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G.I.-30 SEPT. 1976

GEOCRES No. 30M13-9

DIST. 6 REGION

W.P. No. 236-66

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 407

LOCATION Hwy 400 (1 Mile North of Metropolitan Toronto North Limits)
PROPOSED SEWER

No of PAGES - ~

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

30 M13-9

TO: Mr. R. G. Burnfield,
Regional Functional
Planning Engineer,
Central Region (Toronto)

ATTENTION: Central Building

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

DATE: December 17, 1970

OUR FILE REF.

IN REPLY TO JAN - 5 1970

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Sewer
Along the Future Hwy. #407
West of Hwy. #400
District No. 6 (Toronto)
W.O. 70-11099 -- W.P. 236-66

Enclosed, please find our foundation report for the above mentioned project.

We believe the information in the report will be sufficient for your immediate purposes. Additional information will, of course, be required when the project reaches the design stage.

If we can be of any further assistance, please contact this Office.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. R. G. Burnfield (2)
H. A. Tregaskes
D. W. Farren
I. C. Campbell
E. J. McCabe
W. Wigle
H. Greenland
G. K. Hunter (2)
G. C. E. Burkhardt
B. J. Giroux
B. A. Singh

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
The Proposed Sewer
Along the Future Hwy. #407
West of Hwy. #400
District No. 6 (Toronto)
W.O. 70-11099 -- W.P. 236-66

1. INTRODUCTION:

A request for a foundation investigation at the site of a proposed sewer along the proposed Hwy. #407, west of Hwy. #400 was made by Mr. E. J. McCabe, Senior Project Planning Engineer, Central Region. The memo containing the request was dated October 21, 1970.

The purpose of the investigation was to determine whether any major problems might arise in the excavations from a soils point of view, since the proposed sewer would necessitate cuts up to 35 ft. depth. The field and laboratory work were supervised by this Section, the results of which are given in the forthcoming paragraphs, together with some comments on the proposed sewer excavations.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The investigated area is generally flat. East of Weston Rd. the proposed sewer runs across the existing drive-in movie theatre, along the unused land behind the theatre and the Hwy. #400 right-of-way. West of Weston Rd. the area is occupied by farmlands.

Geologically the site lies at the approx. centre of the physiographic region known as "Peel Plain". The underlying geological material of this plain is a till or boulder clay, containing large amounts of Palaezoic shale and limestone. In much of the Peel Plain a shallow veneer of clay, sometimes clearly varved, modifies the stratigraphy.

..... 2

3. FIELD AND LABORATORY INVESTIGATIONS:

The field investigation consisted of 10 sampled boreholes and one dynamic cone penetration test, placed along the proposed sewer line at approx. every 500 ft. The boreholes were carried out by means of a continuous flight auger, which, on the soft ploughed farmland, was towed by a Bombardier. Soil samples were taken at regular intervals by performing Standard Penetration tests. Penetration 'N' values (blows/ft.) are marked on the borelog sheets, together with the results of the laboratory tests. Soil samples were visually examined and identified; some samples were further tested in the laboratory to define grain-size distributions and Atterberg limits of the layers.

The locations and elevations of the boreholes with the estimated soil stratigraphy are plotted on Drawing #70-11099A in the Appendix.

4. SUBSOIL CONDITIONS:

4.1) General:

The field work revealed two prominent soil strata within the investigated 30 - 45 ft. depth. One is a clayey silt to silt with traces of sand and gravel, the other is a silt to silty sand. The latter material was found to consist of pure sand and gravel in a few locations.

Following is a brief description of the deposits.

4.2) Clayey Silt to Silt with traces of Sand and Gravel - (Glacial Till):

The surficial layer at every borehole was found to be clayey silt to silt with traces of sand and gravel. Near the surface, the material is brown, oxidized and mottled, farther down it is grey. Except at the extreme westerly portion of the proposed sewer, the thickness of the layer ranges from 8 ft. to 23 ft. Around el. 593 ft. - 610 ft., underlying the silts and sands, a second layer of this glacial till was found, extending

..... 3

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Clayey Silt to Silt with traces of Sand and Gravel - (Glacial Till): (cont'd.) ...

to the bottom of the borings. Penetration 'N' values were found to vary between 13 blows per ft. to above 100 blows per ft., corresponding to stiff to hard consistency. 'N' values obtained within the lower stratum were all over 100 blows per ft.

