#64-F-217C

W.P.# 27-62

Hwy # 53

C.N.R. SUBWAY

EASTWOOD

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attn: Mr. F. I. Hewson,
Consultant Liaison Engr.

From: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Date: July 23, 1964

Our File Ref.

In reply to

Subject: FOUNDATION INVESTIGATION REPORT BY:
Warnock Hersey Soil Investigations Ltd.
For Canadian National Railways, Toronto.
Reconstruction of Hwy. No. [illegible] Subway
near Eastwood, Ontario, Mile 4.9, Dundas
Sub-Division. (D.H.O. District No. 2)

The report of the foundation investigation at the above site, submitted by Warnock Hersey Soil Investigations Ltd. has been reviewed.

The Consultant has suggested using piles for the foundation of the structure. However, the approach used by the Consultant to arrive at this recommendation is rather unconventional and conservative. It is our opinion that spread footings may be used with a design load of 3 T.S.F. at the proposed elevation of 945.0.

We believe that the foregoing comments will provide the information required. Should there be any queries in connection with this project, please feel free to contact our Office.

for A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

KYL/MdeF

cc: Foundations Office
Gen. Files

B# 1884

WARNOCK HERSEY SOIL INVESTIGATIONS LTD.

250 MADISON AVENUE, TORONTO 7, ONT. WA. 4-9691

S-64-45

Feburary 28, 1964.

Canadian National Railways,
151 Front Street West,
Toronto 1, Ontario.

Attn: Mr. E. J. Napier
Bridge Engineer.

Dear Sirs:

Enclosed is our report on the soil investigation recently conducted for the proposed reconstruction of the Highway No. 53 Subway near Eastwood, Ontario, Mile 44.9, Dundas Sub-Division. (Your File No. 1640-206).

We believe this report to be complete but should you have any queries regarding its content or interpretation, please contact the undersigned.

Yours truly,

WARNOCK HERSEY SOIL INVESTIGATIONS LTD

P. B. Lawrence, P. Eng.,
Manager.

PBL/eb

S-64-45

INTRODUCTION

We were authorized by your letter dated February 11, 1964 to carry out a number of test borings at the proposed reconstruction of Highway No. 53 Subway near Eastwood, Ontario, Mile 44.9 Dundas Sub-Division.

This work consisted of drilling four (4) test holes to about 60 foot depth with soil sampling and penetration resistance tests carried out at regular intervals.

The purpose of this investigation was to determine -

1. Sub-soil strength and bearing values for foundation design.
2. Ground water conditions.
3. Any unusual sub-soil conditions which would require special attention in foundation design.

PROCEDURE

The field work was carried out during the period from February 13th to February 21st, 1964.

The test holes were located in accordance with your drawing by Mr. W. J. Wannemaker, Area Engineer at London and our drilling crew. Surface elevations of these test holes were supplied to us by Mr. Wannemaker. These elevations were taken with reference to the base of rail as shown on the enclosed sketch.

Continued...

S-64-45

PROCEDURE (Cont.)

These test holes were advanced by the wash boring procedure and standard split spoon samples were taken ahead of the BX size pipe used to case the holes. For each split spoon sample, the penetration blows to drive the sampler one foot were recorded. The energy of each blow was 4200 inch-pounds obtained by a 140 pound hammer falling a distance of 30 inches. These penetration blows (N value) in sand and finer grained soils provide an empirical means of determining the strength, density and bearing value of the soil. All samples were returned to our laboratory for examination and classification. Water levels were measured at the completion of the drilling and at intervals of time thereafter. The final static water levels were determined by bailing the test hole dry and recording the depth to water when the equilibrium was reached. These depths and elevations are indicated on the enclosed bore-logs for Test Holes No. 1, 2, and 4A.

SOIL PROFILES

All four (4) test holes showed a surface layer of mixed organic fill ranging in thickness from 1 to 3 feet. Below this is a medium to dense glacial till, which again changes to a less dense very wet sand. This fine sand layer was encountered at the following elevations: -

Bore Hole No. 1	Elevation 952.6
Bore Hole No. 2	Elevation 935.1
Bore Hole No. 3A	Elevation 936.4
Bore Hole No. 4A	Elevation 946.5

Continued...

S-64-45

SOIL PROFILES (Cont.)

