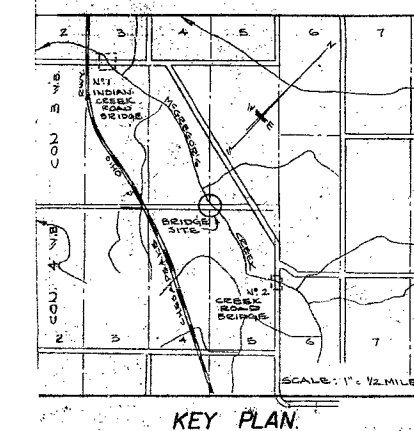
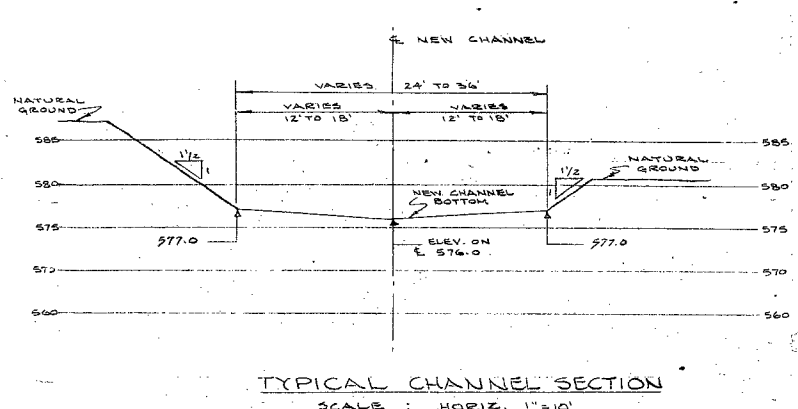
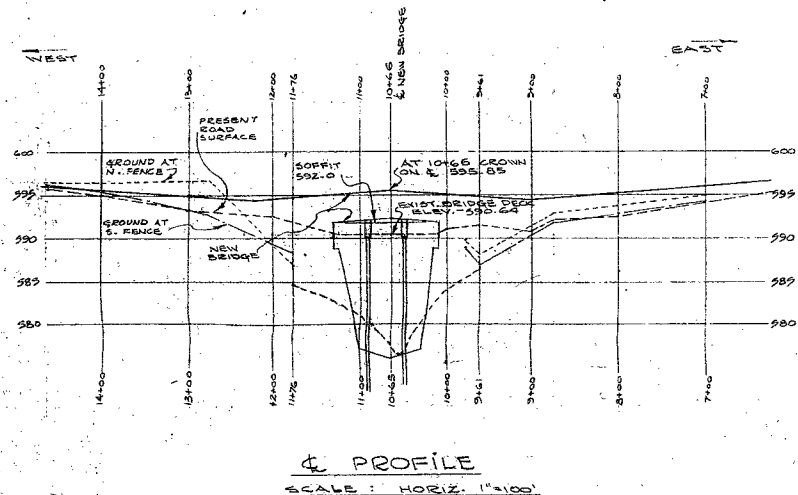
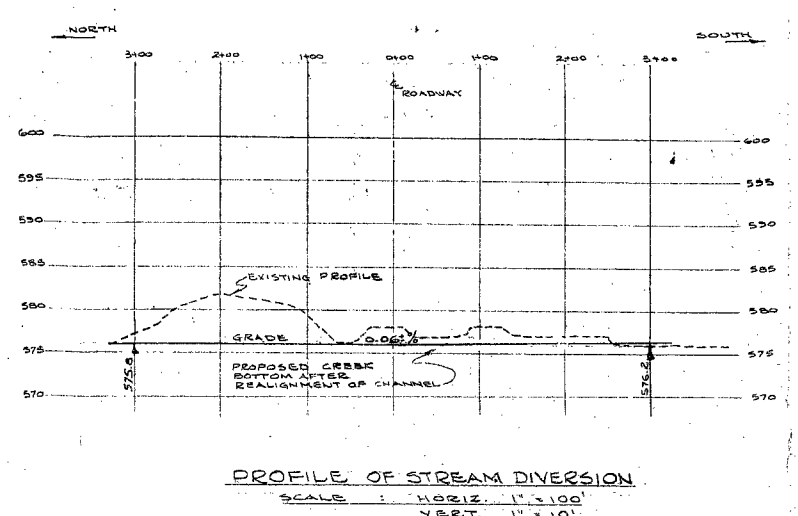
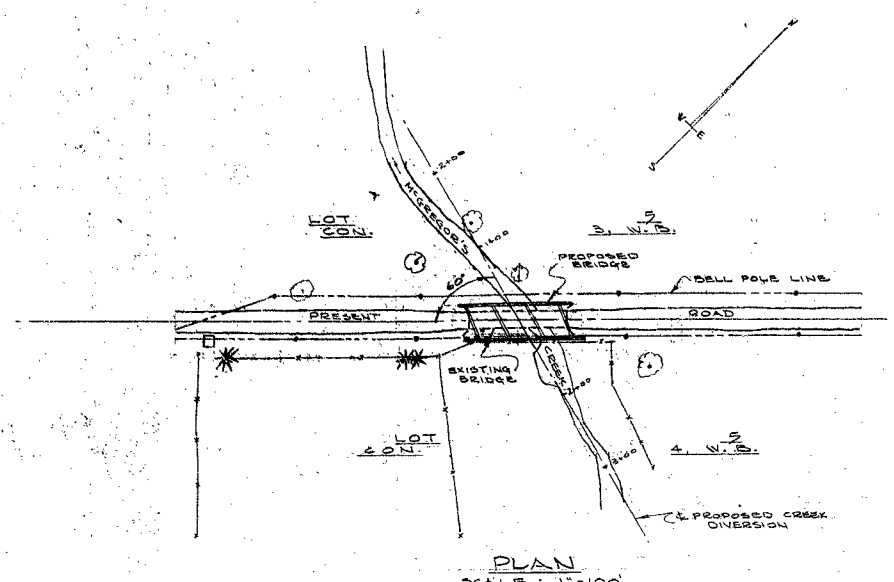


64-F-251M
ENGLISH SIDEROAD
McGREGOR'S CREEK
LOT 5, CON. 3 & 4
HARWICH



FOLLOW SEPARATE INSTRUCTIONS FOR PREPARATION OF BRIDGE SITE PLAN WHEN MAKING BRIDGE SURVEY.

DATA.

1. SPECIAL FEATURES: WATERFALLS, DAMS, EXCEPTIONAL FLOODS, ICE, DRIFTWOOD, SLIDING BANKS, ETC. MAXIMUM HIGH WATER WAS SLN - 592. IN 1941. THIS AND OTHER HIGH WATER LEVELS WERE CAUSED BY BACK-UP FROM THAMES RIVER. MAX. FLOW LEVEL 585. ICE & DRIFTWOOD NOT USUALLY A PROBLEM.

2. (A) UPSTREAM & DOWNSTREAM BRIDGES (ONE LOCATION, LENGTH, HEIGHT ABOVE N.H.W.L., NET CROSS-SECTIONAL AREA AT HIGH WATER & ESTIMATED AGE) (1) DOWNSTREAM SPAN = 74.5', NET X-SECTIONAL AREA = 376 SQ. FT., HEIGHT ABOVE N.H.W.L. = 4', AGE = 50 YRS. (2) UPSTREAM SPAN = 63'-0", NET X-SECTIONAL AREA = 760', HEIGHT ABOVE N.H.W.L. = 24'-0", AGE = 30 YRS.

