

MEMORANDUM

✓ 23-69-05

TO: Mr. G. K. Hunter,
Regional Road Design Engineer,
Central Region (Toronto),
Central Bldg., Downsview.

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

DATE: November 24, 1967

OUR FILE REF.

IN REPLY TO

Dec 5, 1967

SUBJECT:

SOILS INVESTIGATION REPORT
For
The Proposed Sub-Trunk Sewers
At Hwy. #401 and #27 Interchange
District #6 (Toronto)
W.J. 67-F-97 -- W.P. 201-62

Attached, we are forwarding to you, the results of a soils investigation carried out at the above site.

We believe that the factual data and conclusions drawn will be of some assistance to you regarding your design requirements. Should you require additional information, please feel free to contact our Office.

AGS/MacF
Attach.

cc: Messrs. G. K. Hunter (3)

H. A. Tregaskes
D. W. Farren
B. R. Davis (2)
F. Allen
W. S. Melnyshyn
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

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SOILS INVESTIGATION REPORT
For
The Proposed Sub-Trunk Sewers
At Hwy. #401 and #27 Interchange
District #6 (Toronto)
W.J. 67-F-97 -- W.P. 201-62

1. INTRODUCTION:

In a memo dated September 26, 1967, Mr. P. Arkema, Senior Project Soils Engineer, Central Region, requested a soils investigation at the site of the proposed sub-trunk sewers at Hwy. #401 and #27 interchange. The proposal calls for some eight sub-trunk sewers, numbered I to VIII inclusive, all of them emptying into the main trunk sewer.

The soils investigation for sewers IV and V has been undertaken by the Soils Section, the results of which are plotted on attached Drawing #67-F-97A and B. The Soils Section's memo, reporting soil conditions along these two lines, is appended to this report. At the site of the other six proposed sub-trunk sewers, a field and a limited laboratory investigation was carried out by this Section.

In the following paragraphs, a brief description of the soils is given separately for the locations of the individual sewers, together with some remarks as to the excavations and dewatering problems.

2. SUB-TRUNK SEWER I -

2.1) Soil Conditions:

A total of six boreholes was undertaken at the site of this sewer. Since the east - west portion of the sewer will run under the existing Hwy. #401 eastbound lane, no borehole could be placed along the line. Instead, boreholes were offset some 45 ft. south of the proposed location of the sewer. Soil conditions

cont'd. /2 ...

2. SUB-TRUNK SEWER I - (cont'd.) ...

2.1) Soil Conditions: (cont'd.) ...

found in these boreholes - especially the upper surface of the bedrock - would not necessarily be the same at the true location of the sewer. It is suggested, therefore, to use the information from the boreholes as a guide for extrapolation purposes.

Sandy and clayey silt deposits of some 6 - 15 ft. in thickness were found to form the surficial layers. The standard penetration resistance revealed hard consistencies and very dense relative densities within this stratum. A 4 - 10 ft. thick layer of granular sandy gravel and gravelly sand follows the surficial layer. This material is quite permeable, thus holds and carries large quantities of groundwater. The sandy gravel is underlain by a grey clayey silt, identified to be glacial till. This deposit is very hard, corresponding to penetration 'N' values in excess of 100 blows/ft. The upper surface of the bedrock lies between el. 500 ft. and 503 ft. The transition between the hard clayey silt till and the bedrock is somewhat obscure, and the exact boundary was almost impossible to establish in the boreholes. A test pit was, therefore, excavated at the location of borehole #6 in order to confirm the elevation of the rock. The attached soil profile is based upon this open excavation.

The bedrock is identified to be grey shale of the Dundas formation with a soft and flaky texture, having intermittent seams of limestone of a much harder nature.

The groundwater level was first observed around the upper surface of the gravelly sand deposit. Within 24 hours the water table in the boreholes rose to depths of 1 - 6 ft. below ground level.

2.2) Conclusions:

The boreholes and the test pit demonstrated that the proposed sewer would lie partly within the overburden, partly

cont'd. /3 ...