Below this sand stratum, which ranged in depth from 7 to 27 feet, the soil changed back to a medium dense glacial till with several thick sand layers.

A detailed description of all of the soil types encountered with the elevation of strata changes are shown on the enclosed borelogs at the end of this report.

WATER CONDITIONS

All samples below the 12 to 15 foot depth were very moist to wet. In particular, the stratum of sand encountered showed a very high water content.

The static water levels were recorded at the following depths below ground surface and elevations: -

Bore Hole	Depth Below Ground Surface	Elevation
1	15' - 0"	950.1
2	14' - 0"	949.1
4	12' - 0"	948.5

These water levels are shown on the borelogs enclosed at the end of this report.

CONCLUSIONS & RECOMMENDATIONS

1. The following table gives the theoretical allowable bearing values for spread footings at various depths below the ground surface at the boreholes: -

Continued...

ALLOWABLE BEARING VALUES

Tons/Square Foot

Bore Hole No. -	1		2		3A		4A	
Elevation -	965.1		963.1		961.9		960.5	
Footing Width -	5'or less	5-10'	5'or less	5-10'	5'or less	5-10'	5'or less	5-10'
Depth								
3'	1.67	1.67	-	-	-	-	-	-
5'	3.00	3.00	3.36	3.36	4.80	4.80	1.54	1.54
7'	2.76	2.76	3.12	3.12	4.80	4.80	1.92	1.92
10'	3.60	3.60	3.36	3.36	2.16	2.16	3.12	3.12
12'	3.37	2.89	3.60	3.60	2.40	2.40	3.24	3.24
15'	1.99	1.68	4.00	4.00	2.16*	2.16*	2.49*	2.12*
20'	1.50*	1.24*	3.60*	3.60*	4.40	4.40	2.49	2.12
25'	1.25	1.02	2.76	2.76	1.75	1.46	1.99	1.68
30'	2.99	2.56	3.75	3.22	1.75	1.46	3.50	3.00
35'	3.12	2.67	1.99	1.68	4.20	4.20	2.76	2.76
40'	4.50	3.88	3.48	3.48	4.00	4.00	3.24	3.24
45'	4.00	3.44	3.90	3.90	3.24	3.24	4.00	4.00
50'	4.50	3.88	4.75	4.10	4.80	4.50	4.00	4.00
55'	4.75	4.10	4.75	4.10	4.80	4.80	4.60	4.60
60'	4.75	4.10	4.75	4.10	4.75	4.10	4.80	4.80

* Approximate Elevation 945.0 *

S-64-45

CONCLUSIONS & RECOMMENDATIONS (Cont.)

These tabulated values are based on the relationship of standard penetration blows and bearing values of the soil. They include a factor of safety with regard to strength of 3.0 and a maximum settlement of one (1) inch.

Note: When using the above bearing values for design purposes, the smallest value must be chosen from the table for a distance of 1 1/2 times the footing width below the base of the footing. Since we understand the desired footing elevation for this reconstruction is approximately 945.0 feet, the following example has been worked out to illustrate the above note -

Example:

- Bore Hole No. 1(worst condition).
- Footing Width - 10 feet, - Footing depth-Elevation 945.0
- Allowable bearing value is only 1.02 tons per square foot at 15 feet below the footing.

2. To get the preferred allowable bearing value of 3.0 tons per square foot, it would be necessary to found normal spread footing at or below 40 foot depth.

3. If footing base is to be founded about Elevation 945.0, it will be necessary to use a pile foundation. A displacement type pile such as reinforced concrete would probably not penetrate more than 15 to 20 feet below Elevation 945.0.

Continued...

S-64-45

CONCLUSIONS & RECOMMENDATIONS (Cont.)

This would also densify considerably the looser sand stratum. A steel "H" pile designed for skin friction plus end bearing would probably not penetrate more than 20 to 25 feet below Elevation 945.0.

4. Some water seepage is to be expected through the sand stratum when the excavation is carried below the water table at 12 to 14 foot depth.

5. Excavations through the cohesive till material will stand with vertical sides for 10 feet or more, but all excavations through the wet sand stratum will require adequate shoring and bracing.

SUMMARY

The sub-soil at this site just below the preferred footing level, Elevation 945.0, consists of a fine sand which is inadequate for supporting the required bridge loadings on normal spread footings. We feel that it is necessary to use a pile type foundation consisting of quite short steel or concrete piles to support the structure.