The glacial tills have slight plasticity, the average plastic limit moisture content being around 13% and the liquid limit around 20%. The natural moisture contents are usually near the plastic limits, averaging 12%. All the tested samples fell within the CL and CL-ML range, when plotted on the Plasticity Chart. A typical grain-size analysis resulted in 5 - 7% gravel, 25 - 27% sand, 42 - 45% silt, and 20 - 23% clay-size particles. In B.H.'s #9 and 10, placed at the west end of the proposed sewer, the clayey silt stratum extended to the end of the borehole; within the layer, however, a few thin seams of sand were noted at irregular intervals.

4.3) Silts and Sands:

Intersecting the glacial tills a coarse-grained deposit, containing silts, with some clay, sandy silts, silty sands and gravelly sands was observed. The upper surface of this layer lies around el. 607 ft. - 619 ft., having an overall thickness between 5 ft. and 16 ft., except at the west 500 - 800 ft. of the investigated line, where a few thin seams of granular material only, were found. Below the eastern half of the line the granular layer was mainly silt with hardly any plasticity, becoming more sandy and gravelly towards the west. Standard Penetration tests, taken within this stratum, resulted in 'N' values varying from 48 blows per ft. to above 100 blows per ft., indicating generally very dense relative densities. The natural moisture contents averaged around 15% by dry weight, the plastic portion of the silts having plastic limits about 14% and liquid limits of 18%. Several grain-size analyses were carried out in order to determine the particle-size

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4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Silts and Sands: (cont'd.) ...

distributions of the granular layers. A wide variety of particle sizes were noted to be present in the samples as shown on Fig. #1, where the envelope of some 12 curves are plotted. By examining the individual grain-size distribution curves, it has been found that practically all the samples indicated an unstable soil structure when subjected to conditions of unbalanced hydrostatic heads.

4.4) Groundwater:

Groundwater was encountered in every borehole, the equilibrium levels of which are marked on the borelog sheets. Fairly high water levels were recorded along the eastern half or so, of the line, being around 2 - 3.5 ft. below ground level, except under the pavement of the drive-in theatre, where the water level was found around 19 ft. below pavement surface. There appears to be some seepage towards the westerly end of the proposed sewer; water levels at this area were found some 10 - 13 ft. below ground surface.

5. CONCLUSIONS:

The future sewer under the four-level interchange at the crossing of the proposed Hwy. #407 and Hwy. #400 would require cuts up to 35 ft. depth. The Foundation Section was requested to carry out a feasibility study to determine whether any major soil problems would occur in the excavations.

As mentioned earlier, the subsoils were found to consist of clayey silt to silt, glacial till, intersected by silts and sands.

Since no details of the proposed grades, ramps or embankments are available as yet, it is postulated that cuts between the existing ground level and the proposed invert will be implemented.

..... 5

5. CONCLUSIONS: (cont'd.) ...

No difficulties are foreseen for the excavations within the uppermost clayey silt to silt glacial tills. Some groundwater may enter into the cuts - notwithstanding, it is believed that, on account of the cohesive strength of the till, this water could be pumped out by conventional methods, without causing unstable conditions in the cuts. The invert elevation of the proposed sewer is, however, well within the granular stratum of silts, silty sands and gravelly sands, as shown on Drawing #70-11099A. A large amount of groundwater would flow into the excavations along this layer, resulting in instability of the slopes and vigorous 'boiling' of the bottoms of the cuts. A dewatering scheme will be required in order to eliminate the unbalanced hydrostatic heads. In considering cut-and-cover method for the sewer construction, a wellpoint dewatering system or eductor wells might be considered. In the case of tunneling, it will have to be excavated under the application of air pressure. As shown on the soil profile and on the borelogs, the groundwater level was near the ground surface along the larger portion of the investigated line.

