

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-136
~~30M13-48~~

DIST. 6 REGION _____

W.P. No. 49-71-00
~~88-78-00~~

CONT. No. _____

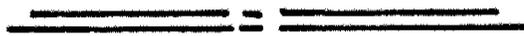
W. O. No. _____

STR. SITE No. _____

HWY. No. 427

LOCATION Rexdale Blvd. to North of
Humber River

No of PAGES - _____



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

G.I.-30 SEPT. 1976

FOUNDATION INVESTIGATION REPORT

For

Feasibility Study
of Hwy. 407 From Airport Road
to Jane Street (Including Hwy. 400)
W.P. 88-78-00
and Hwy. 427 From Finch Avenue to Hwy. 27
W.P. 49-71-00
District 6, Toronto

INTRODUCTION

This report contains the results of a feasibility foundation investigation carried out for the above projects. The fieldwork was carried out from October 13 to November 1, 1978 and consisted of a total of 18 sampled boreholes advanced by means of either solid stem augers or hollow stem augers to depths of 14 to 135 feet below the ground surface. Bedrock was encountered in one boring at a depth of 7 feet and was proven by obtaining 7 feet of BXL size rock core. In addition to our fieldwork we have incorporated in this report 5 borings, B.H. 19 to B.H. 23, that were put down at various pertinent locations by other agencies.

SITE DESCRIPTION AND GEOLOGY

The area under consideration is located immediately north of the city limits of Metropolitan Toronto within the Regional Municipalities of Peel and York. The area for this portion of Hwy. 407 investigated stretches between Airport Road and Jane Street and is located 500 to 2000 feet north of Steeles Avenue. Extending from Finch Avenue to Hwy. 7 between Indian Line and Hwy. 27, is the area of investigation for the feasibility of Hwy. 427. This investigation includes also the portion of Hwy. 400 which runs from the C.N.R. Halton Subdivision to Langstaff Road.

Topographically the overall area can be described as gently undulating, the exception being where creeks or rivers have cut valleys. Land use in the proposed highway right of ways consists

mainly of cultivated open fields; exceptions occur in the vicinities of the Thackeray Land Fill Site and within areas under the jurisdiction of Metropolitan Toronto and Region Conservation Authority.

Physiographically the study area is wholly located within the region known as the "Peel Plain". This area is found to be at elevation 500 to 750 feet above sea level and has a gradual slope toward Lake Ontario. Across the plain, rivers and streams have cut deep valleys and there is, therefore, no large undrained depressions, swamp or bogs in the whole area. The plain is furthermore characterized by an underlying till or boulder clay. In much of the Peel Plain this has been modified by a veneer of clay which, when deep enough, is clearly seen to be varved. Shown on Drawing No. 887800-A are the boundaries and descriptions of the surficial geology, based on the Quaternary Geology, Map 2272, for the Bolton Area.

SUBSURFACE CONDITIONS

Subsurface conditions across the study area are quite variable. Generally the dominant subsurface deposit extending from the ground surface to a depth of up to 105 feet is a heterogeneous mixture of clayey silt, sand and gravel, a glacial till. In some areas a 14 to 25 foot thick deposit of very dense silt and/or sand was encountered within the glacial till deposits.

Exceptions to the above were observed in the areas adjacent to the rivers and creeks.

At Mimico Creek, Plunketts Creek, the west side of Humber River (Main Branch) and at the West Humber River, subsurface conditions consist generally of a surficial deposit of stiff to very stiff clayey silt up to 20 feet thick overlying loose to dense deposits of silt and/or sand followed by a hard glacial till. The glacial till was encountered at depths ranging from 25 to 35 feet below the ground surface in these areas.

Adjacent to Black~~o~~ Creek, subsurface conditions consist of a surficial deposit 18 feet thick of very stiff glacial till overlying up to 115 feet of very stiff to hard stratified cohesive deposits consisting of alternative layers of clayey silt to silty clay overlying hard glacial till.

On the east side of the Humber River (Main Branch) and adjacent to Islington Avenue, it was not possible to carry out borings because of property problems. However, subsurface data obtained by other agencies in this area reveal that the subsurface conditions consist of 20 feet of compact to dense sand and/or silt deposits overlying 60 feet of soft to stiff clay underlain by a hard glacial till.

Because of the complex variations in subsurface conditions no attempt is made to elaborate on detailed descriptions of the various subsoil types. For more detailed descriptions and subsoil/bedrock boundaries, refer to the individual Foundation Data Sheets and the appropriate Borehole Log Sheets. In addition, reference can be made to Drawings No. 887800-B and C on which borehole data is plotted on the \varnothing profile.

Groundwater Conditions

Groundwater observations were carried out during the field investigation by measuring in the open boreholes. Groundwater was observed at depths of 10 to 30 feet below the ground surface, except adjacent to waterways where the groundwater was at the approximate river water level.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a new east-west expressway, Hwy. 407, to freeway design standards, to be located immediately south of existing Hwy. 7. This report is concerned with that section of Hwy. 407 between Airport Road and Jane Street including the section of existing Hwy. 400 from Langstaff southerly to Steeles Avenue and also the section of proposed Hwy. 427 from Langstaff Road to Finch Avenue. This portion of the project will require the crossing of 5 major waterways, some 10 interchanges including 2 major interchanges and some 16 crossings of railways and minor roads; in all requiring some 50 odd structures. The recommended grade for Hwy. 407 will involve cuts up to 35 feet deep and fills up to 45 feet high.

Our comments for the feasibility, design and construction of the various structures are given on the Foundation Data Sheets included in the Appendix. A data sheet is supplied for each of 31 areas; the area location is described on these sheets and is also shown on Drawing No. 887800-A. An explanation of information supplied on the data sheet is outlined below.

1. The site number given (i.e. A1, A2, etc.) is a numbering system developed for the purposes of the feasibility study only. The actual location is shown on Drawing No. 887800-A.
2. The original ground elevation range given is based on a small scale \varnothing profile and as such the accuracy is not great.
3. The proposed roadway-railway grades are based on a small scale \varnothing profile at the intersection of centrelines. The grade given is understood to be preferred by Planning and Design; the grade in brackets is an alternative "second choice" grade under consideration.
4. Subsurface conditions are described here very briefly and are based on generally not more than one boring per area. Consistencies and relative densities, where applicable, are given.

5. Recommendations - Structure

The recommendations are discussed separately for abutments and piers. The options for structure foundations are given in preferential order based on geotechnical/economical considerations. Some general details of structure recommendations are given below.

Compacted Granular Pad - This option is for abutments only where subsurface conditions are competent. This option is not recommended for water crossings. The minimum requirements of a compacted granular pad are shown on Figure 1 in the Appendix. Furthermore, the footing for this scheme could be designed using a maximum allowable load of 3.0 t.s.f.

Spread Footings - This option is given for abutments and piers where subsurface conditions are competent. The maximum elevation and corresponding maximum design load is given. It is to be noted the spread footings should be provided with a minimum of 4 feet of earth cover for frost protection purposes. In addition, where the spread footing is to be founded on a cohesive deposit, subject to softening upon exposure, it would be necessary to protect the base of the footing from softening by placing 3 inches of mass concrete upon completion of the footing excavation. Also, where the footing is located in a granular deposit and the water table is at or above the footing founding level, it will be necessary to prevent the base of the footing from boiling due to an unbalanced excess hydrostatic head. In this case a dewatering scheme would be required, thus alternative dewatering schemes are shown on Figure 2 and Figure 3.

End Bearing Piles - This founding scheme is recommended for abutments and piers where appropriate. The recommendation gives the estimated pile tip elevation. Generally, the end bearing piles can be designed for the maximum allowable structural capacity which is dependent on the pile section chosen. For example, the maximum allowable load for a 12BP74 steel 'H' pile would be 110 tons per pile. It is generally assumed steel 'H' piles will be used, however, if a certain

pile section is not suitable at the specific area this fact is mentioned in the data sheet. Pile driving would be field controlled by the Hiley Formula unless it is being driven to the bedrock surface or in clayey subsoil.

Friction Piles - This foundation is recommended for abutments and piers where it is considered to be suitable and economically competitive with an end bearing pile. The loading recommendations are given for a #14 timber pile of specified length. If a different type of friction pile is contemplated the maximum allowable load could be prorated by comparing the surface area of the pile in question and the timber pile.

6. Recommendation - Approaches

The recommendations for fill slopes, cut slopes and berm requirements, are based on the proposed preliminary grades assuming fills are constructed of acceptable earth borrow according to current M.T.C. Specifications. Any changes in profile grade would require a reassessment of these recommendations. Also discussed under this heading is special treatment, i.e. benching, etc., that is anticipated at this location.

7. Remarks

In this column are discussed actual creek/river flood plain and bed conditions, geotechnical preference of schemes if appropriate, and other options or considerations to be evaluated during this stage of design.

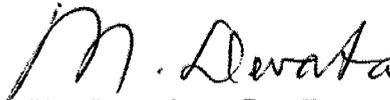
MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. M. MacLean, Project Engineer, using equipment rented from Master Soil Investigation Limited.

This report was written by Mr. M. MacLean and reviewed by
Mr. M. Devata, Supervising Engineer



M. MacLean, P. Eng.
Project Engineer



M. Devata, P. Eng.
Supervising Engineer

December, 1978

RECORD OF BOREHOLE No 1

W P 88-78-00 LOCATION Hwy. 407 & Mimico Creek ORIGINATED BY M.M.
 Coords. N 15 890 590; E 955 960
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers (0-25'), Hollow Stem Augers COMPILED BY M.M.
 (24-40)
 DATUM Geodetic DATE October 13, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH 20 40 60 80 100								
564.8	Ground Surface															
0.0	Clayey Silt		1	SS	9		560									
	Stiff		2	SS	16											
556.8	Very Stiff		3	SS	42											
8.0	Silt, Some Sand		4	SS	44											
	Dense		5	SS	18		550									0 15 84 1
550.8	Sand, Some Silt		6	SS	34											
14.0	Compact		7	SS	39											
534.8			8	SS	50/ 3"		530									
30.0	Heterogeneous Mixture Clayey Silt Sand and Gravel		9	SS	100/ 3"											
	Occasional Cobbles															
523.3	Hard Glacial Till															
41.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 2

W P 88-78-00 LOCATION Hwy. 427 & Finch Avenue ORIGINATED BY MM
 Coords. N 15 891 020; E 966 305
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)	
								20	40	60	80	100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										
555.0	Ground Surface																	
0.0	Clayey Silt Trace Sand Hard		1	SS	32		550											
547.9			2	SS	22													
8.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Glacial Till Hard		3	SS	73										23	27	40	10
			4	SS	111													
			5	SS	68		540								7	22	58	13
			6	SS	50/	5"												
529.4			7	SS	112		530											
26.5	End of Borehole Note: Groundwater Not Encountered																	

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 3

W P 88-78-00 LOCATION Finch Ave. & West Humber ORIGINATED BY MM
 Coords. N 15 891 330; E 967 445
 DIST 6 HWY Finch Ave. BOREHOLE TYPE Hollow Stem Augers & BXL Rock Coring COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY z2.j.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
519.7	Ground Surface																
0.0	Sandy Gravel																
515.7	Loose		1	SS	5												
4.0	Glacial Till																
512.7	Hard		2	SS	48												
7.0	Bedrock, Layers of Limestone and Weathered Shale		3	BXL RC	Rec= ROD=	60% 0%											
505.7			4	BXL RC	Rec= ROD=	60% 0%											
14.0	End of Borehole																
	Note: Groundwater Not Established. Borehole Was Relatively Dry Upon Completion of Augering						490										

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to Sensitivity 20
 15-5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 4

W P 88-78-00 LOCATION Hwy. 407 & Airport Road ORIGINATED BY MM
 Coords. N 15 888 480; E 954 140
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
596.3	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Very Stiff to Hard Brown Grey Very Stiff to Hard		1	SS	32											2 12 46 40	
			2	SS	35												
			3	SS	49												
			4	SS	26												
			5	SS	27												
			6	SS	40												
571.3																	
25.0	Silt, Some Sand Very Dense		7	SS	68/6"												
564.8			8	SS	125												
31.5	End of Borehole Note: Groundwater Not Encountered																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

W P 88-78-00 LOCATION Hwy. 407 & West Humber ORIGINATED BY MM
 Coords. N 15 896 130; E 961 970
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers (0-30'), Hollow Stem Auger & Washing (30-35') COMPILED BY MM
 DATUM Geodetic DATE October 17, 1978 CHECKED BY a.j.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
540.4	Ground Surface																
0.0	Clayey Silt		1	SS	7												
535.4	Stiff		2	SS	24												
5.0	Heterogeneous Mixture Clayey Silt, Sand & Gravel		3	SS	12												
	(Glacial Till)		4	SS	59												
522.4	Stiff to Hard		5	SS	49												
18.0	Silt, Some Sand Compact		6	SS	26												
517.4			7	SS	59												
23.0	Sand, Some Silt Some Gravel Very Dense		8	SS	120/	6"											15 62 21 2
510.4			9	SS	60/	2"											
30.0	Heterogeneous Mixture Silt, Sand and Gravel, Very Dense, Glacial Till																
503.9																	
36.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x⁵: Numbers refer to 20
 15-5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 6

W P 88-78-00 LOCATION Hwy. 407 & Humber Main ORIGINATED BY MM
 Coords. N 15 903 680; E 977 910
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MM
 DATUM Geodetic DATE October 17, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60					
443.5	Ground Surface														
0.0	Fine Sand		1	SS	5										
	Loose		2	SS	5										
	Compact Gravelly Sand		3	SS	16										OM 1%
432.5	Trace Organics														
11.0	Very Stiff		4	SS	26										
	Stiff		5	SS	8										
	Clayey Silt to Silty Clay		6	TW	PH								129		
419.5															
24.0	Clayey Silt to Silt of Slight Plasticity		7	SS	4										
	Very Stiff		8	TW	PH										
409.5															
34.0	Heterogeneous Mixture, Clayey Silt Sand and Gravel Hard (Glacial Till)		9	SS	49										13 17 57 13
			10	SS	134										
			11	SS	100/ 5"										
392.0															
			12	SS	100/ 5"										
51.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers $\times 10$ Sensitivity
 20
 15 $\times 5$ (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 7

W P 88-78-00 LOCATION Hwy. 407 & Kipling Avenue ORIGINATED BY MM
 Coords. N 15 902 520; E 975 330
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY MM
 DATUM Geodetic DATE _____ CHECKED BY VJ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80
456.5	Ground Surface															
0.0	Sand, Some Silt Some Gravel Loose to Compact		1	SS	6		450		End of Cone Test	○	○	○				
447.5			2	SS	21											
9.0	Heterogeneous Mixture Silt, Sand & Gravel (Glacial Till) V. Dense		3	SS	131											
442.5			4	SS	95											
14.0	Sand, Some Silt Some Gravel Compact to Dense		5	SS	45											
			6	SS	11											
			7	SS	50/ 2"											
	Sand, Some Silt Very Dense		8	SS	108											
420.0			9	SS	94											
36.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 8

W P 88-78-00 LOCATION Hwy. 407 @ Hwy. 427 ORIGINATED BY MM
 Coords. N 15 898 530; E 965 070
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 19, 1978 CHECKED BY al

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH						WATER CONTENT (%)
585.8	Ground Surface													
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Very Stiff to Hard (Glacial Till) Red Brown	[Strat Plot]	1	SS	18									
577.8			2	SS	48									
8.0	Sandy Silt Very Dense	[Strat Plot]	3	SS	9									
			4	SS	62									
			5	SS	109									
			6	SS	84									
558.8	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Hard (Glacial Till) Red Brown	[Strat Plot]	7	SS	50									
27.0			8	SS	138									
			9	SS	122									
544.3	End of Borehole Note: Water Level Not Established	[Strat Plot]	10	SS	106								4 26 45 26	
41.5														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

W P 88-78-00 LOCATION Hwy. 427 & Steeles Ave. Coords. N 15 897 460; E 965 250 ORIGINATED BY MM
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 19, 1978 CHECKED BY *al.f.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
578.0	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel	Brown Grey	1	SS	39												
			2	SS	45												
			3	SS	87												
			4	SS	117												
			5	SS	119												
560.0	Hard (Glacial Till)																
18.0	Sandy Silt Very Dense		6	SS	67												
551.5			7	SS	57												
26.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

W P 88-78-00 LOCATION Hwy. 407 & 427 Ramps E of Hwy. 427 ORIGINATED BY MM
 Coords. N 15 899 190; E 966 570
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 20, 1978 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
569.1	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard, Brown Glacial Till		1	SS	30												
			2	SS	45												
558.1			3	SS	124												
11.0	Sandy Silt Some Gravel Very Dense		4	SS	100/6"												
			5	SS	100/6"												28 32 35 5
			6	SS	50/3"												
529.1																	
40.0	Heterogeneous Mixture Clayey Silt, Sand & Gravel, Hard, Glacial Till																
44.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
 15 - 5 (% STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 11

W P 88-78-00 LOCATION Hwy. 407 & Hwy. 50 ORIGINATED BY MM
 Coords. N 15 827 380; E 963 020
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 20, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						SHEAR STRENGTH
578.8	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel (Glacial Till) v. Stiff Brown Hard	1	SS	22	↓										0 4 (96)		
		2	SS	33													
		3	SS	65													
		4	SS	120													
		5	SS	120													
	Very Dense	6	SS	125		570											
555.8	Sandy Silt Very Dense	7	SS	72		560											
23.0						550											
544.8	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Hard (Glacial Till)	8	SS	69		540											
34.0																	
537.3		9	SS	70/2"													
41.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20 IS (20) STRAIN AT FAILURE
 10



RECORD OF BOREHOLE No 12

W P 88-78-00 LOCATION Hwy. 407 & Hwy. 27 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COPILED BY MM
 DATUM Geodetic DATE October 23, 1978 CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60						80
562.5	Ground Surface															
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel (Glacial Till) Hard Brown Grey		1	SS	58											
			2	SS	55											
			3	SS	46											
			4	SS	56											
			5	SS	58											
			6	SS	80											
			7	SS	78											
536.1	End of Borehole															
26.5	Note: Groundwater Not Encountered															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 13

W P 88-78-00 LOCATION Hwy. 407 & Martingrove Road ORIGINATED BY MM
 Coords. N 15 900 900; E 972 020
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 23, 1978 CHECKED BY W.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						WATER CONTENT (%)
559.1	Ground Surface																
0.0	Brown Grey Heterogeneous Mixture Clayey Silt Sand and Gravel (Glacial Till) Hard	1	SS	12													
		2	SS	27													
		3	SS	39													
		4	SS	49													
		5	SS	26													
		6	SS	26													
		7	SS	49													
		8	SS	40													
		9	SS	50													
		10	SS	37													
		11	SS	86													
		12	SS	81													
		13	SS	100/	5"												
487.6			14	SS	100/	2"											
71.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 14

W P 88-78-00 LOCATION Hwy. 407 & Pine Valley Drive Coords. N 15 905 450; E 981 320 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 24, 1978 CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	× LAB VANE	20	40	60	PCF	GR SA SI CL
											400	800	1200	1600	2000		
531.9	Ground Surface																
0.0	Silty Sand Compact		1	SS	24		530										
526.9			2	SS	31												
5.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Very Stiff (Glacial Till)		3	SS	21												
520.9			4	SS	10		520										
11.0	Clayey Silt Very Stiff		5	TW	PH											136	
512.9			6	SS	26												
19.0	Silty Sand to Sandy Silt Some Gravel Compact to Loose		7	SS	18		510										
			8	SS	0												
			9	SS	7		500										
493.9			10	SS	86												
38.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard (Glacial Till)		11	SS	45		490										
			12	SS	29		480										
476.9			13	SS	74		470										
55.0	Silty Sand to Sand, Trace Gravel Dense to Very Dense		14	SS	28		460										
457.9			15	SS	131/6"		450										
74.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard (Glacial Till)		16	SS	60/3"												
440.4																	
91.5	End of Borehole Note: Low 'N' value of 0 blows/foot resulted from excess hydrostatic pressure during sampling procedures.																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15

Hwy. 407 & Weston Road

W P 88-78-00 LOCATION Coords. N 15 908 250; E 987 850 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25, 1978 CHECKED BY d.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR, SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x LAB VANE	20	40	60		
625.0	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Hard		1	SS	13												
	Brown		2	SS	40												
	Grey		3	SS	64												
	(Glacial Till)		4	SS	100												
	Sand		5	SS	113												
			6	SS	136												
			7	SS	75/	5"											
			8	SS	75/	5"											
			9	SS	60/	5"											
583.5			10	SS	60/	4"											
41.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

*3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 16

W P 88-78-00 LOCATION Hwy. 407 & Jane St. ORIGINATED BY MM
 Coords. N 15 910 080 E 993 940
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25-30, 1978 CHECKED BY ajg.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60						80
														WATER CONTENT (%)		
652.7	Ground Surface															
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Very Stiff (Glacial Till) Red Brown Grey		1	SS	17											
			2	SS	19											
			3	SS	39											
			4	SS	62											
			5	SS	72											
634.7	Clayey Silt Trace Sand Stratified Grey Very Stiff to Hard		6	SS	34											
18.0			7	SS	20											
			8	SS	21											
			9	SS	36											
			10	SS	25											
			11	SS	39											
			12	SS	73											
			13	SS	54											
			14	SS	38											
			15	SS	94											
			16	SS	62											
552.7	Cont.															
100.0																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 16 cont

Hwy. 407 & Jane St.