Respectfully submitted,

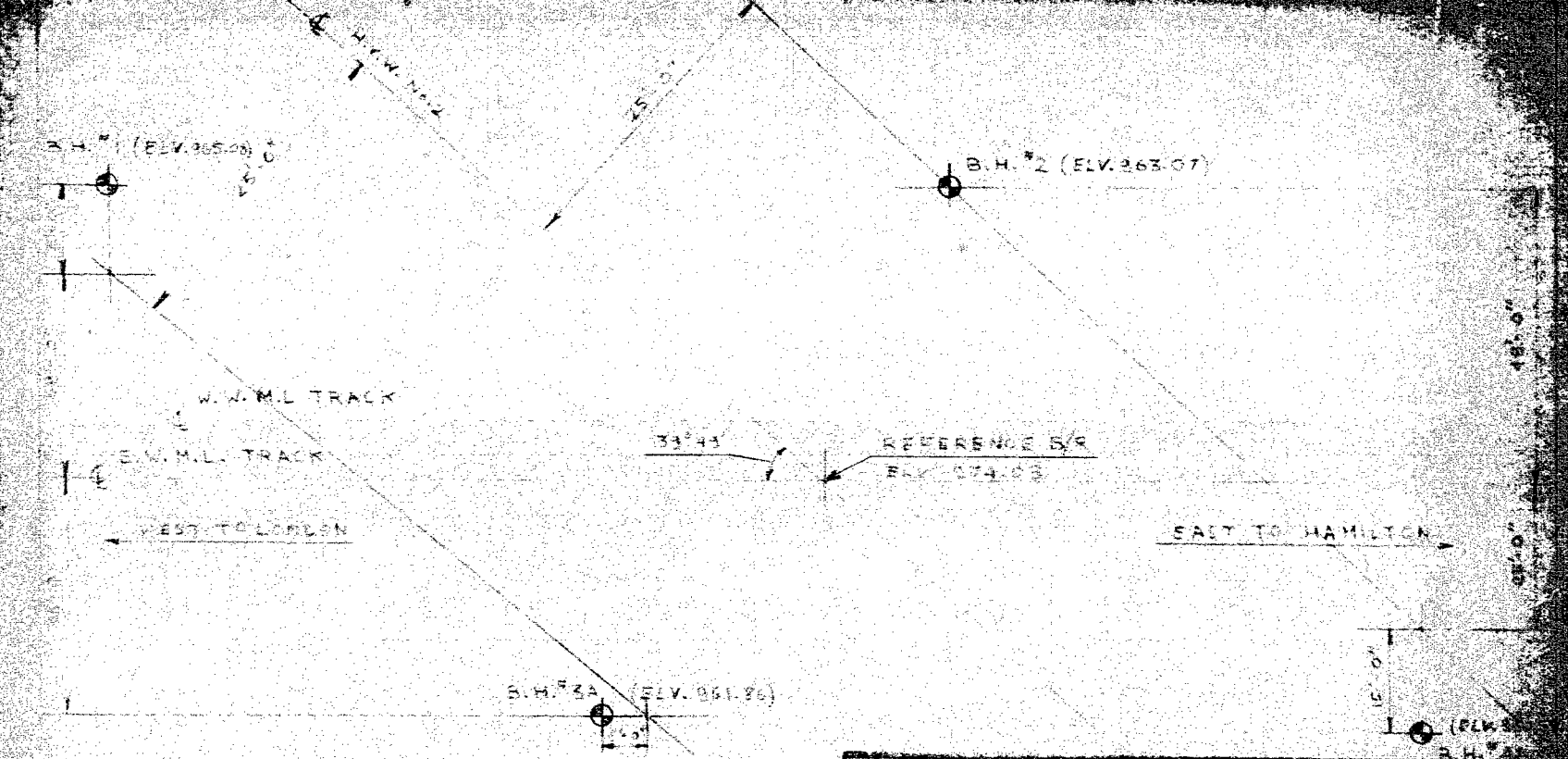
WARNOCK HERSEY SOIL INVESTIGATIONS LTD.

P. B. Lawrence, P. Eng.,
Manager.

Report by -
R. E. Flemming.