The above comments are of a preliminary nature, for estimating purposes only. Further investigations, including more frequent boreholes along the proposed line, and the installations of piezometers will be necessary if this proposal is adopted.

6. MISCELLANEOUS:

The field investigation was carried out during the period November 5 to 12, 1970, under the supervision of Mr. A. K. Barsvary, Senior Foundation Engineer, who also prepared this report.

Equipment used was owned and operated by Johnston Drilling Co., Toronto.

The report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

December, 1970.

APPENDIX I

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,720 N; 989,810 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 6, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
627.5	Ground Level					
0.0	Clayey silt with some gravel (Glacial Till)					
	Very Stiff		1	SS	23	
619.5						620
8.0	Silt, traces of clay & gravel		2	SS	93	
	seams of sand		3	SS	96	
						610
	Very Dense		4	SS	114	
602.5			5	SS	100/8"	
25.0	End of Borehole					600

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w

w_P w w_L

WATER CONTENT %
10 20 30

np

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,650 N; 989,400 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 6, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY AKB

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
633.0	Ground Level					
0.0	Clayey silt to silt, some gravel (Glacial Till)					630
			1	SS	27	
			2	SS	13	
	Stiff to Hard					620
616.0			3	SS	85	
17.0	Silt, traces of clay		4	SS	48	
	Dense					
609.0						610
24.0	Clayey silt to silt, traces of gravel (Till)		5	SS	82	
603.0	Hard		6	SS	100/6"	
30.0	End of Borehole					600

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

0 2 89 9

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,560 N; 988,905 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 6, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
633.5	Ground Level					
0.0	Clayey silt to silt with some gravel (Glacial Till) Very stiff to hard Brown & Grey		1	SS	20	630
			2	SS	56	
619.5						620
14.0	Silt with some clay Hard		3	SS	71	
			4	SS	47	
610.5						610
23.0	Silt to clayey silt with some sand and gravel (Glacial Till) Hard		5	SS	82	
			6	SS	100/7"	
599.0						600
34.5	Silty Sand. Very Dense		7	SS	100/5"	
597.0						
36.5	Clayey Silt (Till) Hard					
593.5			8	SS	100/3"	
40.0	End of Borehole					590

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

w_P w w_L

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.
0 4 86 10
8 44 39 9

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,430 N; 988,430 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 5, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY AR

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
634.4	Ground Level					
0.0	Clayey silt to silt some gravel (Glacial Till)		1	SS	25	630
			2	SS	26	
	Very Stiff to Hard		3	SS	120/9"	620
	Brown & Grey		4	SS	100/6"	
609.4			5	SS	128	610
25.0	Silt with some clay					
	Very Dense		6	SS	100/6"	
601.9						
32.5	Clayey silt, traces of gravel (Glacial Till)		7	SS	121/9"	600
			8	SS	100/6"	
589.9	Hard					
			9	SS	100/6"	
44.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL x LAB. VANE

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.

3 3 83 11

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,310 N; 987,950 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 5, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
634.7	Ground Level					
0.0	Clayey silt to silt, traces of sand & grav. (Till) Very Stiff to Hard Brown & Grey		1	SS	23	630
			2	SS	100/7"	
			3	SS	77	620
			4	SS	90	
611.7						
23.0	Fine sand with some silt.		5	SS	49	610
606.7	Dense					
28.0	Clayey silt to silt, trace of gravel (Glacial Till)		6	SS	111	
			7	SS	133	600
594.7	Hard		8	SS	100/8"	
40.0	End of Borehole					590

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

w_P w w_L

WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

0 89 (11)

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 909,135 N; 987,480 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 9, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
628.8	Ground Level									
0.0	Clayey silt to silt, traces of gravel (Glacial Till)		1	SS	24					
			2	SS	108	620				
	Very Stiff to Hard Brown & Grey		3	SS	65					
606.8			4	SS	55	610				
22.0	Sandy silt to silty sand.		5	SS	131					1 18 66 15
	Very Dense		6	SS	45	600				0 59 39 2
592.8			7	SS	52					0 20 79 1
36.0	Silt with occasional gravel. Till									
588.6	Hard		8	SS	100/8"	590				
40.2	End of Borehole									