W P 88-78-00 LOCATION Coords. N 15 910 080; E 993 940 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25-30, 1978 CHECKED BY W.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
552.7																	
100.0	Clayey Silt Trace Sand Stratified Grey Very Stiff to Hard	[Diagonal Hatching]	17	SS	32												
			18	SS	39												
			19	SS	38												
520.7																	
132.0	Silty Sand, Trace Gravel, Very Dense	[Diagonal Hatching]	20	SS	150/	6"											
517.7																	
135.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 17

W P 88-78-00 LOCATION Hwy. 400 & Langstaff Rd. Coords. N 15 918 013; E 988 502 ORIGINATED BY MM
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers and Washboring COMPILED BY MM
 DATUM Geodetic DATE October 31, 1978 CHECKED BY E.J.

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
			NUMBER	TYPE	'N' VALUES			20	40	60	80	100			PLASTIC LIMIT W_p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W_L	
673.1	Ground Surface																	
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Red Brown Very Stiff (Glacial Till) Hard Grey		1	SS	19		670											
			2	SS	19													
			3	SS	27													
			4	SS	51		660											2 22 55 21
			5	SS	38													
			6	SS	60													
			7	SS	30		650											
			8	SS	31													
			9	SS	131		640											
							630											
628.1																		
45.0	Clayey Silt Grey Hard Varved		10	SS	41		620											
618.1																		
55.0	Sand, Trace Silt Trace Gravel Compact to Very Dense		11	SS	36		610											
							600											
594.1																		
79.0																		
	Clayey Silt * Grey Hard Varved						580											
672.1																		
101.0	Glacial Till * Hard						570											
568.1																		
105.0	End of Borehole * Note: Description based on wash return, nature of washboring operation and other borings in vicinity.																	

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 19

Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR S-E Corner & Indian Line ORIGINATED BY C.N.R.
 Coords. N 15 894 450; E 964 997
 DIST 6 HWY 427 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY ef.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									WATER CONTENT (%)
561.4	Ground Surface															GR SA SI CL	
0.0	Silty Clay Very Stiff	[Strat Plot]	1	SS	22												
555.0			2	SS	22												
6.4	Sandy Silt Some Gravel Very Dense	[Strat Plot]	3	SS	83												
550.0			4	SS	69												
11.4	Sandy Silt Some Gravel Very Dense	[Strat Plot]	5	SS	62												
			6	SS	29												
			7	SS	82												
			8	SS	100												
			9	SS	100												
531.7	Probably Grey Silt Sand and Gravel Very Dense	[Strat Plot]															
29.7																	
522.0																	
39.4	End of Borehole																
	Note: No groundwater observed																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity 20
 15-5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 18

W P 88-78-00 LOCATION Hwy. 400 & Hwy. 427 ORIGINATED BY MM
 Coords. N 15 908 830; E 989 950
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE November 1, 1978 CHECKED BY W.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
630.0	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel, Red (Glacial Till) Brown Very Stiff Hard		1	SS	24												
			2	SS	43												
			3	SS	60/		3"										
			4	SS	105												
			5	SS	147												
			6	SS	130												
			603.5		7	SS	100/	5"									
26.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 21 Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR West Side & Islington Ave. ORIGINATED BY CNR
 Coords. N 15 903 450; E 979 500
 DIST 6 HWY 407 BOREHOLE TYPE N/A COMPILED BY CNR
 DATUM Geodetic DATE N/A CHECKED BY e.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
523.5																	
0.0	Sand, Medium to Coarse With Gravel																
513.5																	
10.0	Sandy Silt			SS	26												
507.5	Compact			SS	17												
16.0	Silty Clay Very Soft to Stiff																
472.5																	
51.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Stiff to Very Stiff (Glacial Till)			SS	26												
				SS	39												
				SS	27												
				SS	27												
				SS	18												
				SS	41												
442.0				SS	20												
81.5	End of Borehole * Note: This borehole data obtained from CNR																

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 22 Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR & Hwy. 400 ORIGINATED BY CNR
 Coords. N 15 906 450; E 990 470
 DIST 6 HWY 400 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY e.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _l		
619.0	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Dense to Very Dense (Glacial Till)																
604.0																	
15.0	Sandy Silt																
598.0	Very Dense																
21.0	Sand, Fine to Medium Dense to Very Dense																
584.0																	
35.0	Heterogeneous Mixture Silt Sand and Gravel Very Dense																
569.0																	
50.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 23

(This data obtained from
Metropolitan Toronto and Region
Conservation Authority)

W P 88-78-00 LOCATION East Side of Clairville Dam ORIGINATED BY Gaocon
 Coords. N 15 89 0 220; E 965 600
 DIST 6 HWY 427 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY a.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
542.0	Ground Surface																
0.0	Topsoil																
1.0	Heterogeneous Mixture Silt, Sand and Gravel Grey to Brown (Glacial Till) Compact to Very Dense																
504.0																	
38.0	Soft Grey Interbedded Shale and Limestone																
500.0	Bedrock																
42.0	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 φ (%) STRAIN AT FAILURE
 10

APPENDIX

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A5 LOCATION Hwy. 407 at West Humber River
 ORIGINAL GROUND ELEV. 555-565 PROPOSED HWY. 407 GRADE ELEV. 565-567
 Claireville Lake H.W.L. 556+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 5</p> <p><u>West Bank</u></p> <p>0-5' clayey silt, stiff</p> <p>5-18' glacial till stiff to hard</p> <p>18-23' silt, some sand compact</p> <p>23-30' sand, some silt some gravel very dense</p> <p><u>East Bank</u></p> <p>Exposed face is composed of very stiff glacial till</p> <p><u>Groundwater</u></p> <p>At 5 feet below ground surface</p>	<p><u>Abutments and Piers</u></p> <p>End bearing piles Estimated tip elevation 505.0 Designed for maximum allowable structural capacity per pile</p>	<p>Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1.</p> <p>It will be necessary to key the approach fill into the flood plains' steep east bank.</p> <p>Grading the east slope would be required for a distance of some 50 feet north and south of the highway.</p> <p>In addition, protective measures against river erosion of the approach fills would be required.</p>	<p>West Humber at this location is 50 feet wide and flows within a floodplain 100-300 feet wide. The river bottom is expected to be comprised of firm clayey silt with trace organics. The floodplain west bank has a gentle slope, whereas the east bank slope is as steep as 75° and up to 30 feet high.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A6 LOCATION Hwy. 407 at Hwy. 50
 ORIGINAL GROUND ELEV. 578-583 PROPOSED HWY. 407 GRADE ELEV. 565+
 Proposed Hwy. 50 Grade Elevation 585+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 11</p> <p>0-13' glacial till very stiff to hard</p> <p>13-23' glacial till very dense</p> <p>23-34' sandy silt very dense</p> <p>34-42'+ glacial till hard</p> <p><u>Groundwater</u></p> <p>28' below ground Level</p>	<p><u>Abutments</u></p> <ol style="list-style-type: none"> 1. Compacted granular pad 2. Spread footing at or below elevation 575.0. Design for maximum allowable load of 3.5 tsf. 3. End bearing piles Estimated tip elevation 540.0 Designed for maximum allowable structural capacity per pile <p><u>Piers</u></p> <ol style="list-style-type: none"> 1. Spread footings at or below elevation 565.0. Design for maximum allowable load of 5 t.s.f. 	<p>Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.</p> <p>Earth cuts up to 20 feet deep will be stable with slopes of 2:1.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A14 LOCATION Hwy. 407 at Kipling Avenue
 ORIGINAL GROUND ELEV. 460-470 PROPOSED HWY. 407 GRADE ELEV. 498+ (496+)
 Proposed Kipling Avenue Grade Elevation 470+ Invert Elevation Plunketts Creek 448+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 6</p> <p>0-9' sand, some silt some gravel loose to compact</p> <p>9-14' glacial till very dense</p> <p>14-25' sand, some silt some gravel compact to dense</p> <p>25-37'+ sand, some silt very dense</p> <p><u>Groundwater</u></p> <p>5' below ground surface</p>	<p><u>Abutments</u></p> <ol style="list-style-type: none"> 1. Compacted granular pad 2. End bearing piles Estimated tip elevation 425.0 Designed for maximum structural capacity per pile <p><u>Piers</u></p> <ol style="list-style-type: none"> 1. End bearing piles as discussed above. 	<p>Fill heights up to 38 ft. will be stable with forward and side slopes of 2:1.</p>	<p>It is understood Plunketts Creek will be relocated slightly and the crossing of Kipling Ave. and Hwy. 407 would be accomplished by a culvert. A concrete box culvert or structural plate pipe or pipe arch would be suitable at this location.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A15 LOCATION Kipling Ave. at C.N.R. Halton Sub.
 ORIGINAL GROUND ELEV. 465-509 PROPOSED HWY. C.N.R. GRADE ELEV. 509+
 Proposed Kipling Ave. Grade Elevation 436+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 7</p> <p>0-9' sand, some silt some gravel loose to compact</p> <p>9-14' glacial till, hard</p> <p>14-25' sand, some silt compact to dense</p> <p>25-37' + glacial till very dense</p> <p><u>Groundwater</u></p> <p>5' below ground surface</p>	<p><u>Abutments and Piers</u></p> <p>End bearing Piles Estimated tip elevation 425.0 Designed for maximum allowable structural capacity of the pile.</p>	<p>Fill heights up to 35 ft. will be stable with forward and side slopes of 2:1.</p> <p>Fill heights in excess of 35 feet would be inherently unstable due to erosion of the slope surface. In view of this fill heights up to 44 feet would require a 10 foot wide 1/3 height berm to reduce future maintenance costs.</p>	<p>In order to construct Kipling Ave. through the existing embankment three alternatives could be adopted.</p> <p>A/ Tunnel Kipling Ave. through the existing C.N.R. embankment</p> <p>B/ Underpin the C.N.R. track during construction of Kipling</p> <p>C/ Detour the C.N.R. north during construction. Detouring north is preferred to detouring south because of the unfavourable subsoil conditions within the Thackeray Land Fill Site. Furthermore, the Plunkett Creek culvert would be required to be designed for the full surcharge of the</p>
		<p>detoured railway embankment (78'). The slopes of the detoured railway embankment would require a 20' wide mid height berm for stability purposes.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A16 LOCATION Hwy. 407 at Humber River
 ORIGINAL GROUND ELEV. 445-503 PROPOSED HWY. 407 GRADE ELEV. 476+
 Humber River H.W.L. 457+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> <u>West Side B.H. 6</u> 0-11' sand to gravelly sand, loose to compact 11-24' clayey silt to silty clay, stiff to very stiff 24-34' silt of slight plasticity very stiff 34-52'+ glacial till, hard <u>East Side B.H. 20</u> Variable subsoil conditions 0-15' sandy silt, some gravel 15-35' clayey silt, stiff to very stiff 35-105' glacial till, dense 105-120'+ glacial till, hard <u>Groundwater</u> At 9' below ground surface</p>	<p><u>Abutments and Piers</u> <u>West Side</u> 1. End bearing piles Estimated tip elevation 400.0 Design for maximum allowable structural capacity of the pile.. <u>East Side</u> 1. End bearing piles Estimated tip elevation 385.0 Design for maximum allowable structural capacity of the pile. 2. Friction piles #14 timber piles 45' long designed for maximum allowable load per pile of 30 tons.</p>	<p><u>West Side</u> Fill heights up to 31 ft. will be stable with forward and side slopes of 2:1. Furthermore, on the west approach, consolidation of the underlying clayey silt will occur. Settlement of the 31' fill will be in the order of 3-4", 90% of which will occur within 6 months of completion of the embankment. In order to minimize post construction settlements preloading for 6 months may be required. <u>East Side</u> it is anticipated the east approach will be in a partial cut through very soft to stiff silty clay. Because of property problems it was not possible to gain access to the concerned area, obtain necessary samples and perform the required testing. Although specific data is lacking it is postulated that nominal berms 10' wide mid height may be required in the cut areas.</p>	<p>At this location river is 50' wide and 3' deep. The river banks are about 8 feet high and slopes about 75°.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A17 LOCATION Hwy. 407 at C.P. R. Mactier Sub.
 ORIGINAL GROUND ELEV. 480-503 PROPOSED HWY. 407 GRADE ELEV. 484[±]
 Proposed C.P.R. Mactier Sub. Grade Elevation 503[±]

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u></p> <p>Because of property access problems it was not possible to carry out the necessary testing, and for feasibility purposes we have used data from the nearby CNR-Islington crossing.</p> <p><u>B.H. 21</u></p> <p>0-10' sand medium to coarse 10-16' sandy silt, compact 16-51' silty clay, very soft to stiff 51-82'+ stiff to very stiff glacial till</p> <p><u>Groundwater</u></p> <p>Not established</p>	<p><u>Abutments and Piers</u></p> <p>1. Friction Piles #14 timber piles 45' long Design load 25 tons per pile</p>	<p>Fill heights up to 23 ft. will be stable with forward and side slopes of 2:1.</p> <p>It is anticipated that the approaches will be located in partial cuts through very soft to stiff silty clay. Although specific data is lacking it is postulated that nominal berms 10' wide mid height may be required.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A26 LOCATION Hwy. 400 at Langstaff Road
 ORIGINAL GROUND ELEV. 680+ PROPOSED HWY. 400 GRADE ELEV. 680+
 Proposed Langstaff Road Grade Elevation 700+

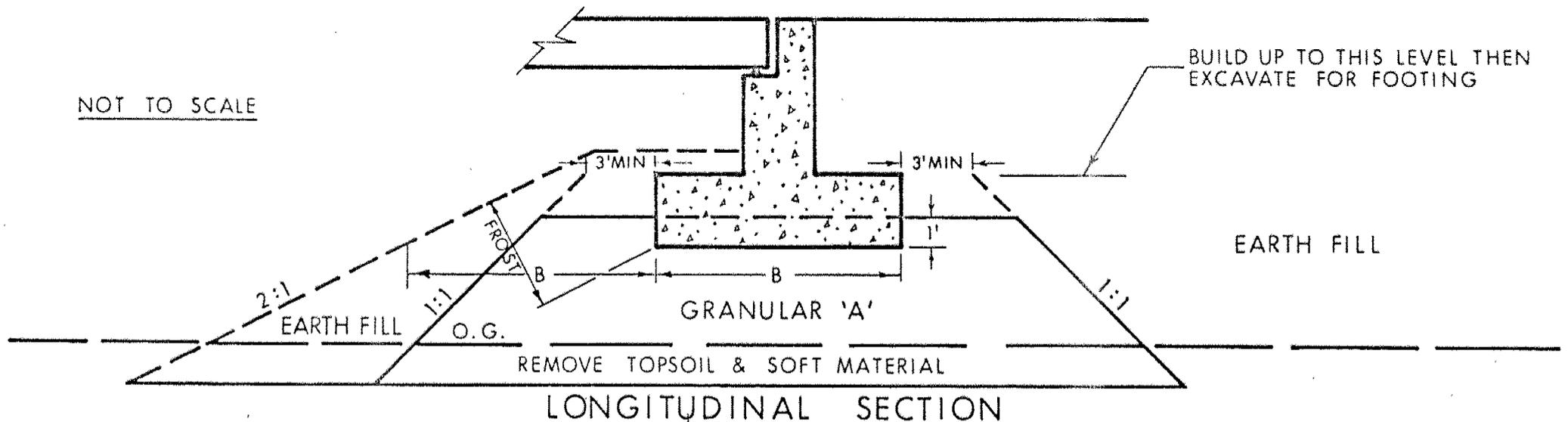
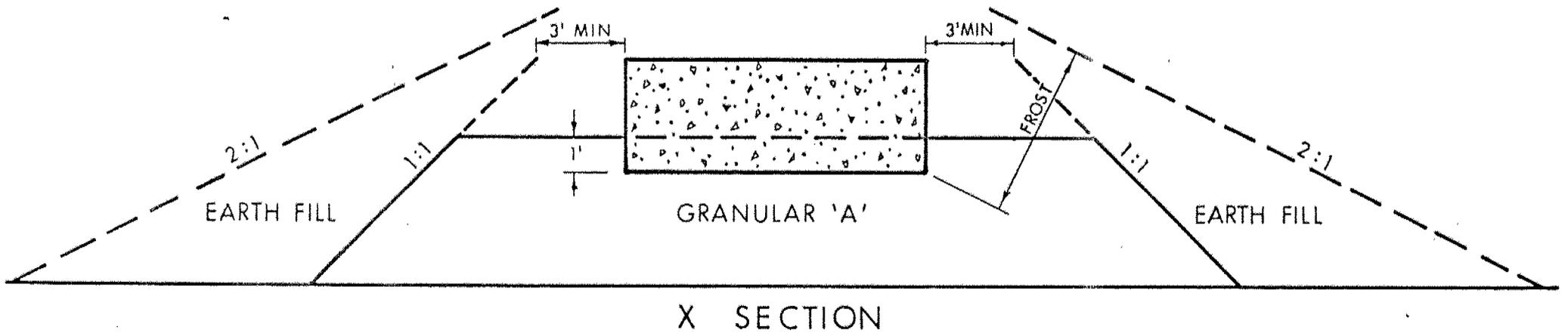
SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 17</p> <p>0-45' glacial till very stiff to hard</p> <p>45-55' clayey silt varved, hard</p> <p>55-79' sand, compact to very dense</p> <p>79-101' clayey silt stratified, hard</p> <p>101-105' glacial till hard</p> <p><u>Groundwater</u></p> <p>9' below ground surface</p>	<p><u>Abutments</u></p> <p style="padding-left: 40px;">Compacted granular pad</p> <p><u>Piers</u></p> <p style="padding-left: 40px;">Spread footings at or below elevation 665. Designed for maximum allowable load of 3 t.s.f.</p>	<p>Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A29 LOCATION Finch Avenue Over West Humber River
 ORIGINAL GROUND ELEV. 515-555 PROPOSED HWY. GRADE ELEV. 548-555
 West Humber River High Water Level 515+

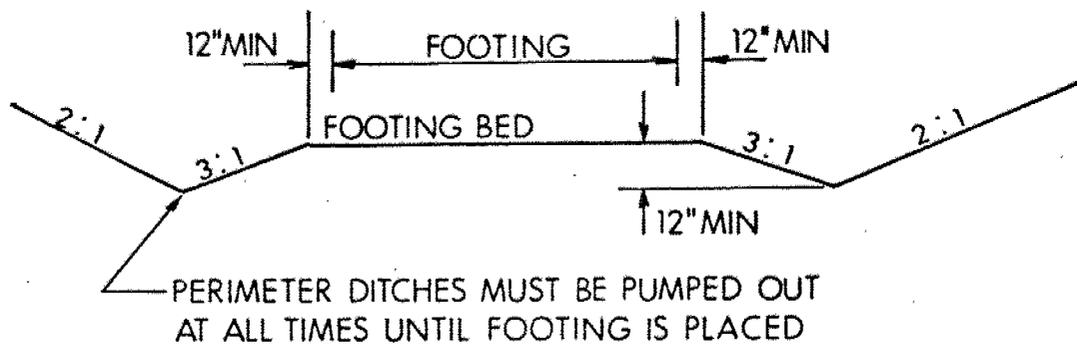
SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 3</p> <p><u>West of River</u></p> <p>0-4' sandy gravel, loose</p> <p>4-7' glacial till, hard</p> <p>7-14' + bedrock, poor quality, layers of limestone and weathered shale</p> <p><u>East of River</u> (in exposed bank)</p> <p>0-10'+ clayey silt very stiff</p> <p>10'+ glacial till, hard</p> <p><u>Groundwater</u></p> <p>Boring was relatively dry upon completion of augering. Groundwater level was not established.</p>	<p>Because of the numerous possibilities of abutment pier locations and foundation elevations the following founding options are provided.</p> <p><u>Abutments and Piers</u></p> <ol style="list-style-type: none"> 1. Spread footings founded on bedrock at or below elevation 512.0. Design for maximum allowable load of 7 t.s.f. 2. End bearing piles driven to bedrock. Estimated tip elevation 512.0. Designed for maximum allowable load per pile. 	<p>Fill heights up to 35 ft. will be stable with forward and side slopes of 2:1.</p> <p>It will be necessary to key the roadway fill into the flood plains' steep banks. Cutting back the east bank slope to a stable 2:1 would be required for a distance of some 150 feet north and south of the roadway. In addition, protective measures against erosion of the roadway fill and east bank will be required. Furthermore, it will be advantageous to permanently divert the river 100 to 500 feet to the west.</p>	<p>At this location during the field investigation the depth of water was 1-2'. Boulders and cobbles are strewn in creek bed.</p>

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



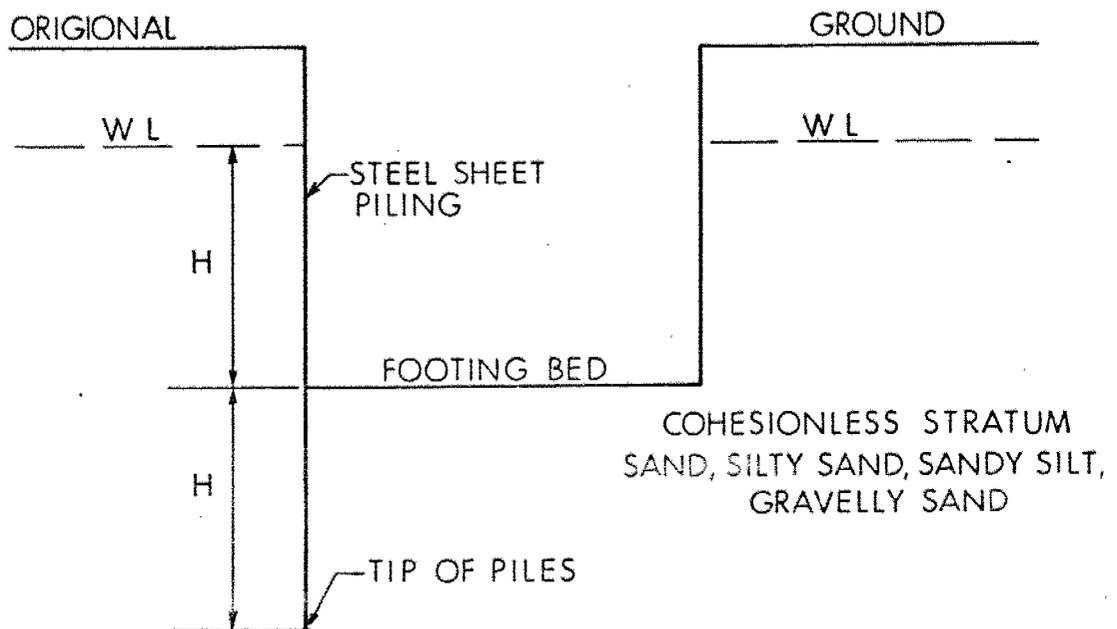
NOTES:

- 1- REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2- PLACE GRANULAR 'A' & EARTH FILL TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3- EXCAVATE COMPACTED GRANULAR 'A' & EARTH FILL FOR FOOTING.