PBL/eb

REGISTERED PROFESSIONAL ENGINEER
P. B. LAWRENCE
PROVINCE OF ONTARIO



WARNOCK HERSEY SOIL INVESTIGATIONS LTD.

LOCATION OF BOREHOLES

No. 53 SUBWAY

EAST WOOD ONTARIO

CANADIAN NATIONAL RAILWAYS

TORONTO DIVISION ONTARIO

JOB NO. 68-45 | DRAWN BY | SCALE

DATE FEB. 20, 69 | CHK'D BY

REGISTERED PROFESSIONAL ENGINEER
P. B. LAWRENCE
PROVINCE OF ONTARIO

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

Warnock Hersey Soil Investigations Ltd

Office Report Of Soil Exploration

Casing BX Diameter 2 3/8" Elevn. 965.08
Casing Hammer 350 lbs. Wt. 24" Drop
Sample Hammer 140 lbs. Wt. 30" Drop

Client Canadian National Railways. Order Number S-64-45
Highway #53 Subway near Eastwood, Ontario. Mile 44.9 Dundas S/D. Borehole Number 1
Date Feb. 16 & 17, 1964.

SAMPLE CONDITION & TYPE

Disturbed
Good
Lost

SS - Split Spoon
CS - Chunk
DO - Drive Open
DF - Drive Footvalve
TO - Thinwalled Open
WS - Washed Sample
RC - Rock Core

ABBREVIATIONS

V - Insitu Vane Shear Test
M - Mechanical Analysis
U - Unconfined Compression
Qc - Triaxial Consolidated Quick
Q - Triaxial Quick
S - Triaxial Slow

- Unit Weight
K - Permeability
C - Consolidation
CA - Casing
WL - Water Level in Casing
WT - Water Table in Soil

Elevn. Feet	Description	Depth Feet	Condition	Type	Number	Pen. Resistance	Depth Recvry. Feet
965.1		0					
964.1	Organic Fill	1'					
	Brown silty and clayey glacial till; medium dense; moist; medium cohesion.			SS	1	14	2-3
				SS	2	25	5-6
				SS	3	23	7-8
				SS	4	33	10-11
952.6		12'6"		SS	5	43	12-13
950.1	Grey very fine sand; medium dense; wet; cohesionless.	WT		SS	6	27	15-16
	"			SS	7	21	20-21
	"			SS	8	17	25-26
	"			SS	9	39	30-31
				SS	10	41	35-36
926.1		39'		SS	11	86	40-40'10"
	Grey silty glacial till; very dense; wet; slight cohesion.			SS	12	50	45-46
	(Layer of sand at 49 - 50 feet.)			SS	13	59	50-51
	Grey silty glacial till; very dense; wet; slight cohesion.			SS	14	68	55-56
904.1	End of Hole.	61'		SS	15	85	60-61

PENETRATION TESTS
standard energy 4200 in. lb.
blows/foot of penetration

20 40 60 80 100

0 5 10 15 20 25 30 35 40 45 50 55 60

Warnock Hersey Soil Investigations Ltd

Office Report Of Soil Exploration

Casing BX Diameter 2 3/8" Elevn. 963.07
Casing Hammer 350 lbs. Wt. 24" Drop
Sample Hammer 140 lbs. Wt. 30" Drop

Client Canadian National Railways. Order Number S-64-45
Highway #53 Subway near Eastwood, Ontario. Mile 44.9 Dundas S/D. Borehole Number 2
Date Feb. 13,14 & 15, 1964.

SAMPLE CONDITION & TYPE

Disturbed
Good
Lost

SS - Split Spoon
CS - Chunk
DO - Drive Open
DF - Drive Footvalve
TO - Thinwalled Open
WS - Washed Sample
RC - Rock Core

