The ground water level is near the surface and there is a possibility that at some location in this general area the frost susceptible soil will be near the subgrade and thus can be the potential cause of frost heave.

E. M. PETO ASSOCIATES LTD.,

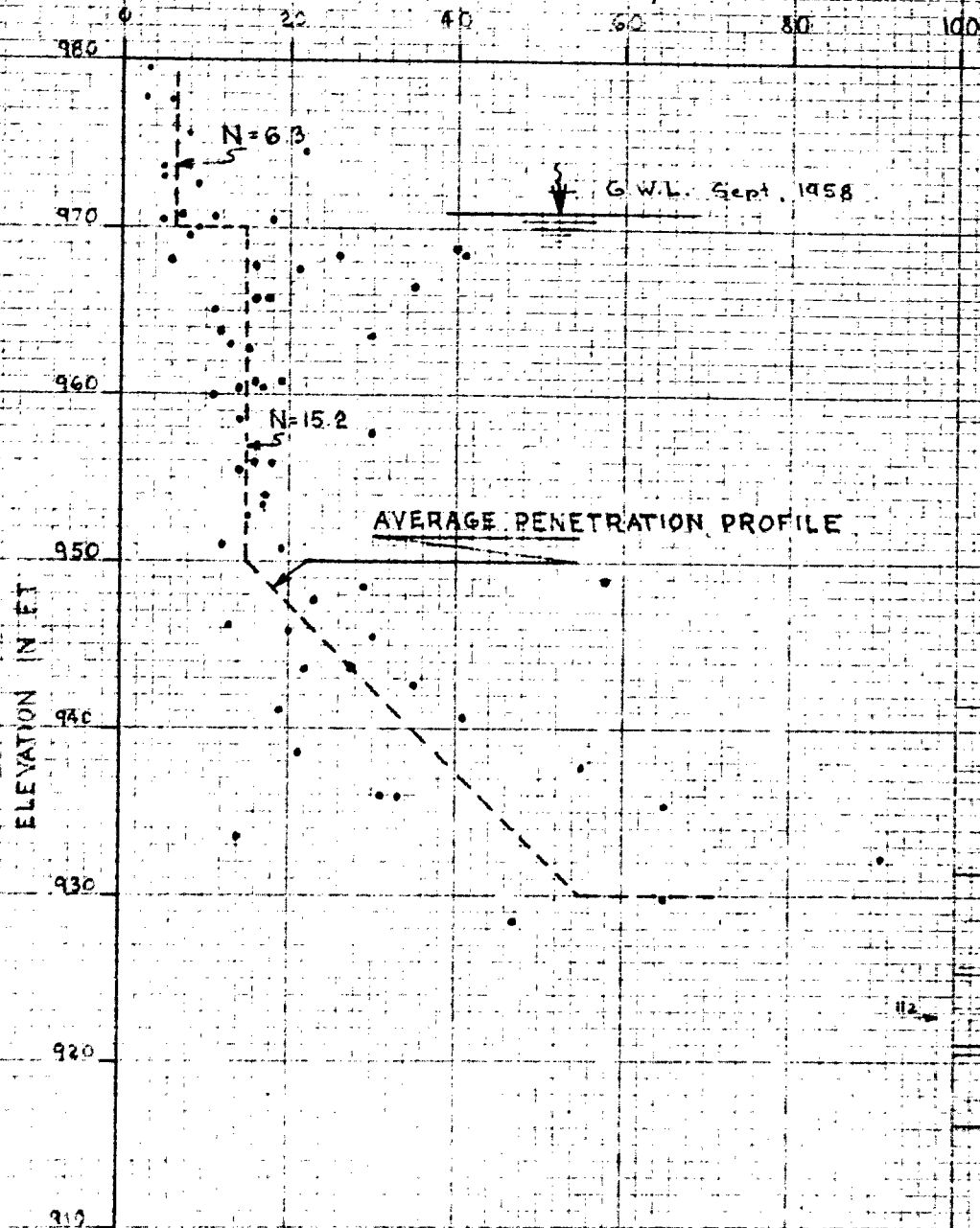


E. M. Peto, P. Eng.

APPENDIX I

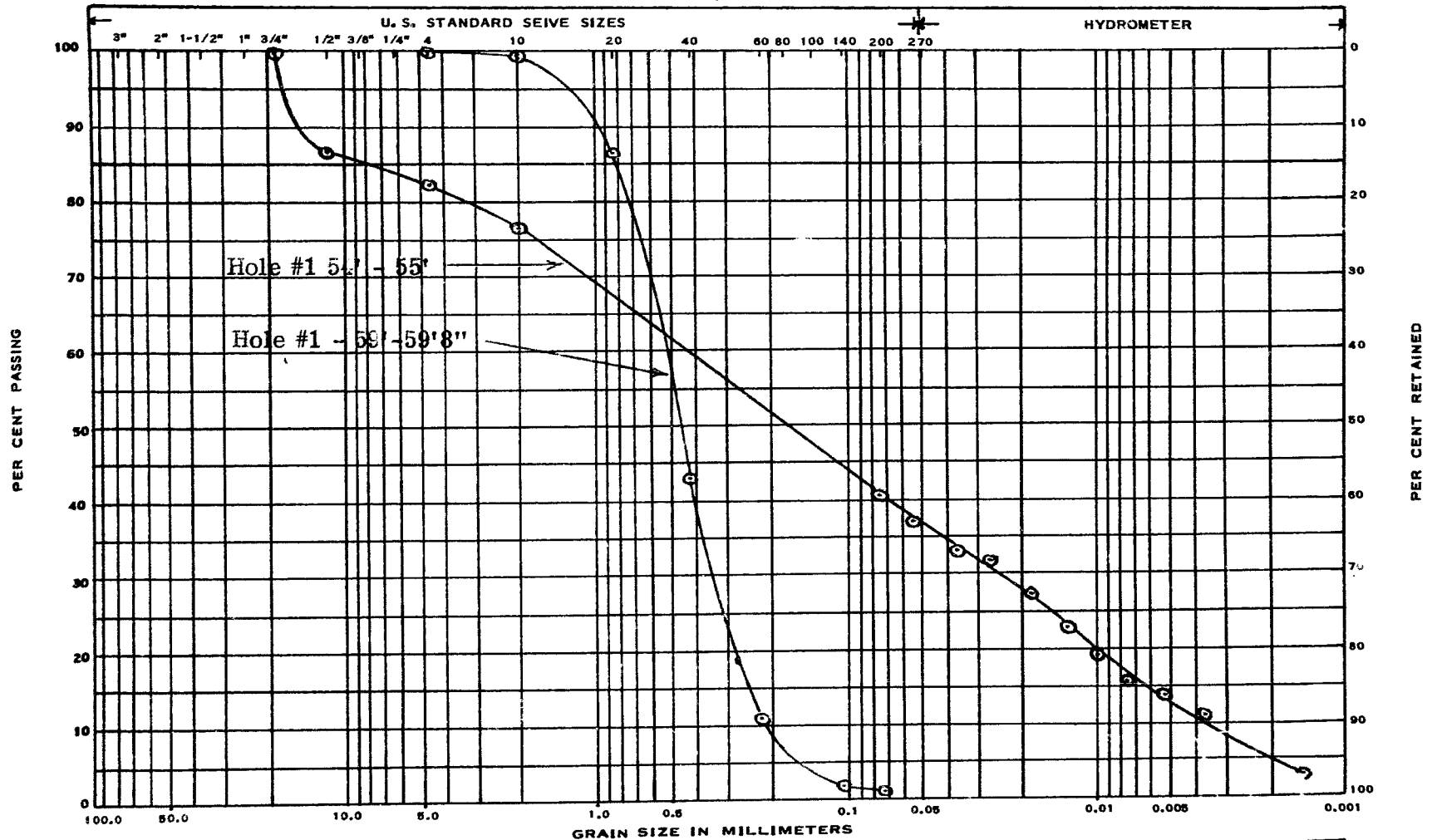
LABORATORY TEST RESULTS

STANDARD PENETRATION BLOWS/FT.



e m peto & associates Ltd

e. m. peto associates ltd.
TORONTO, ONTARIO



