

Mr. A. M. Toye,

June 30, 1960.

Bridge Engineer.

FOUNDATION INVESTIGATION REPORT

Materials & Research Section.

by - William A. Trow & Assoc., Ltd.

Attention: Mr. S. McCombie.

Re: Underpass of York Boulevard -
Chedoke Expressway, Hamilton.
W.P. 195-60 -- Dist. 4.

Attached to this memo, we are forwarding to you,
the foundation investigation report submitted by W. A. Trow
& Associates, Ltd.

Upon reviewing the given factual data, we have come
to the same conclusions as contained in the report. We believe
that the given recommendations will be adequate for your future
design work. However, should there be any other questions in
connection with the mentioned site that you would like to
discuss, please feel free to call on our Section.

L. G. Soderman,
PRINCIPAL FOUNDATIONS ENGR.

Per:

AS/MdeF
Attach.

Astermac
(A. Stermac,
FOUNDATIONS OFFICE ENGR.)

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. G. Ramsay
I. Campbell
R. E. Richardson
T. J. Kovich
A. Watt
C. C. Parker & Associates (4)
Foundations Office
Gen. Files.

BA 1085

WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS
AND
SOIL MECHANICS CONSULTATION

W. A. TROW, M.A.S.C., M.E.I.C., P.ENG.

60-F-311C

884 WILSON AVE.
DOWNSVIEW, ONT.
ME 5-5921

Project: J 515

June 27, 1960

Mr. A. Rutka,
A/Materials and Research Engineer,
Department of Highways of Ontario,
Parliament Buildings,
Toronto 2, Ontario

Attention: Mr. L. G. Soderman
Principal Soils and Foundations Engineer

York Boulevard Underpass W.P. 195-60
Chedoke Expressway, Hamilton

Dear Sirs:

In response to your request of May 12, 1960, we have carried out a soils investigation at the above site. In view of the straightforward and excellent foundation conditions that exist at this location we take the liberty to present our report in letter form.

Soil Conditions Encountered

A total of five borings were put down in the immediate vicinity of the underpass structure - see drawing 1 for exact locations. An attempt was made to use continuous flight auger equipment but conditions of refusal to augering were reached at shallow depth in four out of the five holes. Two of these incompletd borings were continued to full depth using diamond drill equipment.

Very dense sand, gravel and cobbles were encountered in all of the borings. These materials are in layers of varying thickness and composition. In some of the layers the soil grains are cemented together. Thin layers of stiff clayey silt were noted below elevation 295 in hole 10.

The upper fifteen to twenty feet of this deposit can be readily observed on a vertical face of the adjacent railway cut. Elsewhere along the cut the lower reaches of the granular soil can be studied.

Photographs taken along the railway are presented in drawing 7.

A log has been prepared for each boring showing the type of soil encountered and the results of penetration tests in these materials. These logs are contained in drawings 2 to 6. A subsoil profile, on which the proposed underpass and ramp have been projected, is presented on drawing 1.

Foundation Considerations

Ramp level at this underpass will be elevation 321 approximately. Frost protection requirements will necessitate footings for the underpass structure being placed at about elevation 314 or 315. The sand and gravel soil at and within 20 feet below this depth is very dense. Empirical rules relating penetration resistance measurements to safe footing capacity for 1 inch limiting settlement have been published.* Referring to this published relationship and using the minimum standard penetration value of about 80, which occurred within a depth of 5 feet below footing level in hole 14, the safe bearing capacity can be estimated to be in excess of 7 tons per square foot - the limit of the chart.

A retaining wall is proposed along the line of borings 12 and 14. Footings for this wall will be placed on the very dense soil proven by these two borings. The minimum penetration resistance measured was 63 at 15 feet depth in hole 12. From the chart indicated previously, the safe capacity of the soil is between 6 and 7 tons per square foot depending on footing size.