2. SUB-TRUNK SEWER I - (cont'd.) ...

2.2) Conclusions: (cont'd.) ...

within the bedrock. The bottom of the sewer along the westerly, approx. 700-ft. length, will likely be in the slightly cohesive clayey silt. This material is believed to have adequate fines, so that no major dewatering problems are foreseen. The upper section of the sewer, however, will be within the granular sandy gravel, and it is anticipated that water will enter into the excavation from this layer. Continuous pumping will be necessary at the bottom of the trench. The excavation walls should be constructed with 1:1, or flatter, slopes to avoid sloughing or caving of the granular layer.

Along the easterly, approx. 500-ft. length, the bedrock lies higher than the proposed invert elevation. Rock excavation within this section will be necessary.

3. SUB-TRUNK SEWER II -

3.1) Soil Conditions:

Some nine boreholes were placed along the proposed line of this sewer. The uppermost layers were observed to be sandy silts beneath the northern half of the line, becoming clayey silts and silty clays beneath the southern half. The depth of the layers vary between 6 and 20 ft. Some embedded gravel is evident within these strata. Granular sandy gravel was found to underlie the sandy silts beneath the north portion of the site, having very dense relative densities. This rather thick layer was entirely missing in boreholes #7 to #10, where the grey-coloured clayey silt till was found to overlies the shale bedrock. Due to the uncertainties in pinpointing the bedrock surface in the boreholes, two test pits were excavated along this line as well. The pits were carried out at the locations of borings #1 and #8. The elevation of the bedrock was found to vary between 497 ft. and 503 ft.

cont'd. /4 ...

3. SUB-TRUNK SEWER II - (cont'd.) ...

3.1) Soil Conditions: (cont'd.) ...

High water level was observed below the low ground in holes #7 - #10 inclusive, the free water table being at or a few feet below ground level. Beneath the higher ground, the water level was established near the upper surface of the granular gravelly stratum.

3.2) Conclusions:

As shown on the attached soil profile, the invert elevation of sub-sewer II will be lower than the bedrock surface, except along the southerly approx. 200-ft. length. Rock excavation will be necessary, therefore, the depth of which will vary from 2 to 8 ft.

On account of the anticipated large amount of seepage within the sandy gravel layer, dewatering of the excavation will be necessary as mentioned in connection with sub-trunk sewer I. Since the bottom of the excavation will be in rock, no "boiling" of the base can occur, so that open pumping may be employed.

4. SUB-TRUNK SEWER III -

4.1) Soil Conditions:

Three boreholes were placed along the proposed sub-trunk sewer III, as indicated on the drawings. An approx. 10 - 12 ft. thick layer of sandy silt to silty sand was found to be the uppermost material, underlain by a granular deposit of sand and gravel. The thickness of this layer appears to diminish towards borehole #4, where only a rather thin layer of boulders indicated the presence of the coarse deposit. In boreholes #1 and #3, a three - four ft. thick grey silty clay (glacial till) was observed to overlie the Dundas shale bedrock. The bedrock elevation was again confirmed by an open excavation at the location of boring #4.

cont'd. /5 ...

4. SUB-TRUNK SEWER III - (cont'd.) ...

4.1) Soil Conditions: (cont'd.) ...

The bedrock surface was established around el. 501 ft. south of existing Hwy. #401, and around el. 508 ft. at the test pit location. The groundwater level coincides with the upper portion of the sand and gravel layer.

4.2) Conclusions:

The excavation of sub-trunk sewer III will be deeper than the bedrock surface along its entire length, the invert elevation being some 6 - 8 ft. beneath the upper rock level. Rock excavation, using blasting operations, will likely be needed within the shale and intermittent limestone bedrock. Water will enter the excavations from the sand and gravel layers so that continuous pumping will be required in order to lower the water level within the trench.

5. SUB-TRUNK SEWERS IV and V -

(See Soil Section's memo, attached to the end of this report.)

6. SUB-TRUNK SEWER VI -

6.1) Soil Conditions:

Four boreholes, numbered 1A, 1B, 2 and 3, were put down along this line. No bedrock was encountered within the investigated 13 - 20 ft. depth. Sandy silt deposits with traces of fine gravel were found to be the uppermost layer, the depth of which varied between 2.5 ft. and 13 ft. Penetration 'N' values of 49 to above 100 blows/ft. indicated dense and very dense relative densities. Underlying the sandy silt layers, clayey silt deposits were encountered, having some gravel and fragments of shale. The consistency of this stratum was established to be hard.

cont'd. /6 ...