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

MASS. INST. OF TECH. CLASSIFICATION

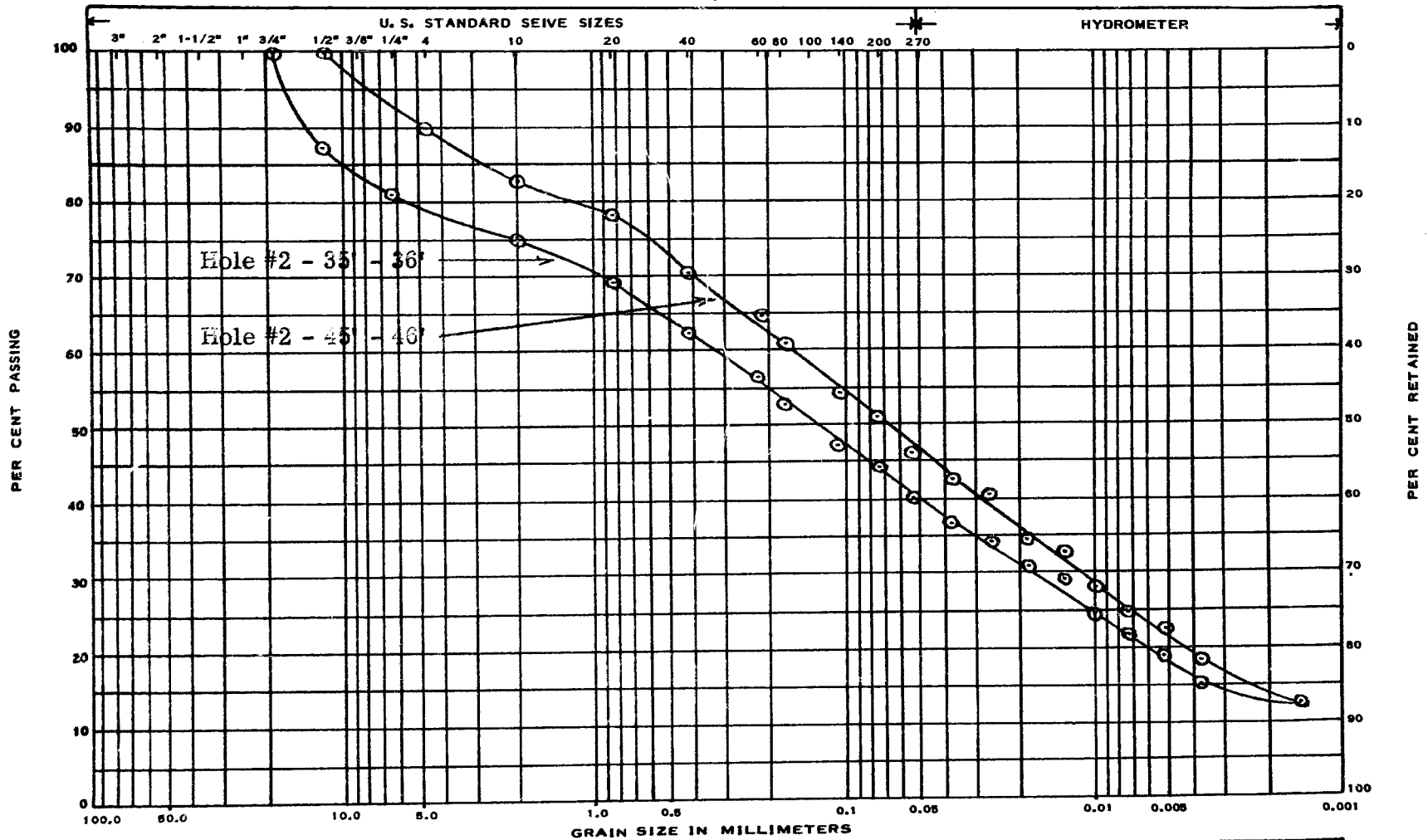
JOB NAME Hwy. 401 Underpass County Road JOB NO. 58102 HOLE NO. #1 SAMPLE NO. 16 and 18

DEPTH see chart

ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
TORONTO, ONTARIO



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

MASS. INST. OF TECH. CLASSIFICATION

JOB NAME Hwy. 401 Underpass - County Rd. JOB NO. 58102 HOLE NO. #2 SAMPLE NO. 12 and 14