The maximum vertical soil face along the railway cut is of the order of 15 to 20 feet high. Talus slopes have developed at the base of these vertical faces; the talus extends much higher at some locations than others. Inspection of these faces reveals that some of the sand and gravel layers are more strongly cemented than others and that many layers show no signs of cementation at all. The amount of talus deposited depends on the proportion of soil that can be weathered readily, such as the uncemented and weakly bonded materials. The cemented layers tend to keep the face vertical.

Because of the variability of the soil, it is difficult to estimate the maximum height of vertical face that can be constructed. It is probable that the 25 to 30 foot walls of the proposed cuts will remain vertical even though unsupported. On a long term basis, however,

* "Foundation Engineering" - Peck, Thornburn and Hanson pg. 225

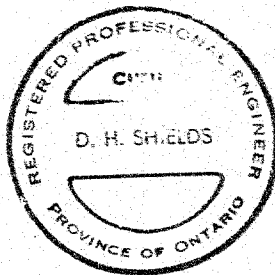
sufficient clearance must be left between the soil walls and the roadway to allow for the development of the talus. It may be less expensive to allow only a limited area for material that sloughs off the walls and to haul away the soil when it becomes excessive. Otherwise, provisions must be made to accommodate a bank of soil sloping at 30° to the horizontal to a height of about two-thirds of the depth of cut.

Recommendations

- 1) A pressure in excess of 5 tons per square foot can be carried safely by the soil below the proposed footing levels both of the underpass structure and the retaining wall.
- 2) An angle of friction of up to 40° can be used in design involving undisturbed material at this site. When used as back-fill, the material will probably have an angle of friction of about 30° .
- 3) No groundwater problems can be anticipated at this site.

We trust that the information contained in this brief report will enable the design of this structure to be carried out. We will be pleased to answer any questions that may come to mind regarding this work.

DHS/gc
Encl.



Yours very truly,

A handwritten signature in cursive script that reads "D. H. Shields".

D.H. Shields, P.Eng.

APPENDIXField Work

Continuous flight auger equipment was used initially at all five hole locations shown on drawing 1. Only borehole 14 could be augered to full depth of 40 feet. At the other hole locations refusal conditions were encountered from 20 to 27 feet below ground level. Cemented gravel and cobbles were intersected at these elevations.

Holes 6 and 10 were continued to 40 feet and 50 feet respectively by alternately driving and washing out 3 inch casing. Drilling with diamond coring bits and smaller casing was employed at some depths to expedite the work.

A standard two inch diameter split sampler was driven into the undisturbed soil ahead of the auger hole or casing. A 140 pound hammer dropping 30 inches drove the sampler. The number of hammer blows required for a nominal amount of penetration was recorded at most sampling intervals. Where practical the sampler was driven the full 18 inches set forth in the standard penetration test procedure. The number of blows for the last 12 inches of penetration was recorded in these instances.

On withdrawal the sampler was dismantled and the soil identified. A representative specimen was retained in a moisture proof container.

An undisturbed sample of the soil encountered at depth in hole 10 was obtained with a thin wall Shelby tube. This two inch diameter sampler was driven with the same energy outlined above.

Logs showing the sampling interval, soil type encountered and penetration resistance measurement at each hole location are presented as drawings 2 to 6.

PROJECT NO.

515

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Underpass of York Blvd.,
 LOCATION Chedoke Expressway, Hamilton
 HOLE LOCATION See Drawing 1
 HOLE ELEVATION AND DATUM 344.2
 By D.H.O., Survey Party

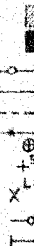
BOREHOLE NO. 6
 FIELD SUPERVISOR
 DRILLER
 PREP.

DRAWING NO.