6. SUB-TRUNK SEWER VI - (cont'd.) ...

6.1) Soil Conditions: (cont'd.) ...

In borehole #1B an intermittent three-ft. thick layer of sandy silt was observed within the cohesive deposit.

High water level prevails along the investigated line, water tables being established in the boreholes at some 1 - 3 ft. below ground surface.

6.2) Conclusions:

Sub-trunk sewer VI will be placed within the overburden. Except around the location of borehole #1B, the proposed invert elevation is within the cohesive clayey silt (glacial till) deposits. The material exhibited very slow dilatancy or no dilatancy at all; consequently, no major dewatering problems are anticipated in the excavations within this layer. Around borehole #1B, however, some quick conditions may occur, inasmuch as sandy silt soils are present around the invert elevation. Some dewatering scheme may, therefore, be required at this location.

7. SUB-TRUNK SEWER VII -

7.1) Soil Conditions:

Two new borings, numbered 4 and 4A, were carried out along proposed sewer VII north of the existing Hwy. #401. The soil stratigraphy south of Hwy. #401 was established on the basis of the existing shaft excavation, near the proposed entrance of the sub-trunk sewer into the main sewer. Along the north half of the line, clayey silt with traces of sand and gravel was revealed by the drillings, having very stiff to hard consistency, with penetration 'N' values of 18 blows/ft. up to above 100 blows/ft. Due to the shallow depth of the proposed invert elevation along the north end of the sewer, borehole #4A was terminated at a depth of 11.5 ft. below ground level, within the uppermost layer.

cont'd. /7 ...

7. SUB-TRUNK SEWER VII - (cont'd.) ...

7.1) Soil Conditions: (cont'd.) ...

In borehole #4, and in the open shaft, sand and gravel deposits were found to underlie the clayey silts. The very dense coarse layer has an overall thickness of approx. 12 ft. The elevation of the shale bedrock was established at el. 492 ft. around the centre of the line, and at el. 496 ft. at the south end.

Some fluctuation of the groundwater level along the proposed line was evident. The elevations of the free water table may be taken to be between 500 ft. and 512 ft.

7.2) Conclusions:

The proposed sewer will lie partly within the overburden, partly below the rock surface. It is postulated that along the south, approx. 300-ft. length, some rock excavation will be necessary to reach the proposed invert elevation. Along the middle section, the sewer will be based on the granular sand and gravel layer. Within this section dewatering problems are foreseen, since the granular layer is susceptible to conditions of unbalanced hydrostatic head. A dewatering scheme for the section should be contemplated. The northern, approx. 300 - 400-ft. length of the sewer will lie within the surficial clayey silt stratum, which is believed to possess adequate fines to render the material practically impervious. Slow seepage is anticipated within this layer, which will cause no special problems.

8. SUB-TRUNK SEWER VIII -

8.1) Soil Conditions:

Soil stratigraphy along the proposed sewer VIII was based upon two recent boreholes, numbered 2 and 3; also, on borehole #9 carried out for the trunk sewer project during last summer. The invert elevation of the sewer is proposed to be between 471 ft. and 475 ft. - i.e., some 25 - 32 ft. below

8. SUB-TRUNK SEWER VIII - (cont'd.) ...

8.1) Soil Conditions: (cont'd.) ...

existing ground level. No bedrock was observed within the investigated depth. The overburden was found to consist of a brown surface layer of sandy silts, followed by grey sandy and clayey silts with traces of gravel. The latter material belongs to the glacial till deposits, hence the very dense relative density and hard consistency. All the boreholes were terminated within the glacial till, some 2 - 4 ft. below the proposed invert of the sewer.

The free water level in the boreholes was established between el. 488.0 ft. and 503.0 ft., indicating a hydraulic gradient towards the lower ground.

8.2) Conclusions:

Sub-trunk sewer VIII will be constructed within the overburden along its full length. From the soil stratigraphy, it appears that the sewer will be entirely in the glacial till. It is felt, that due to the preconsolidated nature and the fines content of this stratum, no major dewatering problems will occur. Water seeping into the excavations should be able to be pumped out by conventional means.