(B) REASONS WHY THESE BRIDGES ARE, OR ARE NOT, FAIR INDICATIONS OF SIZE OF PROPOSED BRIDGE. IMPROVED DRAINAGE HAS INCREASED RUN-OFF SOMEWHAT IN LAST 50 YEARS.

3. REASONS FOR CHANGES IN HEIGHT OR LENGTH FROM THAT OF OLD BRIDGE: HEIGHT INCREASED TO CLEAR MAXIMUM N.H.W.L. OF 592. LENGTH INCREASED SLIGHTLY TO ALLOW FOR SLOPING BANKS.

DATA (contd.)

4. IS DITCH, STREAM, OR RIVER GRADIENT LIABLE TO BE LOWERED? NOT LIKELY, THOUGH VERY REMOTELY POSSIBLE.

5. NAVIGATION CLEARANCES REQUIRED, IF ANY: NONE.

6. RAILWAY CLEARANCE REQUIRED, IF ANY: NONE.

7. IF STRUCTURE IS OVER OR UNDER A RAILWAY HAS APPROVAL BEEN OBTAINED? (A) FROM RAILWAY CO. (B) FROM BOARD OF TRANSPORT COMMISSIONERS.

8. HAS APPROVAL BEEN OBTAINED UNDER NAVIGABLE WATERS PROTECTION ACT?

9. IS A TEMPORARY DETOUR REQUIRED? NO. WHO WILL BUILD IT? WHO WILL MAINTAIN IT?

10. INFORMATION AND EVIDENCE OF EXTREME FLOODING HAS OBTAINED FROM NEIGHBOURING OWNERS AND REFLECTS HIGHEST WATER ELEVATION IN THE AREA OF THIS CONSTRUCTION TO BE 592. AND THE LOWEST WATER ELEVATION TO BE 577 (SEE PART 1 ABOVE).

11. ROAD DESIGN INFORMATION: ESTIMATED A.D.T. 300. DESIGN SPEED: 50 M.P.H. STOPPING SIGHT DISTANCE: 350'.

STRUCTURE DATA.

1. NET SPAN LENGTH AND TYPE OF BRIDGE: 118' 5" SPAN, LINTEL STRUCTURE, OPEN PILES ON STEEL TAPER PILES.

2. ROADWAY WIDTH ON BRIDGE: 28 FT.

3. NUMBER & WIDTH OF SIDEWALKS: TWO 3' FOOT SAFETY CURBS.

4. SKEW ANGLE: 30° FROM A RIGHT ANGLE.

5. TOTAL LENGTH & TYPE OF PILING: 16" CIRCULAR STEEL TAPER PILES FILLED WITH CONCRETE.

6. APPROX. VOLUME OF CONCRETE: 280 CU. YDS.

7. APPROX. WEIGHT OF STEEL: 2 TONS.

8. APPROX. WEIGHT OF REINFORCEMENT: 250 LBS.

9. APPROX. VOLUME OF APPROACH FILL: 1200 CU. YDS.

10. DRAINAGE AREA: 24 SQ. MI.

FIELD INVESTIGATION MADE APRIL 1964 BY H. H. TODGHAM SURVEY ENGINEER.

PRELIMINARY

TODGHAM & CASE LTD. CONSULTING CIVIL ENGINEERS

CHATHAM ONTARIO

PROPOSED BRIDGE OVER MCGREGOR'S CREEK

OWNER: TWP. OF HARNICH MUNICIPAL DIST. No. 1

Co. OF KENT ROAD No.

TWP. OF HARNICH LOT 5 R.T.S. CON. 364 R.T.W.B.

SITE PLAN.

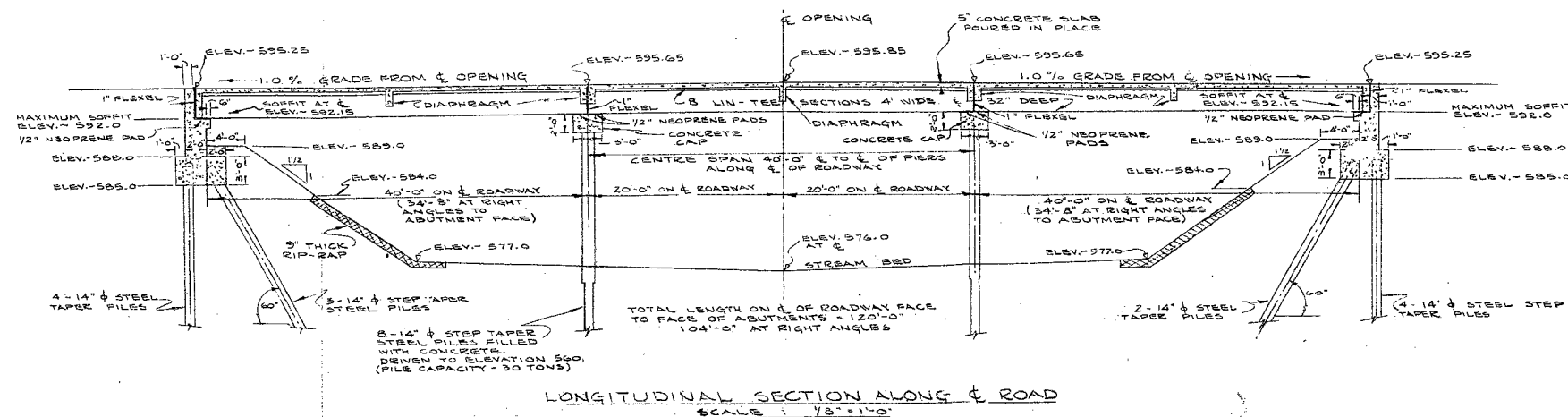
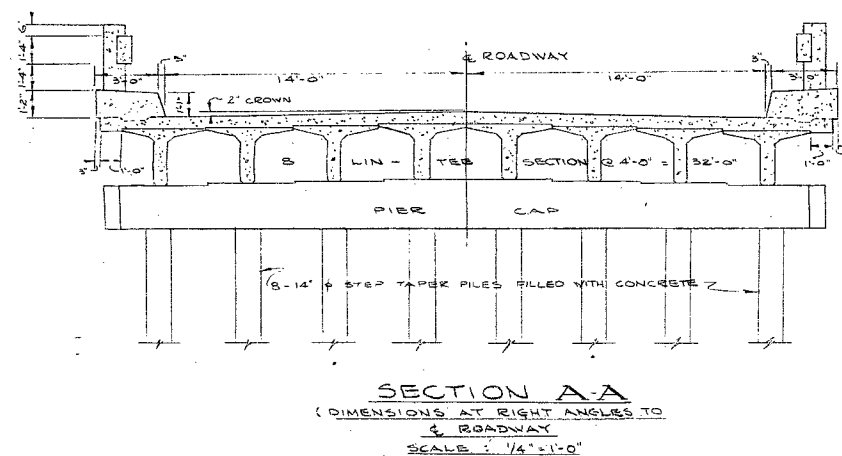
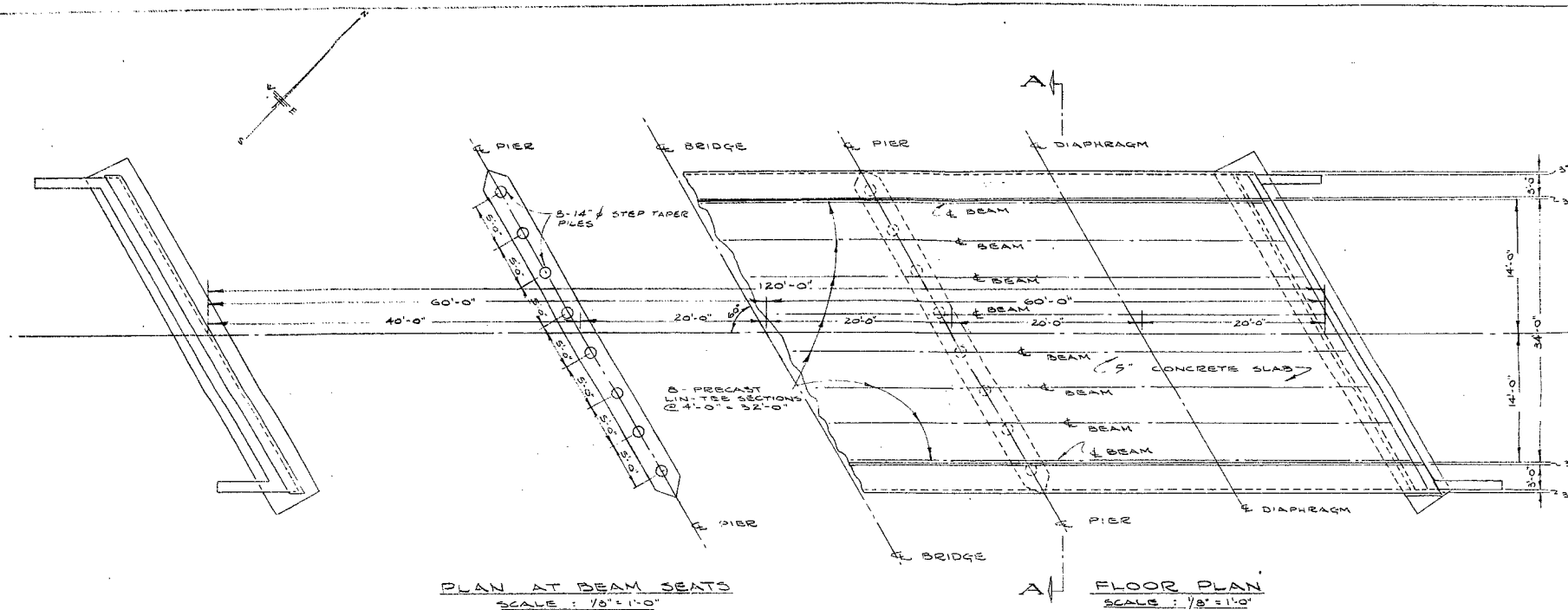
JUNE 1, 1964 DATE