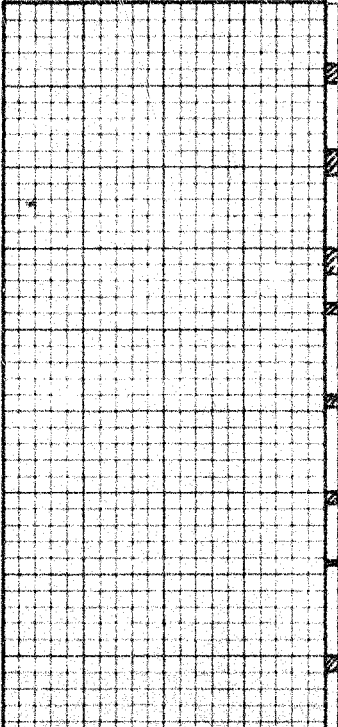
2

LEGEND

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 CASING
 2" SHELBY
 1/2 UNCONFINED COMPRESSION (Qu)
 VANE TEST (C) AND SENSITIVITY (S)
 NATURAL MOISTURE AND
 LIQUIDITY INDEX
 LIQUID LIMIT
 PLASTIC LIMIT



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	Ground Surface - 3" Topsoil	344.2	0	20 40 60 80	
	Very dense sand, gravel and cobbles - boulders on occasion - layered			BLOWS/FT.	
			10	40 for 6"	
			20	38 for 6"	
			25	36 for 2"	
			30	65 for 2"	
			35	40 for 2"	
	Refusal to augering at this depth				
	End of Hole	301.7	40	103 for 2"	

CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.			
		<input checked="" type="checkbox"/> 1	
		<input checked="" type="checkbox"/> 2	
		<input checked="" type="checkbox"/> 3	
		<input checked="" type="checkbox"/> 4	
		<input checked="" type="checkbox"/> 5	
		<input checked="" type="checkbox"/> 6	
		<input checked="" type="checkbox"/> 7	
		<input checked="" type="checkbox"/> 8	

Notes: 1) Hole 5" dia. and uncased to 27 feet 3) Hole dry
 Hole 3" dia. and cased below 27 feet 4) 18 feet of casing broke off in hole.
 2) 350 ft. lb. hammer used to drive casing

PROJECT NO.

515

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Underpass of York Blvd.

LOCATION Chedoke Expressway, Hamilton

HOLE LOCATION See drawing 1

HOLE ELEVATION AND DATUM 344.5

BOREHOLE NO. 8

FIELD SUPERVISOR

DRILLER

PREP.

DRAWING NO.

3

LEGEND

2" DIA. SPLIT TUBE

2" SHELBY TUBE

2" SPLIT TUBE

2" DIA. CONE

CASING

2" SHELBY

1/2 UNCONFINED COMPRESSION (Qu)

VANE TEST (C) AND SENSITIVITY (S)

NATURAL MOISTURE AND

LIQUIDITY INDEX

LIQUID LIMIT

PLASTIC LIMIT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				P.S.F.	
	Ground Surface - 4" Topsoil	344.5	0	BLOWS/FT.	
	Very dense sand and gravel to cobbles - layered.			20	40
			10		
			20		
			30		
	Refusal to augering		40		
Notes: 1) Hole 5" dia. uncased to full depth 2) 350 ft.lbs energy used to drive sampler 3) Hole dry					

CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT - % DRY WT.		
	1	
	2	
	3	
	4	
	5	

PROJECT NO.

515

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

DRAWING NO.

4

LEGEND

2" DIA. SPLIT TUBE
 2" SHELBY TUBE
 2" SPLIT TUBE
 2" DIA. CONE
 CASING
 2" SHELBY
 1/2 UNCONFINED COMPRESSION (QU)
 VANE TEST (C) AND SENSITIVITY (S)
 NATURAL MOISTURE AND
 LIQUIDITY INDEX
 LIQUID LIMIT
 PLASTIC LIMIT

PROJECT Underpass of York Blvd.,
 LOCATION Charlotte Expressway, Hamilton
 HOLE LOCATION See Drawing 1
 HOLE ELEVATION AND DATUM 344.6

BOREHOLE NO. 10

FIELD SUPERVISOR

DRILLER

PREP.