FORM OB-MT-126 (REV. 1969)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 908,970 N, 987,000 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 9, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
627.8	Ground Level					
0.0	Clayey silt to silt, seams of sand		1	SS	20	
	Very Stiff to Hard					620
			2	SS	91	
	Brown & Grey					
			3	SS	47	
609.3						610
18.5	Sand with some silt.		4	SS	67	
602.8	Very Dense					
			5	SS	90	
25.0	Silt with occasional gravel (Glacial Till)					600
			6	SS	99	
592.8	Hard					
			7	SS	100/7"	
35.0	End of Borehole					590

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

3 36 56 5

0 87 (13)

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 908,760 N. 986,565 E. ORIGINATED BY AMB
W.P. 236-66-01 BORING DATE Nov. 9, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
623.2	Ground Level					
0.0	Clayey silt with some sand & gravel (Glacial Till) Hard Brown		1	SS	31	620
			2	SS	81	
609.2						610
14.0	Gravelly sand becoming sandy silt Very Dense		3	SS	78	
			4	SS	78	
			5	SS	60	600
593.7						
29.5	Clayey silt, traces of gravel (Till) Hard		6	SS	110/8"	
588.2			7	SS	100/7"	590
35.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR. SA. SI. CL.
7 25 45 23
39 52 (9)
6 37 50 7

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 908,540 N; 986,100 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 12, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE		WATER CONTENT % 10 20 30		GR. SA. SI. CL.
619.0	Ground Level									
0.0	Clayey silt with traces of sand and gravel		1	SS	11					
	seams of sand		2	SS	42	610				
	Stiff to Hard		3	SS	72					
	Brown to Grey		4	SS	100/10"	600				
			5	SS	100/9"					
588.5			6	SS	102	590				
30.5	End of Borehole					580				
						570				

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

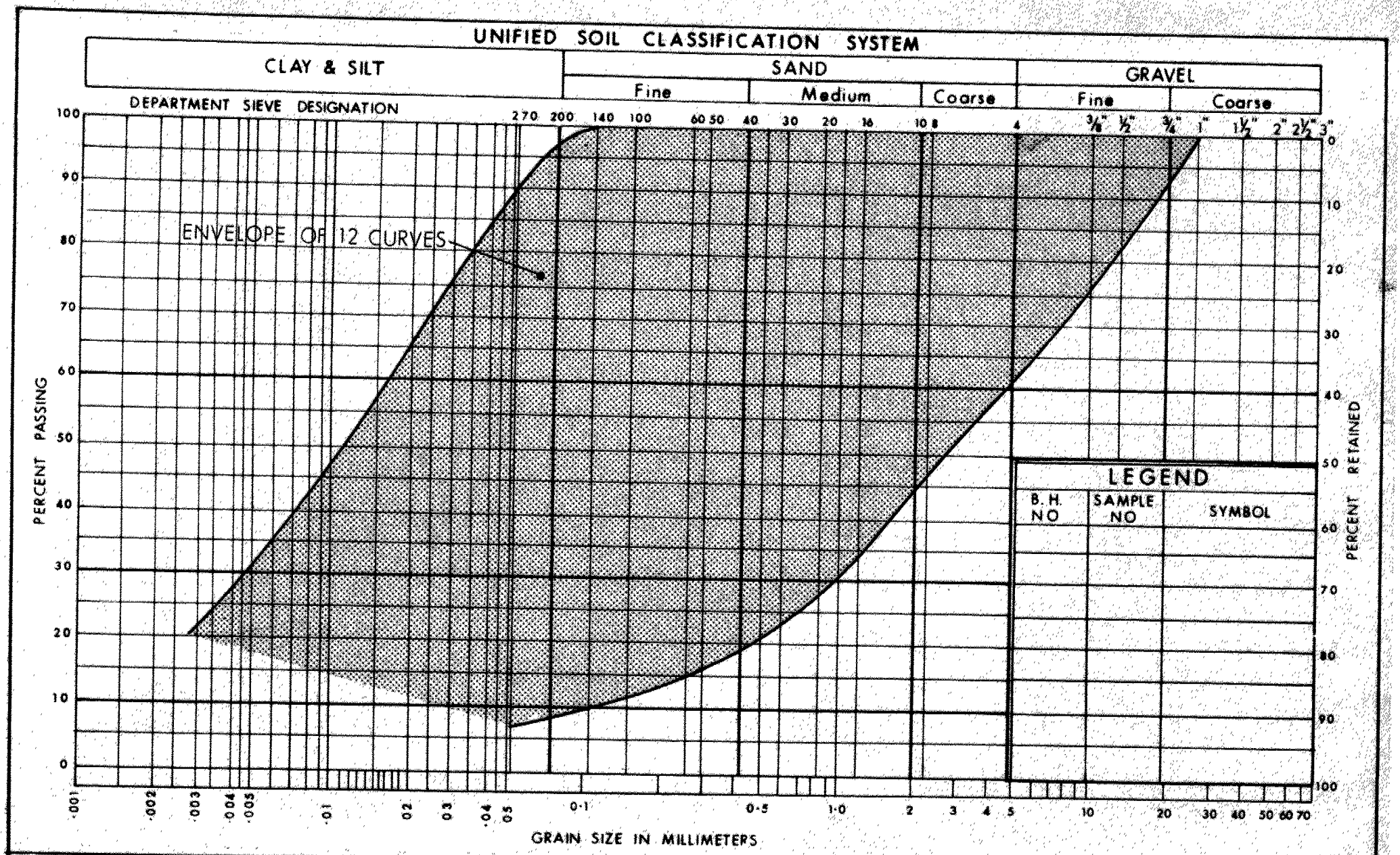
RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 70-11099 LOCATION Co-ords. 908,300 N; 985,678 E. ORIGINATED BY AKB
W.P. 236-66-01 BORING DATE November 12, 1970 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				GR. SA. SI. CL.
605.5	Ground Level									
0.0	Clayey silt to silt, traces of gravel, seams of sand (Glacial Till)		1	SS	106	600		○		
			2	SS	107			○ ⊢		
592.5	Hard									
13.0	End of Borehole					590				
						580				

