#59-F-220C

BRIDGE #14

C.P.R. OVERPASS

@ OTTAWA

QUEENSWAY

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS AND SURVEYORS
OTTAWA 1
CANADA

G. C. McROSTIE, B.A.Sc., O.L.S., P. ENG., M.E.I.C.
ASSOCIATES
A. SETO, B. ENG., P. ENG., M.E.I.C.
G. E. B. SINCLAIR, B.Sc., D.L.S., P. ENG., M.E.I.C.
W. J. MacLEAN, B.A., D.L.S., O.L.S.
ASSOCIATE CONSULTANT
D. F. COATES, M. ENG., M.A., P. ENG., M.E.I.C.

393 BELL STREET
TELEPHONE CE. 2-5334

59-F-220c

C.P.R. OVERPASS - BRIDGE NO. 14.

1. TERMS OF REFERENCE

We were requested by the Ottawa Office of De Leuw Cather and Company of Canada Ltd. to investigate foundation conditions at the site of Bridge No. 14 to carry the Queensway over C.P. Railway, and a report was to be prepared on the investigation.

2. RECOMMENDATIONS

2.1 Foundation Type

East Abutment

We would recommend using footings to distribute the abutment load on the rock. The wing-wall footings may rest on the rock or dense till soil above the rock.

West Abutment

For this abutment it is suggested that footings be used to transfer the abutment load to rock. The wing-wall footings should follow the rock surface since loose and medium dense sand and till soils overlie the rock in both wing-wall locations. However, towards the westerly end of the south wing-wall, where the embankment retained by the wall is considerably smaller, a shallower wing-wall footing might be raised to rest on the denser, higher soil layers.

2.2 Soil and Rock Strengths.

Bearing values for units of the structure can be recommended as follows: -

East Abutment

Abutment on Rock below elevation 194	30,000 POUNDS PER SQUARE FOOT with construction grouting required
Abutment on rock below elevation 194	10,000 POUNDS PER SQUARE FOOT without construction grouting
Wing-walls on rock or dense till at about elevation 195	10,000 POUNDS PER SQUARE FOOT

West Abutment

Abutment on rock below elevation 197	30,000 POUNDS PER SQUARE FOOT
Wing-walls on rock at elevation 202 to 195	10,000 POUNDS PER SQUARE FOOT WITHOUT CONSTRUCTION grouting
Westerly end of South wing-wall, soils at elevation 213 to 208	4,000 POUNDS PER SQUARE FOOT

2.3 Construction Grouting

To develop the maximum rock bearing values recommended above, 10-foot drill holes should be bored in the footing base areas and grouting attempted in the holes. Should the lower rock capacities suggested satisfy an economical design, grouting would not be required.

2.4 Soil Compressibilities

Long term consolidation settlements are not expected to occur since the soils used as foundation support are basically granular.

2.5 Groundwater Control

Groundwater control may be necessary during wet seasons because water can be expected to flow through the pervious upper rock layers. Sump pumps of adequate capacity, installed within the excavation, would be satisfactory for controlling the flow of groundwater.

2.6 Construction Precautions

Some interference with normal construction operations may arise from two sources: firstly, the foundations of the existing railway bridge abutments and the existing approachfill, secondly, the existence of the warehouse building of C.A. Johannsen & Sons Ltd. which abuts the southerly property boundary line and will probably require underpinning. Our experience during test drilling operations also indicates that the normal railway traffic would significantly affect construction production.

3. SITE INVESTIGATION

3.1 Field Work

Eight boreholes were made at the site with our test drilling rig in the locations shown on Plate No. 1. Thirty-five two-inch split barrel samples were recovered from cohesionless soil layers and visually classified. Standard penetration resistance tests were performed at various depths in each borehole to supply an indication of the relative densities of the strata encountered. Groundwater levels were also observed and recorded during the test drilling operations.

Rock, encountered in all eight boreholes, was diamond drilled and cores were recovered for inspection and logging. Some recovery percentages were determined as an aid in evaluating the structural properties of the rock. The presence of seams in the rock formation was detected by careful watch for drops of drill rods occurring during the drilling.