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE		CONSISTENCY	SAMPLE	NATURAL UNIT WT. P.C.F.
				P. S. F.				
				BLOWS/FT.				
	Ground Surface	344.6	0	20	40	60	80	
	Very dense, sand, gravel and cobbles- boulders at some depths - layered							

PROJECT NO. 515

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Underpass of York Boulevard
LOCATION Chedoke Expressway, Hamilton
HOLE LOCATION See drawing 1
HOLE ELEVATION AND DATUM 344.0

BOREHOLE NO. 12
FIELD SUPERVISOR
DRILLER
PREP.

DRAWING NO.

11

LEGEND

- 2¹¹ DIA. SPLIT TUBE
2¹¹ SHELBY TUBE
2¹¹ SPLIT TUBE
2¹¹ DIA. CONE
CASING
2¹¹ SHELBY
1/2 UNCONFINED COMPRESSION (QU)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND
LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

[illegible][illegible]

PROJECT NO. 515

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Underpass of York Boulevard

LOCATION Chedoke Expressway, Hamilton

HOLE LOCATION See Drawing 1

HOLE ELEVATION AND DATUM 343.2
from D.H.O. Survey

BOREHOLE NO. 14

FIELD SUPERVISOR

DRILL Continuous Flight Auger

PREP

DRAWING NO.

6

LEGEND

2" DIA. SPLIT TUBE
2" SHELBY TUBE
2" SPLIT TUBE
2" DIA. CONE
CASING
2" SHELBY
1/2 UNCONFINED COMPRESSION (Qu)
VANE TEST (C) AND SENSITIVITY (S)
NATURAL MOISTURE AND
LIQUIDITY INDEX
LIQUID LIMIT
PLASTIC LIMIT

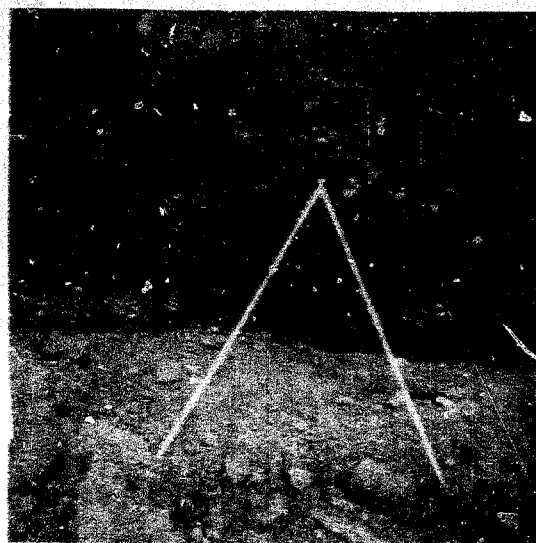


SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				P.S.F.			
				BLOWS/FT.			
	Ground Surface - 4" Topsoil	343.2	0	20	40	60	80
	Very dense, sand, gravel and cobbles - layered						
			10				
			20				
			30				
			40				
	Notes: 1) Hole 5 inches diameter uncased to full depth 2) 350 ft.lbs energy used to drive sampler 3) Hole dry on completion						
	End of Hole	303.2	40				

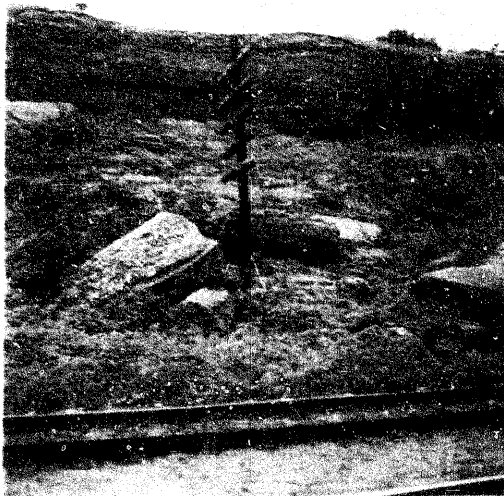
CONSISTENCY		SAMPLE	NATURAL UNIT WT. P.C.F.	
MOIST. CONTENT- % DRY WT.				
		1		
			2	
			3	
			4	
			5	
			6	
			7	
			8	