DEPTH see chart ELEVATION _____ REMARKS _____

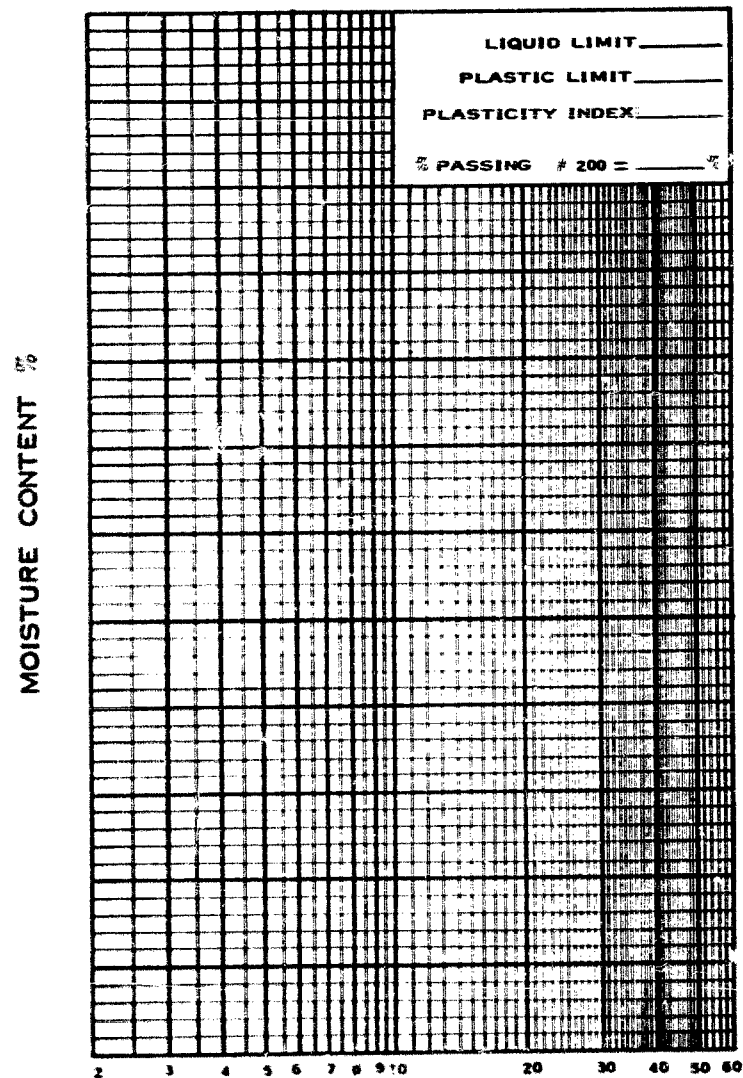
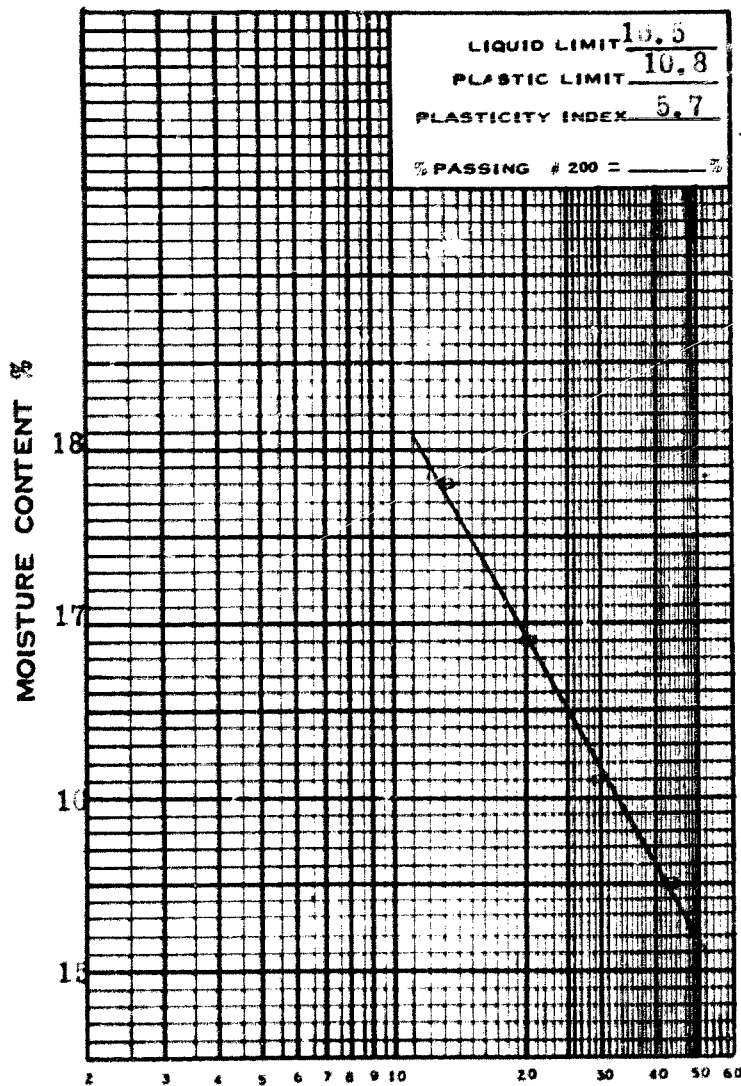
GRAIN SIZE DISTRIBUTION

e. m. peto associates ltd.
SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

JOB No. 58102 PROJECT Hwy. 401 Underpass County Road, Drumbo
SAMPLE FROM B.H. #1, Sample 1 SAMPLE FROM _____
DEPTH 48' - 49' DEPTH _____