OVERSIZE EXCAVATION WITH PERIMETER DRAINS

FIG No 2



STEEL SHEET PILING

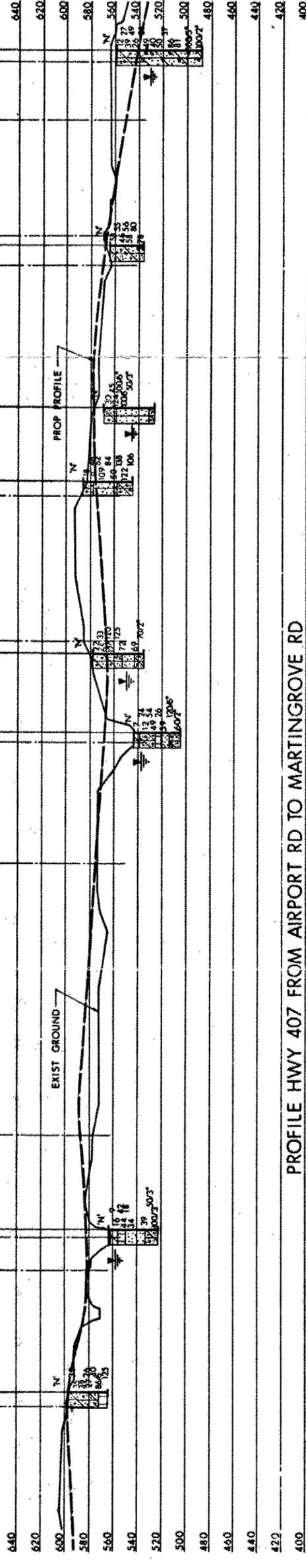
FIG No 3

CONT No
WP No 88-78-00

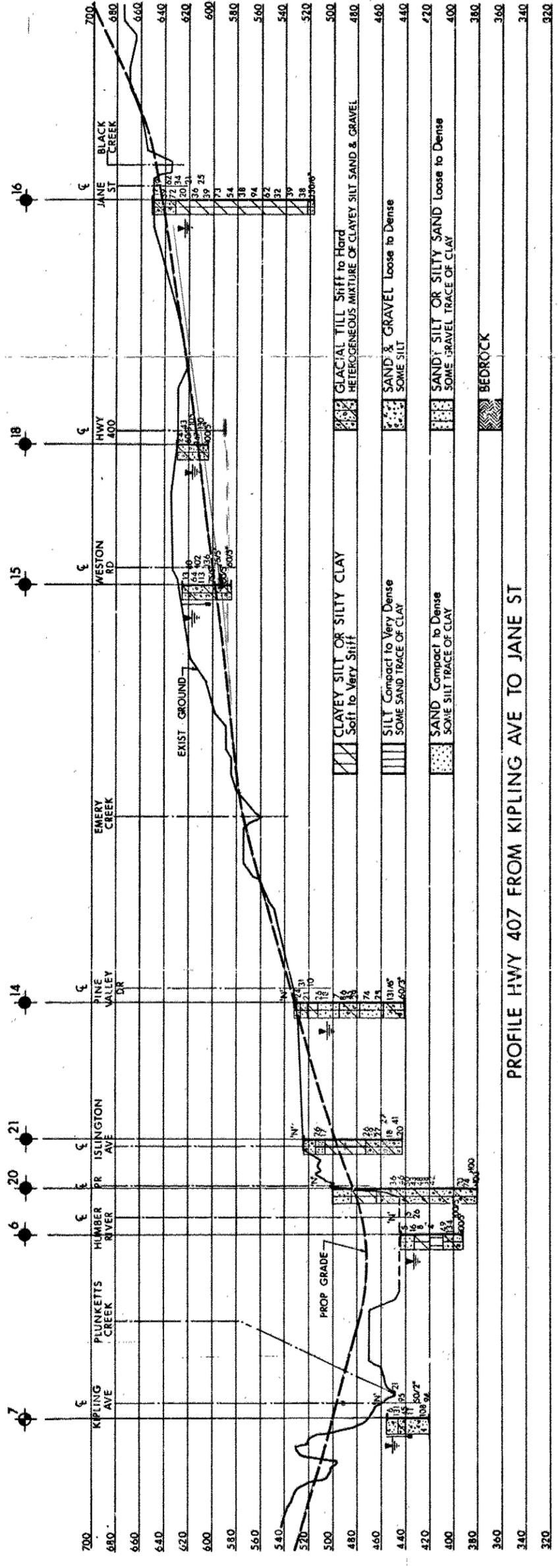
HWY 407

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



PROFILE HWY 407 FROM AIRPORT RD TO MARTINGROVE RD

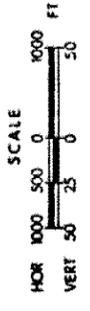


PROFILE HWY 407 FROM KIPLING AVE TO JANE ST

- LEGEND**
- Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊖ Bore Hole & Cone
 - N' Blows/ft (Std Pen Test 350ft lbs energy)
 - CONE Blows/ft (60° Cone, 350ft lbs energy)
 - ↓ WL at time of investigation
 - NO WL Established in BH No 2 3 4 8 12 19 20 21 & 23

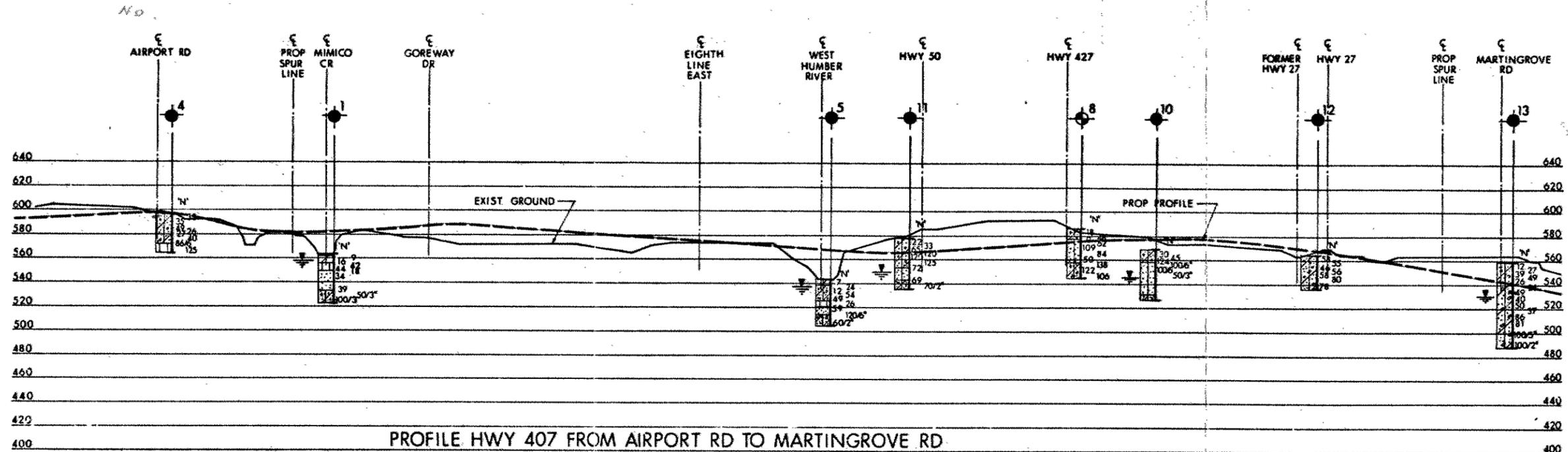
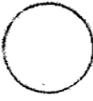
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	564.8	15 890 390	955 950
2	555.9	15 891 020	966 305
3	519.7	15 891 330	967 445
4	596.3	15 888 480	954 140
5	540.4	15 896 150	961 970
6	443.5	15 903 680	977 910
7	456.5	15 902 520	975 330
8	578.0	15 898 530	965 070
9	569.1	15 897 190	966 570
10	578.8	15 897 380	963 020
11	562.6	15 899 840	949 280
12	559.1	15 900 900	972 020
13	531.9	15 905 450	981 320
14	625.0	15 908 250	987 850
16	652.7	15 910 080	993 940
17	673.1	15 918 013	988 502
18	630.0	15 908 830	989 950
19	561.4	15 894 450	964 997
20	500.0	15 903 050	978 100
21	523.5	15 903 450	979 500
22	619.0	15 906 450	990 470
23	542.0	15 890 220	965 600

-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

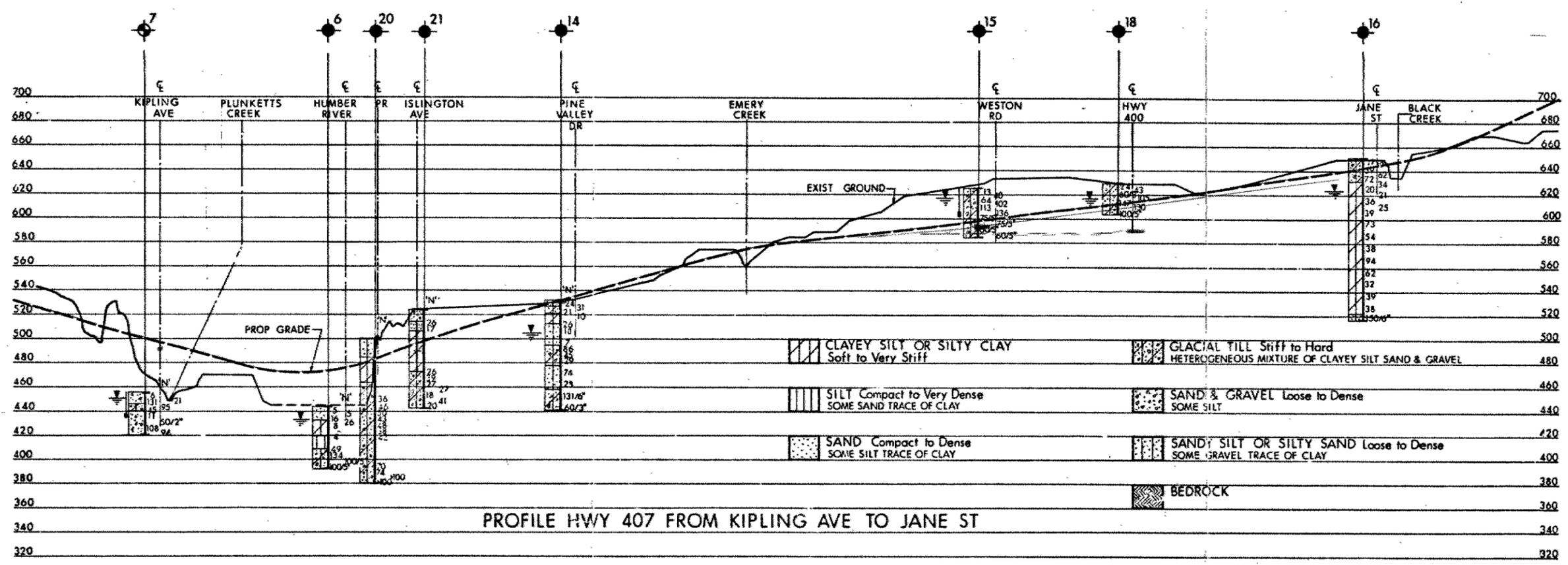


REVISIONS

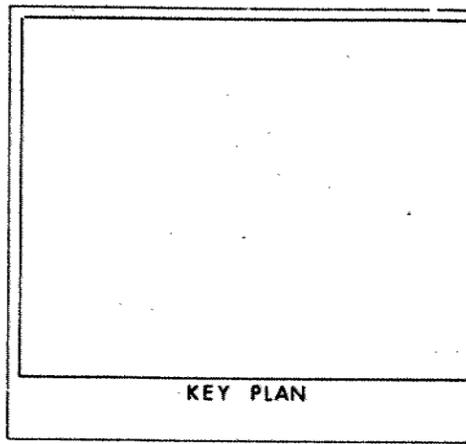
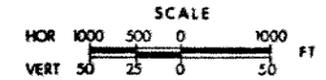
DATE	BY	DESCRIPTION



PROFILE HWY 407 FROM AIRPORT RD TO MARTINGROVE RD



PROFILE HWY 407 FROM KIPLING AVE TO JANE ST



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊗ Bore Hole & Cone
- N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- ↓ WL at time of investigation
- NO WL Established in BH No 2 3 4 8 12 19 20 21 & 23

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	564.8	15 890 590	955 760
2	555.9	15 891 020	966 305
3	519.7	15 891 330	967 445
4	596.3	15 888 480	954 140
5	540.4	15 896 130	961 970
6	443.5	15 903 680	977 910
7	456.5	15 902 520	975 330
8	585.8	15 898 530	965 070
9	578.0	15 897 460	965 250
10	569.1	15 899 190	966 570
11	578.8	15 897 380	963 020
12	562.6	15 899 840	969 280
13	559.1	15 900 900	972 020
14	531.9	15 905 450	981 320
15	625.0	15 908 250	987 850
16	652.7	15 910 080	993 940
17	673.1	15 918 013	988 502
18	630.0	15 908 830	989 950
19	561.4	15 894 450	964 997
20	500.0	15 903 050	978 100
21	523.5	15 903 450	979 500
22	619.0	15 906 450	990 470
23	542.0	15 890 220	965 600

-NOTE-
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO 3115 DIMITIS



GENERAL NOTES
CLASS OF CONCRETE

APPROACH SLABS : 20 MPa
 CONCRETE SLOPE PAVING : 20 MPa
REINFORCING STEEL
 GRADE 400. BAR MARKS WITH THE SUFFIX "C" SHALL BE COATED BARS.
CLEAR COVER TO REINF. STEEL
 APPROACH SLABS : 2" EXCEPT AS NOTED
 SIDEWALKS & MEDIAN : 2"
 REMAINDER : 3"

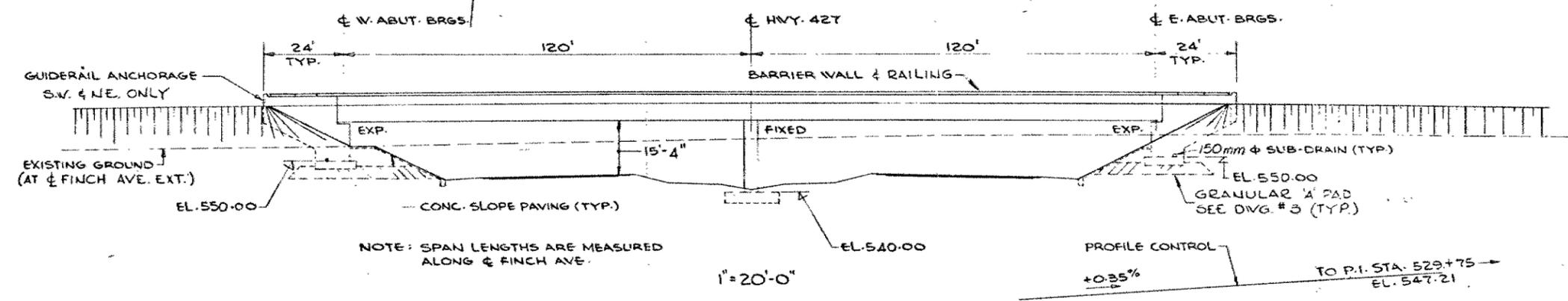
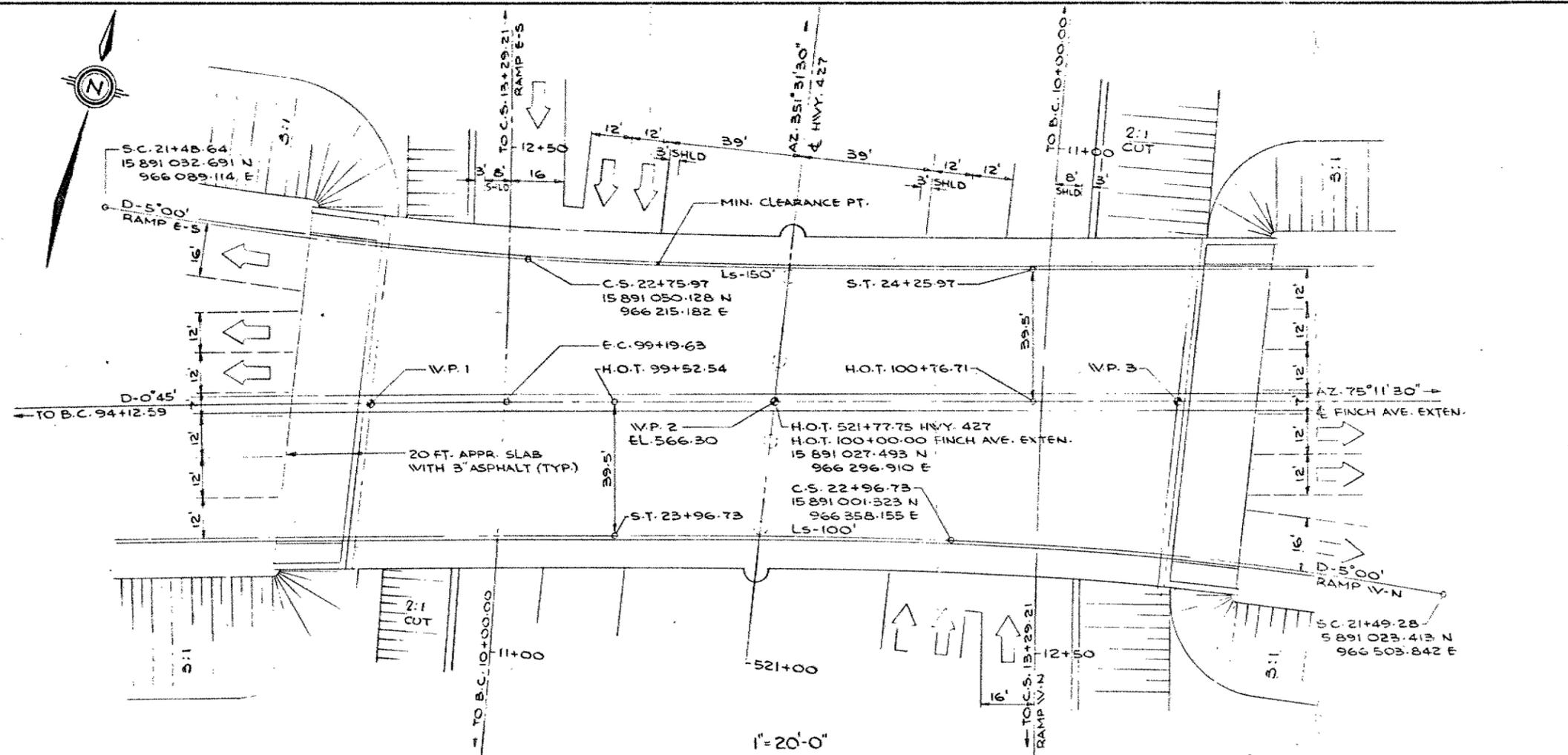
NOTE
 STRUCTURAL WORK ON THIS CONTRACT INCLUDES ONLY THE FOLLOWING:
 C) CONCRETE SLOPE PAVING, APPROACH SLABS ASPHALT & WATER PROOFING AT SITE 37-1084
 b) APPROACH SLABS, ASPHALT AND WATERPROOFING AT SITE 37-633 A
 C) ASPHALT & WATERPROOFING AT SITE 37-633 B