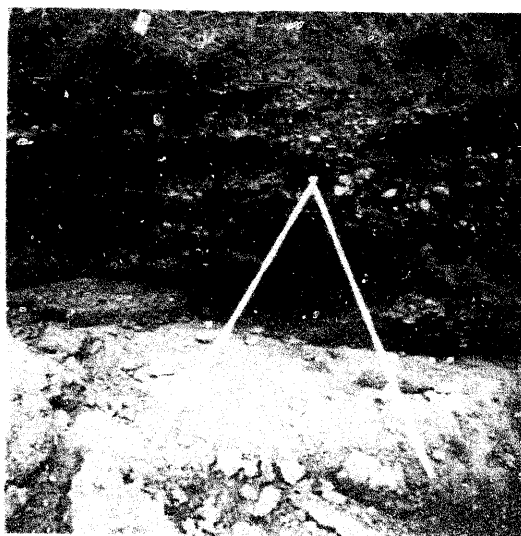
View from railway toward York Boulevard
Note: vertical face and talus slope



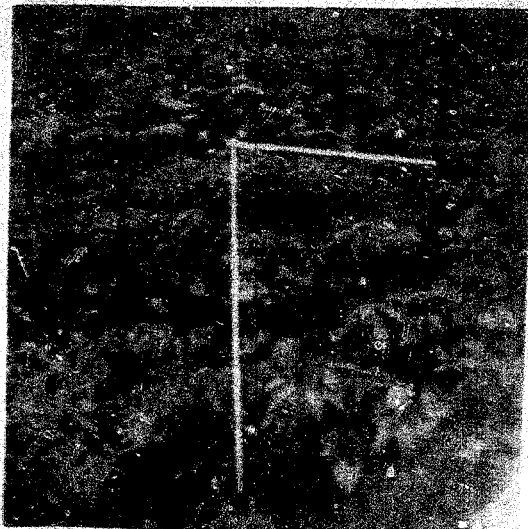
Soil exposed at railway level immediately north of site
(Folded six foot rule indicates scale)



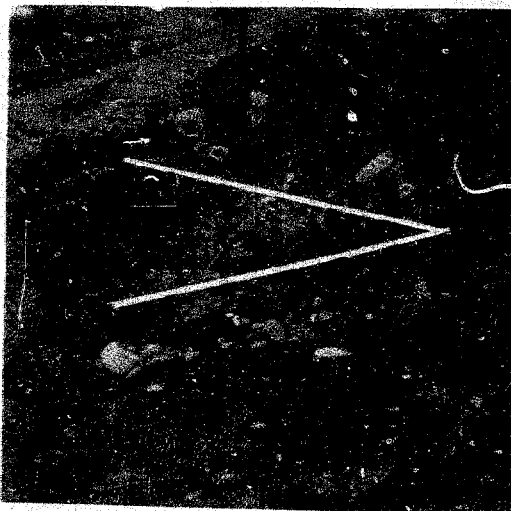
View from railway toward York Boulevard
Note: vertical face and talus slope



Soil exposed at railway level immediately north of site
(Folded six foot rule indicates scale)



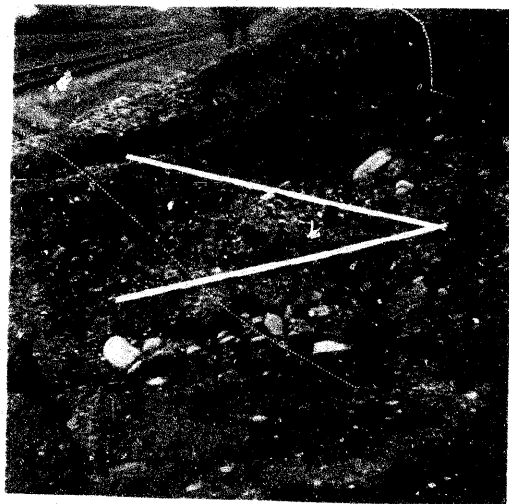
Exposure near top of railway cut
immediately east of site
(six foot folding rule shown)