9. MISCELLANEOUS:

The field investigation, carried out during October - November 1967, was supervised by Messrs. S. Nassif, A. Seppala, and P. Payer, Project Foundation Engineers. Mr. A. K. Barsvary, Senior Foundation Engineer, was in charge of the entire project, and also wrote this report. Mr. K. G. Selby, Supervising Foundation Engineer, reviewed the report.

November, 1967

APPENDIX I

MEMORANDUM

TO: Mr. A. Stermac,
Pr. Foundation Engr.,
Materials & Testing Division.

FROM: Materials & Testing Division,
Central Region,
Room 134, Lab. Bldg.

Attn: Mr. K. Selby

DATE: November 3, 1967.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Sub-Trunk Sewers
W.P. 201-62
Highway 401/27 Interchange
Toronto District

In October 1967 investigations were commenced to determine the overburden and bedrock conditions for the eight proposed sub-trunk sewer lines.

The investigation was carried out by the Foundation Section using conventional pen drill auger and diamond drill equipment. Due to some difficulties in establishing bedrock contact of the soft shale with this equipment, sub-trunk sewers IV and V were investigated with a Becker Hammer drill unit on a "try-out" basis.

Sub-trunk sewers IV and V run northerly and immediately west of the present Renforth Drive structure and are relatively short. They drain southerly into the main trunk sewer at manholes T 12 and T 11 respectively.

The Becker Hammer drill drives a heavy, double-walled casing, provided with a special shoe, into the ground with a diesel hammer. The high impact and energy of this hammer readily breaks-up cobbles and stones. Compressed air brought down between the double wall of the casing, forcefully ejects soils and particles through the inner portion of the casing. After passing through a cyclone, part of the blown-out material can be sampled although many of the fines are lost.

The investigation found dense material of a tilly nature and consisting of sand, silt and clay with a few stone fragments in all the holes. However, at the trunk sewer end of sub-trunk sewer IV a stoney and gravelly layer was found from approximately eight to 14 feet in depth.

continued:-

-2-

Mr. A. Stermac,
Pr. Foundation Engr.,
Materials & Testing Division,

Attn: Mr. K. Selby

November 3, 1967.

Seepage into the holes during the investigation was minimal, but after about five days water levels in the holes had risen to to two and one-half to three feet below the surface.

The grey shale bedrock was found on:

(a) Sub-Trunk Sewer IV

at elevation 498, 20' below ground level at the
trunk sewer

at elevation 501, 16' below ground level 100' from
the trunk sewer - W.L. 514'


at elevation 501, 16' below ground level 280' from
the trunk sewer

(b) Sub-Trunk Sewer V

at elevation 497, 21' below ground level at the
trunk sewer

at elevation 500, 16' below ground level 220' from
the trunk sewer

at elevation 498, 17' below ground level 370' from
the trunk sewer - W.L. 512'



P. Arkema,
SR. PROJ. SOILS ENGINEER.

PA/js.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

W. P. 201-62

DATUM ^oGedetic

BORING DATE Oct. 5, 1967

BOREHOLE TYPE Auger

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

ORIGINATED BY PP

COMPILED BY _____ AKB

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

W. P. 201-62

DATUM Geodetic

LOCATION Co-ord. 866,650 N; 974,800 E.

BORING DATE October 5, 1967

BOREHOLE TYPE Auger & Diamond Drill

RECORD OF BOREHOLE NO. I 2

FOUNDATION SECTION

ORIGINATED BY _____ PP

COMPILED BY _____ AKB

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

ORIGINATED BY AMS

COMPILED BY AKB

CHECKED BY

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 866,930 N; 975,250 E.

W. P. 201-62

BORING DATE Oct. 6, 1967

DATUM Geodetic

BOREHOLE TYPE Auger

FOUNDATION SECTION
AMS

ORIGINATED BY

COMPILED BY

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
526.3	Ground Level											
0.0	Clayey silt with gravel. Very dense.											
521.4			1	SS	129	520						
4.9	Silty sand becoming sandy gravel.		2	SS	64/5"							
	Very Dense											
509.3			3	SS	55/3"	510						
17.0	Clayey silt with traces of gravel.											
504.3	Hard		4	SS	21/4"							
			5	SS	75/5"							
22.0	End of Borehole					500						

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. I 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 857,060 N; 975,690 E.