- LIST OF DRAWINGS**
- 1 GENERAL ARRANGEMENT I
 - 2 20 FT. APPROACH SLAB
 - 3 DETAILS OF CONC. SLOPE PAVING
 - 4 GENERAL ARRANGEMENT II
 - 5 20 FT. APPROACH SLAB
 - 6 GENERAL ARRANGEMENT III

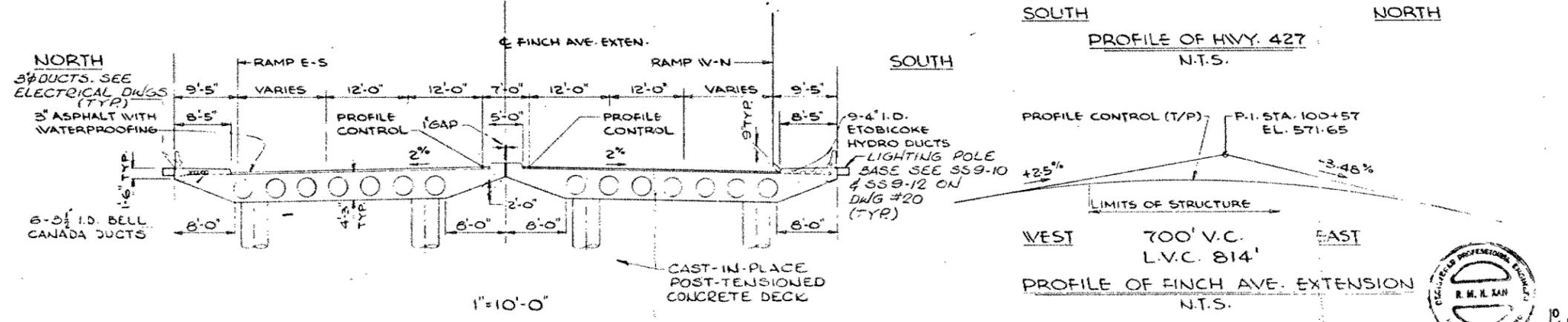
CONCRETE QUANTITIES
 CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:

SITE 37-1084
 APP. SLABS - 134 cu. yds.
 CONC. SLOPE PAVING - 97 cu. yds.

SITE 37-633A - APP. SLABS - 79 cu. yds.

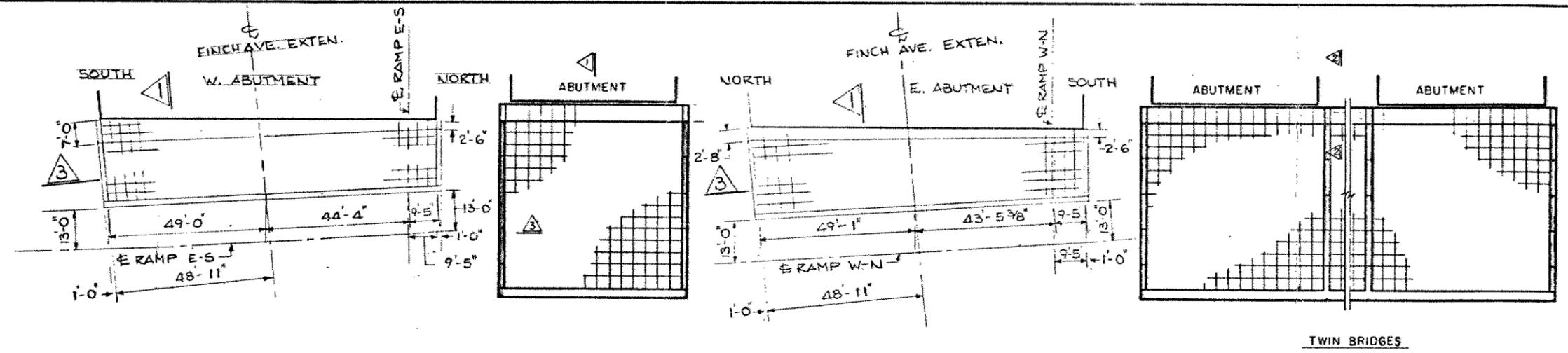


NOTE: SPAN LENGTHS ARE MEASURED ALONG ϕ FINCH AVE.



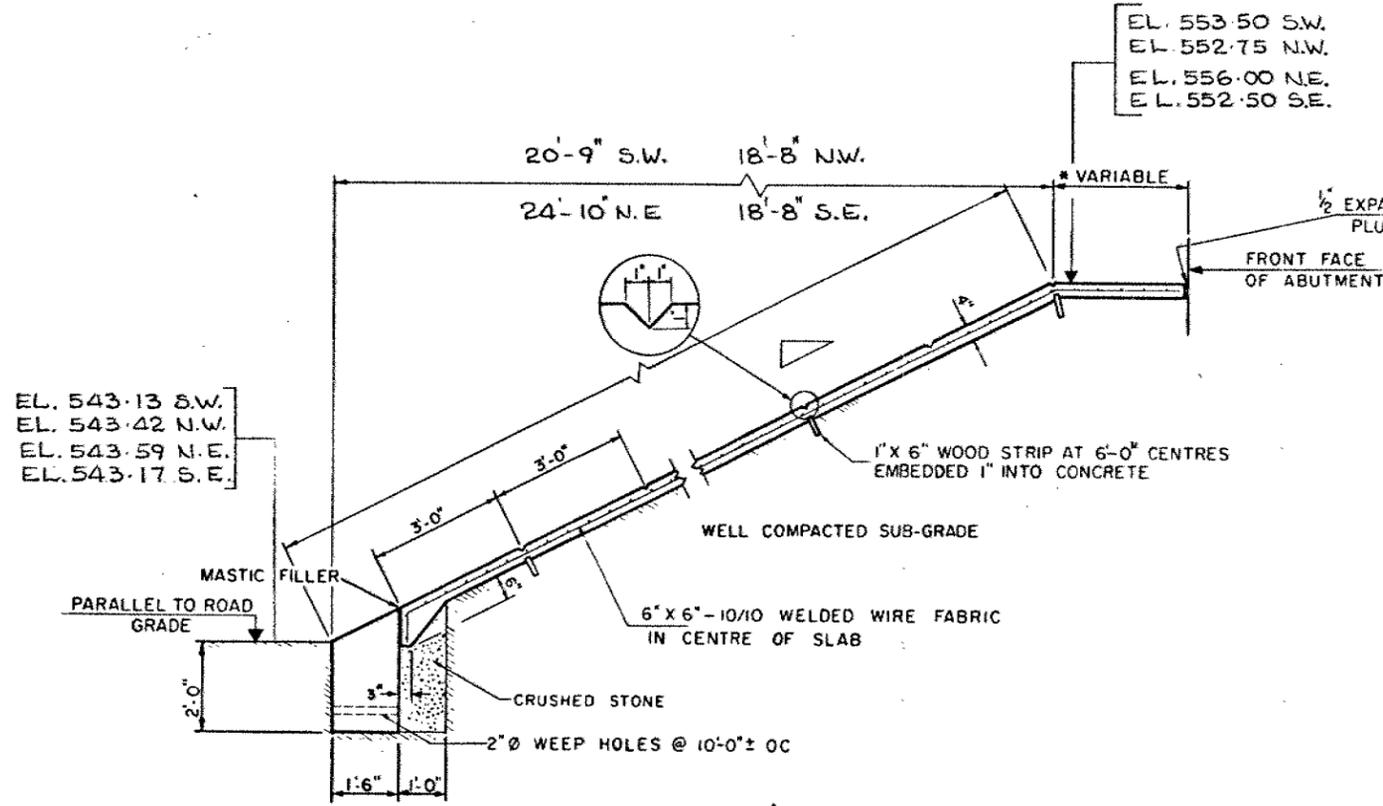
FOR REDUCED PLAN
 USE SCALE BELOW
 1" = 2 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION



SLOPE PAVING LAYOUTS

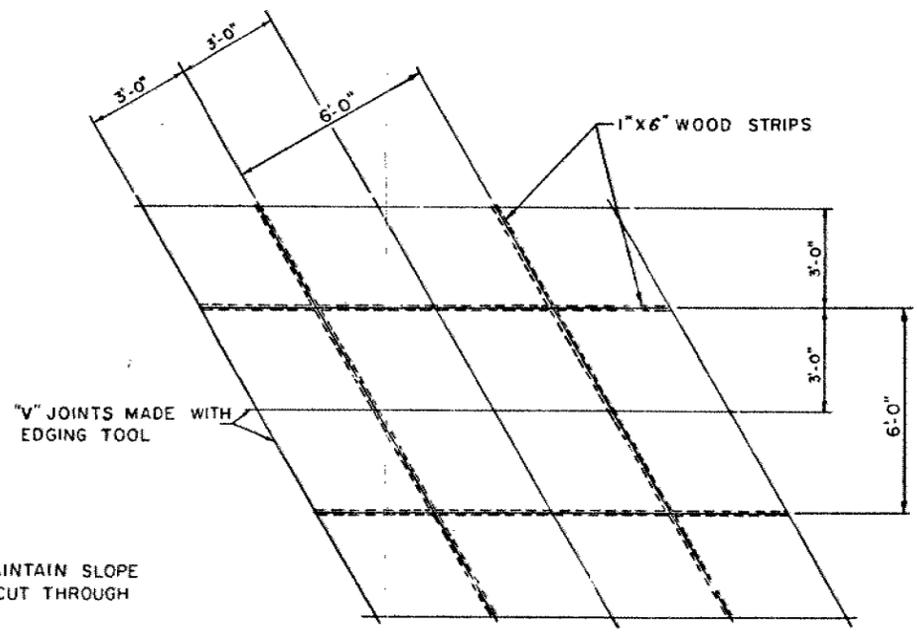
TWIN BRIDGES



EL. 543.13 S.W.
EL. 543.42 N.W.
EL. 543.59 N.E.
EL. 543.17 S.E.

NOTES

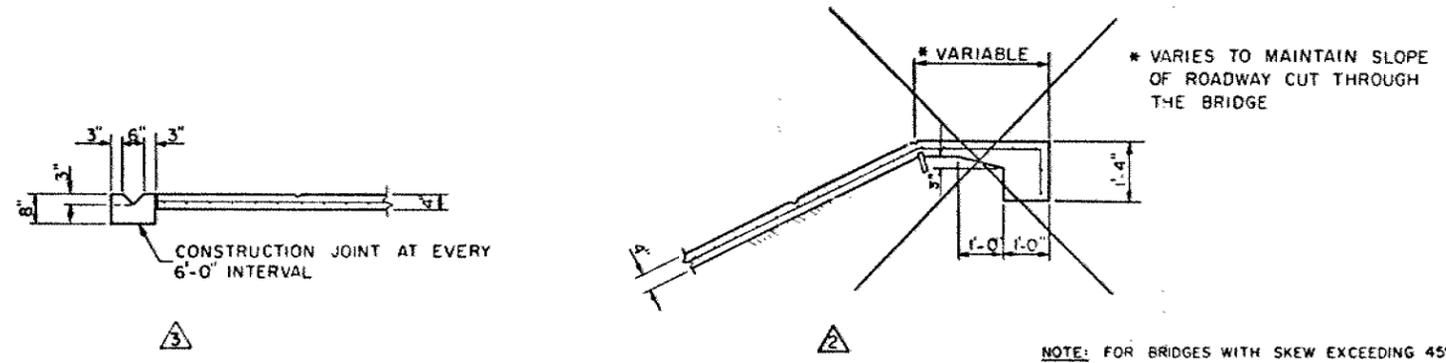
- CLASS OF CONCRETE 20M₂ -INSITU.
- THE GROOVES SHALL BE PARALLEL TO THE ROAD GRADE IN ONE DIRECTION AND PARALLEL TO THE SKEW IN THE OTHER DIRECTION



WOOD FRAME AND "V" JOINT LAYOUT

NOTE

SECTIONS AND DETAILS TYPICAL FOR ALL LAYOUTS



NOTE: FOR BRIDGES WITH SKEW EXCEEDING 45°
"V" GROOVES SHALL BE PROVIDED AT 6' O C
OVER WOOD FRAME STRIPS ONLY

REVISIONS	DATE	BY	DESCRIPTION
DESIGN			
DRAWING			

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DS-BR-15



Ontario

Ministry of
Transportation and
Communications

Structural Section,
Central Region,
3501 Dufferin Street,
Downsview, Ontario.
M3K 1N6
Telephone: 248-3097

March 28, 1979

Mr. E.N. Mroz, P. Eng.,
Proctor & Redfern Limited,
75 Eglinton Avenue East,
Toronto, Ontario.

Dear Sir:

Re: Hwy. 427, Rexdale Blvd. to North of Humber River
W.P. 49-71-01 District 6, Toronto

The following preliminary structural foundation information is provided for your use in the design of the above project. Subsurface conditions are based in general on only one boring per area. General details of the structure recommendations are given below.

a) Morning Star Drive U'Pass

No preliminary foundation investigation was carried out at this site, but it may be assumed that steel H-Piles will be required for the abutment foundations and spread footings for the centre pier. This is based on requirements at the Rexdale Blvd. structure to the south.

b) Finch Avenue U'Pass - Site A 28

Preliminary borehole (BH 2) was advanced at this area. Recommendations are given in the attached foundation Data Sheet which shows the preferential order for the abutment and pier foundations.

These recommendations as per our report and previous verbal discussions with K. Pilgrim. MM 79 03 30

Files

WP 88-78-00



..... 2

c) Finch Ave. Crossing of Humber River - Site A 29

Preliminary borehole (BH 3) was advanced at this area and recommendations are given on the attached foundation Data Sheet with preferential order shown.

d) Hwy. 427, Crossing of Humber River (including ramps) Site A 27

Borehole BH 23 at the existing dam was used to determine recommendations shown on the foundation Data Sheet.

Compacted Granular Pad - This option is for abutments only where subsurface conditions are competent. This option is not recommended for water crossings. The minimum requirements of a compacted granular pad are shown on Figure 1 in the Appendix. Furthermore, the footing for this scheme could be designed using a maximum allowable load of 3.0 t.s.f.

Spread Footings - This option is given for abutments and piers where subsurface conditions are competent. The maximum elevation and corresponding maximum design load is given. It is to be noted the spread footings should be provided with a maximum of 4 feet of earth cover for frost protection purposes. In addition, where the spread footing is to be founded on a cohesive deposit, subject to softening upon exposure, it would be necessary to protect the base of the footing from softening by placing 3 inches of mass concrete upon completion of the footing excavation.

End Bearing Piles - This founding scheme is recommended for abutments and piers where appropriate. The recommendation gives the estimated pile tip elevation. Generally, the end bearing piles can be designed for the maximum allowable structural capacity which is dependent on the pile section chosen. For example, the maximum allowable load for a 12BP74 steel 'H' pile would be 110 tons per pile. It is generally assumed steel 'H' piles will be used, however, if a certain pile section is not suitable at the specific area this fact is mentioned in the data sheet. Pile driving would be field controlled by the Hiley Formula unless it is being driven to the bedrock surface or in clayey subsoil.

Recommendation - Approaches

The recommendations for fill slopes, cut slopes and berm requirements, are based on the proposed preliminary grades assuming fills are constructed of acceptable earth borrow according to current M.T.C. Specifications. Any changes in profile grade would require a reassessment of these recommendations.

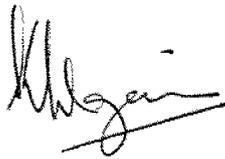
Remarks

In this column are discussed actual creek/river flood plain and bed conditions, geotechnical preference of schemes if appropriate, and other options or considerations to be evaluated during this stage of design.

The above recommendations are excerpts from a preliminary foundation Investigation and Design Report, which was prepared mainly for the proposed highway 407 Structures.

The fieldwork for that investigation was carried out under the supervision of Mr. M. MacLean, Project Engineer, M.T.C. Soil Mechanics Section.

Please do not hesitate to contact this office if any further information is required.



KP:lc
Attach.

K. Pilgrim,
Senior Structural Engineer,
for:
G.C.E. Burkhardt,
Head, Structural Section.

cc: M. MacLean ✓
P. Penev

RECORD OF BOREHOLE No 2

W P 88-78-00 LOCATION Hwy. 427 & Finch Avenue ORIGINATED BY MM
 Coords. N 15 891 020; E 966 305
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x LAB VANE	20	40	60		
555.0	Ground Surface																
0.0	Clayey Silt Trace Sand Hard		1	SS	32												
547.9			2	SS	22												
8.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Glacial Till Hard		3	SS	73											23 27 40 10	
			4	SS	111												
			5	SS	68											7 22 58 13	
			6	SS	50/	5"											
529.4			7	SS	112												
26.5	End of Borehole Note: Groundwater Not Encountered																

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A29 LOCATION Finch Avenue Over West Humber River
 ORIGINAL GROUND ELEV. 515-555 PROPOSED HWY. _____ GRADE ELEV. 548-555
 West Humber River High Water Level 515+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 3</p> <p><u>West of River</u></p> <p>0-4' sandy gravel, loose</p> <p>4-7' glacial till, hard</p> <p>7-14' + bedrock, poor quality, layers of limestone and weathered shale</p> <p><u>East of River</u> (in exposed bank)</p> <p>0-10'+ clayey silt very stiff</p> <p>10'+ glacial till, hard</p> <p><u>Groundwater</u></p> <p>Boring was relatively dry upon completion of augering. Groundwater level was not established.</p>	<p>Because of the numerous possibilities of abutment pier locations and foundation elevations the following founding options are provided.</p> <p><u>Abutments and Piers</u></p> <ol style="list-style-type: none"> 1. Spread footings founded on bedrock at or below elevation 512.0. Design for maximum allowable load of 7 t.s.f. 2. End bearing piles driven to bedrock. Estimated tip elevation 512.0. Designed for maximum allowable load per pile. 	<p>Fill heights up to 35 ft. will be stable with forward and side slopes of 2:1.</p> <p>It will be necessary to key the roadway fill into the flood plains' steep banks. Cutting back the east bank slope to a stable 2:1 would be required for a distance of some 150 feet north and south of the roadway. In addition, protective measures against erosion of the roadway fill and east bank will be required. Furthermore, it will be advantageous to permanently divert the river 100 to 500 feet to the west.</p>	<p>At this location during the field investigation the depth of water was 1-2'. Boulders and cobbles are strewn in creek bed.</p>

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 23

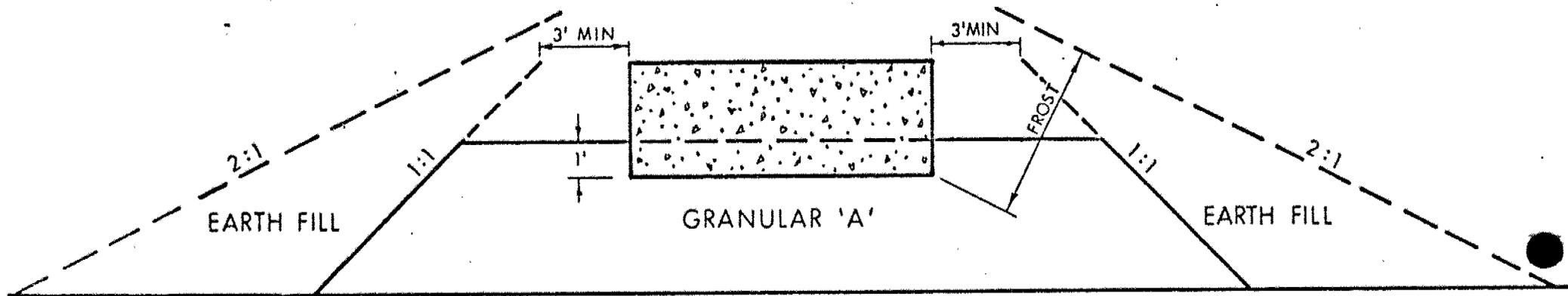
(This data obtained from Metropolitan Toronto and Region Conservation Authority)

W P 88-78-00 LOCATION East Side of Clairville Dam ORIGINATED BY Gaocon
 Coords. N 15 89 0 220; E 965 600
 DIST 6 HWY 427 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY W.J.