H. H. TODGHAM DESIGN ENGINEER

BRIDGE NAME: ENGLISH SIDEROAD BRIDGE

LOADING: BRIDGE No. 420-516

DWG. No. 64166-1



PRELIMINARY			
TODGHAM & CASE LTD. CONSULTING CIVIL ENGINEERS			
CHATHAM		ONTARIO	
PROPOSED BRIDGE OVER MCGREGOR'S CREEK			
OWNER TWP. OF HARNICH		MUNICIPAL DIST. No. 1	
CO. OF KENT		ROAD No.	
TWP. OF HARNICH LOT 5		R.T.S. CON 3 & 4	
STRUCTURAL DETAILS			
	JUNE 1, 1964 DATE		
	BRIDGE NAME		
	ENGLISH SIDEROAD BRIDGE		
	LOADING	BRIDGE No.	
H20-516		64166-2	

B.H. 1853

E. M. PETO ASSOCIATES LIMITED

1287 Caledonia Road,
Toronto 19, Ontario.

Our Job Number 6428

789 - 1126.

24th March 1964.

Township of Harwich, - CO. KENT.
c/o Todgham and Gase Ltd.,
Consulting Civil Engineers,
151 Thames Street,
P. O. Box 386,
Chatham, Ontario.

64-F-251M

Attention: Mr. H.H. Todgham.

Gentlemen,

Soil Investigation
English Sideroad Bridge
McGregor's Creek

We have pleasure in forwarding to you five copies of our
soil investigation report.

In the following report we have described briefly the soil
conditions encountered and have given our observations and conclusions
regarding the foundations for the proposed structure.

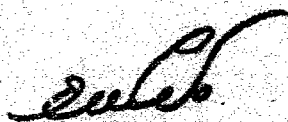
"Continued"

PAGE TWO

We trust that we have covered all the points within your terms of reference. Should you, however, have some questions arising from this report, do not hesitate to call on us.

Yours very truly,

E. M. PETO ASSOCIATES LTD.

A handwritten signature in dark ink, appearing to read 'E. M. Peto', written in a cursive style.

E. M. Peto, P. Eng.

BL/ap

TOWNSHIP OF HARWICH,
C/O TODGHAM and CASE LTD.,
CONSULTING CIVIL ENGINEERS.

SOIL INVESTIGATION
ENGLISH SIDEROAD BRIDGE
MC GREGOR'S CREEK

E. M. PETO ASSOCIATES LTD.
1287 Caledonia Road,
Toronto 19, Ontario.

TABLE OF CONTENTS

	<u>Page Number</u>
A. INTRODUCTION	
B. GENERAL INFORMATION	1
C. SOIL CONDITIONS	2
D. WATER CONDITIONS	4
E. OBSERVATIONS and CONCLUSIONS	5

TABLE "A" ATTERBERG LIMITS

FIGS. 1, 2 & 3 MECHANICAL ANALYSES

BOREHOLE LOGS

SITE PLAN

PROFILES

A. INTRODUCTION

We were authorized by the Consulting Engineers in a letter dated February 6th, 1964, to carry out a sub-soil investigation at the location of the bridge over McGregor's Creek in the Township of Harwich.

We understand that a new bridge will replace the existing bridge; the new span will be some 80 feet, and there may be a central pier.

In addition an area south of the existing bridge was investigated for the suitability of the material for the fill.

B. GENERAL INFORMATION

1. The test holes were located in accordance with the Consulting Engineers general directions at the points shown on the attached site plan; an inferred soil profile is shown on the same drawing.
2. The elevations given in the report and the drawings are in reference to the geodetic elevation.
3. The laboratory test results are given on Table A, and Fig's. 1 to 3 inclusive.

C. SOIL CONDITIONS

Geologically, the main deposit at the site, belong to the glacial deposits which were deposited during the last glaciation. The upper most deposits (organic strata) are of recent, alluvial origin.