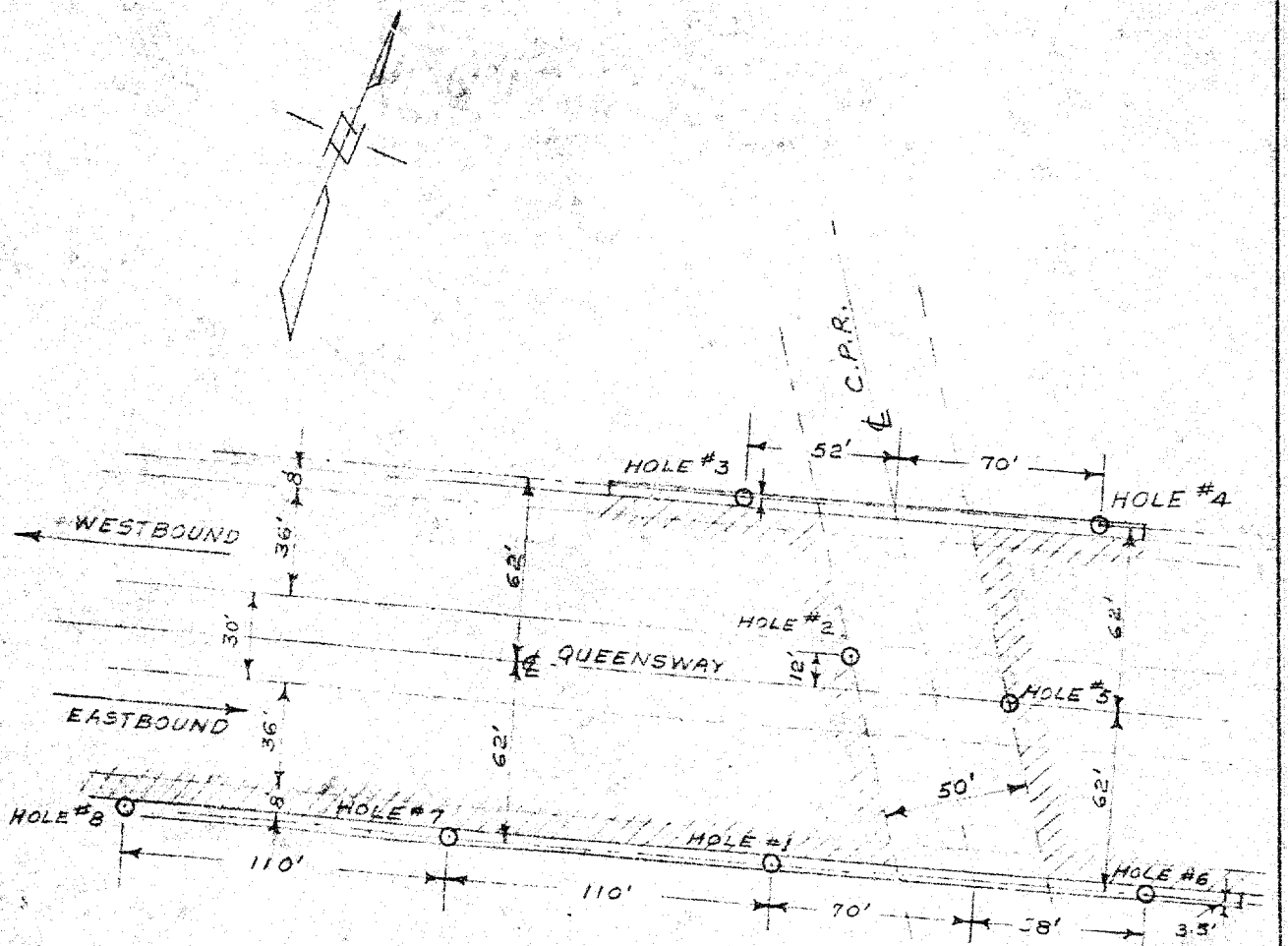
3.2 Observations:

Details of the soils and rock encountered in the investigated area are shown on the accompanying Plates 2 to 9. The subsoil formation can be generalized as follows. A few feet of fill generally overlie from 2 to 17 feet of medium dense and dense fine sand and till. However, at the southwest corner of the site some loose soils were found at footing depths. Standard penetration tests performed on these soils supplied an indication of their relative densities. The results of tests carried out in fine sand below the groundwater table were adjusted to compensate for the penetration resistance offered by pore pressures. Adjusted values are indicated on the borehole summaries by the suffix "A".

Groundwater elevations were 2 to 6 feet below the surface during the investigation. These levels can be considered to be near the seasonal low point and water levels would likely rise to the ground surface during wet seasons.

The entire overburden investigated is underlain by shaley limestone rock of the Ottawa Formation. The upper layers of this rock are, in part, weathered in some areas. The occurence of seams in the upper layers of the rock may be expected since drops were observed during the drilling program. However, precautionary measures have been suggested regarding this feature in the recommendations given above.