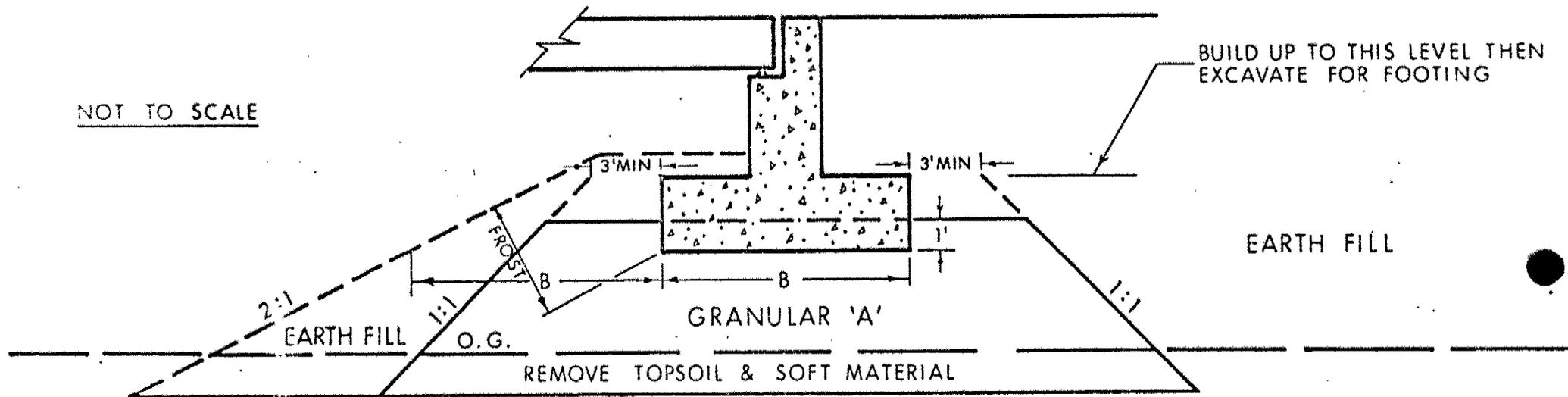
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
542.0	Ground Surface													
0.0	Topsoil													
1.0	Heterogeneous Mixture Silt, Sand and Gravel Grey to Brown (Glacial Till) Compact to Very Dense						540							
							530							
							520							
							510							
504.0														
38.0	Soft Grey Interbedded Shale and Limestone													
500.0	Bedrock													
42.0	End of Borehole						500							

OFFICE REPORT ON SOIL EXPLORATION

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION



LONGITUDINAL SECTION

NOTES:

- 1- REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2- PLACE GRANULAR 'A' & EARTH FILL TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3- EXCAVATE COMPACTED GRANULAR 'A' & EARTH FILL FOR FOOTING.

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 150 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
Jointing	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
Bedding	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. C_{IU} = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
 W S WASH SAMPLE
 S T SLOTTED TUBE SAMPLE
 B S BLOCK SAMPLE
 C S CHUNK SAMPLE
 T W THINWALL OPEN
 T P THINWALL PISTON
 O S OSTBERG SAMPLE
 F S FOIL SAMPLE
 R C ROCK CORE
 P H T.W. ADVANCED HYDRAULICALLY
 P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_a COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_p COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N, N_c, N_q, N_{γ} BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 u_v PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL.



Memorandum

To: Mr. G.C.E. Burkhardt
Head, Structural Section
Central Region
3501 Dufferin St., Downsview

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Attention:
Mr. K. Pilgrim

Date: 78 11 06

Our File Ref.

In Reply to

Subject: Re: Feasibility Study, Hwy. 407 From Airport Road
to Jane Street, W.P. 88-78-00
Hwy. 427 from Finch Avenue to Hwy. 406, W.P. 49-71-00 ✓

Introduction

Further to your request of September 11, 1978 we have completed the foundation investigation fieldwork for the above mentioned project. As per your verbal request of September 8, 1978 we are hereby providing you with our preliminary assessment of the subsoil conditions, general recommendations on structure foundations and the stability of embankments and a preliminary assessment of problem areas.

Fieldwork

The fieldwork was carried out during the period from October 3 to November 1, 1978 and consisted of a total of 18 sampled boreholes advanced by means of either solid stem augers or hollow stem augers to depths of 14 to 135 feet below ground surface. Bedrock was encountered in one boring (within the floodplain of the West Humber River at the proposed Finch Ave. crossing) at a depth of 7 feet and was proven by obtaining 7 feet of BXL size rock core.

In addition to our fieldwork we have assembled a number of boring records located within the study area that have been previously carried out by ourselves and other agencies. This data enabled us to reduce significantly the necessary fieldwork and we will incorporate portions of the data in our report.

Subsurface Conditions

The study area for this portion of Hwy. 407-Hwy. 427-Hwy. 400 is wholly located within the physiographic region known as the "Peel Plain". This area is found to be at elevation 500 to 750 feet above sea level and has a gradual slope toward Lake Ontario. Across the plain, rivers and streams have cut deep valleys and there is, therefore, no large undrained depressions, swamp or bogs in the whole area. The plain is furthermore characterized by an underlying till or boulder clay. In much of the Peel Plain this has been modified by a veneer of clay which when deep enough is clearly seen to be varved.

The fieldwork revealed that across the study area generally favourable conditions exist for structure and embankment foundations. Generally, the dominant subsurface deposit extending from the ground surface to a depth of up to 105 feet is a heterogeneous mixture of clayey silt, sand and gravel, a glacial till. The consistency is very stiff ('N' values 18 to 58 blows per foot) in the upper 10 feet and becoming very hard ('N' values greater than 100 blows per foot) at depths ranging from 15 to 100 feet being generally in the order of 40 feet below the ground surface. In some locations a 14 to 25 foot thick deposit of very dense silty sand was encountered within the glacial till deposit. Exceptions to the above occur adjacent to the major water courses in the study area. At Mimico Creek, Plunketts Creek, the west side of Humber River (Main Branch) and at the West Humber River, subsurface conditions consist of generally a surficial deposit of stiff to very stiff clayey silt up to 20 feet thick overlying loose to dense deposits of silt, silty sand and sand overlying a very hard glacial till ('N' values greater than 100 blows per foot). The glacial till was encountered at depths ranging from 25 to 35 feet below the ground surface. Adjacent to Blacks Creek subsurface conditions consist of a surficial deposit 18 feet thick of very stiff glacial till overlying up to 115 feet of very stiff to hard varved silty clay overlying hard glacial till. Because of property problems it was not possible to place a boring on the east side of the Humber River (Main Branch) at Islington Avenue. However, other borings carried out in this area indicate subsurface conditions consist of 20 feet of compact to dense sand and silt deposits overlying 60 feet of soft to stiff silty clay overlying a very hard glacial till.

Groundwater was encountered at depths of about 10 to 30 feet below the ground surface, except adjacent to waterways where the groundwater was at the approximate river water level.

Discussion and Recommendations

It is proposed to construct a new east-west highway, Hwy. 407, constructed to freeway design standards, to be located immediately south of existing Hwy. 7. This report is concerned with that section of Hwy. 407 between Airport Road and Jane Street including the section of Hwy. 400 from Langstaff southerly to Steeles Avenue and also the section of Hwy. 427 from Hwy. 407 to Finch Avenue. This portion of the project will require the crossing of 5 major waterways, some 10 interchanges including 2 major interchanges, and some 16 crossings of railways and minor roads; in all requiring some 50 odd structures. The recommended grade for Hwy. 407 will involve roadway cuts up to 35 feet deep and roadway fills up to 45 feet high.

cont'd.....

Subsurface conditions across the site are generally favourable for structure and embankment foundations.

In Table 1 attached we have listed the areas where it is proposed to construct structures. Beside each is indicated the suitability for various structure foundation possibilities as follows.

Compacted Granular 'A' Pad - For abutments only, where the maximum allowable bearing pressure is in the order of 3.5 tsf.

Spread Footings - For abutments or piers where the maximum allowable loading will be in excess of 2.5 to 3.0 tsf.

Short End-Bearing Piles - For abutments or piers where the estimate pile tip elevation is 30 to 50 feet below the existing ground surface and the piles can be loaded to the maximum allowable load.

Long End-Bearing Piles - For abutments or piers where the estimated pile tip elevations is 80 to 140 feet below the existing ground surface and the piles can be loaded to the maximum allowable load.

Friction Piles - For abutments or piers where a competent end-bearing stratum is in the order of 80 feet deep and 45 foot #14 timber piles can be used at a loading of 30 tons/pile.

Embankments can be constructed using 2:1 cut slopes in the majority of areas. Where berms in the fill or cut slope may be required for stability purposes this is noted beside the appropriate area.

There are two areas where additional comment is thought necessary at this time. One area is the Hwy. 407-Islington Avenue location and vicinity. Here subsoil conditions consist of up to 20 feet of compact to dense sand and silt deposits overlying up to 60 feet of soft to stiff silty clay overlying hard glacial till. The proposed grade at this location will require a 35 foot cut. It is anticipated that berms will be required for stability purposes at this location. The second area is the Hwy. 407-Weston Road area and vicinity. Here the profile grade also requires a 35 foot cut. Subsoil conditions here consist of up to 42 feet of hard glacial till with a water bearing silty sand deposit 15 to 20 feet below ground surface. Slope protection measures will be required at this location to control seepage from the water bearing stratum.

cont'd.....

It is to be noted that the recommendations contained herein are very general and for the purposes of the Structural Planning Office to proceed with their discussions. In the final feasibility report we will provide more detailed recommendations for the structure and embankment foundation.

If you have any questions please do not hesitate to contact this office.

M MacLean

M. MacLean
Project Engineer

MM/gs

Attach.

cc: Files ✓

TABLE 1

Area	Description	Structure Foundations				Berm Required
		Compacted Granular Fill	Spread Footings	End Bearing Piles Short	End Bearing Piles Long	
A1	Hwy. 407 @ Airport Rd.	X	X			
A2	Hwy. 407 @ Brampton Terminal Spurline		X	X		
A3	Hwy. 407 @ Mimico Creek			X		
A4	Hwy. 407 @ Goreway Dr.	X		X		
A5	Hwy. 407 @ West Humber			X		
A6	Hwy. 407 @ Hwy. 50	X	X			
A7	Hwy. 407 @ Hwy. 427	X	X			
A8	Hwy. 427 @ Steeles Ave.	X	X			
A9	Hwy. 427 @ Albion Rd.	X	X			
A10	Hwy. 427 @ C.N.R.			X		
A11	Hwy. 407-Hwy. 427 Ramps East of Hwy. 427	X	X			
A12	Hwy. 407 @ Hwy. 27	X	X			
A13	Hwy. 407 @ Martingrove		X	X		
A14	Hwy. 407 @ Kipling			X		POSSIBLE
A15	Kipling @ C.N.R.			X		POSSIBLE
A16	Hwy. 407 @ Humber			X		
A17	Hwy. 407 @ C.P.R.				X	
A18	Hwy. 407 @ Islington				X	YES
A19	Hwy. 407 @ Pine Valley Dr.				X	

TABLE 1

Area	Description	Structure Foundations				Berm Required	
		Compacted Granular Fill	Spread Footings	End Bearing Piles Short	Long		Friction Piles
A20	Hwy. 407 @ Weston		X				POSSIBLE
A21	Hwy. 407 @ Hwy. 400	X	X				
A22	Hwy. 400-Hwy. 407 Ramps N. of Hwy. 407	X	X				
A23	Hwy. 400 @ Hwy. 7	X	X				
A24	Hwy. 407 @ Jane St.	X			X	X	
A25	Hwy. 400 @ C.N.R.	X	X				
A26	Hwy. 400 @ Langstaff				X	X	
A27	Hwy. 427 @ West Humber			X			
A28	Hwy. 427 @ Finch	X	X				
A29	Finch @ West Humber	X	X	X			

Legend

X denotes suitability for structure foundations according to the following.

Compacted Granular 'A' Pad: Abutments Only, Max. Allowable Load 3.5 tsf.

Spread Footings: Pier of Abutments Max. Allowable Load in Excess of 2.5 to 3.0 tsf.

Short End-Bearing Piles: Piers or Abutments Estimated Pile Tip Elev. 30-50' Below Ground Level
Max. Allowable Load Per Pile

Long End-Bearing Piles: Piers of Abutments Estimated Pile Tip Elev. 80-140' Below Ground Level
Max. Allowable Load Per Pile

Friction Piles: Piers or Abutments 45' Long #14 Timber Piles @ Load 30 tons/pile

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCREs No. 30M12-136
30M13-48

DIST. 6 REGION _____

W.P. No. 88-78-00

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 407

LOCATION Hwy 407

(FROM AIRPORT RD TO JANE ST)

No. of PAGES - _____



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 88-78-00 DIST 6
49-71-00
HWY 407 & 427 STR SITE N/A
Hwy. 407 From
Airport Road to Jane Street
Hwy. 427 From
Finch Avenue to Hwy. 27

DISTRIBUTION

G.C.E. Burkhardt (3)
R.D. Gunter
M.R. Ernesaks
D.E. Thrasher (2)

C. Grebski
G.A. Wrong
B.J. Giroux
R.S. Pillar

R. Hore

R. Fitzgibbon)
J. Anderson) cover only
G. Sloan)

Files

GEOCRE 30M12-136
30M13-48

DATE

FOUNDATION INVESTIGATION REPORT

For

Feasibility Study
of Hwy. 407 From Airport Road
to Jane Street (Including Hwy. 400)
W.P. 88-78-00
and Hwy. 427 From Finch Avenue to Hwy. 27
W.P. 49-71-00
District 6, Toronto

INTRODUCTION

This report contains the results of a feasibility foundation investigation carried out for the above projects. The fieldwork was carried out from October 13 to November 1, 1978 and consisted of a total of 18 sampled boreholes advanced by means of either solid stem augers or hollow stem augers to depths of 14 to 135 feet below the ground surface. Bedrock was encountered in one boring at a depth of 7 feet and was proven by obtaining 7 feet of BXL size rock core. In addition to our fieldwork we have incorporated in this report 5 borings, B.H. 19 to B.H. 23, that were put down at various pertinent locations by other agencies.

SITE DESCRIPTION AND GEOLOGY

The area under consideration is located immediately north of the city limits of Metropolitan Toronto within the Regional Municipalities of Peel and York. The area for this portion of Hwy. 407 investigated stretches between Airport Road and Jane Street and is located 500 to 2000 feet north of Steeles Avenue. Extending from Finch Avenue to Hwy. 7 between Indian Line and Hwy. 27, is the area of investigation for the feasibility of Hwy. 427. This investigation includes also the portion of Hwy. 400 which runs from the C.N.R. Halton Subdivision to Langstaff Road.

Topographically the overall area can be described as gently undulating, the exception being where creeks or rivers have cut valleys. Land use in the proposed highway right of ways consists

mainly of cultivated open fields; exceptions occur in the vicinities of the Thackeray Land Fill Site and within areas under the jurisdiction of Metropolitan Toronto and Region Conservation Authority.

Physiographically the study area is wholly located within the region known as the "Peel Plain". This area is found to be at elevation 500 to 750 feet above sea level and has a gradual slope toward Lake Ontario. Across the plain, rivers and streams have cut deep valleys and there is, therefore, no large undrained depressions, swamp or bogs in the whole area. The plain is furthermore characterized by an underlying till or boulder clay. In much of the Peel Plain this has been modified by a veneer of clay which, when deep enough, is clearly seen to be varved. Shown on Drawing No. 887800-A are the boundaries and descriptions of the surficial geology, based on the Quaternary Geology, Map 2272, for the Bolton Area.

SUBSURFACE CONDITIONS

Subsurface conditions across the study area are quite variable. Generally the dominant subsurface deposit extending from the ground surface to a depth of up to 105 feet is a heterogeneous mixture of clayey silt, sand and gravel, a glacial till. In some areas a 14 to 25 foot thick deposit of very dense silt and/or sand was encountered within the glacial till deposits.

Exceptions to the above were observed in the areas adjacent to the rivers and creeks.

At Mimico Creek, Plunketts Creek, the west side of Humber River (Main Branch) and at the West Humber River, subsurface conditions consist generally of a surficial deposit of stiff to very stiff clayey silt up to 20 feet thick overlying loose to dense deposits of silt and/or sand followed by a hard glacial till. The glacial till was encountered at depths ranging from 25 to 35 feet below the ground surface in these areas.

Adjacent to Blacks Creek, subsurface conditions consist of a surficial deposit 18 feet thick of very stiff glacial till overlying up to 115 feet of very stiff to hard stratified cohesive deposits consisting of alternative layers of clayey silt to silty clay overlying hard glacial till.

On the east side of the Humber River (Main Branch) and adjacent to Islington Avenue, it was not possible to carry out borings because of property problems. However, subsurface data obtained by other agencies in this area reveal that the subsurface conditions consist of 20 feet of compact to dense sand and/or silt deposits overlying 60 feet of soft to stiff clay underlain by a hard glacial till.

Because of the complex variations in subsurface conditions no attempt is made to elaborate on detailed descriptions of the various subsoil types. For more detailed descriptions and subsoil/bedrock boundaries, refer to the individual Foundation Data Sheets and the appropriate Borehole Log Sheets. In addition, reference can be made to Drawings No. 887800-B and C on which borehole data is plotted on the ϕ profile.

Groundwater Conditions

Groundwater observations were carried out during the field investigation by measuring in the open boreholes. Groundwater was observed at depths of 10 to 30 feet below the ground surface, except adjacent to waterways where the groundwater was at the approximate river water level.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a new east-west expressway, Hwy. 407, to freeway design standards, to be located immediately south of existing Hwy. 7. This report is concerned with that section of Hwy. 407 between Airport Road and Jane Street including the section of existing Hwy. 400 from Langstaff southerly to Steeles Avenue and also the section of proposed Hwy. 427 from Langstaff Road to Finch Avenue. This portion of the project will require the crossing of 5 major waterways, some 10 interchanges including 2 major interchanges and some 16 crossings of railways and minor roads; in all requiring some 50 odd structures. The recommended grade for Hwy. 407 will involve cuts up to 35 feet deep and fills up to 45 feet high.

Our comments for the feasibility, design and construction of the various structures are given on the Foundation Data Sheets included in the Appendix. A data sheet is supplied for each of 31 areas; the area location is described on these sheets and is also shown on Drawing No. 887800-A. An explanation of information supplied on the data sheet is outlined below.

1. The site number given (i.e. A1, A2, etc.) is a numbering system developed for the purposes of the feasibility study only. The actual location is shown on Drawing No. 887800-A.
2. The original ground elevation range given is based on a small scale \varnothing profile and as such the accuracy is not great.
3. The proposed roadway-railway grades are based on a small scale \varnothing profile at the intersection of centrelines. The grade given is understood to be preferred by Planning and Design; the grade in brackets is an alternative "second choice" grade under consideration.
4. Subsurface conditions are described here very briefly and are based on generally not more than one boring per area. Consistencies and relative densities, where applicable, are given.

pile section is not suitable at the specific area this fact is mentioned in the data sheet. Pile driving would be field controlled by the Hiley Formula unless it is being driven to the bedrock surface or in clayey subsoil.

Friction Piles - This foundation is recommended for abutments and piers where it is considered to be suitable and economically competitive with an end bearing pile. The loading recommendations are given for a #14 timber pile of specified length. If a different type of friction pile is contemplated the maximum allowable load could be prorated by comparing the surface area of the pile in question and the timber pile.

6. Recommendation - Approaches

The recommendations for fill slopes, cut slopes and berm requirements, are based on the proposed preliminary grades assuming fills are constructed of acceptable earth borrow according to current M.T.C. Specifications. Any changes in profile grade would require a reassessment of these recommendations. Also discussed under this heading is special treatment, i.e. benching, etc., that is anticipated at this location.

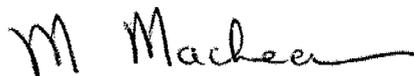
7. Remarks

In this column are discussed actual creek/river flood plain and bed conditions, geotechnical preference of schemes if appropriate, and other options or considerations to be evaluated during this stage of design.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. M. MacLean, Project Engineer, using equipment rented from Master Soil Investigation Limited.