FORM OB MT - 17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SILTS & SANDS

W.P No. 236-66-01

JOB No: 70-11099

FIG. 1

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 :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
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 INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
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 (YOUNGS 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_o	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

OVERSIZE DRAWING

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac,
Pr. Foundation Engr.,
Foundation Office,
Materials & Testing Office.

From: Materials & Testing Office,
Central Region,
Room 134, Lab. Bldg.

Attention:

Date: October 21, 1970.

Our File Ref.

In reply to

Subject: 236-66-01
W.P. ~~237-66-~~00, Highway 407
Toronto District

UP 236-66-01

Because of the depth of the borings involved, it would be expeditious for your Office to carry out the necessary work. Thank you. Plan and profile is included in the package.

T. J. Kovich,
Regional Materials Engineer.

TJK/js,
Encls.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: T. Kovich
Regional Materials Engineer
Central Region.

ATTENTION: P. Arkema

OUR FILE REF.

FROM: E. J. McCabe
Functional Planning
Central Region.

DATE: September 24, 1970.

IN REPLY TO

SUBJECT:

Highway 407 - Hwy. 27 to Yonge St.
W.P. 237-66, District 6, Toronto.

This office is investigating the possibility of providing a 4 level interchange between Hwy. 407 and Hwy. 400.