ORIGINATED BY SN

W. P. _____ 201-62

BORING DATE Oct. 16, 1967

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

[illegible]

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

LOCATION Co-ord. 867,010 N; 975,770 E.

ORIGINATED BY AMS

BORING DATE Oct. 11, 1967

COMPILED BY _____ AKB

BOREHOLE TYPE Auger & Diamond Drill

CHECKED BY

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. II 1

FOUNDATION SECTION

JOB 67-F-97LOCATION Co-ord. 867,100 N; 976,240 E.ORIGINATED BY AMSW.P. 201-62BORING DATE Oct. 11, 1967COMPILED BY AKBDATUM GeodeticBOREHOLE TYPE Auger & Diamond DrillCHECKED BY AKB

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WP	W	WL		
523.9	Ground Level															
0.0	Sandy Silt					520										
515.9	Very dense		1	SS	50											
8.0	Sandy gravel		2	SS	80											
	Very dense		3	SS	100	510										
501.9	Boulders		4	SS	100	500										
22.0	Shale		5	SS	50											
	Bedrock		6	SS	100											
			7	RC												
490.4			8	RC		490										
33.5	End of Borehole															

517.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 867,000 N; 976,250 E.

ORIGINATED BY AMS

W.P. 201-62

BORING DATE Oct. 12, 1967

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. II 4

FOUNDATION SECTION

JOB 67-F-97

LOCATION Co-ord. 866,910 N; 976,030 E.

ORIGINATED BY AMS

W.P. 201-62

BORING DATE Oct. 12, 1967

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Auger & Diamond Drill

CHECKED BY HR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — WL PLASTIC LIMIT — wp WATER CONTENT — w				BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT % 10 20 30					
530.4	Ground Level															
0.0	Sandy silt					520									518.5	
	compact to very dense		1	SS	13											
			2	SS	60											
518.4																
12.0	Sandy gravel					510										
	traces of silt		3	SS	118											
			4	SS	105 1/6"											
	Very dense.		5	SS	105 1/6"											
502.4																
28.0	Shale bedrock					500										
			6	SS	110 1/6"											
	Weathered		7	SS	150 1/2"											
			8	RC	40%											
491.0																
39.4	End of Borehole															

518.5

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 866,710 N; 976,110E

W.P. _____ 201-62

BORING DATE Oct. 12, 1967

DATUM Geodetic

BOREHOLE TYPE Auger

RECORD OF BOREHOLE NO. II 5

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY AKB

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. II 6

FOUNDATION SECTION

JOB 67-F-97 LOCATION Co-ord. 866,530 N; 976,200 E. ORIGINATED BY _____
W.P. 201-62 BORING DATE Oct. 13, 1967 COMPILED BY _____
DATUM Geodetic BOREHOLE TYPE _____ CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — WL PLASTIC LIMIT — wp WATER CONTENT — w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT % wp — w — WL 10 20 30				
533.6	Ground Level														
0.0	Clayey silt becoming sandy silt with some gravel.		1	SS	50	530									
	Very dense		2	SS	75 1/8"										
			3	SS	50 1/2"	520									
513.6			4	SS	100 1/4"										
20.0	Sandy gravel.														
509.6	Very dense.		5	SS	100 1/3"	510									
24.0	Clayey silt, traces of sand.		6	SS	110 1/4"										
	Hard														
500.6															
33.0	Shale - Bedrock		7	SS	100 1/2"	500									
34.2	End of Borehole														

516.6

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. II 7

FOUNDATION SECTION

MATERIALS & TEST DIVISION

JOB 67-F-97

LOCATION Co-ord. 866,320 N; 976,410 E.

ORIGINATED BY AMS

W. P. 201-62

BORING DATE Oct. 13, 1967

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Core Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				<div>wp — w — WL</div> <div>10 20 30</div> WATER CONTENT %				
517.5	Ground Level														
0.0	Sandy silt, some gravel.					510									516.0
509.5	Very dense.		1	SS	95										
8.0	Clayey silt with shale fragments.		2	SS	110	1"									
502.5	Hard		3	SS	100	2"									
15.0	Shale Bedrock		4	RC		500									
497.5	Weathered		5	RC											
20.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97W.P. 201-62DATUM GeodeticLOCATION Co-ord. 866,200 N; 976,750 E.BORING DATE Oct. 17, 1967BOREHOLE TYPE Auger