This report was written by Mr. M. MacLean and reviewed by
Mr. M. Devata, Supervising Engineer



M. MacLean, P. Eng.
Project Engineer



M. Devata, P. Eng.
Supervising Engineer

December, 1978

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A5 LOCATION Hwy. 407 at West Humber River
 ORIGINAL GROUND ELEV. 555-565 PROPOSED HWY. 407 GRADE ELEV. 565-567
 Claireville Lake H.W.L. 556+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 5</p> <p><u>West Bank</u></p> <p>0-5' clayey silt, stiff</p> <p>5-18' glacial till stiff to hard</p> <p>18-23' silt, some sand compact</p> <p>23-30' sand, some silt some gravel very dense</p> <p><u>East Bank</u></p> <p>Exposed face is composed of very stiff glacial till</p> <p><u>Groundwater</u></p> <p>At 5 feet below ground surface</p>	<p><u>Abutments and Piers</u></p> <p>End bearing piles Estimated tip elevation 505.0 Designed for maximum allowable structural capacity per pile</p>	<p>Fill heights up to 25 ft. will be stable with forward and side slopes of 2:1.</p> <p>It will be necessary to key the approach fill into the flood plains' steep east bank.</p> <p>Grading the east slope would be required for a distance of some 50 feet north and south of the highway.</p> <p>In addition, protective measures against river erosion of the approach fills would be required.</p>	<p>West Humber at this location is 50 feet wide and flows within a floodplain 100-300 feet wide. The river bottom is expected to be comprised of firm clayey silt with trace organics. The floodplain west bank has a gentle slope, whereas the east bank slope is as steep as 75° and up to 30 feet high.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A6 LOCATION Hwy. 407 at Hwy. 50
 ORIGINAL GROUND ELEV. 578-583 PROPOSED HWY. 407 GRADE ELEV. 565+
 Proposed Hwy. 50 Grade Elevation 585+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 11</p> <p>0-13' glacial till very stiff to hard</p> <p>13-23' glacial till very dense</p> <p>23-34' sandy silt very dense</p> <p>34-42'+ glacial till hard</p> <p><u>Groundwater</u></p> <p>28' below ground Level</p>	<p><u>Abutments</u></p> <ol style="list-style-type: none"> 1. Compacted granular pad 2. Spread footing at or below elevation 575.0. Design for maximum allowable load of 3.5 tsf. 3. End bearing piles Estimated tip elevation 540.0 Designed for maximum allowable structural capacity per pile <p><u>Piers</u></p> <ol style="list-style-type: none"> 1. Spread footings at or below elevation 565.0. Design for maximum allowable load of 5 t.s.f. 	<p>Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.</p> <p>Earth cuts up to 20 feet deep will be stable with slopes of 2:1.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A14 LOCATION Hwy. 407 at Kipling Avenue
 ORIGINAL GROUND ELEV. 460-470 PROPOSED HWY. 407 GRADE ELEV. 498+ (496+)
 Proposed Kipling Avenue Grade Elevation 470+ Invert Elevation Plunketts Cree' 448+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 6</p> <p>0-9' sand, some silt some gravel loose to compact</p> <p>9-14' glacial till very dense</p> <p>14-25' sand, some silt some gravel compact to dense</p> <p>25-37'+ sand, some silt very dense</p> <p><u>Groundwater</u></p> <p>5' below ground surface</p>	<p><u>Abutments</u></p> <ol style="list-style-type: none"> 1. Compacted granular pad 2. End bearing piles Estimated tip elevation 425.0 Designed for maximum structural capacity per pile <p><u>Piers</u></p> <ol style="list-style-type: none"> 1. End bearing piles as discussed above. 	<p>Fill heights up to 38 ft. will be stable with forward and side slopes of 2:1.</p>	<p>It is understood Plunketts Creek will be relocated slightly and the crossing of Kipling Ave. and Hwy. 407 would be accomplished by a culvert. A concrete box culvert or structural plate pipe or pipe arch would be suitable at this location.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A15 LOCATION Kipling Ave. at C.N.R. Halton Sub.
 ORIGINAL GROUND ELEV. 465-509 PROPOSED HWY. C.N.R. GRADE ELEV. 509+
 Proposed Kipling Ave. Grade Elevation 436+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 7</p> <p>0-9' sand, some silt some gravel loose to compact</p> <p>9-14' glacial till, hard</p> <p>14-25' sand, some silt compact to dense</p> <p>25-37' + glacial till very dense</p> <p><u>Groundwater</u></p> <p>5' below ground surface</p>	<p><u>Abutments and Piers</u></p> <p>End bearing Piles Estimated tip elevation 425.0 Designed for maximum allowable structural capacity of the pile.</p>	<p>Fill heights up to 35 ft. will be stable with forward and side slopes of 2:1.</p> <p>Fill heights in excess of 35 feet would be inherently unstable due to erosion of the slope surface. In view of this fill heights up to 44 feet would require a 10 foot wide 1/3 height berm to reduce future maintenance costs.</p> <p>detoured railway embankment (78'). The slopes of the detoured railway embankment would require a 20' wide mid height berm for stability purposes.</p>	<p>In order to construct Kipling Ave. through the existing embankment three alternatives could be adopted.</p> <p>A/ Tunnel Kipling Ave. through the existing C.N.R. embankment</p> <p>B/ Underpin the C.N.R. track during construction of Kipling</p> <p>C/ Detour the C.N.R. north during construction. Detouring north is preferred to detouring south because of the unfavourable subsoil conditions within the Thackeray Land Fill Site. Furthermore, the Plunkett Creek culvert would be required to be designed for the full surcharge of the</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A16 LOCATION Hwy. 407 at Humber River
 ORIGINAL GROUND ELEV. 445-503 PROPOSED HWY. 407 GRADE ELEV. 476+
 Humber River H.W.L. 457+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> <u>West Side B.H. 6</u> 0-11' sand to gravelly sand, loose to compact 11-24' clayey silt to silty clay, stiff to very stiff 24-34' silt of slight plasticity very stiff 34-52'+ glacial till, hard <u>East Side B.H. 20</u> Variable subsoil conditions 0-15' sandy silt, some gravel 15-35' clayey silt, stiff to very stiff 35-105' glacial till, dense 105-120'+ glacial till, hard <u>Groundwater</u> At 9' below ground surface</p>	<p><u>Abutments and Piers</u> <u>West Side</u> 1. End bearing piles Estimated tip elevation 400.0 Design for maximum allowable structural capacity of the pile.. <u>East Side</u> 1. End bearing piles Estimated tip elevation 385.0 Design for maximum allowable structural capacity of the pile. 2. Friction piles #14 timber piles 45' long designed for maximum allowable load per pile of 30 tons.</p>	<p><u>West Side</u> Fill heights up to 31 ft. will be stable with forward and side slopes of 2:1. Furthermore, on the west approach, consolidation of the underlying clayey silt will occur. Settlement of the 31' fill will be in the order of 3-4", 90% of which will occur within 6 months of completion of the embankment. In order to minimize post construction settlements preloading for 6 months may be required. <u>East Side</u> It is anticipated the east approach will be in a partial cut through very soft to stiff silty clay. Because of property problems it was not possible to gain access to the concerned area, obtain necessary samples and perform the required testing. Although specific data is lacking it is postulated that nominal berms 10' wide mid height may be required in the cut areas.</p>	<p>At this location river is 50' wide and 3' deep. The river banks are about 8 feet high and slopes about 75°.</p>

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A17 LOCATION Hwy. 407 at C.P. R. Mactier Sub.
 ORIGINAL GROUND ELEV. 480-503 PROPOSED HWY. 407 GRADE ELEV. 484⁺
 Proposed C.P.R. Mactier Sub. Grade Elevation 503⁺

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u></p> <p>Because of property access problems it was not possible to carry out the necessary testing, and for feasibility purposes we have used data from the nearby CNR-Islington crossing.</p> <p><u>B.H. 21</u></p> <p>0-10' sand medium to coarse 10-16' sandy silt, compact 16-51' silty clay, very soft to stiff 51-82'+ stiff to very stiff glacial till</p> <p><u>Groundwater</u></p> <p>Not established</p>	<p><u>Abutments and Piers</u></p> <p>1. Friction Piles #14 timber piles 45' long Design load 25 tons per pile</p>	<p>Fill heights up to 23 ft. will be stable with forward and side slopes of 2:1.</p> <p>It is anticipated that the approaches will be located in partial cuts through very soft to stiff silty clay. Although specific data is lacking it is postulated that nominal berms 10' wide mid height may be required.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A18 LOCATION Hwy. 407 at Islington Avenue
 ORIGINAL GROUND ELEV. 520-525 PROPOSED HWY. 407 GRADE ELEV. 497+
 Proposed Islington Avenue Grade Elevation 525+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 21</p> <p>0-10' sand, medium to coarse</p> <p>10-16' sandy silt, compact</p> <p>16-51' silty clay, very soft to stiff</p> <p>51-82'+glacial till very stiff</p> <p><u>Groundwater</u></p> <p>Not established</p>	<p>As discussed under A17</p>	<p>Earth cuts up to 15' deep will be stable with slopes of 2:1.</p> <p>Although specific data is lacking it is postulated that cuts up to 30' deep would require mid height berms up to 30' wide and 2:1 slopes for stability purposes.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A19 LOCATION Hwy. 407 at Pine Valley Drive
 ORIGINAL GROUND ELEV. 530-535 PROPOSED HWY. 407 GRADE ELEV. 537+
 Proposed Pine Valley Drive Grade Elevation 556+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 14</p> <p>0-5' silty sand, compact</p> <p>5-11' glacial till very stiff</p> <p>11-19' clayey silt, stiff</p> <p>19-38' sandy silt to silty sand, some gravel loose to compact</p> <p>38-55' glacial till, hard</p> <p>55-74' silty sand dense to very dense</p> <p>74'-92'+ glacial till, hard</p> <p><u>Groundwater</u></p> <p>25' below ground surface</p>	<p><u>Abutments and Piers</u></p> <p>1. End bearing piles Driven to estimated tip elevation 445.0 Designed for maximum allowable structural capacity of the pile.</p>	<p>Fill heights up to 26 ft. will be stable with forward and side slopes of 2:1.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A26 LOCATION Hwy. 400 at Langstaff Road
 ORIGINAL GROUND ELEV. 680+ PROPOSED HWY. 400 GRADE ELEV. 680+
 Proposed Langstaff Road Grade Elevation 700+

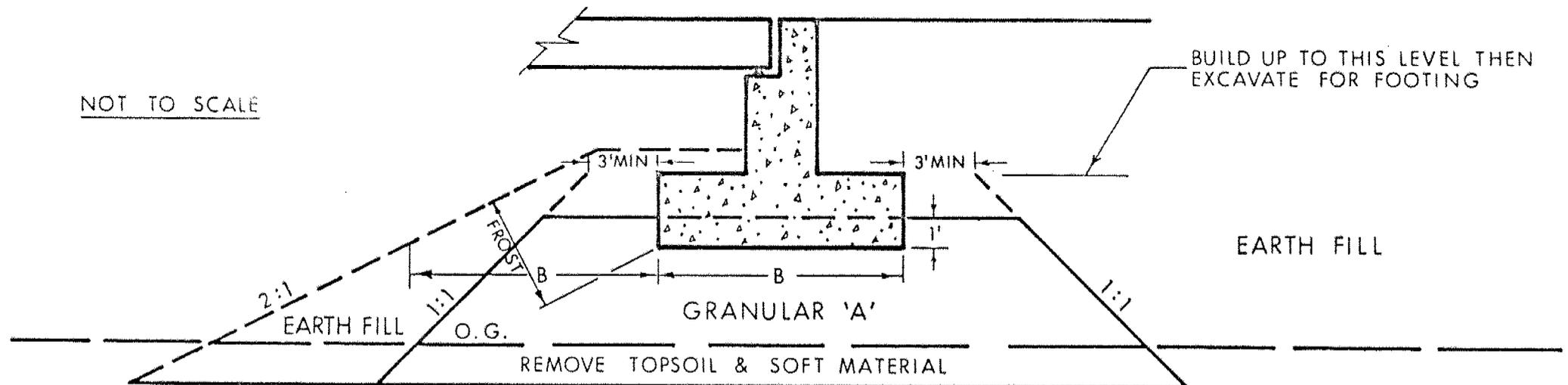
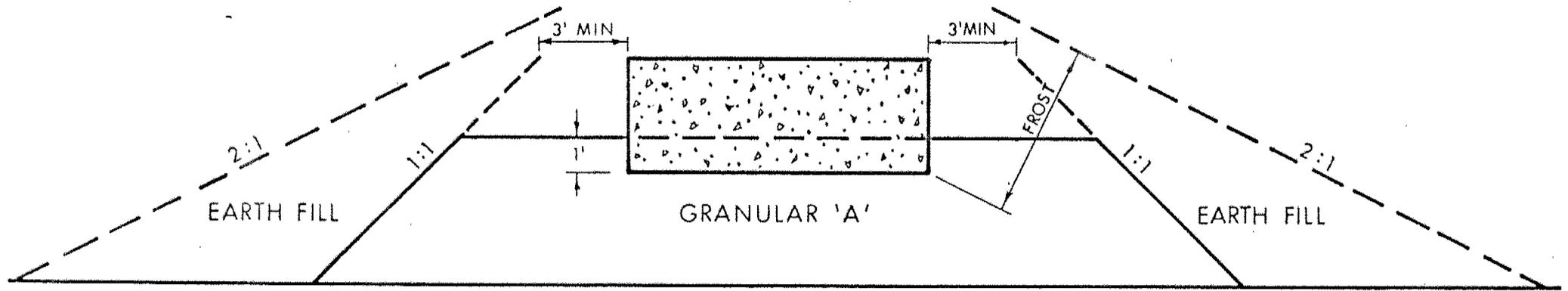
SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 17</p> <p>0-45' glacial till very stiff to hard</p> <p>45-55' clayey silt varved, hard</p> <p>55-79' sand, compact to very dense</p> <p>79-101' clayey silt stratified, hard</p> <p>101-105' glacial till hard</p> <p><u>Groundwater</u></p> <p>9' below ground surface</p>	<p><u>Abutments</u></p> <p style="padding-left: 40px;">Compacted granular pad</p> <p><u>Piers</u></p> <p style="padding-left: 40px;">Spread footings at or below elevation 665. Designed for maximum allowable load of 3 t.s.f.</p>	<p>Fill heights up to 20 ft. will be stable with forward and side slopes of 2:1.</p>	

FOUNDATION DATA SHEET

W.P. 88-78-00 SITE A29 LOCATION Finch Avenue Over West Humber River
 ORIGINAL GROUND ELEV. 515-555 PROPOSED HWY. GRADE ELEV. 548-555
 West Humber River High Water Level 515+

SUBSURFACE CONDITIONS	RECOMMENDATIONS		REMARKS
	STRUCTURE	APPROACHES	
<p><u>Reference Boreholes</u> 3</p> <p><u>West of River</u></p> <p>0-4' sandy gravel, loose</p> <p>4-7' glacial till, hard</p> <p>7-14' + bedrock, poor quality, layers of limestone and weathered shale</p> <p><u>East of River</u> (in exposed bank)</p> <p>0-10'+ clayey silt very stiff</p> <p>10'+ glacial till, hard</p> <p><u>Groundwater</u></p> <p>Boring was relatively dry upon completion of augering. Groundwater level was not established.</p>	<p>Because of the numerous possibilities of abutment pier locations and foundation elevations the following founding options are provided.</p> <p><u>Abutments and Piers</u></p> <ol style="list-style-type: none"> 1. Spread footings founded on bedrock at or below elevation 512.0. Design for maximum allowable load of 7 t.s.f. 2. End bearing piles driven to bedrock. Estimated tip elevation 512.0. Designed for maximum allowable load per pile. 	<p>Fill heights up to 35 ft. will be stable with forward and side slopes of 2:1.</p> <p>It will be necessary to key the roadway fill into the flood plains' steep banks. Cutting back the east bank slope to a stable 2:1 would be required for a distance of some 150 feet north and south of the roadway. In addition, protective measures against erosion of the roadway fill and east bank will be required. Furthermore, it will be advantageous to permanently divert the river 100 to 500 feet to the west.</p>	<p>At this location during the field investigation the depth of water was 1-2'. Boulders and cobbles are strewn in creek bed.</p>

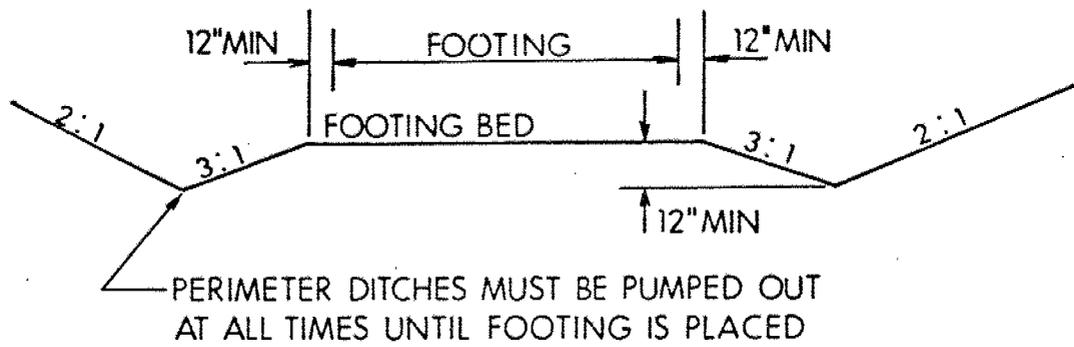
ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



NOTES:

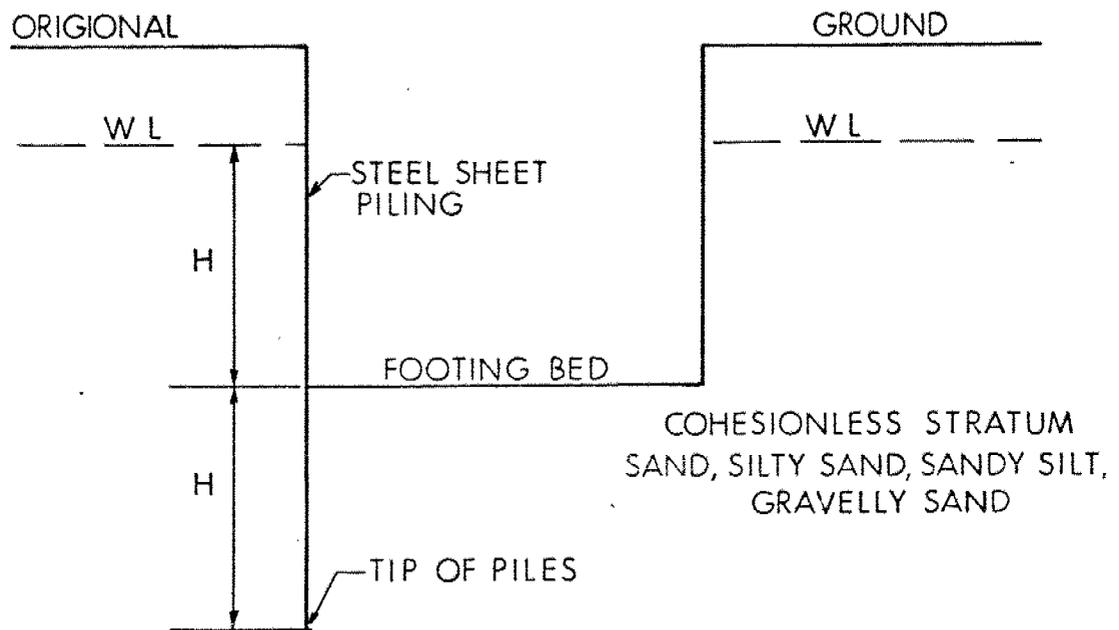
- 1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
- 2 - PLACE GRANULAR 'A' & EARTH FILL TO TOP OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.
- 3 - EXCAVATE COMPACTED GRANULAR 'A' & EARTH FILL FOR FOOTING.