ABBREVIATIONS

V - Insitu Vane Shear Test
M - Mechanical Analysis
U - Unconfined Compression
Qc - Triaxial Consolidated Quick
Q - Triaxial Quick
S - Triaxial Slow
- Unit Weight
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SOIL PROFILE				PENETRATION TESTS standard energy 4200 in. lb. blows/foot of penetration	SAMPLES				
Elevn. Feet	Description	Strata Plot	Depth Scale Feet	0 20 40 60 80 100	Condition	Type	Number	Pen. Resistance	Depth Recvry. Feet
963.1			0						
	Black organic matter.					SS	1	8	2-3
960.1			3'						
	Brown clayey silt; medium stiff; moist; medium cohesion.		5			SS	2	28	5-6
						SS	3	26	7-8
			10			SS	4	28	10-11
						SS	5	30	12-13
949.1			14'						
948.1			15			SS	6	36	15-16
	Grey clayey glacial till; medium stiff to stiff; moist; medium cohesion.		20			SS	7	33	20-21
			25			SS	8	23	25-26
935.1			28'						
	Grey fine sand; medium to dense; wet; cohesionless.		30			SS	9	48	30-31
			35			SS	10	26	35-36
925.1			38'			WS			36-40
	Grey sandy silty glacial till; dense; moist; medium cohesion. Boulder at 40'10".		40			SS	11	29	40-41
			45			SS	12	33	45-46
	"		50			SS	13	49	49-50
	"		55			SS	14	120	55-56
	"		60						
902.1	End of Hole.		61'			SS		60	60-61

Warnock Hersey Soil Investigations Ltd

Office Report Of Soil Exploration

Casing BX Diameter 2 3/8" Elevn. 961.86
Casing Hammer 350 lbs. Wt. 24" Drop
Sample Hammer 140 lbs. Wt. 30" Drop

Client Canadian National Railways.
Highway #53 Subway near Eastwood Ontario. Mile 44.9 Dundas S/D

Order Number S-64-45
Borehole Number 3A
Date Feb. 18 & 19, 1964.

SAMPLE CONDITION & TYPE

Disturbed
Good
Lost

SS - Split Spoon
CS - Chunk
DO - Drive Open
DF - Drive Footvalve
TO - Thinwalled Open
WS - Washed Sample
RC - Rock Core

ABBREVIATIONS

V - Insitu Vane Shear Test
M - Mechanical Analysis
U - Unconfined Compression
Qc - Triaxial Consolidated Quick
Q - Triaxial Quick
S - Triaxial Slow

- Unit Weight
K - Permeability
C - Consolidation
CA - Casing
WL - Water Level in Casing
WT - Water Table in Soil

Elevn. Feet	Description	Depth Feet	PENETRATION TESTS standard energy 4200 in. lb. blows/foot of penetration	Condition	Type	Number	Pen. Resistance	Recvry. Feet
961.9		0						
	Organic Fill							
959.4	Brown silty and clayey glacial till; dense to very dense; moist; medium cohesion.	2(6"			SS	1	8	2-3
		5			SS	2	49	5-6
					SS	3	37	7-8
951.9		10			SS	4	18	10-11
	Grey clayey glacial till; medium dense; very moist; medium cohesion.				SS	5	20	12-13
		15			SS	6	18	15-16
		20			SS	7	41	20-21
936.4		25'6"			SS	8	24	25-26
	Grey very fine sand; medium dense; wet; cohesionless.							
		30			SS	9	23	30-31
929.9		32'						
	Grey silty glacial till; medium dense; very moist; medium dense.	35			SS	10	38	35-36
	"	40			SS	11	36	40-41
	"							
	"	45			SS	12	27	45-46
	"	50			SS	13	48	50-51
	"							
		55			SS	14	56	55-56
903.9	Grey medium to coarse sand; wet; very dense.	58'						
		60			SS	15	62	60-61
900.9	End of Hole.	61'						

Warnock Hersey Soil Investigations Ltd

Office Report Of Soil Exploration

Casing BX Diameter 2 3/8" Elevn. 960.53
Casing Hammer 350 lbs. Wt. 24" Drop
Sample Hammer 140 lbs. Wt. 30" Drop

Client Canadian National Railways. Order Number S-64-45
Highway #53 Subway near Eastwood, Ontario. Mile 44.9 Dundas S/D. Borehole Number 4A.
Date Feb. 20, 1964

SAMPLE CONDITION & TYPE

Disturbed
Good
Lost

SS - Split Spoon
CS - Chunk
DO - Drive Open
DF - Drive Footvalve
TO - Thinwalled Open
WS - Washed Sample
RC - Rock Core