The following individual soil deposits were met:-

i) Fill

Fill was met in the area of test holes 1, 2, 3 and 4. The depth of this man-made stratum varied between 2.0 and 7.0 feet. It was mostly non-cohesive composed of sandy silt to silty fine sand with traces of organic matter. The fill was loose to compact and wet to saturated.

ii) Very silty fine sand

This layer was found in the area of test hole 1 only. It had a till - like texture, and contained some grits and pebbles. A typical grading curve is given on Fig. 2. It was loose to compact and moist to wet.

iii) Organic strata

In the area of test holes 2 and 3, and again in the area of test hole 4 organic strata were met. The organic deposit was mainly an organic clayey silt with occasional sand seams. It was very soft to soft and wetter than its plastic limit. This deposit when subjected to loads will undergo considerable settlements.

C. SOIL CONDITIONS - Cont'd

i v) Clayey silt till

The main deposit at the site investigated is formed by the till stratum which, on the basis of the result of mechanical analyses (see Fig's. 1 and 3), may be classified as a "clayey silt till". The variation in the grading was only nominal thus it is fairly uniform, apart from the numerous seams and layers of sand and gravel.

The Atterberg limits were: (average values)

Liquid Limit 32%, Plastic Limit 16%, and Plasticity Index 16%.

Based on the N-values, an average undrained shear strength in excess of 2500 lb/sq. ft may be assumed and the wet density will be about 135 lb/cu. ft.

In the body of the glacial till there were numerous seams and layers of sand, gravel, and then silt with silty clay. The location of these seams may be seen from the attached soil profile, or taken from the borehole logs. Some of the sand or gravel seams were water bearing, and contained some gas. However, the pressure in these seams was insignificant and will not have any serious effect on the proposed structure.

D. WATER CONDITIONS

The following are the water conditions:

- Test hole #1 No seepage seams down to the depth of sandy gravel (25.5 to 26.25 feet depth). Only minor seepage in the gravel seam. Water level at about 14.5 feet below grade. Minor gas content.
- Test hole #2 Some perched water in the organic deposit (water level at 4.5 feet below grade). It was cut off by extending the casing into the clayey till. Sand and gravel seams (at 12.2 and 15.7 feet below grade) are water bearing, with water under minor pressure. Some gas is contained in these seams. Gravel seams at 18 feet and 27 to 29.8 feet are water bearing with water under moderate pressure. The final water level is at 1'-4' below grade.
- Test hole #3 Test hole dry to 6.5 feet below grade. Very minor water in the organic deposit (perched water). The seams of medium sand, and fine to medium sand are water bearing layers. The water contained in these seams was cut off when casing was extended into the clayey till deposit. The final water level was about 6 feet below grade.

E. OBSERVATIONS and CONCLUSIONS

1. The recommended foundation elevation for the abutments is elevation 571.5 as proposed by the Consulting Engineers.

For the centre pier the foundation should be lowered by 1 foot, down to elevation 570.5. This is necessary in view of the organic deposit in this area. (see borehole of test hole #2).

2. For the foundation elevation as recommended above the allowable bearing value is: 2.5 ton/sq.ft for continuous, and 3.0 ton/sq.ft for isolated footings.

3. Because the sub-soil is pre-consolidated, and no appreciable differential settlements will take place a continuous type of structure with a centre pier may be adopted.

4. To protect against possible scour effect in the area of the proposed centre pier revetting in the form of pitching may be considered.

5. Excavation for the abutments, especially where the excavations have to penetrate through the organic deposit will require bracing and some water control measures. The foundation excavation may be carried out most conveniently within some form of cofferdam, penetrating into the clayey silt till, slightly below excavation level. In this connection, where the toe of the sheeting is stopped inadvertently in a random water bearing sand or gravel layer, some increased seepage

E. OBSERVATIONS and CONCLUSIONS - Cont'd

may occur; further driving to greater depth should overcome this.

6. The area of test holes 4 and 5 does not contain an ideal fill material. The soils in this area are similar to the deposits found at the bridge. The organic deposit between 7.0 and 14.5 feet below grade in the area of test hole #4 should not be used as a fill, due to its high organic content. The clayey silt till, according to the grading analyses, and the D. H. O. Standards of soil suitability with respect to frost heaving for roads is an unacceptable material, because it contains more than the 60% of very fine sand and silt; however, it may be used as a bulk fill provided it is not wetter than at present, and it is appreciated adverse weather conditions can make this material very difficult, if not impossible, to compact to a satisfactory standard.

7. It is proposed to raise the existing embankment by about 9 feet maximum in the area of test hole #3. Here there is a layer some 3 feet thick of poor organic soil at a depth of 7 feet.

E. OBSERVATIONS and CONCLUSIONS - Cont'd

The extent of this layer in a direction away from the bridge is not known, but it probably pinches out. From a construction aspect it would be preferable to remove this layer completely, but since it is now covered by 7 feet of soil it is probably no longer economical to do so. Assuming an undrained shear strength of 400 p.s.f. for this soil, it is apparent that no grave risk of a failure of any serious consequence is likely and accordingly it may be left in position provided some long term settlement can be tolerated.

Report prepared by:

B. Lewicki

B. Lewicki, P. Eng.

E. M. PETO ASSOCIATES LTD.

C. F. Freeman

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

BL/ap

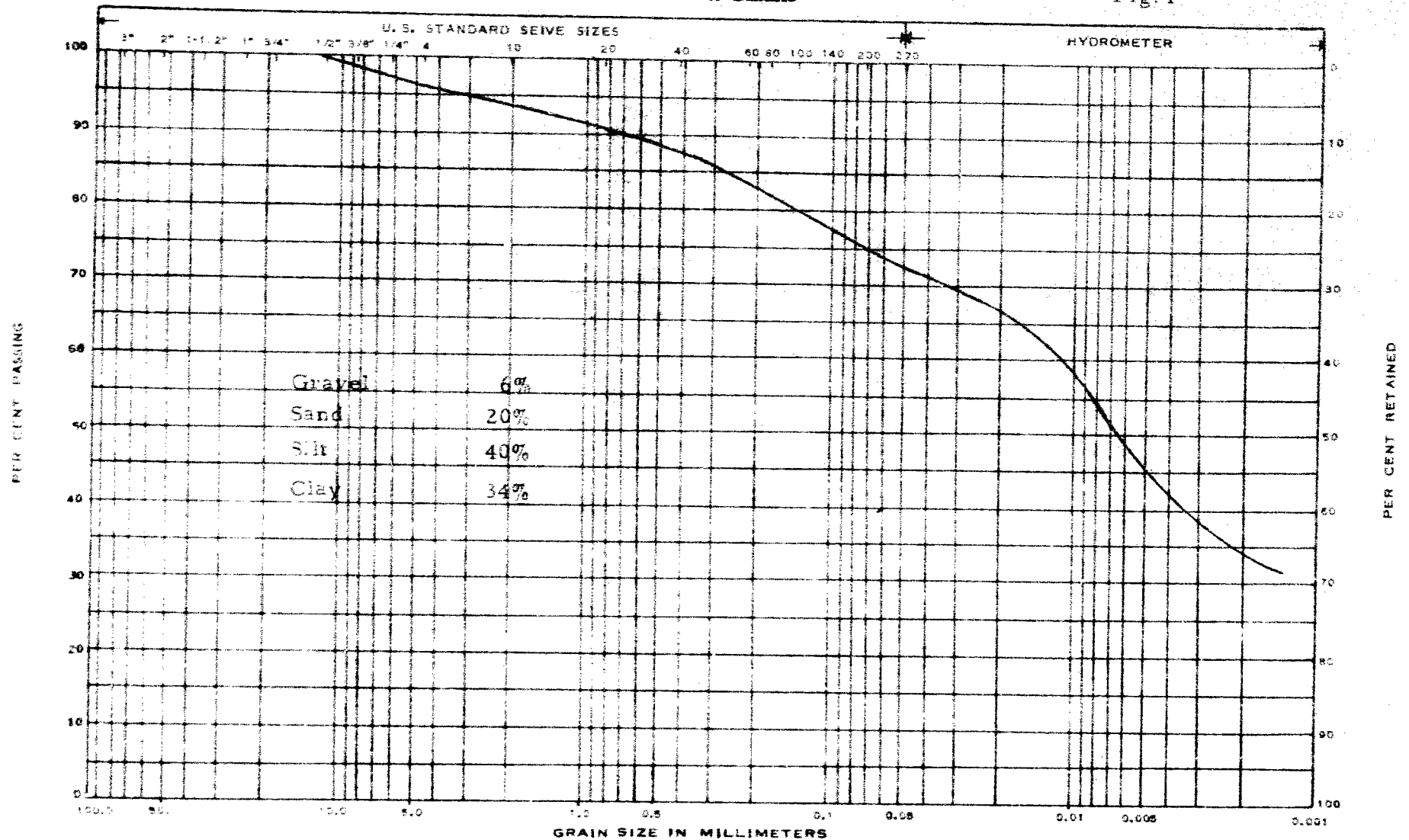
Our Job Number 6428

24th March 1964.

TABLE "A"

ATTERBERG LIMIT TESTS

Test hole	Depth	Liquid Limit %	Plastic Limit %	Plasticity Index %
1	20'0" - 21'6"	30.9	15.3	15.6
3	12'0" - 13'6"	32.0	15.8	16.2
5	15'0" - 16'6"	33.0	16.5	16.5



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

MASS. INST. OF TECH. CLASSIFICATION

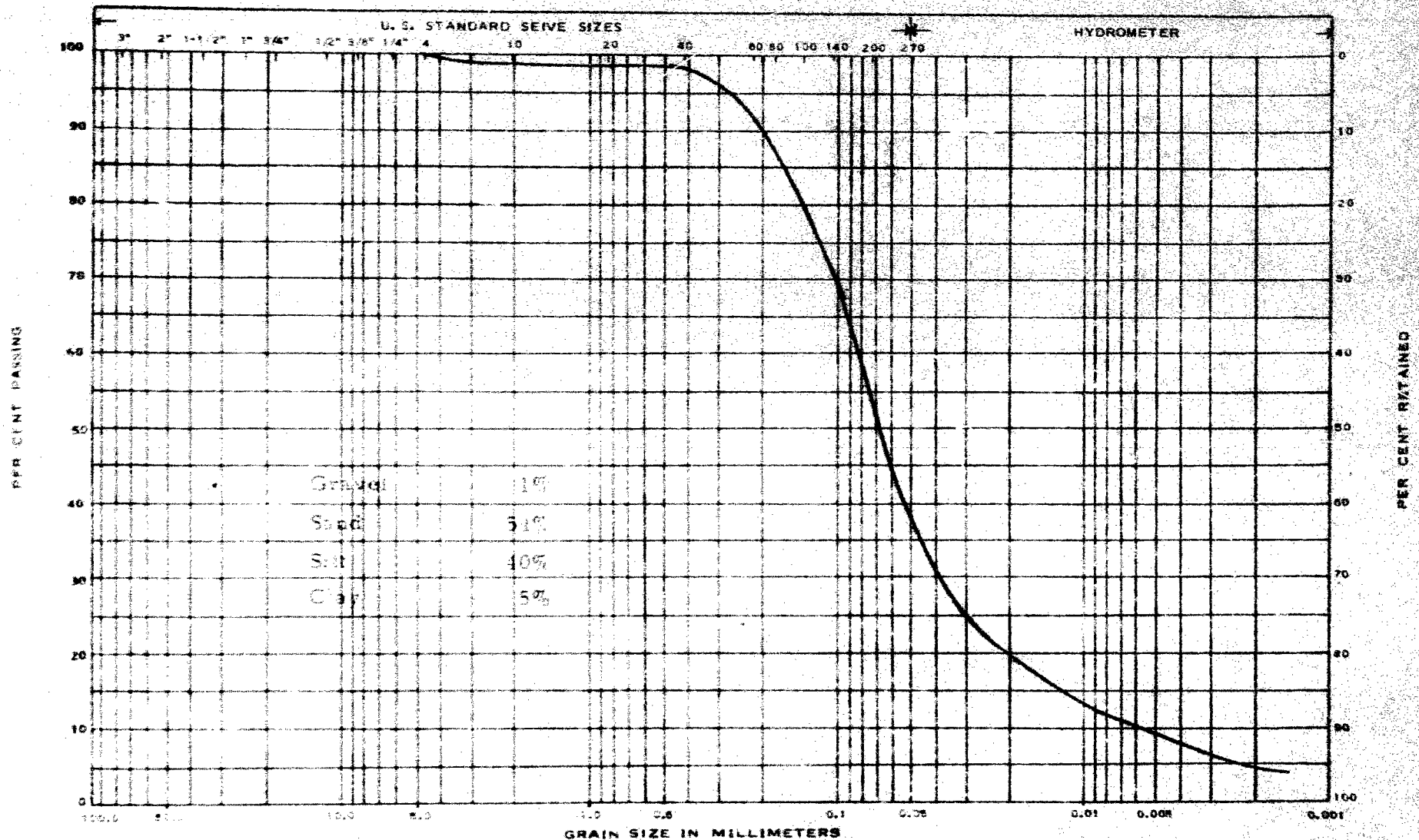
JOB NAME English Sideroad BridgeJOB NO. 6428HOLE NO. 1SAMPLE NO. 8DEPTH 15'-16'6"