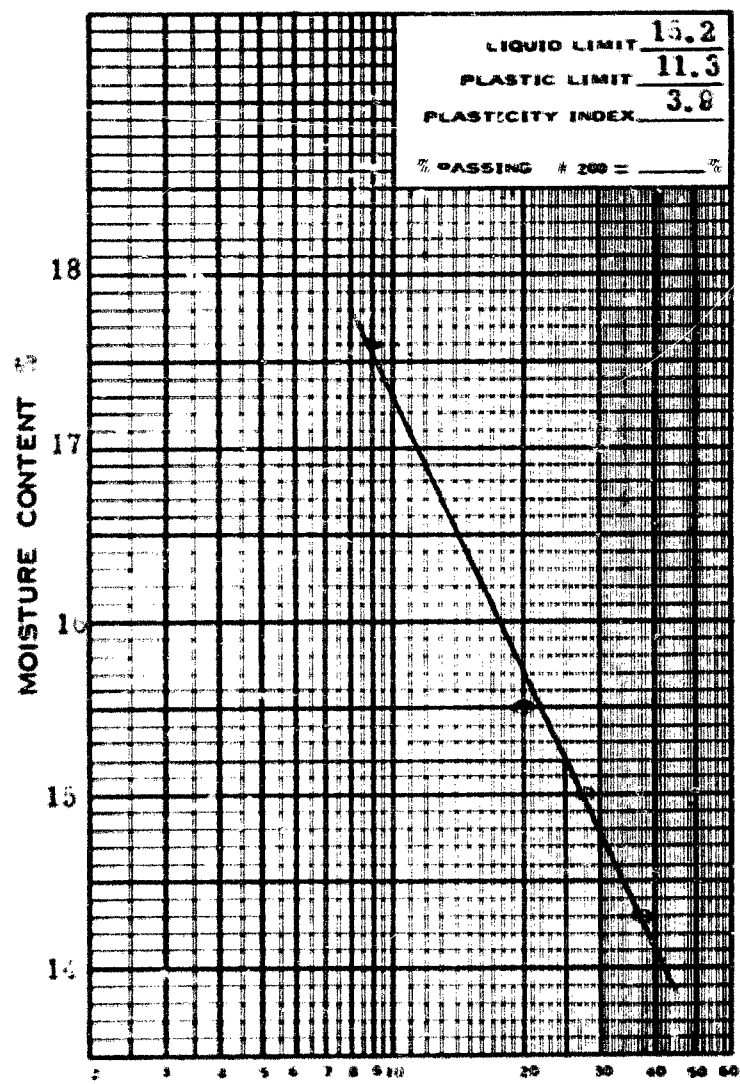
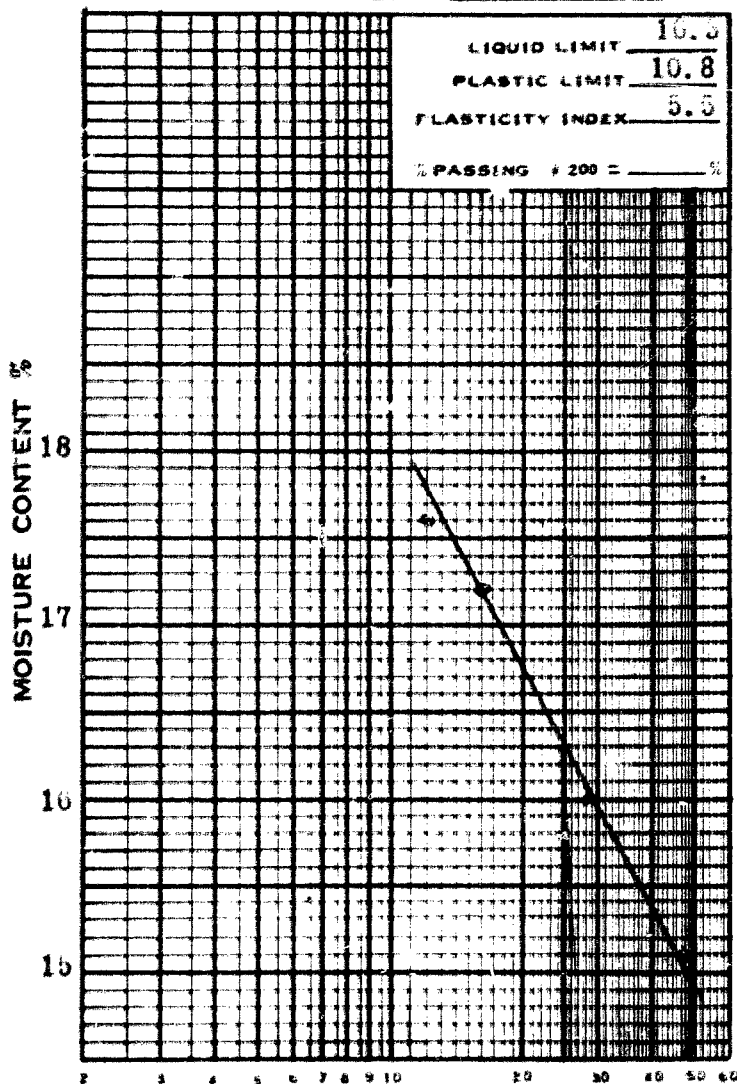
e. m. peto associates ltd. SOIL TESTING LABORATORY

LIQUID LIMIT TEST

FLOW LINE CHARTS

Job No. 58102 PROJECT Hwy. #01 Underpass - County Road, Drumbo
 SAMPLE FROM B.H. #2 Sample 13 DEPTH 50' - 51'

SAMPLE FROM B.H. #2, Sample 15
 DEPTH 50' - 50'8"



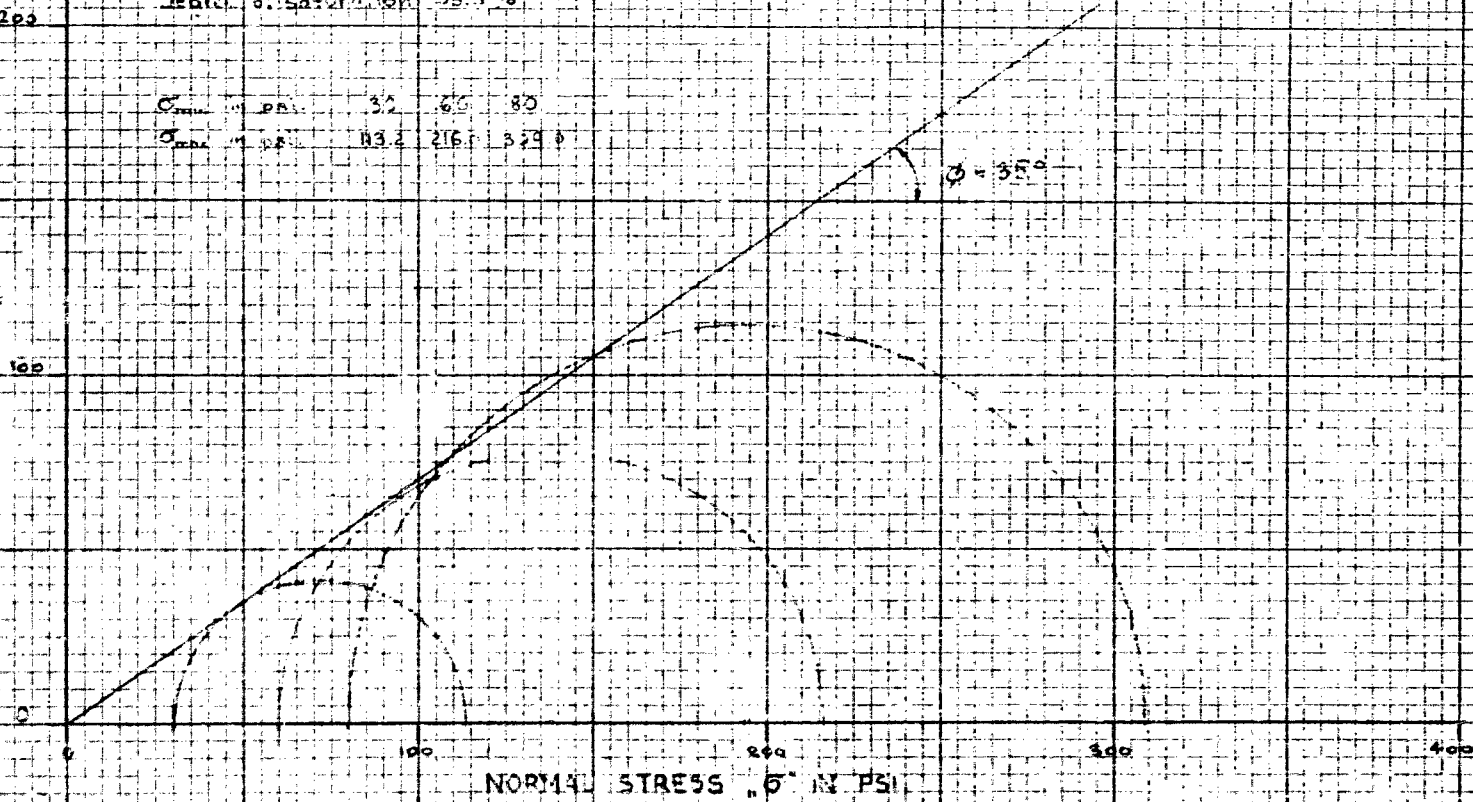
NO. OF BLOWS (LOG SCALE)