FORM S-11-2



McROSTIE & ASSOCIATES

CONSULTING ENGINEERS

BOREHOLE LOCATIONS

QUEENSWAY & C.P.R.

SCALE 1" = 50'

PLATE

FORM S-10 3

McROSTIE & ASSOCIATES
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OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 211.9 DATE 13 MAY/59 HOLE NO. 1

REMARKS B.M. EL. 197.90 - PEG UNDER C.P.R. BRIDGE - SOUTH EAST CORNER ABUTMENT AT PRESTON ST.

[redacted] LB. HAMMER [redacted] INCH DROP NO CASING [redacted] INCH DIA. ROD

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE		
					0.0'	211.9
		3	1-1	FILL		
		10	1-2			
		26	1-3			
		6 FOR 6" 19A	1-4	MEDIUM DENSE FINE SAND WITH A FEW PEBBLES	10.0'	201.9
					12.5'	199.4
				SHALY LIMESTONE		
				CORE RECOVERY 96%		
					17.3'	
				CORE RECOVERY 100%		
					22.3'	189.6
				BOTTOM OF HOLE		

SAND ⊙ CLAYEY ⊙

OVERNIGHT W.L. EL. 207.4

⊙

⊙

⊙

0 10 20 30 40 50

% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊡
PLASTIC LIMIT △

PLATE 2

A = ADJUSTED

L.-M. CO.—A33048

FORM S-10-3

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OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 207.3 DATE 7 MAY /59 HOLE No. 2

REMARKS SEE PLATE NO. 2

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE		
				FILL	0.0	207.3
		16	2-1	MEDIUM DENSE FINE SAND	2.5	
		14	2-2			
		10A&6	2-3		6.0	
		6 FOR 6"	2-4	MEDIUM DENSE SANDY SILT		
		21A&9		DENSE SILT AND STONES WITH A LITTLE SAND	8.0	
				SHALY LIMESTONE	8.8	198.5
				CORE RECOVERY 68%		
					13.7	
				CORE RECOVERY 98%		
				BOTTOM OF HOLE	18.8	188.5

A = ADJUSTED

LB. HAMMER ..... INCH DROP

NO CASING ..... INCH DIA. ROD

0 10 20 30 40 50

% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊡
PLASTIC LIMIT △

PLATE 3

L-M. CO.—A23048

FORM S-10-3

McROSTIE & ASSOCIATES
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OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 206.9 DATE 7-8 MAY '59

REMARKS SEE PLATE NO. 2

HOLE NO. 3

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0.0'	206.9
				FILL		
		16	S-1		4.0'	
				MEDIUM DENSE FINE SAND		
		15	S-2		6.0'	
		8A6=6"	S-3	MEDIUM DENSE SANDY SILT WITH FEW PEBBLES	7.5'	199.4
			5" DROP	SHALY LIMESTONE		
				CORE RECOVERY 85%	11.3'	
				CORE RECOVERY 80%		
				BOTTOM OF HOLE	16.3'	190.6

A = ADJUSTED

..... LB. HAMMER
..... INCH DROP
NO CASING
..... INCH DIA. ROD

SAND ⊙ ORGANIC ⊙

0 10 20 30 40 50
WATER CONTENT %
NATURAL ⊙
LIQUID LIMIT ⊟
PLASTIC LIMIT ▲

PLATE 4

L.-M. CO.—A33048

FORM S-10-3

McROSTIE & ASSOCIATES
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OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 202.2 DATE 4-5 MAY/59 HOLE NO. 4

REMARKS SEE PLATE NO. 2

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0.0	202.2
		64	4-1	FILL		
		34 FOR 6" 80 FOR 6" 100 FOR 3"	4-2	WEATHERED OR FRACTURED	5.5	196.7
		2" DROP		SHALY LIMESTONE	6.4	
				CORE RECOVERY 54 %	7.5	194.7
		2" DROP		SHALY LIMESTONE		
				CORE RECOVERY 77 %	12.5	
				CORE NOT RECOVERED		
				BOTTOM OF HOLE	17.7	184.5

.....LB. HAMMER
.....INCH DROP
NO CASING
.....INCH DIA. ROD

OVERNIGHT W.L. EL. 199.7

0 10 20 30 40 50
% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊡
PLASTIC LIMIT △

PLATE 5

L.-M. CO.—A33048

FORM S-1-3

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OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 204.0 DATE 6 MAY /59