ELEVATION

REMARKS

Clayey silt till

GRAIN SIZE DISTRIBUTION



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

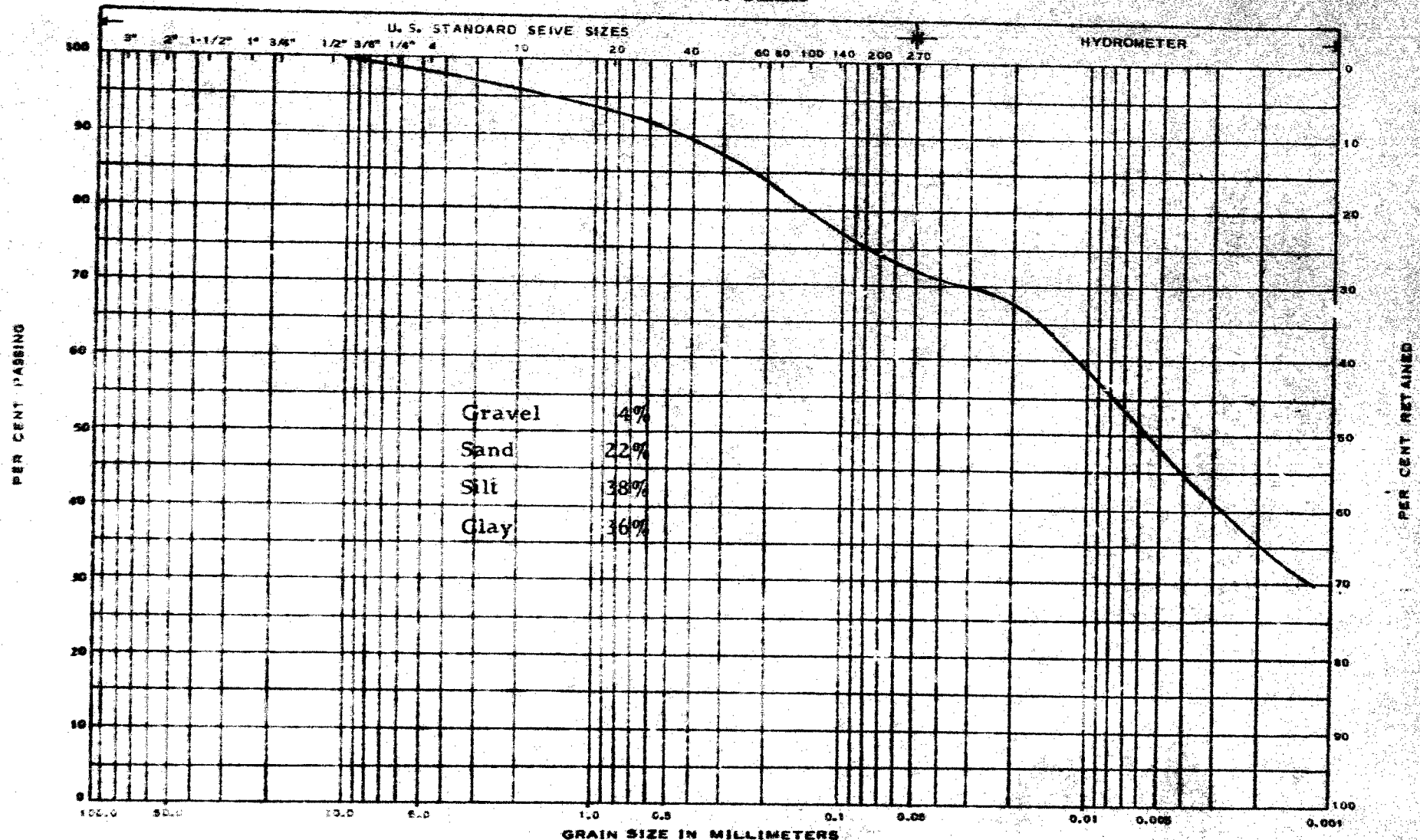
MASS. INST. OF TECH. CLASSIFICATION

JOB NAME English Sideroad Bridge JOB NO. 6128 HOLE NO. 2 SAMPLE NO. 3
 5'-6" ELEVATION
 DEPTH _____ ELEVATION _____ REMARKS Silty sand

GRAIN SIZE DISTRIBUTION

FIG. 2

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 English Sideroad Bridge JOB NO. 6428 HOLE NO. 5 SAMPLE NO. 6

DEPTH 10'-11'6" ELEVATION _____ REMARKS Clayey silt till

GRAIN SIZE DISTRIBUTION

FIG. 3

BOREHOLE LOG

Borehole No. 1
Boring Date Feb. 22nd & 24th, 1964
Checked By V. M.

ABBREVIATIONS

V.T.	IN SITU VANE SHEAR TEST
M.	MOIST
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
A.P.L.	ABOUT PLASTIC LIMIT

[illegible]

BOREHOLE LOG

ABBREVIATIONS





V.T.	IN SITU VANE SHEAR TEST
M.	MOIST
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
A.P.L.	ABOUT PLASTIC LIMIT

[illegible]

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

English Sideroad Bridge
 Job Name McGregor's Creek Job No. 6428 Borehole No. 3
 Client Township of Norwich Casing 4" & BX Boring Date Feb. 24 & 25, 1964
 Elevation Geodetic Compiled By P. L. Checked By V. M.