FOUNDATION SECTION

ORIGINATED BY AMSCOMPILED BY AKBCHECKED BY AKB

RECORD OF BOREHOLE NO. II 8

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WP	W	WL		
511.8	Ground Level														
0.0	Clayey silt					510									
	Brown														
	Very stiff		1	SS	28										
502.8	Grey														
9.0	Shale		2	SS	100/4"	500									
496.3	Bedrock		3	SS	100/5"										
15.5	End of Borehole					490									

509.8

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT _____ WL PLASTIC LIMIT _____ wp WATER CONTENT _____ w <div>wp w WL</div>			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.			WATER CONTENT % 10 20 30				
509.7	Ground Level													
0.0	Silty clay seams of sand		1	TW	PM	500								508.2
499.7			2	TW	PM									
10.0	Bedrock		3	SS	5072"									
11.4	End of Borehole					490								

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

W. P. 201-62

DATUM Geodetic

LOCATION Co-ord. 865,820 N; 976,570 E.

BORING DATE Oct. 17, 1967

BOREHOLE TYPE Auger


RECORD OF BOREHOLE NO. II 10

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W			
509.2	Ground Level												
0.0	Silty clay					500					P.C.F.	at Ground	
	Firm		1	SS	4								
497.7			2	SS	83								
11.5	End of Borehole					490							

RECORD OF BOREHOLE NO. III 1

FOUNDATION SECTION

LOCATION Co-ord. 867,090 N; 975,930 E.

ORIGINATED BY AMS

BORING DATE Oct. 17, 1967

COMPILED BY _____ AKB

BOREHOLE TYPE Auger

CHECKED BY AK

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

W. P. 201-62

DATUM Geodetic

RECORD OF BOREHOLE NO. III 3

LOCATION Co-ord. 867,440 N; 975,810 E.

BORING DATE October 18, 1967

BOREHOLE TYPE Auger

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY _____ AKB

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WP	WL			
527.9	Ground Level											
0.0	Silty sand to sandy silt.		1	SS	100	5"						
519.9	Very dense.											
8.0	Sand & gravel		2	SS	113							
509.9	Very dense											
18.0	Silty clay.		4	SS	100	5"						
505.9	Hard. Grey											
22.0	Shale		5	GS	150	5"						
	Bedrock											
	with seams of limestone											
487.9												
40.0	Refusal											

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 867,640 N; 976,070 E.

W. P. 201-62

BORING DATE Oct. 19, 1967

DATUM Geodetic

BOREHOLE TYPE Auger

FOUNDATION SECTION

AMS

ORIGINATED BY

AKG

COMPILED BY

CHECKED BY

RECORD OF BOREHOLE NO. III 4

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. IV 1

FOUNDATION SECTION

JOB 67-F-97

LOCATION Co-ord. 867.270 N; 976.470 E.

ORIGINATED BY PA

W. P. 201-62

BORING DATE Oct. 4, 1967

COMPILED BY JM

DATUM Geodetic

BOREHOLE TYPE Becker Hammer Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					
518.3	Ground Level											
0.0	Sandy and clayey silt traces of gravel. Very dense.	[Pattern]				510						
510.3												
8.0	Sand and gravel. Dirty and very dense.	[Pattern]										
504.3												
14.0	Grey Clay (Till) (Shale Fragments) Very dense.	[Pattern]				500						
498.3												
20.0	Grey shale bedrock Soft, with thin limestone streaks.	[Pattern]				490						
485.3												
33.0	End of Borehole					480						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 867,370 N, 976,410 E.

W. P. 201-62

BORING DATE Oct. 4, 1967

DATUM _____ Geodetic

BOREHOLE TYPE Becker Hammer Drill

RECORD OF BOREHOLE NO. IV 2

FOUNDATION SECTION

ORIGINATED BY PA

COMPILED BY _____ JM

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. IV - 3

FOUNDATION SECTION

JOB 67-F-97

LOCATION Co-ord. 867,560 N: 976,350 E.