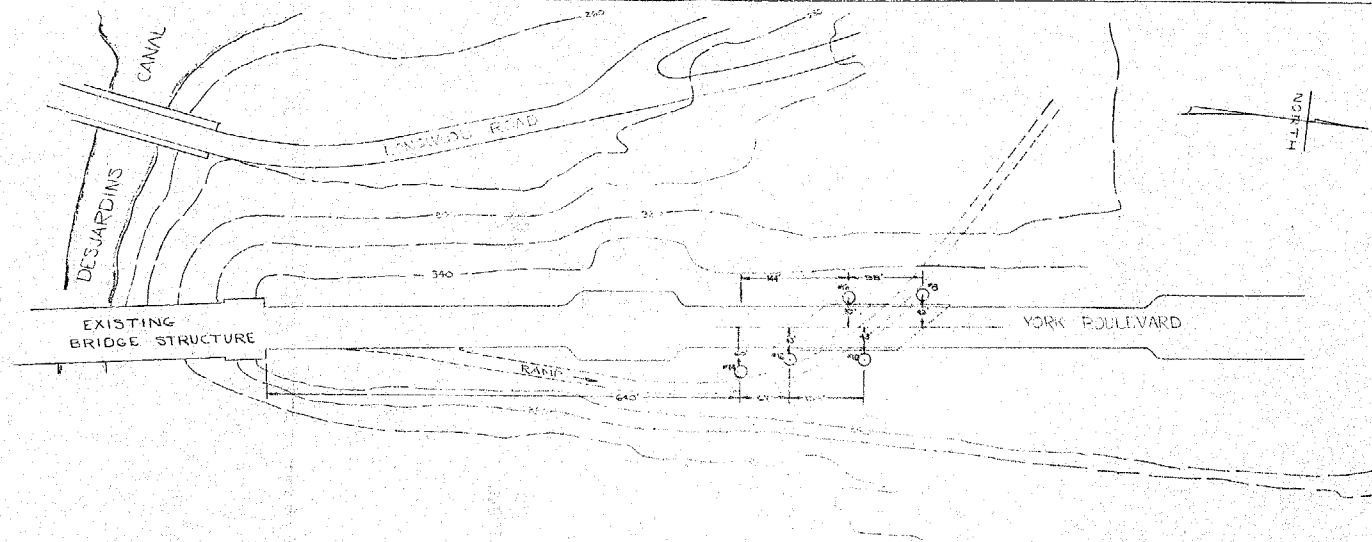
Bedding of a large soil fragment
near railway level
(folded six foot rule indicates scale)



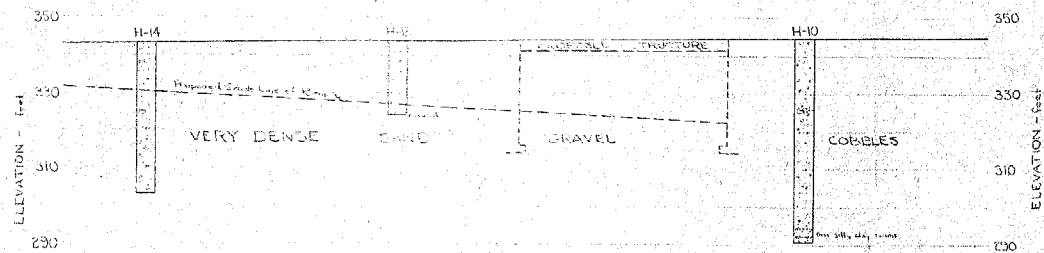
Exposure near top of railway cut
immediately east of site
(six foot folding rule shown)



Bedding of a large soil fragment
near railway level
(folded six foot rule indicates scale)



Borehole Location Plan
SCALE 1"=20'



Estimated Subsoil Stratigraphy
SCALE 1"=20'

UNDERPASS at YORK BOULEVARD
CHEDoke EXPRESSWAY

WILLIAM A. TROW & ASSOCIATES LTD.

Drawing 1