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

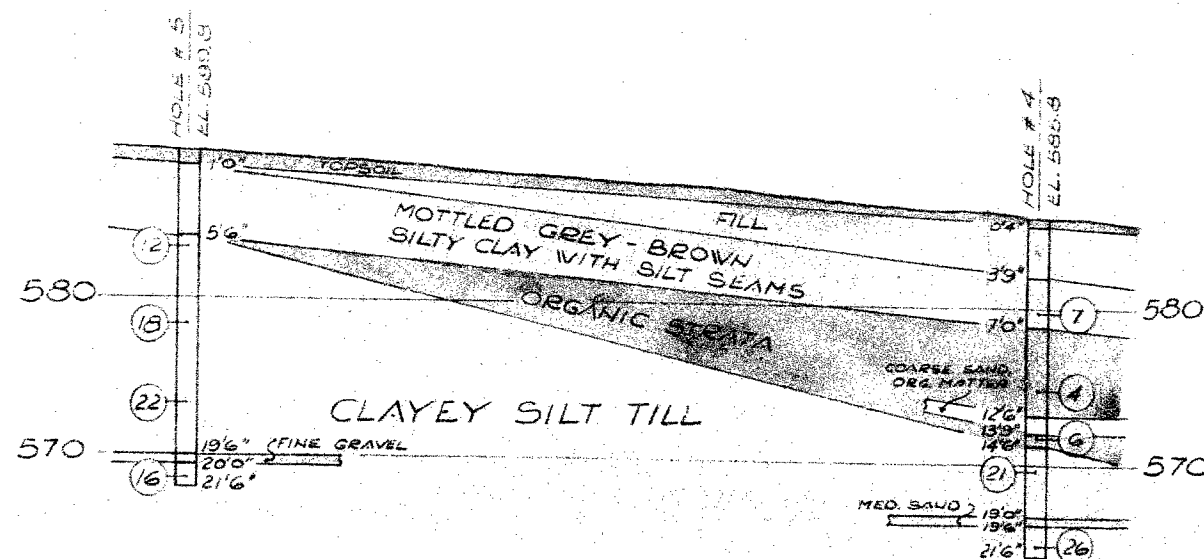
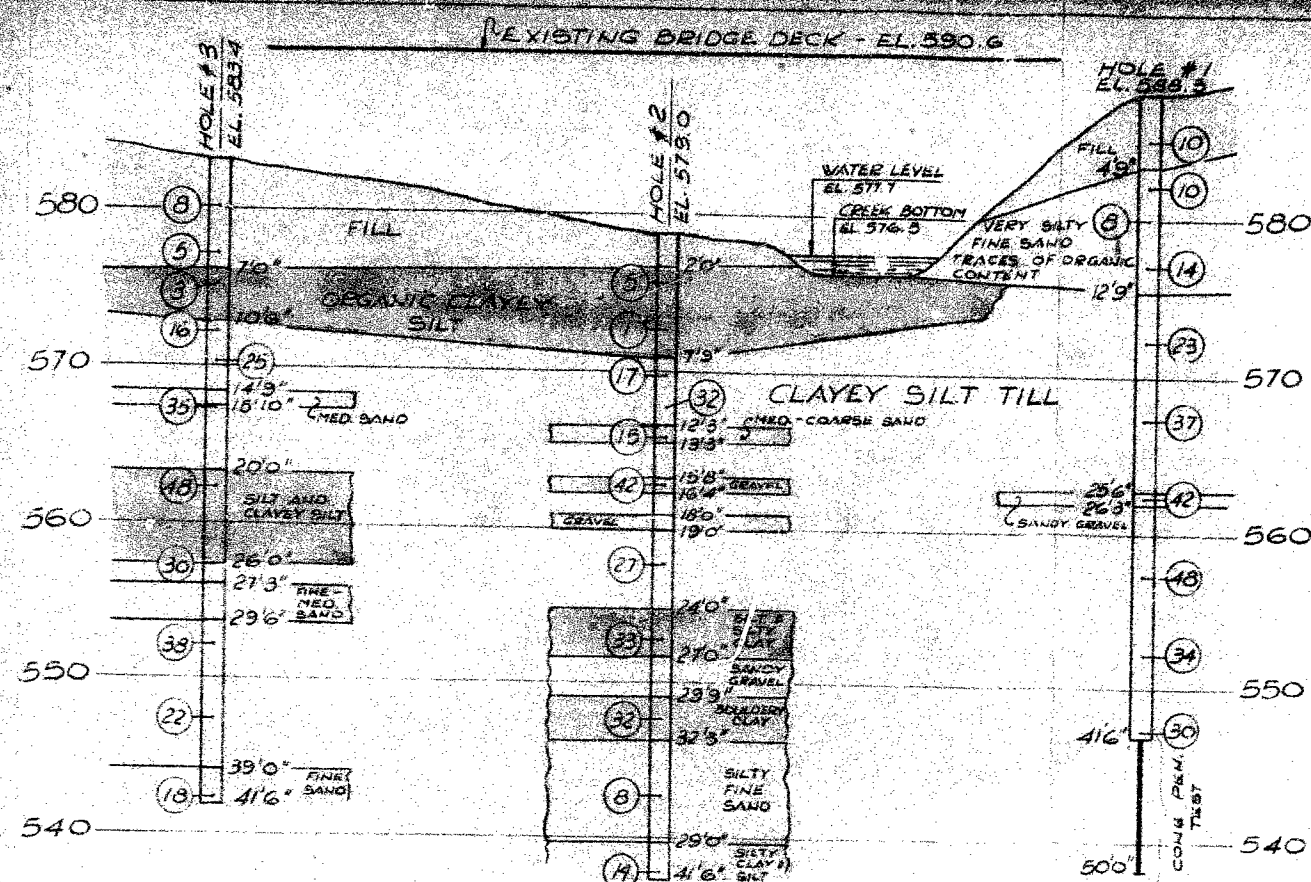
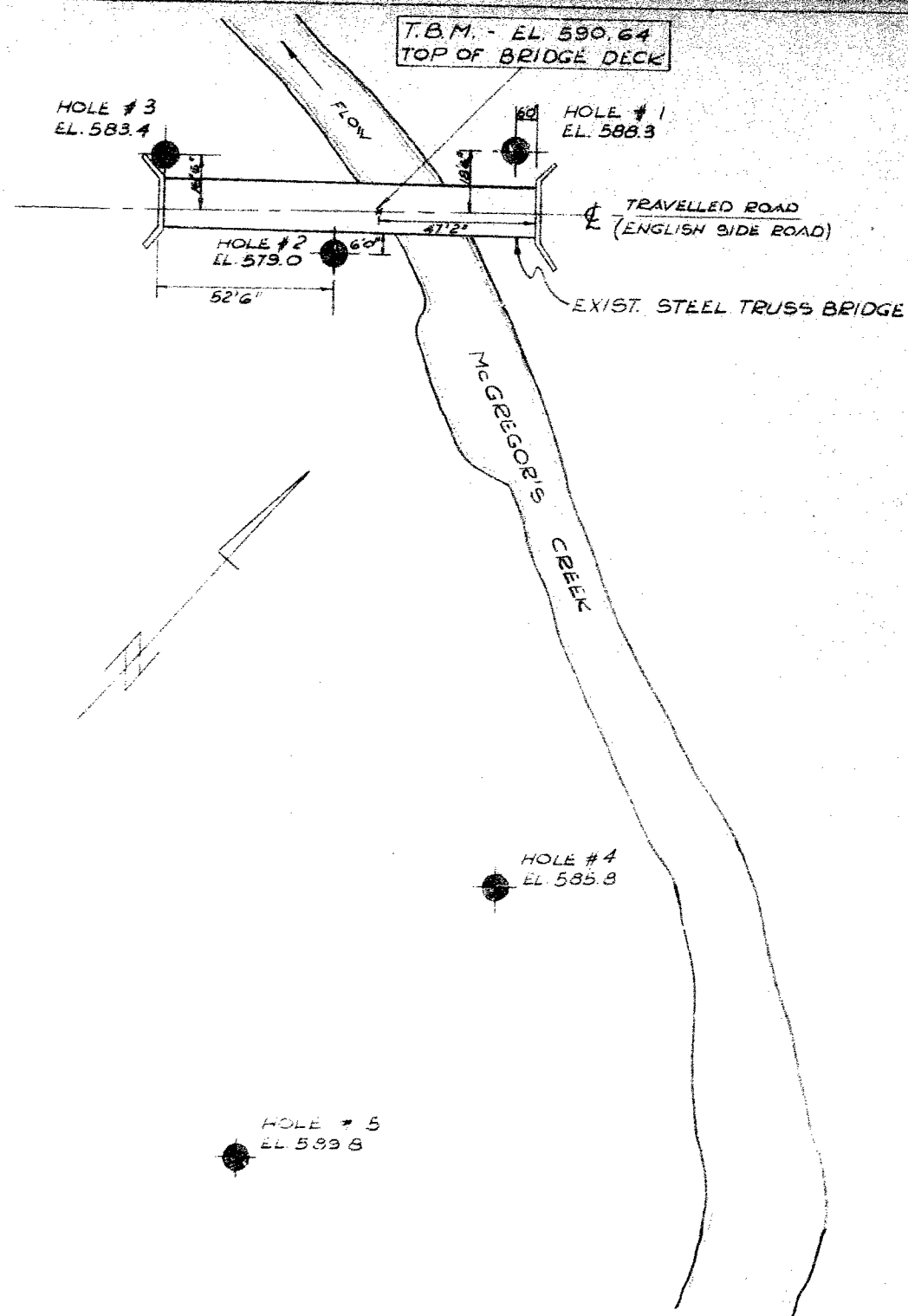
V.T. IN SITU VANE SHEAR TEST
 M. MOIST
 W.L. WATER LEVEL IN CASING
 W.T. GROUND WATER TABLE IN SOIL
 W.T.P.L. WETTER THAN PLASTIC LIMIT
 D.T.P.L. DRIER THAN PLASTIC LIMIT
 A.P.L. ABOUT PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft	Natural Moisture Content	WATER LEVELS & REMARKS
Topsoil	Dark brown	583.4	0'0"						
			0'6"						
Fill (sandy silt to silty fine sand)	Mixed brown	Loose			1	SS	8	17.4	Moist
Fill (silty clay, medium sand)	Mixed grey and brown	Very loose to loose	7'0"		2	SS	5	26.0	Wet & W.T.P.L.
Organic clayey silt	Olive-grey	Soft			3	SS	3	21.1	W.T.P.L.
Clayey silt till	Grey	Stiff to very stiff	10'6"		4	SS	16	15.9	D.T.P.L.
Ditto	Ditto	Very stiff			5	SS	25	14.1	D.T.P.L.
			14'9"						
Medium sand	Grey		15'10"		6	SS	35	12.2	Wet
Clayey silt till with clay seams	Grey								D.T.P.L.
			20'0"						
Silt and clayey silt	Grey	Hard			7	SS	48	12.7	Moist
Silt with layers of coarse sand	Grey	Dense	26'0"		8	SS	30	15.0	
Clayey silt till	Grey		27'3"						D.T.P.L.
Fine-medium sand some silt content	Dark grey		29'6"		9	CS		3.0	Almost dry
Clayey silt till	Grey	Hard			10	SS	38	16.6	D.T.P.L.
			33'0"						
Silty clay till	Grey	Very stiff			11	SS	22	21.3	W.T.P.L.
			39'0"						
Fine sand	Grey	Compact	41'6"		12	SS	18	21.2	Saturated