ORIGINATED BY JM

W.P. 201-62

BCRING DATE Oct. 6, 1967

COMPILED BY JM

DATUM Geodetic

BOREHOLE TYPE Becker Hammer Drill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— WL Plastic Limit ——— WP Water Content ——— W	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WP ——— W ——— WL WATER CONTENT %		
515.1	Ground Level									
0.0	Clayey silt, trace of gravel.					510				
501.1	Clayey silt (Till)									
499.6	(dry moist)					500				
15.5	Grey Shale					490				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. V 3

FOUNDATION SECTION

67-F-97

JOB	LOCATION	Co-ord. 867.480 N; 976.650 E.	ORIGINATED BY	PA
W.P. 201-62	BORING DATE	October 5, 1967	COMPILED BY	JM
DATUM Geodetic	BOREHOLE TYPE	Becker Hammer Drill	CHECKED BY	<i>[Signature]</i>

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
515.0	Ground Level											
0.0	Sandy and clayey silt with occasional gravel.											
	Very dense.		1	SS	85	510						
502.0												
13.0	Grey Clay (Till)											
499.2	Very dense.		2	SS	65/8"	500						
15.5												
497.0	Grey shale											
18.0	End of Borehole											
						490						

FOUNDATION SECTION

ORIGINATED BY JM

COMPILED BY

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

67-F-97

W. P. 201-62

DATUM Geodetic

DATUM _____

RECORD OF BOREHOLE NO. V 14 (67-F-35)

LOCATION 867,502 N; 976,820 E.

BORING DATE April 26, 1967

BOREHOLE TYPE Cont. Flight Auger

ORIGINATED BY AKB

COMPILED BY _____ AKE


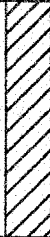
CHECKED BY

FOUNDATION SECTION

[illegible]

FOUNDATION SECTION

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT _____ WL PLASTIC LIMIT _____ wp WATER CONTENT _____ w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT % 10 20 30				
514.4	Ground Level														
0.0 511.9	Sandy Silt														▼ 512.4
2.5	Clayey silt, traces of sand and gravel (Hard		1	SS	49	510									
			2	SS	50 7/8"										
498.5			3	SS	100 1/4"	500									
15.9	End of Borehole					490									

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. VI 1B

FOUNDATION SECTION

JOB 67-F-97LOCATION Co-ord. 869,040 N; 976,100 E.ORIGINATED BY AMSW.P. 201-62BORING DATE October 20, 1967COMPILED BY AMSDATUM GeodeticBOREHOLE TYPE Cont. Flight AugerCHECKED BY SR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — FL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.S.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				wp	w	wL		
516.0	Ground Level														
0.0															
513.5	Sandy silt														
2.5	Clayey silt, trace of gravel.														
508.0	Hard		1	SS	35	510									
8.0	Sandy silt, traces of clay and gravel.		2	SS	113.7"										
504.5	Very Dense														
503.0	Clayey silt, traces of sand and gravel. Hard		3	SS	120.6"										
13.0	End of Borehole					500									

515.0

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord 868,750 N; 975,510 E.

W. P. 201-62

BORING DATE Oct. 19, 1967

DATUM Geodetic

BOREHOLE TYPE Auger

RECORD OF BOREHOLE NO. VI 3

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY AKB

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT _____ W _L			BULK DENSITY P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT			PLASTIC LIMIT _____ W _P				
							SHEAR STRENGTH P.S.F.			WATER CONTENT _____ W				
525.8	Ground Level													
0.0	Sandy silt					520								
517.8	Dense		1	SS	49									
8.0	Clayey silt, traces of gravel & shale fragments.		2	SS	38									
510.8	Hard		3	SS	100/2"	510								
15.0	End of Borehole													

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. VII 4A

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-97

LOCATION Co-ord. 868,080 N; 976,670 E.

ORIGINATED BY AMS

W. P. 201-62

BORING DATE October 23, 1967

COMPILED BY _____ AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. VIII 2

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-P-97

LOCATION Co-ord. 868,350 N; 978,770 E.

ORIGINATED BY AMS

W.P. 201-62

BORING DATE October 24, 1967

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY *JK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WP	W	WL		
498.0	Ground Level														
0.0															
495.5	Sandy silt														
2.5	Clayey silt, traces of sand and gravel.		1	SS	55	490									
	Hard		2	SS	105										
480.0	Boulder		3	SS	92/8"	480									
18.0	Silty sand, trace of gravel.		4	SS	125/5"										
475.5	Very dense.														
22.5	Clayey silt Shale fragments (Hard)		5	SS	100/5"	470									
468.0															
30.0	End of Borehole														

488.