Quick drained triaxial compression test

gel. water content, vol. % 21.5 soil type, clay, silty, clayey, silty
 No. 11392
 σ_v 8.0, 24
 σ_h 100, 0, 0
 Degree of saturation 58.5%

$\sigma_{vertical}$ in psi	3.2	6.0	8.0
$\sigma_{horizontal}$ in psi	13.2	216.0	329.0

SHEAR STRESS " τ " IN PSI



G.V.S.
Sept 10, 1952

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name County Rd. Overpass, Drumbo.

Job No. 58 102

Borehole No. 1

Client Dept. of Highways of Ontario

Casing B.X.





Boring Date Aug 30 1958

Datum D.H.O.

Compiled By G.Y.S.

Checked By C.F.F.

SAMPLE CONDITION































-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- 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
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No and Condition	Sample Type	No of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					
Sandy loam & organic matter	brown		475.4		1  bag			Moist
Sand, fine, lumps of organic matter	Lt. yellowish brown	loose			2  S.S.	5	M.C. 4.5%	Moist
			5' 0"					
Sand, fine to medium	Lt. brown	loose			3  S.S.	9		Saturated
As above	-11-	-11-			4  S.S.	6		saturated
			10' 0"					
Sand, medium some fine grits & pebbles, lump of silt	brown	compact			5  S.S.	11		saturated
Sand, medium some coarse	-11-	-11-			6  S.S.	13		saturated
			15' 0"					
Sand, very fine	Lt. yellowish brown	- 2m, - 1			7  S.S.	11	M.C. 20.7%	Saturated
As above	-11-				8  S.L.		M.C. 20.2%	Dry density 108.0 pcf
As above with thin layers of silt	-11-	compact	20' 0"		9 	16	M.C. 18.3%	Saturated
Sand, fine	Lt. brown	compact	25' 0"		10  S.S.	12	M.C. 23.5%	Saturated
Sand, very fine	brown	compact	30' 0"		11  S.S.	13		saturated
As above	brown	compact	35' 0"		12  S.S.	19	M.C. 20.5%	saturated
Sand, very fine, some silt	grey	dense	40' 0"		13  S.S.	31	M.C. 17.9%	saturated
Till, sandy silt	grey	very dense	43' 0" 432.4 45' 0"		14  S.S.	91	M.C. 7.5%	saturated
			49' 0" 426.4					
Sand, fine to medium	brown				15  W.S.	80		

Client Dept. of Highways, St. Ontario

Casing B.X.





Boring Date Aug 30, 1958

Datum D.H.O.

Compiled By G.Y.S.

Checked By C.F.F.

SAMPLE CONDITION

-  UNDISTURBED
 FAIR
 DISTURBED
 LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
 S.L. SPLIT BARREL WITH LINERS
 S.T. THIN-WALLED SHELBY TUBE SAMPLE
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- V.T. IN SITU VANE SHEAR TEST
 Q/ UNCONFINED COMPRESSIVE STRENGTH
 W.L. WATER LEVEL IN CASING
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SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					
Sandy loam & organic matter	brown		475.4		1	bag		Moist
Sand, fine, lumps of organic matter	Lt. yellowish brown	loose	5' 0"		2	S.S.	5	M.C. 4.5% Moist
Sand, fine to medium	Lt. brown	loose			3	S.S.	9	Saturated
As above	-"-	-"-			4	S.S.	6	saturated
Sand, medium some fine grits & pebbles, lump of silt	brown	compact	10' 0"		5	S.S.	11	saturated
Sand, medium some coarse	-"-	-"-			6	S.S.	13	saturated
Sand, very fine	Lt. yellowish brown	compact	15' 0"		7	S.S.	11	M.C. 20.7% Saturated
As above	-"-				8	S.L.		M.C. 20.2% Dry density 108.0 pcf
As above with thin layers of silt	-"-	compact	20' 0"		9		16	M.C. 18.3% Saturated
Sand, fine	Lt. brown	compact	25' 0"		10	S.S.	12	M.C. 23.5% saturated
Sand, very fine	brown	compact	30' 0"		11	S.S.	13	saturated
As above	brown	compact	35' 0"		12	S.S.	19	M.C. 20.5% saturated
Sand, very fine, some silt	grey	dense	40' 0"		13	S.S.	31	M.C. 17.9% saturated
Till, sandy silt	grey	very dense	43' 0" 432.4 45' 0"		14	S.S.	91	M.C. 7.5% saturated
Sand, fine to medium	brown		49' 0" 426.4		15	W.S.	80	
Sand, silty very fine mixed with grits & pebbles & rock fragments	Lt grey brown	very dense	55' 0"		16 17	S.S. W.S.	154	V. moist
Sand, fine to medium	grey							
Sand, medium some coarse	grey	very dense	60' 0"		18	S.S.	100/8"	saturated

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name County Rd Overpass, Drums

Job No. 58 102

Borehole No. 2

Client Dept. of Highways of Ontario

Casing B.X.