ABBREVIATIONS

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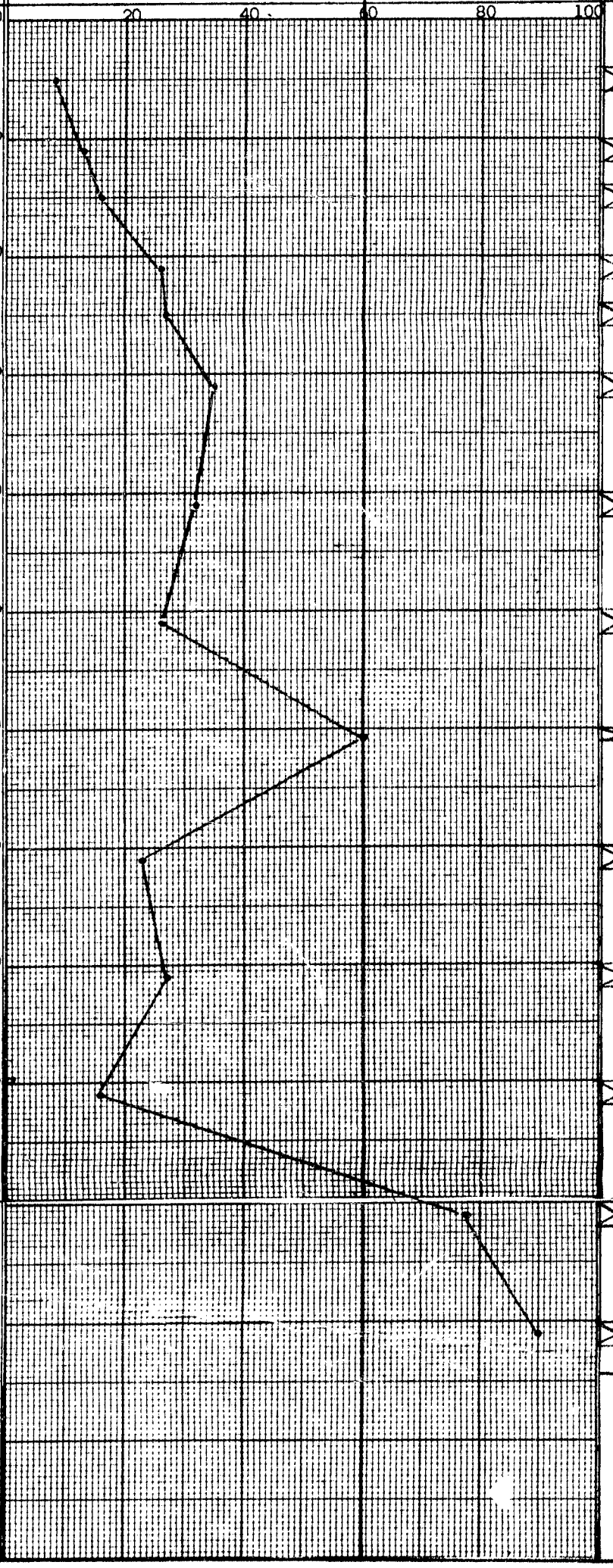
CA - Casing
WL - Water Level in Casing
WT - Water Table in Soil

Elevn. Feet	Description	Depth Feet
960.5		
958.5	Organic Fill.	2'
	Brown silty glacial till; loose; moist; slight cohesion.	
953.5		7'
	Grey silty & clayey glacial till; medium dense; moist; medium cohesion.	
948.5		12'
946.5		14'
	Grey fine to medium sand; medium dense; wet; cohesionless.	
	"	
	"	
	"	
936.5		34'
	Grey silty glacial till; medium dense; very moist; slight cohesion.	
916.5		44'
	Grey fine sand; loose to very dense; wet; cohesionless.	
906.5		54'
	Grey sand & silty glacial till; very dense; moist.	
903.5	End of Hole.	57'

PENETRATION TESTS
standard energy 4200 in. lb.
blows/foot of penetration



Condition	Type	Number	Pen. Resistance	Depth Recvry. Feet
	SS	1	8	2-3
	SS	2	13	5-6
	SS	3	16	7-8
	SS	4	26	10-11
	SS	5	27	12-13
	SS	6	35	15-16
	SS	7	32	20-21
	SS	8	26	25-26
	SS	9	60	30-30'6"
	SS	10	23	35-36
	SS	11	27	40-41
	SS	12	16	45-46
	SS	13	78	50-51
	SS	14	90	55-56