Checked By V. M.

V.T.	IN SITU VANE SHEAR TEST
M.	MOIST
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
A.P.L.	ABOUT PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Moisture Content	WATER LEVELS & REMARKS
			BOREHOLE #4						
Existing Grade		588.8	0'0"						
Topsoil			0'4"						
Very silty fine sand (Fill)	Brown				1	CS			Moist
Silty clay with sandy silt seams (fill)	Mottled grey-brown	Firm	7'0"		2	SS	7	18.0	Clay D. T. P. L.
Silty clay & silt with organic content	Dark brown				3	CS			
					4	CS			
Organic clayey silt with sand seams	Grey-brown	Soft to firm			5	SS	4	22.4	W. T. P. L.
			12'6"		6	CS			Casing
Coarse sand, organic matter	Dark grey	Firm	13'9"		7	SS	6	19.8	Saturated
Organic clayey silt	Grey-brown		14'6"						W. T. P. L.
Clayey silt till	Grey	Very stiff			9	SS	21	16.7	D. T. P. L.
Medium sand	Grey-brown		19'0"		10	CS			
			19'6"		10	CS			
Clayey silt till	Grey	Very stiff	21'6"		11	SS	26	12.8	
TESTHOLE TERMINATED AT							21'6"		
			BOREHOLE #5						
Existing Grade		589.8	0'0"						
Topsoil			1'0"						
Silty clay with silt seams, grits odd pebble and stone	Mottled brown some grey				1	CS			Near P. L.
Clayey silt till	Grey	Stiff	5'6"		2	SS	12	14.8	Almost P. L.
					3	CS			
Ditto	Ditto				4	CS			D. T. P. L.
Ditto	Ditto	Very stiff	10'0"		5	CS			
					6	SS	18	14.2	Almost P. L.
Ditto	Ditto				7	CS			D. T. P. L.
Ditto	Ditto	Very stiff			8	SS	22	14.1	
Fine gravel	Dark grey		19'6"		9	CS			
Clayey silt till	Grey	Stiff to very stiff	20'0"		10	CS			Saturated
			21'6"		11	SS	16	13.7	
TESTHOLE TERMINATED AT							21'6"		



LEGEND

- BOREHOLE
—(14) BLOWS/FOOT S.P.T.

SECTION SCALES

HOR.: 20' TO 1"
VERT.: 10' TO 1"

NOTES:

- a) SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.
- b) BOREHOLES 1, 2 & 3 SET OUT BY E. M. PETO ASSOCIATES LTD., BOREHOLES 4 & 5 SET OUT BY TODGHAM & CASE LTD.

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



THE TOWNSHIP OF HARVICH
% TODGHAM & CASE LTD, CONS. ENGINEERS

ENGLISH SIDEROAD BRIDGE
McGREGOR'S CREEK

PREPARED BY
e.m. peto associates ltd.

JOB NO. 6428	DATE MARCH 1964	DVN BY K.K.	CHECK'D BY B.L.
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e. m. peto associates ltd.

YOUR REFERENCE:

OUR REFERENCE: 6428

B.A. 1853
1287 caledonia road
TORONTO 19, ONTARIO.
Telephone: 783-1126

7th May 1964.

Todgham & Case Limited,
Consulting Civil Engineers,
P. O. Box 386,
151 Thames Street,
Chatham, Ontario.

Attention: Mr. H. H. Todgham.

Gentlemen,

English Sideroad Bridge
McGregor's Creek

We thank you for your letter dated 1st May 1964, and wish to comment as follows:

We follow and appreciate the reason underlying your desire to change the foundation design from spread footings to driven displacement type piles. There are however, some practical difficulties in respect of this latter proposal which arise from certain characteristics of the clayey silt stratum, detailed as follows:

- (i) The main stratum of clayey silt till contains appreciable layers or seams of silt, sand and gravel.
- (ii) Below elevation 570, the N-values indicate a very stiff to hard soil.
- (iii) Some of the sand and gravel seams are water bearing.

The two former characteristics will make driving to a satisfactory depth very difficult for a displacement pile of the type you have in mind. In fact it is possible that one of the sand or gravel layers may bring about refusal.

Preboring is a possible solution to overcome this problem, however, the water bearing seams would probably require a lined hole, and it would be hazardous to guarantee the length of liner required.

The solution to such variable conditions appears to be a compromise and to this end we suggest using a pile load of 30 tons/per pile of unit cross sectional area driven ^{to} elevation 560 approximately. A representative pile should be submitted to a load test.

Greater penetration will lead to higher allowable pile loads, but we believe that attempting to drive displacement piles to any appreciably greater depth could prove impractical.

(a) Turning now to the specific queries raised in your letter, the clayey silt till will provide lateral support for pipe piles and some further support could be counted upon from the soils above elevation 570.

(b) We feel that to regard driven displacement piles as end bearing only, is unrealistic and would lead to having to drive the piles to depths which would be impractical, or at best terminal pile depths would bear very little relation to the calculated depth.

(c) We would prefer a "step taper" pile filled with concrete rather than a steel shell of constant diameter, since we believe such a shape may be easier to drive, and seems to provide greater carrying capacity, at least in non-cohesive soils, for reasons which are not yet fully understood.

(d) We do not believe we can answer this question realistically in view of the number of variables, however, a rough guide which is probably conservative may be obtained from the following expression:

$$Q \text{ allowable tons} = 5.7 D^2 + 0.75 D \times L$$

Where D = pile diameter in feet

L = Embedded length in feet.

Yours very truly,

E. M. PETO ASSOCIATES LTD.



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

CFF/ap

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