Boring Date Sept 1, 1958

Datum D.H.O.

Compiled By G.Y.S.

Checked By C.F.F.

SAMPLE CONDITION



















-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- 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
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					
Very sandy loam mixed with organic matter	Reddish brown		2' 5.4"		1  bag			moist
Sand, fine to medium	Lt. brown	loose			2  bag			moist
					3  S.S.	5	M.C. 6.6%	moist
As above	yellowish brown	-II-	5' 0"		4  S.S.	5	M.C. 18.9%	saturated
Gravel, some fine to coarse sand	grey & brown	dense			5  S.S.	26		saturated
Sand, very fine	Lt. brown	dense	10' 0"		6  S.S.	35	M.C. 15.6%	saturated
As above	-II-				7A  S.L.		M.C. 20.5	dry density 111.5 pcf
Sand, fine to very fine some silt	Lt. brown	compact	15' 0"		8  S.S.	14	M.C. 21.2%	saturated
As above	-II-	-II-	20' 0"		9  S.S.	14	M.C. 22.2%	saturated
As above	-II-		25' 0"		10B  S.L.		sample taken from liner	saturated
As above	-II-						M.C. 20.3%	dry density 111.6 pcf
Sand, fine occasional silt pockets	greyish brown	Dense	30' 0"		11  S.S.	30	M.C. 19.3%	saturated
Fill, sandy silt, some gravel	grey	very dense	33' 0" 342.4" 35' 0"		12  S.S.	128	M.C. 8.4%	saturated
As above	-II-	-II-	40' 0"		13  S.S.	65		saturated
As above	-II-	-II-	45' 0"		14  S.S.	100/9"		saturated
As above	-II-		50' 0"		15  S.S.	100/8"	M.C. 9.2%	saturated

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

Job Name County Rd. Overpass, Drumbo
Client Dept. of Highways of Ontario
Datum D. H. O.

Job No. 58 102
Casing B. X.
Compiled By G. V. S.

Borehole No. 3
Boring Date Sept 2, 1958
Checked By C. F. F.

SAMPLE CONDITION

UNDISTURBED
 FAIR
 DISTURBED
 LOST

SAMPLE TYPE

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
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground surface			0' 0"					
Loam, very sandy & organic matter	reddish brown		982.1		1	bag		moist
Sand, fine to medium, some organic matter	Lt. brown				2	bag		moist
	-11-	Very loose			3	S.S.	3	M.C. 3.6% moist
As above	-11-	Loose	5' 0"		4	S.S.	6	M.C. 21.2% moist
Sand, very fine	Lt. brown				5			M.C. 19.1% moist
Sand, medium some coarse grits & pebbles	Lt. grey brown	compact			6	S.S.	22	M.C. 3.2% slightly moist
Sand, medium to fine	Lt. brown		10' 0"		7	S.L.		M.C. 7.8% dry density 106.9 pcf
					8			G.W.L. 10' 6" Sept 3, 1958
Sand, fine to medium	Lt. grey brown	Loose			8	S.S.	8	M.C. 19.7% saturated
As above	-11-	compact	15' 0"		9	S.S.	21	saturated
Sand, very fine	Lt. brown	compact	20' 0"		10	S.S.	15	M.C. 19.5% saturated
As above	-11-	-11-	25' 0"		11	S.S.	30	M.C. 15.7% saturated
As above	-11-	-11-	30' 0"		12	S.S.	15	M.C. 24.3% saturated
As above	-11-	-11-	35' 0"		13	S.S.	23	M.C. 18.6% saturated
Till, sandy silt with gravel	grey	dense	38' 6" 442.6 40' 0"		14	S.S.	35	M.C. 10.2% saturated
As above with less & finer gravel	"	Very dense	45' 0"		15	S.S.	57	M.C. 8.3% saturated
As above	-11-	-11-	50' 0"		16	S.S.	150/10"	saturated

Datum: D. H. O.

Compiled By...G.Y.S

Checked By C.F.F.

SAMPLE CONDITION



SAMPLE TYPE

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

Y. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground surface			0' 0"					
Loam, very sandy & organic matter	reddish brown		982.1	S.S.	1	bag		moist
Sand, fine to medium, some organic matter	Lt. brown	Very loose		S.S.	2	bag		moist
"	- " -				3	S.S.	3	M.C. 3.6% moist
As above	- " -	Loose	5' 0"		4	S.S.	6	M.C. 21.2% moist
Sand, very fine	Lt. brown				5			M.C. 19.1% moist
Sand, medium some coarse grits & pebbles	Lt. grey brown	compact			6	S.S.	22	M.C. 3.2% slightly moist
Sand, medium to fine	Lt. brown		10' 0"		7	S.L.		M.C. 7.8% dry density 106.9 pcf
					8			G.W.L. 10' 6" Sept 3, 1958
Sand, fine to medium	Lt. grey brown	Loose			8	S.S.	8	M.C. 19.7% saturated
As above	- " -	compact	15' 0"		9	S.S.	21	saturated
Sand, very fine	Lt. brown	compact	20' 0"		10	S.S.	15	M.C. 19.5% saturated
As above	- " -	- " -	25' 0"		11	S.S.	30	M.C. 15.7% saturated
As above	- " -	- " -	30' 0"		12	S.S.	15	M.C. 24.3% saturated
As above	- " -	- " -	35' 0"		13	S.S.	23	M.C. 18.6% saturated
Till, sandy silt with gravel	grey	dense	38' 6" 393.6" 40' 0"		14	S.S.	35	M.C. 10.2% saturated
As above with less & finer gravel	"	very dense	45' 0"		15	S.S.	57	M.C. 8.3% saturated
As above	- " -	- " -	50' 0"		16	S.S.	150/10"	saturated
Gravel mixed with sandy silt	- " -	- " -	55' 0" 927.1		17	S.S.	150/4"	Wet
Sand, coarse to medium	- " -	- " -			18	W.S.		
			60' 0"		19	S.S.	150/3 1/2"	
			922.1 hole terminated					

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO





BOREHOLE LOG

Job Name: County Rd. Overpass, Drumbo
Client: Dept. of Highways of Ontario
Datum: D. H. O.

Job No. 58.102
Casing: B.X.
Compiled By: G.Y.S.

Borehole No. 4
Boring Date: Sept. 3, 1958
Checked By: C.F.F.