FIG. 1



OVERSIZE EXCAVATION WITH PERIMETER DRAINS

FIG No 2



STEEL SHEET PILING

FIG No 3

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. CIU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
 W S WASH SAMPLE
 S T SLOTTED TUBE SAMPLE
 B S BLOCK SAMPLE
 C S CHUNK SAMPLE
 T W THINWALL OPEN
 T P THINWALL PISTON
 O S OSTERBERG SAMPLE
 F S FOIL SAMPLE
 R C ROCK CORE
 P H T.W. ADVANCED HYDRAULICALLY
 P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_0 COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 α SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 $\gamma_1, \gamma_2, \gamma_3, \gamma_c$ STABILITY CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_0 INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{w_L - w_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{w_L - w_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2\mu\text{m Soil Fraction}}$
 Om ORGANIC MATTER CONTENT

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE POWER PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 ν COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 α TERZAGHI-CAROLLO RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS: σ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE

RECORD OF BOREHOLE No 1

W P 88-78-00 LOCATION Hwy. 407 & Mimico Creek ORIGINATED BY M.M.
 Coords. N 15 890 590; E 955 960
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers (0-25'), Hollow Stem Augers COMPILED BY M.M.
 (24-40)
 DATUM Geodetic DATE October 13, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
564.8	Ground Surface																
0.0	Clayey Silt		1	SS	9												
	Stiff		2	SS	16												
556.8	Very Stiff		3	SS	42												
8.0	Silt, Some Sand		4	SS	44												
	Dense		5	SS	18												
550.8	Sand, Some Silt		6	SS	34												
14.0	Compact		7	SS	39												
534.8	Heterogeneous		8	SS	50/3"												
300.0	Mixture Clayey Silt		9	SS	100/3"												
	Sand and Gravel																
	Occasional Cobbles																
	Hard																
523.3	Glacial Till																
41.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15-5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 2

W P 88-78-00 LOCATION Hwy. 427 & Finch Avenue
 Coords. N 15 891 020; E 966 305 ORIGINATED BY MM
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY *W.J.*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100							
555.0	Ground Surface														
0.0	Clayey Silt Trace Sand Hard		1	SS	32										
547.9			2	SS	22										
8.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Glacial Till		3	SS	73									23 27 40 10	
			4	SS	111										
	Hard		5	SS	68									7 22 58 13	
			6	SS	50/ 5"										
529.4			7	SS	112										
26.5	End of Borehole Note: Groundwater Not Encountered														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 4

W P 88-78-00 LOCATION Hwy. 407 & Airport Road ORIGINATED BY MM
 Coords. N 15 888 480; E 954 140
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 16, 1978 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
596.3	Ground Surface															
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Very Stiff to Hard Brown Grey Very Stiff to Hard		1	SS	32											2 12 46 40
			2	SS	35											
			3	SS	49											
			4	SS	26											
			5	SS	27											
			6	SS	40											
571.3			7	SS	68/	6"										
25.0	Silt, Some Sand Very Dense															
564.8			8	SS	125											
31.5	End of Borehole Note: Groundwater Not Encountered															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 5

W P 88-78-00 LOCATION Hwy. 407 & West Humber ORIGINATED BY MM
 Coords. N 15 896 130; E 961 970
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers (0-30'), Hollow Stem Auger & Washing (30-35') COMPILED BY MM
 DATUM Geodetic DATE October 17, 1978 CHECKED BY a.j.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
											○ UNCONFINED	+	FIELD VANE	WATER CONTENT (%)			
											● QUICK TRIAXIAL	x	LAB VANE	20	40	60	
											400	800	1200	1600	2000		
540.4	Ground Surface																
0.0	Clayey Silt																
535.4	Stiff		1	SS	7												
5.0	Heterogeneous Mixture Clayey Silt, Sand & Gravel		2	SS	24												
	(Glacial Till)		3	SS	12												
522.4	Stiff to Hard		4	SS	54												
			5	SS	49												
18.0	Silt, Some Sand		6	SS	26												
517.4	Compact																
23.0	Sand, Some Silt		7	SS	59												
510.4	Some Gravel																
30.0	Very Dense		8	SS	120/6"												15 62 21 2
503.9	Heterogeneous Mixture Silt, Sand and Gravel, Very Dense, Glacial Till		9	SS	60/2"												
36.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

W P 88-78-00 LOCATION Hwy. 407 & Humber Main ORIGINATED BY MM
 Coords. N 15 903 680; E 977 910
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MM
 DATUM Geodetic DATE October 17, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
443.5	Ground Surface																
0.0	Fine Sand		1	SS	5												
	Loose		2	SS	5												
	Compact Gravelly Sand		3	SS	16												
432.5	Trace Organics		4	SS	26												OM 1%
11.0	Very Stiff		5	SS	8												
	Stiff		6	TW	PH												
419.5	Clayey Silt to Silty Clay		7	SS	4												129
24.0	Clayey Silt to Silt of Slight Plasticity Very Stiff		8	TW	PH												130
409.5	Heterogeneous Mixture, Clayey Silt Sand and Gravel Hard (Glacial Till)		9	SS	49												
			10	SS	134												
34.0			11	SS	100/	5"											
392.0			12	SS	100/	5"											
51.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15
 10
 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 7

W P 88-78-00 LOCATION Hwy. 407 & Kipling Avenue ORIGINATED BY MM
 Coords. N 15 902 520; E 975 330
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY MM
 DATUM Geodetic DATE _____ CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20						40	60	80	100	
456.5	Ground Surface																	
0.0	Sand, Some Silt Some Gravel Loose to Compact	[Strat Plot]	1	SS	6	[Water Table Symbol]	450	[Cone Penetration Plot]	[Moisture Content Plot]	[Liquid Limit Plot]	[Unit Weight Plot]	[Remarks]						
447.5			2	SS	21													
9.0	Heterogeneous Mixture Silt, Sand & Gravel (Glacial Till)V.Dense	[Strat Plot]	3	SS	131								440	End of Cone Test	[Moisture Content Plot]	[Liquid Limit Plot]	[Unit Weight Plot]	[Remarks]
442.5			4	SS	95													
14.0	Sand, Some Silt Some Gravel Compact to Dense	[Strat Plot]	5	SS	45								430	[Moisture Content Plot]	[Liquid Limit Plot]	[Unit Weight Plot]	[Remarks]	
			6	SS	11													
			7	SS	50/ 2"													
	Sand, Some Silt Very Dense	[Strat Plot]	8	SS	108								420	[Moisture Content Plot]	[Liquid Limit Plot]	[Unit Weight Plot]	[Remarks]	
			9	SS	94													
420.0	End of Borehole																	
36.5	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 8

W P 88-78-00 LOCATION Hwy. 407 @ Hwy. 427 ORIGINATED BY MM
Coords. N 15 898 530; E 965 070
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 19, 1978 CHECKED BY al

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE
585.8	Ground Surface													
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Very Stiff to Hard (Glacial Till) Red Brown	[Strat Plot]	1	SS	18									
577.8			2	SS	48									
8.0	Sandy Silt Very Dense	[Strat Plot]	3	SS	9									
			4	SS	62									
			5	SS	109									
			6	SS	84									
558.8	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Hard (Glacial Till) Red Brown	[Strat Plot]	7	SS	50									
27.0			8	SS	138									
			9	SS	122									
544.3			10	SS	106								4 26 45 26	
41.5	End of Borehole Note: Water Level Not Established													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

W P 88-78-00 LOCATION Hwy. 427 & Steeles Ave. Coords. N 15 897 460; E 965 250 ORIGINATED BY MM
 DIST 6 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 19, 1978 CHECKED BY alj.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100
											○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
											● QUICK TRIAXIAL	x LAB VANE	20	40	60		
578.0	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel	Brown Grey	1	SS	39												
			2	SS	45												
			3	SS	87												
			4	SS	117												
			5	SS	119												
560.0	Hard (Glacial Till)																
18.0	Sandy Silt Very Dense		6	SS	67												
551.5			7	SS	57												
26.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

W P 88-78-00 LOCATION Hwy. 407 & 427 Ramps E of Hwy. 427 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 20, 1978 CHECKED BY _____

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH								
						20	40	60	80	100						
569.1	Ground Surface															
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard, Brown Glacial Till	[Strat Plot]	1	SS	30											
			2	SS	45											
558.1			3	SS	124											
11.0	Sandy Silt Some Gravel Very Dense	[Strat Plot]	4	SS	100/6"											
			5	SS	100/6"											
			6	SS	50/3"											
529.1																
40.0	Heterogeneous Mixture Clayey Silt, Sand & Gravel, Hard, Glacial Till	[Strat Plot]														
44.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 11

W P 88-78-00 LOCATION Hwy. 407 & Hwy. 50 ORIGINATED BY MM
 Coords. N 15 827 380; E 963 020
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 20, 1978 CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH							
							20	40	60	80	100				
							○ UNCONFINED + FIELD VANE * QUICK TRIAXIAL x LAB VANE				20 40 60				
578.8	Ground Surface														
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel (Glacial Till) v. Stiff Brown Hard	[Strat Plot]	1	SS	22										0 4 (96)
			2	SS	33										
			3	SS	65										
			4	SS	120										
			5	SS	120										
	Very Dense		6	SS	125										
555.8															
23.0	Sandy Silt Very Dense		7	SS	72										
544.8															
34.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Hard (Glacial Till)		8	SS	69										
537.3			9	SS	70/2"										
41.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12

W P 88-78-00 LOCATION Hwy. 407 & Hwy. 27 ORIGINATED BY MM
 Coords. N 15 899 840; E 969 280
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 23, 1978 CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT:				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									WATER CONTENT (%) 20 40 60	
562.5	Ground Surface																	
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel (Glacial Till) Hard Brown Grey		1	SS	58		560											
			2	SS	55													
			3	SS	46													
			4	SS	56			550										
			5	SS	58													
			6	SS	80													
			7	SS	78			540										
536.1	End of Borehole																	
26.5	Note: Groundwater Not Encountered																	

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 \diamond 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 13

W P 88-78-00 LOCATION Hwy. 407 & Martingrove Road ORIGINATED BY MM
 Coords. N 15 900 900; E 972 020
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 23, 1978 CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						
559.1	Ground Surface																	
0.0	Brown Grey Heterogeneous Mixture Clayey Silt Sand and Gravel (Glacial Till) Hard		1	SS	12													
			2	SS	27													
			3	SS	39													
			4	SS	49													
			5	SS	26													
			6	SS	26													
			7	SS	49													
			8	SS	40													
			9	SS	50													
			10	SS	37													
			11	SS	86													
			12	SS	81													
			13	SS	100/	5"												
487.6					14	SS	100/	2"										
71.5	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to 20
Sensitivity 15-5 (% STRAIN AT 10

RECORD OF BOREHOLE No 14

W P 88-78-00 LOCATION Hwy. 407 & Pine Valley Drive Coords. N 15 905 450; E 981 320 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 24, 1978 CHECKED BY *e.f.*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
							20	40	60	80	100						
							400	800	1200	1600	2000						
531.9	Ground Surface																
0.0	Silty Sand Compact		1	SS	24												
526.9			2	SS	31												
5.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Very Stiff (Glacial Till)		3	SS	21												
520.9			4	SS	10												
11.0	Clayey Silt Very Stiff		5	TW	PH												
512.9			6	SS	26												
19.0	Silty Sand to Sandy Silt Some Gravel Compact to Loose		7	SS	18												
			8	SS	0												
			9	SS	7												
493.9			10	SS	86												
38.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard (Glacial Till)		11	SS	45												
			12	SS	29												
476.9			13	SS	74												
55.0	Silty Sand to Sand, Trace Gravel Dense to Very Dense		14	SS	28												
457.9			15	SS	131/ 6"												
74.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Hard (Glacial Till)		16	SS	60/ 3"												
440.4																	
91.5	End of Borehole																
	Note: Low 'N' value of 0 blows/foot resulted from excess hydrostatic pressure during sampling procedures.					Casing Boiling											

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 15

Hwy. 407 & Weston Road

W P 88-78-00 LOCATION Coords. N 15 908 250; E 987 850 ORIGINATED BY MM
 DIST 6 HWY 407 BOREHOLE TYPE Solid Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25, 1978 CHECKED BY E.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR, SA, SI, CL	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80	100			PLASTIC LIMIT W _p
625.0	Ground Surface													
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Hard	1	SS	13										
	Brown	2	SS	40										
	Grey (Glacial Till)	3	SS	64										
		4	SS	102										
	Sand	5	SS	113										
		6	SS	136										
		7	SS	75/	5"									
		8	SS	75/	5"									
		9	SS	60/	5"									
583.5		10	SS	60/	4"									
41.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

*3, x5: Numbers refer to Sensitivity
 20
 15 ϕ 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 16

W P 88-78-00 LOCATION Hwy. 407 & Jane St. ORIGINATED BY MM
 Coords. N 15 910 080 E 993 940
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25-30, 1978 CHECKED BY e.g.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40	60	80						100
652.7	Ground Surface															
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Very Stiff (Glacial Till) Red Brown Grey	1	SS	17		650										
		2	SS	19												
		3	SS	39												
		4	SS	62			640									
		5	SS	72												
634.7	Clayey Silt Trace Sand Stratified Grey Very Stiff to Hard	6	SS	34		630										
18.0		7	SS	20												
		8	SS	21			620									
		9	SS	36												0 5 49 46
		10	SS	25			610									
		11	SS	39												
		12	SS	73			600									
		13	SS	54			590									
		14	SS	38			580									
		15	SS	94			570									
		16	SS	62			560									
552.7	Cont.															
100.0																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 16 cont

W P 88-78-00 LOCATION Hwy. 407 & Jane St. ORIGINATED BY MM
 Coords. N 15 910 080; E 993 940
 DIST 6 HWY 407 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE October 25-30, 1978 CHECKED BY w.j.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH								
							20	40	60	80	100					
552.7																
100.0	Clayey Silt Trace Sand Stratified Grey Very Stiff to Hard		17	SS	32											
				18	SS	39										
				19	SS	38										
520.7																
132.0	Silty Sand, Trace Gravel, Very Dense		20	SS	150/6"											
517.7																
135.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 17

W P 88-78-00 LOCATION Hwy. 400 & Langstaff Rd. ORIGINATED BY MM
 Coords. N 15 918 013; E 988 502
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers and Washboring COMPILED BY MM
 DATUM Geodetic DATE October 31, 1978 CHECKED BY [Signature]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
673.1	Ground Surface																
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel, Red Brown Very Stiff (Glacial Till) Hard Grey		1	SS	19		670										2 22 55 21
			2	SS	19		660										
			3	SS	37		650										
			4	SS	51		640										
			5	SS	38		630										
			6	SS	60		620										
			7	SS	30		610										
			8	SS	31		600										
			9	SS	131		594.1										
			10	SS	41		79.0										
628.1			Clayey Silt Grey Hard Varved														
618.1	Sand, Trace Silt Trace Gravel Compact to Very Dense																
594.1																	
79.0																	
672.1	Clayey Silt * Grey Hard Varved						580										
101.0	Glacial Till *						570										
568.1	Hard																
105.0	End of Borehole * Note: Description based on wash return, nature of washboring operation and other borings in vicinity.																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 18

W P 88-78-00 LOCATION Hwy. 400 & Hwy. 427 ORIGINATED BY MM
 Coords. N 15 908 830; E 989 950
 DIST 6 HWY 400 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MM
 DATUM Geodetic DATE November 1, 1978 CHECKED BY W.S.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80						100	SHEAR STRENGTH	
											○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%)					
630.0	Ground Surface																		
0.0	Heterogeneous Mixture Clayey Silt Sand and Gravel, Red (Glacial Till) Brown Very Stiff Hard		1	SS	24														
			2	SS	43														
			3	SS	60/		3"												
			4	SS	105														
			5	SS	147														
			6	SS	130														
			7	SS	100/		5"												
603.5																			
26.5	End of Borehole																		

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 19

Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR S-E Corner & Indian Line ORIGINATED BY C.N.R.
 Coords. N 15 894 450; E 964 997
 DIST 6 HWY 427 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY ef.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						SHEAR STRENGTH
											○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT (%)				
561.4	Ground Surface																	
0.0	Silty Clay Very Stiff		1	SS	22		560											
555.0			2	SS	22													
6.4	Sandy Silt Some Gravel Very Dense		3	SS	83													
550.0			4	SS	69													
11.4	Sandy Silt Some Gravel Very Dense		5	SS	62		550											
			6	SS	29													
			7	SS	82													
			8	SS	100		540											
531.7			9	SS	100													
29.7	Probably Grey Silt Sand and Gravel Very Dense						530											
522.0																		
39.4	End of Borehole																	
	Note: No groundwater observed																	

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15-25 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21 Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR West Side & Islington Ave. ORIGINATED BY CNR
 Coords. N 15 903 450; E 979 500
 DIST 6 HWY 407 BOREHOLE TYPE N/A COMPILED BY CNR
 DATUM Geodetic DATE N/A CHECKED BY l.f.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
523.5	0.0 Sand, Medium to Coarse With Gravel															
513.5	10.0 Sandy Silt			SS	26											
507.5	Compact			SS	17											
16.0	Silty Clay Very Soft to Stiff															
472.5																
51.0	Heterogeneous Mixture Clayey Silt Sand and Gravel Stiff to Very Stiff (Glacial Till)			SS	26											
				SS	39											
				SS	27											
				SS	27											
				SS	18											
				SS	41											
442.0				SS	20											
81.5	End of Borehole * Note: This borehole data obtained from CNR															

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to 20
15-5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 22 Borehole Data Obtained From C.N.R.

W P 88-78-00 LOCATION CNR & Hwy. 400 Coords. N 15 906 450; E 990 470 ORIGINATED BY CNR
 DIST 6 HWY 400 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY *W.J.*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH							
							20	40	60	80	100				
619.0	Ground Surface														
0.0	Heterogeneous Mixture Clayey Silt, Sand and Gravel Dense to Very Dense (Glacial Till)														
604.0															
15.0	Sandy Silt														
598.0	Very Dense														
21.0	Sand, Fine to Medium														
	Dense to Very Dense														
584.0															
35.0	Heterogeneous Mixture Silt Sand and Gravel Very Dense														
569.0															
50.0	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 23

(This data obtained from
Metropolitan Toronto and Region
Conservation Authority)

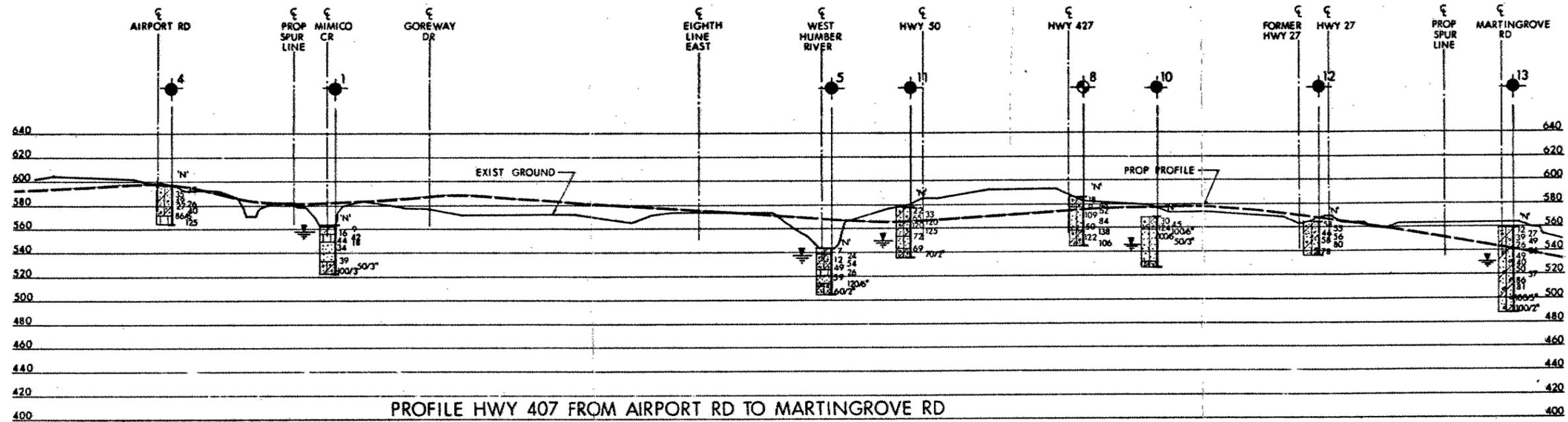
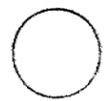
W P 88-78-00 LOCATION East Side of Clairville Dam Coords. N 15 89.0 220; E 965 600 ORIGINATED BY Geocon
 DIST 6 HWY 427 BOREHOLE TYPE N/A COMPILED BY MM
 DATUM Geodetic DATE N/A CHECKED BY w.f.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH									
								20	40	60	80	100					
								c UNCONFINED + FIELD VANE									
								• QUICK TRIAXIAL x LAB VANE									
542.0	Ground Surface																
0.0	Topsoil																
1.0	Heterogeneous Mixture Silt, Sand and Gravel Grey to Brown (Glacial Till) Compact to Very Dense						540										
							530										
							520										
							510										
504.0																	
38.0	Soft Grey Interbedded Shale and Limestone																
500.0	Bedrock						500										
42.0	End of Borehole																