REMARKS SEE PLATE NO. 2

HOLE NO. 5

UNCONFINED COMPRESSIVE STRENGTH, KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE		
					0.0	204.0
		15	5-1	FILL		
					5.0	
		50A	5-2	DENSE FINE SAND AND STONES WITH A LITTLE CLAY & SILT		
		17A5a6"	5-3		8.2	195.8
				SHALY LIMESTONE		
				CORE RECOVERY 76%		
				SHALY LIMESTONE	13.0	
				CORE RECOVERY 80%	13.8	
				CORE RECOVERY 90%		
					18.8	185.2
				BOTTOM OF HOLE		

..... LB. HAMMER ..... INCH DROP

NO CASING ..... INCH DIA. ROD

OVERNIGHT W.L. EL. 197.2

A = ADJUSTED

0 10 20 30 40 50

% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊡
PLASTIC LIMIT ▲

PLATE 6

L.-M. CO.—A38048

FORM S-10-3

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No.14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 212.9 DATE 14 MAY /59 HOLE NO. 6

REMARKS SEE PLATE NO. 2

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0.0	212.9
		6	6-1	FILL		
		8	6-2			
		16	6-3			
		23	6-4		10.0	202.9
		18	6-5	MEDIUM DENSE SANDY TILL	13.5	
		72	6-6		15.0	
		25 for 6"	6-7	DENSE SANDY TILL		
		94 for 11"	6-8		20.9	192.0
				SHALY LIMESTONE		
				CORE RECOVERY 100%	25.8	
				CORE RECOVERY 100%	30.8	182.1
				BOTTOM OF HOLE		

..... LB. HAMMER
..... INCH DROP
NO CASING
..... INCH DIA. ROD

ORGANIC CLAYEY
SAND CLAYEY
SILT
ORGANIC

0 20 40 60 80 100
% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊞
PLASTIC LIMIT △

PLATE 7

L.-M. CO.—A35048

FORM S-10-3

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 214.3 DATE 12 MAY/59 HOLE NO. 7

REMARKS SEE PLATE NO. 2

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0.0'	214.3
		8	7-1	FILL	4.0'	
		55	7-2	DENSE TILL WITH SOME SMALL SAND POCKETS	7.5'	
		17 A	7-3	MEDIUM DENSE FINE SAND WITH PEBBLES AND A 2" SILT LAYER	9.0'	205.3
		3	7-4	LOOSE SANDY TILL	11.8'	202.5
			½" DROP	SHALY LIMESTONE		
			1" DROP			
				CORE RECOVERY 89%	17.0'	
				CORE RECOVERY 84%	22.3'	192.0
				BOTTOM OF HOLE		

..... LB. HAMMER
..... INCH DROP
NO CASING
..... INCH DIA. ROD

OVERNIGHT W.L. EL. 211.8

SAND ⊙ SILT ⊙

A = ADJUSTED

0 10 20 30 40 50
% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊡
PLASTIC LIMIT △

PLATE 8

L.-M. CO.—A33048

FORM S-10-3

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SOIL PROFILE AND SUMMARY OF FIELD AND LABORATORY TESTS

QUEENSWAY & C.P.R. BRIDGE No. 14

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 215.8 DATE 11-12 MAY /59 HOLE NO. 8

REMARKS SEE PLATE NO. 2

UNCONFINED COMPRESSIVE STRENGTH # KIPS/FT.²	SMALL SCALE PENETROMETER #KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0.0	215.8
				FILL		
		11 12 FOR 6"	8-1	MEDIUM DENSE TILL	2.5	
		16 FOR 6"	8-2	DENSE TILL	5.0	
					7.5	208.3
		16	8-3	MEDIUM DENSE SANDY TILL		
		14 3 FOR 6"	8-4	MEDIUM DENSE TILL WITH POCKETS OF SILT AND WELL GRADED SAND	10.0	205.8
				LOOSE TILL WITH SILT POCKETS	11.0	
		23 A	8-5	MEDIUM DENSE FINE SAND WITH A LITTLE COARSE SAND	12.5	
		8 A FOR 6"	8-6A	MEDIUM DENSE SANDY SILT	14.5	
		14	8-6	MEDIUM DENSE TILL	15.3	
					20.0	195.8
				SHALY LIMESTONE		
				CORE RECOVERY 91 %	24.8	
				CORE RECOVERY 100%		
				BOTTOM OF HOLE	29.8	186.0

A = ADJUSTED

1.B. HAMMER ..... INCH DROP

NO CASING ..... INCH DIA. ROD

OVERNIGHT W.L. EL 209.5

10 20 30 40 50

% WATER CONTENT
NATURAL ⊙
LIQUID LIMIT ⊠
PLASTIC LIMIT △

PLATE 9

M. CO.—A33048