SAMPLE CONDITION

-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- 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
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL





SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					
Sandy, silty loam & org. matter	Dk. brown		980.2		1	bag from casing		moist
Sand, fine to medium	reddish brown				2			moist
Sandy loam	-11-	Soft			3	S.S.	3	M.C. 16.9% At plastic limit
Sand, medium some coarse	Lt. brown	Loose	5' 0"		4	S.S.	8	M.C. 3.3% moist
As above	-11-	-11-			5	S.S.	9	M.C. 4.6% moist
As above	-11-	Compact	10' 0"		6	S.S.	11	G.W.L. 8' 6" Sept. 3, 1958 M.C. 18.7% saturated
As above	-11-	-11-			7	S.S.	16	M.C. 19.1% saturated
As above with scattered gravel	-11-	-11-	15' 0"		8	S.S.	16	saturated
As above, no gravel	-11-	-11-	20' 0"		9	S.S.	19	M.C. 18.1% saturated
Sand, fine to medium	brown	-11-	25' 0"		10	S.S.	18	saturated
Sand, medium to coarse with fine gravel	grey-brown				11	W.S.		
Sand, very fine	Lt. brown	-11-	30' 0"		12	S.S.	19	M.C. 19.1% saturated
As above	-11-	-11-	35' 0"		13	S.S.	20	saturated
As above	-11-	Dense	40' 0"		14	S.S.	41	M.C. 17.3% saturated
Till, sandy silt, some gravel	grey	-11-	44' 6" 435.7		15	S.S.	33	M.C. 9.8% saturated
Gravel, coarse, some fines	grey	very dense	50' 0" 430.2		16	S.S.	65	saturated

Datum D. H. O.

Compiled By G.Y.S.

Checked By C.F.F.

SAMPLE CONDITION

	UNDISTURBED
	FAIR
	DISTURBED
	LOST

SAMPLE TYPE

S.S.	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
Q/u	UNCONFINED COMPRESSIVE STRENGTH
W.L.	WATER LEVEL IN CASING
W.T.	GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					
Sandy, silty loam & org. matter	Dk. brown		980.2		1	bag from casing		moist
Sand, fine to medium	reddish brown				2			moist
Sandy loam	-11-	Soft			3	S.S.	3	M.C. 16.9% At plastic limit
Sand, medium some coarse	Lt. brown	Loose	5' 0"		4	S.S.	8	M.C. 3.3% moist
As above	-11-	-11-			5	S.S.	9	M.C. 4.6% moist
As above	-11-	Compact	10' 0"		6	S.S.	11	G.W.L. 8' 6" Sept. 3, 1958 M.C. 18.7% saturated
As above	-11-	-11-			7	S.S.	16	M.C. 19.1% saturated
As above with scattered gravel	-11-	-11-	15' 0"		8	S.S.	16	saturated
As above, no gravel	-11-	-11-	20' 0"		9	S.S.	19	M.C. 18.1% saturated
Sand, fine to medium	brown	-11-	25' 0"		10	S.S.	18	saturated
Sand, medium to coarse with fine gravel	grey-brown				11	W.S.		
Sand, very fine	Lt. brown	-11-	30' 0"		12	S.S.	19	M.C. 19.1% saturated
As above	-11-	-11-	35' 0"		13	S.S.	20	saturated
As above	-11-	Dense	40' 0"		14	S.S.	41	M.C. 17.3% saturated
Till, sandy silt, some gravel	grey	-11-	44' 5" 935.7		15	S.S.	33	M.C. 9.8% saturated
Gravel, coarse, some fines	grey	very dense	50' 0" 930.2		16	S.S.	65	saturated
Gravel, coarse mixed with sandy silt	grey	-11-	55' 0"		17	S.S.	125/8"	wet
Sand, coarse to medium mixed with fine gravel	-11-		60' 0" 920.16		18	W.S.	150/2"	

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name County Rd. Overpass, Drumbo

Job No. 58102

Borehole No. 5

Client Dept. of Highways of Ontario

Casing B.X.





Boring Date Sept. 7-8, 1958

Datum D.H.O.

Compiled By G.Y.S.

Checked By C.F.F.

SAMPLE CONDITION

































-  UNDISTURBED
-  FAIR
-  DISTURBED
-  LOST

SAMPLE TYPE

- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
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ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL





SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					G.W. L. 1'5" Sept 8, 1958
Sandy loam with organic matter	Dk. brown		972.8		1 			sample taken from casing moist
and fine with rock fragm. & org. matter	Lt. brown				2 			sample taken from casing moist
and fine to coarse mixed with gravel up to 1 1/2"	" - "	compact			3 	S.S.	18	M.C. 9.9% saturated
and coarse mixed with gravel up to 1"	" - "	dense	5' 0"		4 	S.S.	41	saturated
As above, changing to silt	" - "	very dense			5 	S.S.	174/6"	M.C. 18.5% saturated
Sand, very fine	Lt. brown	compact	10' 0"		6 	S.S.	30	saturated
Sand, fine to very fine	greyish brown	compact			7 	S.S.	17	saturated
As above	" - "	compact	15' 0"		8 	S.S.	14	M.C. 20.7% saturated
Sand, very fine with seams of silt	Lt. brown	compact	20' 0"		9 	S.S.	17	saturated
Sand, very fine	Lt. brown	dense	25' 0"		10 	S.S.	29	saturated
As above	" - "	compact	30' 0"		11 	S.S.	22	saturated
As above with some silt	greyish brown	compact	35' 0"		12 	S.S.	21	saturated
Sandy silt, changing to gravelly silt	grey brown	compact	40' 0" 932.8		13 	S.S.	14	M.C. 21.2% saturated
Till, sandy silt with gravel	grey	dense	45' 0"		14 	S.S.	47	M.C. 10.6% saturated
Sand, very fine	grey brown		47' 0" 925.8		15 	W.S.		
Till, sandy silt with gravel & rock fragments	grey	very dense	50' 0" 900.6 922.2		16 	S.S.	100/5"	saturated

Client Dept. of Highways of Ontario
 Datum D. H. O.

Casing B.X.
 Compiled By G.Y.S.

Boring Date Sept. 7-8, 1958
 Checked By C.F.F.