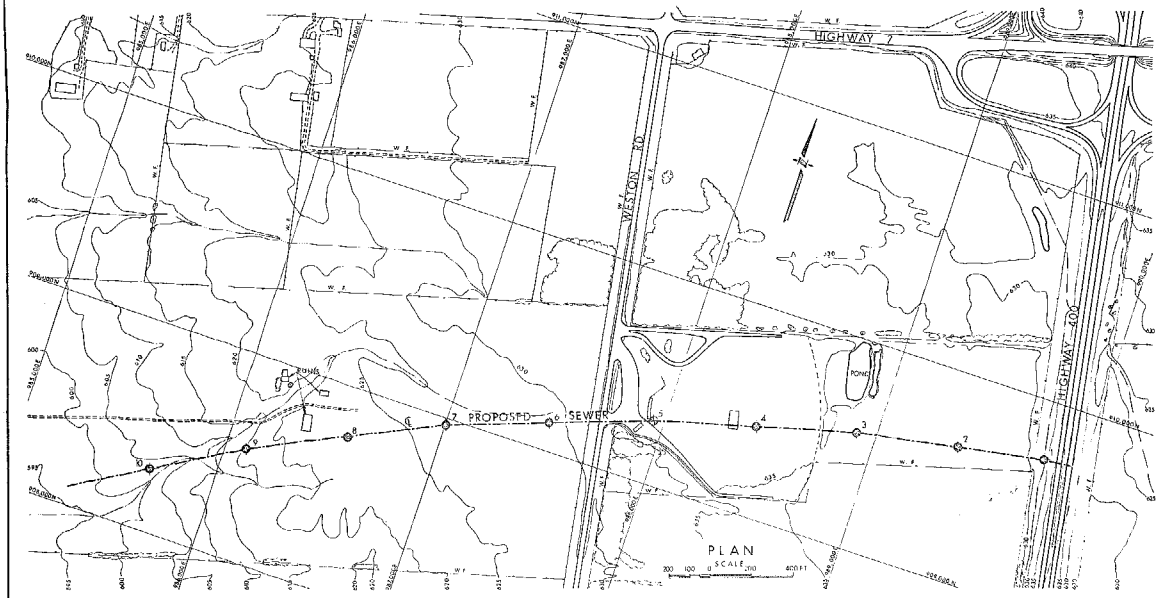
To avoid excessive earth borrow costs in such an interchange, it is necessary to locate the lowest grade within the interchange as low as possible. The elevation in the interchange under investigation would appear to be 615±. The practicability of such a design is, however, dependant upon it being possible to construct a sewer from this point westerly along the right of way.

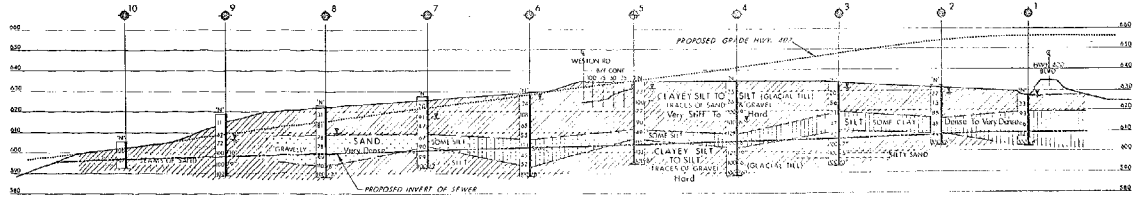
As can be seen from the attached plan and profile, cuts up to 35' deep would be required for such a sewer and we would be grateful to receive your comments as to whether any major problems could be anticipated from a soils point of view if this design were proceeded with.

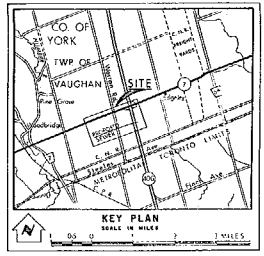
J. S. Sutherns
for E. J. McCabe
Sr. Project Planning Engineer

/mcl
Attached

Kevin → Park







LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, NOV. 1970.

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	627.5	909 720	989,810
2	633.0	909,650	989,400
3	633.5	909,560	988,905
4	634.4	909,430	988,430
5	634.7	909,312	987,950
6	628.8	909,135	987,480
7	627.8	908,972	987,000
8	623.2	908,760	986,565
9	619.0	908,560	986,100
10	605.5	908,390	985,678

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

PAINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

PROPOSED SEWER

KING'S HIGHWAY NO. 407 PROPOSED DIST. NO. 6
CO. YORK
TWP. VAUGHAN LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SURVEYED A.B.	CHECKED		W.P. DRAWING NO. 70-11099A
DRAWN	CHECKED		
DATE DEC 1970			BRIDGE DRAWING NO.
APPROVED			