	Elev		W.L Elev
B.H #2	945.0	N = 35 (Material – glacial till) clayey silt etc)	949.0
B.H # 1	945.0	N = 20 (fine Sand)	W.L 951.0
B.H # 3A	"	N = 20 (clayey silt till)	W.L Not recorded
B.H # 4A	"	N = 35 (fine to Med Sand)	W.L 944.5

$$q = \tfrac{1}{2} B \gamma N_\gamma + \gamma D_f N_q$$

$$= \tfrac{1}{2} \times 10 \times 65 \times 20 + 65 \times 5 \times 20$$

$$= 5 \times 65 \times 20 + 65 \times 20 \times 5$$

$$= 65 \times 20 (5+5) = \frac{65 \times \cancel{100}\ 200}{6000}$$

Say 2 t.s.f

However N values in B.H #1 in Sand may be corrected according to Gibbs & Holtz — 3 t.s.f may be safe. Elsewhere 3 t.s.f can be used — Even in the vicinity of B.H #1 the footings may be placed slightly lower — piles necessary.

Department of Highways Ontario
Copy for the information of

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

file
ags

Bridge Division,
Downsview, Ontario.
August 14, 1964.

Canadian National Railways,
151 Front Street West,
Toronto 1, Ontario.

Att.: Mr. J. Geronimus

RE: Your File 1640-206,
Our W.P. 27-62,
CNR Subway Near Eastwood,
Hwy. #53 Dist. #2.

Dear Sir:

Attached is a copy of the comments of our Foundation Engineer on Warnock Hersey's report on the soil investigation they conducted at this site.

Mr. Stermac would be happy to discuss this further if you so desire.

Yours truly,

FIH:go
c.c. A. G. Stermac

F. I. Hewson,
Consultant Liaison Engineer.

Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. F. I. Hewson,
Consultant Liaison Engr.

July 23, 1964

FOUNDATION INVESTIGATION REPORT BY:
Warnock Hersey Soil Investigations Ltd.
For Canadian National Railways, Toronto.
Reconstruction of Hwy. No. 53 Subway
near Eastwood, Ontario, Mile 44.9, Dundas
Sub-Division. (D.H.O. District No. 2)

The report of the foundation investigation at the above site, submitted by Warnock Hersey Soil Investigations Ltd. has been reviewed.

The Consultant has suggested using piles for the foundation of the structure. However, the approach used by the Consultant to arrive at this recommendation is rather unconventional and conservative. It is our opinion that spread footings may be used with a design load of 3 T.S.F. at the proposed elevation of 945.0.

We believe that the foregoing comments will provide the information required. Should there be any queries in connection with this project, please feel free to contact our office.

A. G. Sternac,
PRINCIPAL FOUNDATION ENGINEER

KYL/MdeF

cc: Foundations Office
Gen. Files

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac,
Principal Foundation Eng.
Room 107, Lab. Bldg.

To be filed with Consultants' reports
Wasnod - Hersey
964

Bridge Division,
Downsview, Ontario,
February 3, 1964.

Mr. W. E. Griffiths,
Regional Chief Engineer,
Canadian National Railways,
151 Front Street, Room 868,
TORONTO, Ontario.

RE: Bridge Site #24-175 W.P. 27-62
C.N.R. Subway at Eastwood
Hwy. 53 District #2

Dear Sir:

The location of the above structure has been approved as on Line "A" shown on the attached Preliminary Print of the Bridge Site Plan.

The clearances we will require for the Highway are vertical 15'-3" and horizontal 38' (28' roadway) as measured normal to the highway.

We understand from your Mr. Workman that before establishing the depth of deck, and hence the drainage and highway profiles, it would be desirable to make a foundation soils investigation for this site.

Please consider this your authority to arrange, as soon as practicable, for the Foundation Soils Investigation for the above bridge.

We will be pleased to know, at your earliest convenience, the depth of deck (base of rail to soffit) you propose to use for the design also as to whether the present rail elevation must be maintained.

Yours truly,

G.Scott, P. Eng.
Bridge Location Engineer.

GS/es
cc. J. Walter
cc. S. McCombie
cc. A. Stermac
cc. W. Kinnear
cc. C. Hansen
cc. R. Fitzgibbon