SAMPLE CONDITION









































-  UNDISTURBED
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SAMPLE TYPE

- 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
- Q/u UNCONFINED COMPRESSIVE STRENGTH
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					G.W.L. 1'5" Sept 8, 1958
Sandy loam with organic matter	Dk. brown		972.8		1			sample taken from casing moist
and fine with rock fragm. & org. matter	Lt. brown				2			sample taken from casing moist
and fine to coarse mixed with gravel up to 1/2"	" "	compact			3		S.S. 18	M.C. 9.9% saturated
and coarse mixed with gravel up to 1"	" "	dense	5' 0"		4		S.S. 41	saturated
As above, changing to silt	" "	very dense			5		S.S. 174/6"	M.C. 18.5% saturated
Band, very fine	Lt. brown	compact	10' 0"		6		S.S. 30	saturated
Band, fine to very fine	greyish brown	compact			7		S.S. 17	saturated
As above	" "	compact	15' 0"		8		S.S. 14	M.C. 20.7% saturated
and very fine with seams of silt	Lt. brown	compact	20' 0"		9		S.S. 17	saturated
Band, very fine	Lt. brown	dense	25' 0"		10		S.S. 29	saturated
As above	" "	compact	30' 0"		11		S.S. 22	saturated
As above with some silt	greyish brown	compact	35' 0"		12		S.S. 21	saturated
Sandy silt, changing to gravelly silt	grey brown	compact	40' 0" 932.8		13		S.S. 14	M.C. 21.2% saturated
Till, sandy silt with gravel	grey	dense	45' 0"		14		S.S. 47	M.C. 10.6% saturated
Sand, very fine	grey brown		47' 0" 925.8		15		W.S.	
Till, sandy silt with gravel & rock fragments	grey	very dense	49' 0" 50' 0" 50' 6" 922.3		16		S.S. 100/5"	saturated
Till, fine, coarse sand grits & pebbles	Lt. grey	very dense	55' 0"		17		S.S. 150/6	M.C. 5.4% moist
Band, medium to coarse	grey				18		W.S.	
Band, fine to medium	grey		60' 0"		19		W.S. 100/10"	
As above	" "		61' 6" 911.3		20		W.S.	Hoie terminated





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

Job Name County Rd Overpass, Drumbo
Client Dept. of Highways of Ontario
Datum D. 4.0.

Job No. 53 102
Casing B.X.
Compiled By G.Y.S.

Borehole No. 6
Boring Date Sept. 6 - 1958
Checked By C.F.F.

SAMPLE CONDITION
















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SAMPLE TYPE

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ABBREVIATIONS





- V.T. IN SITU VANE SHEAR TEST
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- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					G.W.L. 1' 9" Sept 6, 1958
Sandy loam & organic matter	Dk. brown		473.10		1			sample taken from casing moist
Sand, fine to medium some silt	yellowish brown				2			sample taken from casing moist
Sand, fine some silt, grits & pebbles	yellowish brown	loose			3	S.S.	7	M.C. 18.2% saturated
Gravel, well graded, some sandy silt	grey, mottled lt. brown	dense	5' 0"		4	S.S.	40	saturated
Sand, medium to coarse, mixed with gravel upto 1"	brown	compact			5	S.S.	17	M.C. 13.0% saturated
Sand, very fine, silty	lt. brown	compact	10' 0"		6	S.S.	12	M.C. 18.9% saturated
Sand, very fine	lt. brown	compact			7	S.S.	16	saturated
As above	- " -	very dense	15' 0"		8	S.S.	40/6"	saturated
Sand, fine to very fine	lt. brown	compact	20' 0"		9	S.S.	17	saturated
Sand, very fine	lt. grey brown	very dense	25' 0"		10	S.S.	58	M.C. 17.5% saturated
Sand, very fine silty	grey brown	compact	30' 0"		11	S.S.	27	saturated
Till, sandy silt, some gravel	grey	very dense	33' 0" 940 35' 0"		12	S.S.	152	saturated
As above	- " -	- " -	40' 0"		13	S.S.	105	M.C. 8.5% saturated
As above	- " -	- " -	45' 0"		14	S.S.	102	saturated
As above with rock fragments	- " -	- " -			15	S.S.	112	moist

SAMPLE CONDITION

SAMPLE TYPE

ABBREVIATIONS

 UNDISTURBED
 FAIR
 DISTURBED
 LOST

S.S. 2" STANDARD SPLIT TUBE SAMPLE
S.L. SPLIT BARREL WITH LINERS
S.T. THIN-WALLED SHELBY TUBE SAMPLE
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V. T. IN SITU VANE SHEAR TEST
Q/u UNCONFINED COMPRESSIVE STRENGTH
W. L. WATER LEVEL IN CASING
W. T. GROUND WATER TABLE IN SOIL

SOIL DESCRIPTION	COLOR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	WATER LEVELS, SOIL MOISTURE & REMARKS
Ground Surface			0' 0"					G.W.L. 119" Sept 6, 1958
Sandy loam & organic matter	Dk. brown		473.10		1			sample taken from casing moist
Sand, fine to medium some silt	yellowish brown	- II -			2			sample taken from casing moist
Sand, fine some silt, grits &	yellowish brown	loose			3	S.S.	7	M.C. 18.2% saturated
pebbles	grey mottled				4	S.S.	40	saturated
Gravel, well graded, some	lt. brown	dense	5' 0"					
sandy silt								
Sand, medium to coarse, mixed	brown	compact			5	S.S.	17	M.C. 13.0% saturated
with gravel upto 1"								
Sand, very fine, silty	lt. brown	compact	10' 0"		6	S.S.	12	M.C. 18.9% saturated
Sand, very fine	lt. brown	compact			7	S.S.	16	saturated
As above	- II -	very dense	15' 0"		8	S.S.	46/6"	saturated
Sand, fine to very fine	lt. brown	compact	20' 0"		9	S.S.	17	saturated
Sand, very fine	lt grey brown	very dense	25' 0"		10	S.S.	58	M.C. 17.5% saturated
Sand, very fine silty	grey brown	compact	30' 0"		11	S.S.	27	saturated
			33' 0"					
			340'					
			35' 0"					
Till, sandy silt, some gravel	grey	very dense			12	S.S.	152	saturated
			40' 0"					
As above	- II -	- II -			13	S.S.	105	M.C. 23% saturated
			45' 0"		14	S.S.	102	saturated
As above	- II -	- II -						
			50' 0"					
As above with rock fragments	- II -	- II -			15	S.S.	112	moist
			55' 0"					
As above, more gravel & rock	- II -	- II -	56' 0"		16	S.S.	159/8"	wet
fragments			917.1					
			Hole terminated					

APPENDIX II

METHOD OF OPERATION

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.

e. m. peto associates ltd.