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. VIII 3

FOUNDATION SECTION

JOB 67-F-97LOCATION Co-ord. 868,890 N; 978,740 E.ORIGINATED BY AMSW.P. 201-62BORING DATE Oct. 23 & 24, 1967COMPILED BY AMSDATUM GeodeticBOREHOLE TYPE Cont. Flight AugerCHECKED BY SR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WP	W	WL		
507.8	Ground Level														
0.0	Sandy silt to silty sand.														
502.3	Compact														
5.5	Clayey silt, traces of sand and gravel		1	SS	26	500									
			2	SS	13										
			3	SS	41	490									
	Hard.		4	SS	87										
			5	SS	33	480									
			6	SS	134										
472.3			7	SS	150/6"										
35.5	End of Borehole														

503.3

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. VIII 4

FOUNDATION SECTION

JOB 67-F-97

LOCATION Co-ord. 868,090 N; 977,040 E.

ORIGINATED BY AMS

W.P. 201-62

BORING DATE October 23, 1967

COMPILED BY AMS

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT _____ WL PLASTIC LIMIT _____ WP WATER CONTENT _____ W			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT				SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
517.3	Ground Level															
0.0 514.8	Sandy silt															
2.5	Clayey silt, traces of sand.		1	SS	74	510										
504.3	Hard		2	SS	100	515"										
13.0	Sand and gravel to gravel.		3	SS	110	500										
	Very dense.		4	SS	70											
492.3																
25.0	End of Borehole Bedrock															

499.8

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 67-F-97

W. P. 201-62

DATUM Geodetic

LOCATION Co-ord. 868,179 N; 978,883 E.

BORING DATE April 25, 1967

BOREHOLE TYPE Cont. Flight Auger

RECORD OF BOREHOLE NO. VIII 9 (67-F-35)

FOUNDATION SECTION

ORIGINATED BY AMS

COMPILED BY _____ AKB

CHECKED BY

[illegible]

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engr.,
Materials & Testing Division.

FROM: Materials & Testing Division,
Central Region,
Room 134, Lab. Bldg.

Attn: Mr. K. Selby

DATE: September 26, 1967.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Sub-Trunk Sewers
W.P. 201-62
Highway 401/27 Interchange
Toronto District

This memorandum confirms our verbal request at a short meeting on Friday September 22, 1967 for a Foundation investigation for eight sub-trunk sewers with a total length of about 7,400 feet. These sub-trunk sewers will empty into the large trunk sewer for which the investigation was done in the spring of this year and which is now under contract 67-129.

The required depth of the borings ranges from 12 feet to 40 feet as indicated on the 100 feet to one inch scale plan, which was handed to you.

Yesterday we received profiles of the sub-trunk sewer lines from Fenco, the design consultants for the project, and one copy was delivered to your office.

The Property Section is obtaining permission to enter on the Smith Estate property and has already contacted the lawyer of the estate.

In order to complete their design in time, Fenco would appreciate receiving the information not later than October 2, 1967 as far as the "red contract" is concerned: the others could follow later.

PA/js.

P. Arkema,
SR. PROJECT SOILS ENGINEER.

401 & Keele Street
Downsview, Ontario

November 15, 1967

Becker Drilling (Alberta) Ltd.
1100 Finch Avenue
Downsview, Ontario

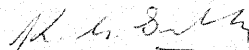
Dear Sirs:

This is to confirm our request of November 3, 1967 for the supply of a Becker Drill together with all necessary equipment, at Hwy. 401 & 27 Interchange, Richview Side Rd. & Renforth Drive, Toronto, Ontario on November 6, 1967.

Payment will be in accordance with your letter to Mr. A. Rutka dated October 10, 1967.

This project bears Job Number 67-F-97.

Yours truly,



KGS:mt

E. G. Selby
Supervising Foundation Engineer
for: A. G. Stermac
Principal Foundation Engineer

cc: H. Konings
Foundation Files 110
General File

#67-F-97

W.P. # 201-62

HWY # 4018[#]27

INTERCHANGE

SUB-TRUNK

SEWERS