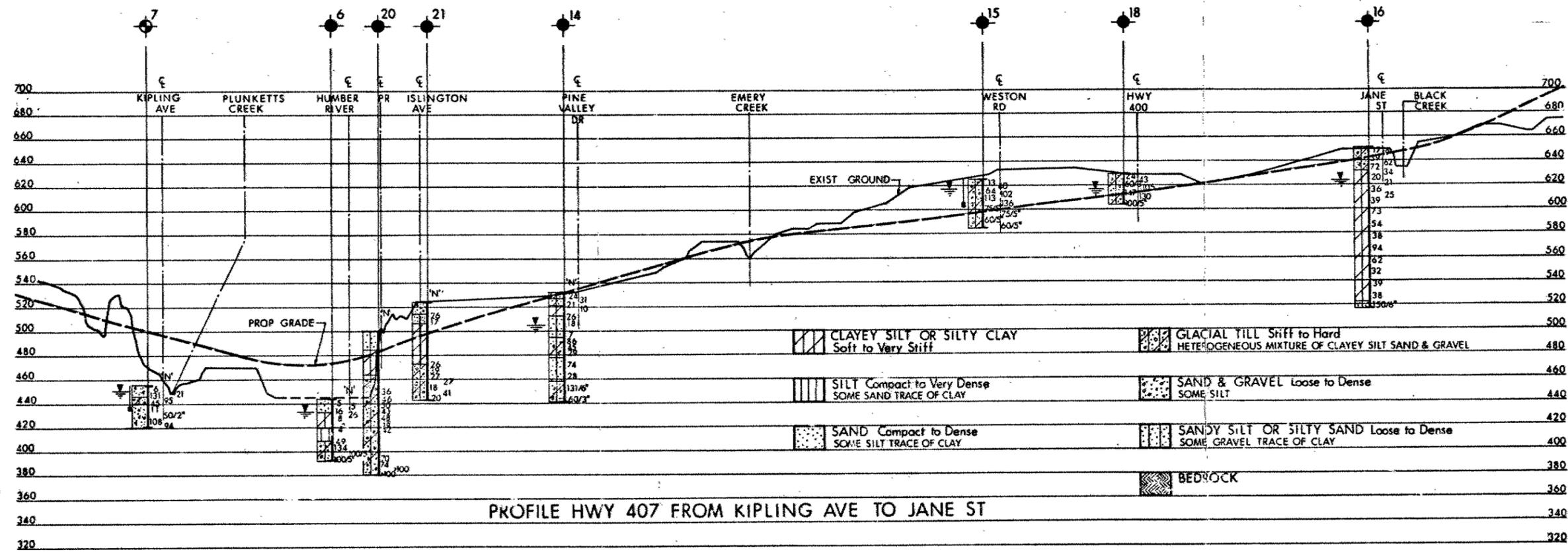
OFFICE REPORT ON SOIL EXPLORATION

APPENDIX

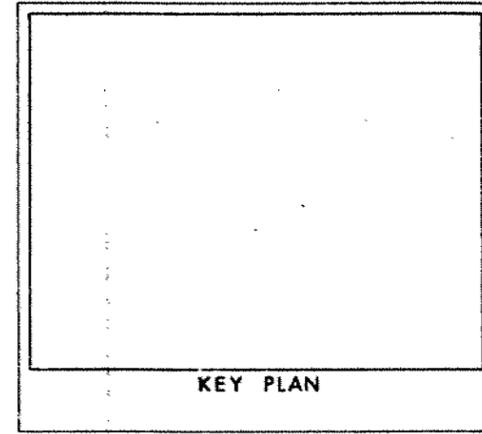
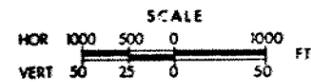
OVERSIZE DRAWING



PROFILE HWY 407 FROM AIRPORT RD TO MARTINGROVE RD



PROFILE HWY 407 FROM KIPLING AVE TO JANE ST



KEY PLAN

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- ↓ WL at time of investigation
- NO WL Established in BH No 2 3 4 8 12 19 20 21 & 23

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	564.8	15 890 590	955 960
2	555.9	15 891 020	966 305
3	519.7	15 891 330	967 445
4	596.3	15 888 480	954 140
5	540.4	15 896 130	951 270
6	443.5	15 903 680	977 910
7	456.5	15 902 520	975 330
8	585.8	15 898 530	965 070
9	578.0	15 897 460	965 250
10	569.1	15 899 190	966 570
11	578.8	15 897 380	963 020
12	562.6	15 899 840	969 280
13	559.1	15 900 900	972 020
14	531.9	15 905 450	981 320
15	625.0	15 908 250	987 850
16	652.7	15 910 050	993 940
17	673.1	15 918 013	988 502
18	630.0	15 908 830	989 950
19	561.4	15 894 450	964 997
20	500.0	15 903 050	978 100
21	523.5	15 903 450	979 500
22	619.0	15 906 450	990 470
23	542.0	15 896 220	965 600

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Giffels Associates Limited

Divisions
Giffels Associates
Giffels, Davis & Jorgensen
Strategic Planning Services

30 International Blvd.
Toronto (Rexdale), Ontario
Canada M9W 5P3

Telex 06-989215
Telephone
(416) 675-5950

Giffels

May 9, 1979

Mr. P. Penev
Geotechnical Section
Engineering and Right of Way Office
Central Region
Ministry of Transportation
and Communications
Downsview, Ontario
M3K 1N6

Re: WP 88-78-00, Hwy. 407
Preliminary Design fr.
Airport Road Easterly
to Jane Street
Our Job Number W7834

Dear Sir :

As you are aware, we are currently assessing alternate Highway 407/400 interchange directional ramp profiles. The major factors yet to be fully assessed are subsoil conditions and stability, and groundwater impacts for the deep cuts proposed west of Highway 400. Based on available information, we are unable to fully determine the impacts of the "directionals under" scheme and the associated deep cuts.

We have reviewed the information generated to date by the Soils Mechanics Section and the Geotechnical Section and feel that additional work is required with your assessment and recommendations to resolve the following:

1. Viability of proposed deep cuts. Assessment of any special problems associated with the "directionals under" alternative and preliminary recommendations for construction. Factors to be assessed include:
 - a) Location and implications of the water bearing sand seam.
 - b) Subexcavation requirements.
 - c) Suitability of cut for embankment construction. Percentage of cut to assume as waste.
 - d) Water table impacts of deep cuts, notably local wells.
 - e) Other factors that come to light in the course of further investigations and assessment.
2. Review of previous recommendations for the "directionals over", deep fill alternative with supplementary recommendations where required.

.....2



↓ MM
↓ Files

Giffels Associates Lim

Ministry of Transportation & Communications
Att: Mr. P. Penev

Page Two
May 9/79

The above is required as soon as possible to resolve a profile recommendation for the 407/400 interchange. Programmed detailed design (Hwy. 400/7 interchange) elements depend on this decision.

If more information or discussion is required, please contact the writer.

Yours very truly,



Paul MacLeod, P.Eng.
Project Manager
Giffels, Davis & Jorgensen Division

pm-kas

cc: L. Dutchak
K. Pilgrim
M. MacLean —

.les

Mr. L. Dutchak
Planning and Design Section
Central Region
3501 Dufferin St., Downsview

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

79 04 10

Re: Hwy. 407 From Airport Road to Jane Street
W.P. 88-78-00, District 6, Toronto

On your referral, Mr. W. Lachmaniuk of Giffels Associates Limited, contacted our office for comments/recommendations concerning proposed grade revisions for Hwy. 407. We have reviewed the recommendations made in our earlier report for this project in view of the proposed grade revisions and are submitting the necessary additional/revise recommendations in the sheets attached.

It is important to note that the scope of our original foundation investigation fieldwork did not include the assessment of deep cuts in the area of Martingrove to Hwy. 400. As such, the necessary data, both for subsurface and groundwater conditions, to make firm recommendations in these areas is lacking. However, the preliminary recommendations attached will enable you to proceed with your evaluations. For property and final design requirements, further fieldwork will be required.

If you have any further queries please call.

M. MacLean
Project Engineer

For: M. Devata
Supervising Engineer

MM/MD/gs

Attach.

cc: G.C.E. Burkhardt, Attn: K. Pilgrim
R.D. Gunter
W. Lachmaniuk (Giffels Assoc.)
Files ✓

Location	Subsurface Conditions	Earth Cuts		Earth Fill	
		Depth of Cut	Slope/Berm Requirements	Ht. of Fill	Slope Berm Requirement
Airport Road Vicinity Sta. 645+00 to Sta. 675+00	0-25' glacial till very stiff to hard Groundwater not encountered	0-18 ft.	2:1 cut slopes	11 ft.	2:1 fill slopes
Watercourse and Vicinity Sta. 749+50	0-25' very stiff glacial till Groundwater not encountered			20 ft.	2:1 fill slopes
Hwy. 50 to Hwy. 427 Sta. 105+00 to Sta. 130+00	0-13' very stiff to hard glacial till 13-23' very dense glacial till 23-34' very dense sandy silt 34-42' hard glacial till Groundwater: 28' below ground	0-25 ft.	2:1 cut slopes		
Martingrove and Vicinity Sta. 183+00 to Sta. 222+00	0-57' hard glacial till ① Groundwater 28' below ground surface	0-30 ft.	2:1 cut slopes		
West of Plunketts Crk. Sta. 225+00 to Sta. 234+00	0-57' hard glacial till ①② possible sand layers	0-30 ft.	2:1 cut slopes		
Kipling Avenue - North of Hwy. 407 Kipling Ave. Sta. 89+00 to Sta. 98+00	glacial till with possible sand layers ①②	0-30 ft.	2:1 cut slopes		
		30-50 ft.	2:1 cut slopes, mid- height 15' wide berms		

Location	Subsurface Conditions	Earth Cuts		Earth Fill	
		Depth of Cut	Slope/Berm Requirements	Ht. of Fill	Slope Berm Requirement
Weston Road and Vicinity Sta. 355+00 to Sta. 405+00	0-42' hard glacial till with sand layers Groundwater 8' below ground surface ①②③	0-35 ft.	2:1 cut slopes		
Hwy. 400/407 Interchange Option A - Ramps Under 407	0-42' glacial till with sand layers Groundwater 8' below ground surface ①②③	0-30'	2:1 cut slopes	0-30 ft	2:1 fill slopes
		30-50'	2:1 cut slopes mid-height 15' wide berms		
Hwy. 400/407 Interchange Option B Ramps Over 400	0-42' glacial till with sand layers Groundwater 8' below ground surface ①②③	0-20'	2:1 cut slopes	0-35 ft	2:1 fill slopes
				35-50 ft	2:1 fill slopes with mid-height 15' wide berms

- ① Subsurface and groundwater information in this area is not sufficiently adequate to access deep cuts. Further fieldwork in this area would be required for final design.
- ② In view of the presence of water bearing sand seams in these areas, cuts intersecting these will require subdrains and nominal interceptor ditching at sand seams.
- ③ The sand seams in these areas are a source of water for local wells. With highway cuts intersecting these water bearing sand seams, the possibility of compensating well owners for either road salt contamination or loss of water source because of drawdown should be considered within a one mile radius of the proposed cut locations.



Memorandum

To: Mr. M. Devata,
Supervising Engineer,
Soil Mechanics Section,
Central Building, Downsview.

From: G.C.E. Burkhardt,
Structural Section,
Central Region.

Attention:

Date: 1978-11-20

Our File Ref.

In Reply to

Subject: RE: Feasibility Study,
Hwy. 407 Airport Rd. to Jane St. (incl. Hwy. 400),
W.P. 88-78-00, Hwy. 427 - Finch Ave. to Hwy. 27,
W.P. 49-71-00, District 6, Toronto

Further to our memo of 1978-09-11 and our recent telephone conversation, attached please find a copy of plan and profile of Highway 427 showing new sites A30 and A31. At this time, all factors are being assessed with respect to putting Highway 407 over Highway 7 and vice-versa, as shown on the profile drawing.

It is realized that no boreholes were put down at these locations, but it will nevertheless be appreciated if recommendations could be included for these sites in your report. Please let us also have your comments or preference regarding the grade separation at site A30.

KP:gj
Attach.

K. Pilgrim,
Senior Structural Engineer,
for:
G.C.E. Burkhardt,
Head, Structural Section.



7 m.m.
K
Zim



Memorandum

To: Mr. G.C.E. Burkhardt
Head, Structural Section
Central Region
3501 Dufferin St., Downsview

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Attention:
Mr. K. Pilgrim

Date: 78 11 06

Our File Ref.

In Reply to

Subject: Re: Feasibility Study, Hwy. 407 From Airport Road
to Jane Street, W.P. 88-78-00 ✓
Hwy. 427 from Finch Avenue to Hwy. 406, W.P. 49-71-00

Introduction

Further to your request of September 11, 1978 we have completed the foundation investigation fieldwork for the above mentioned project. As per your verbal request of September 8, 1978 we are hereby providing you with our preliminary assessment of the subsoil conditions, general recommendations on structure foundations and the stability of embankments and a preliminary assessment of problem areas.

Fieldwork

The fieldwork was carried out during the period from October 3 to November 1, 1978 and consisted of a total of 18 sampled boreholes advanced by means of either solid stem augers or hollow stem augers to depths of 14 to 135 feet below ground surface. Bedrock was encountered in one boring (within the floodplain of the West Humber River at the proposed Finch Ave. crossing) at a depth of 7 feet and was proven by obtaining 7 feet of BXL size rock core.

In addition to our fieldwork we have assembled a number of boring records located within the study area that have been previously carried out by ourselves and other agencies. This data enabled us to reduce significantly the necessary fieldwork and we will incorporate portions of the data in our report.

Subsurface Conditions

The study area for this portion of Hwy. 407-Hwy. 427-Hwy. 400 is wholly located within the physiographic region known as the "Peel Plain". This area is found to be at elevation 500 to 750 feet above sea level and has a gradual slope toward Lake Ontario. Across the plain, rivers and streams have cut deep valleys and there is, therefore, no large undrained depressions, swamp or bogs in the whole area. The plain is furthermore characterized by an underlying till or boulder clay. In much of the Peel Plain this has been modified by a veneer of clay which when deep enough is clearly seen to be varved.

The fieldwork revealed that across the study area generally favourable conditions exist for structure and embankment foundations. Generally, the dominant subsurface deposit extending from the ground surface to a depth of up to 105 feet is a heterogeneous mixture of clayey silt, sand and gravel, a glacial till. The consistency is very stiff ('N' values 18 to 58 blows per foot) in the upper 10 feet and becoming very hard ('N' values greater than 100 blows per foot) at depths ranging from 15 to 100 feet being generally in the order of 40 feet below the ground surface. In some locations a 14 to 25 foot thick deposit of very dense silty sand was encountered within the glacial till deposit. Exceptions to the above occur adjacent to the major water courses in the study area. At Mimico Creek, Plunketts Creek, the west side of Humber River (Main Branch) and at the West Humber River, subsurface conditions consist of generally a surficial deposit of stiff to very stiff clayey silt up to 20 feet thick overlying loose to dense deposits of silt, silty sand and sand overlying a very hard glacial till ('N' values greater than 100 blows per foot). The glacial till was encountered at depths ranging from 25 to 35 feet below the ground surface. Adjacent to Blacks Creek subsurface conditions consist of a surficial deposit 18 feet thick of very stiff glacial till overlying up to 115 feet of very stiff to hard varved silty clay overlying hard glacial till. Because of property problems it was not possible to place a boring on the east side of the Humber River (Main Branch) at Islington Avenue. However, other borings carried out in this area indicate subsurface conditions consist of 20 feet of compact to dense sand and silt deposits overlying 60 feet of soft to stiff silty clay overlying a very hard glacial till.

Groundwater was encountered at depths of about 10 to 30 feet below the ground surface, except adjacent to waterways where the groundwater was at the approximate river water level.

Discussion and Recommendations

It is proposed to construct a new east-west highway, Hwy. 407, constructed to freeway design standards, to be located immediately south of existing Hwy. 7. This report is concerned with that section of Hwy. 407 between Airport Road and Jane Street including the section of Hwy. 400 from Langstaff southerly to Steeles Avenue and also the section of Hwy. 427 from Hwy. 407 to Finch Avenue. This portion of the project will require the crossing of 5 major waterways, some 10 interchanges including 2 major interchanges, and some 16 crossings of railways and minor roads; in all requiring some 50 odd structures. The recommended grade for Hwy. 407 will involve roadway cuts up to 35 feet deep and roadway fills up to 45 feet high.

cont'd.....

Subsurface conditions across the site are generally favourable for structure and embankment foundations.

In Table 1 attached we have listed the areas where it is proposed to construct structures. Beside each is indicated the suitability for various structure foundation possibilities as follows.

Compacted Granular 'A' Pad - For abutments only, where the maximum allowable bearing pressure is in the order of 3.5 tsf.

Spread Footings - For abutments or piers where the maximum allowable loading will be in excess of 2.5 to 3.0 tsf.

Short End-Bearing Piles - For abutments or piers where the estimate pile tip elevation is 30 to 50 feet below the existing ground surface and the piles can be loaded to the maximum allowable load.

Long End-Bearing Piles - For abutments or piers where the estimated pile tip elevations is 80 to 140 feet below the existing ground surface and the piles can be loaded to the maximum allowable load.

Friction Piles - For abutments or piers where a competent end-bearing stratum is in the order of 80 feet deep and 45 foot #14 timber piles can be used at a loading of 30 tons/pile.

Embankments can be constructed using 2:1 cut slopes in the majority of areas. Where berms in the fill or cut slope may be required for stability purposes this is noted beside the appropriate area.

There are two areas where additional comment is thought necessary at this time. One area is the Hwy. 407-Islington Avenue location and vicinity. Here subsoil conditions consist of up to 20 feet of compact to dense sand and silt deposits overlying up to 60 feet of soft to stiff silty clay overlying hard glacial till. The proposed grade at this location will require a 35 foot cut. It is anticipated that berms will be required for stability purposes at this location. The second area is the Hwy. 407-Weston Road area and vicinity. Here the profile grade also requires a 35 foot cut. Subsoil conditions here consist of up to 42 feet of hard glacial till with a water bearing silty sand deposit 15 to 20 feet below ground surface. Slope protection measures will be required at this location to control seepage from the water bearing stratum.

cont'd.....

It is to be noted that the recommendations contained herein are very general and for the purposes of the Structural Planning Office to proceed with their discussions. In the final feasibility report we will provide more detailed recommendations for the structure and embankment foundation.

If you have any questions please do not hesitate to contact this office.

M Maclean

M. MacLean
Project Engineer

MM/gs

Attach.

cc: Files ✓

TABLE 1

Area	Description	Structure Foundations				Berm Required
		Compacted Granular Fill	Spread Footings	End Bearing Piles Short	End Bearing Piles Long	
A1	Hwy. 407 @ Airport Rd.	X	X			
A2	Hwy. 407 @ Brampton Terminal Spurline		X	X		
A3	Hwy. 407 @ Mimico Creek			X		
A4	Hwy. 407 @ Goreway Dr.	X		X		
A5	Hwy. 407 @ West Humber			X		
A6	Hwy. 407 @ Hwy. 50	X	X			
A7	Hwy. 407 @ Hwy. 427	X	X			
A8	Hwy. 427 @ Steeles Ave.	X	X			
A9	Hwy. 427 @ Albion Rd.	X	X			
A10	Hwy. 427 @ C.N.R.			X		
A11	Hwy. 407-Hwy. 427 Ramps East of Hwy. 427	X	X			
A12	Hwy. 407 @ Hwy. 27	X	X			
A13	Hwy. 407 @ Martingrove		X	X		
A14	Hwy. 407 @ Kipling			X		POSSIBLE
A15	Kipling @ C.N.R.			X		POSSIBLE
A16	Hwy. 407 @ Humber			X		
A17	Hwy. 407 @ C.P.R.				X	
A18	Hwy. 407 @ Islington				X	YES
A19	Hwy. 407 @ Pine Valley Dr.				X	

TABLE 1

Area	Description	Structure Foundations				Berm Required	
		Compacted Granular Fill	Spread Footings	End Bearing Piles Short	Long		Friction Piles
A20	Hwy. 407 @ Weston		X				POSSIBLE
A21	Hwy. 407 @ Hwy. 400	X	X				
A22	Hwy. 400-Hwy. 407 Ramps N. of Hwy. 407	X	X				
A23	Hwy. 400 @ Hwy. 7	X	X				
A24	Hwy. 407 @ Jane St.	X			X	X	
A25	Hwy. 400 @ C.N.R.	X	X				
A26	Hwy. 400 @ Langstaff				X	X	
A27	Hwy. 427 @ West Humber			X			
A28	Hwy. 427 @ Finch	X	X				
A29	Finch @ West Humber	X	X	X			

Legend

X denotes suitability for structure foundations according to the following.

Compacted Granular 'A' Pad: Abutments Only, Max. Allowable Load 3.5 tsf.

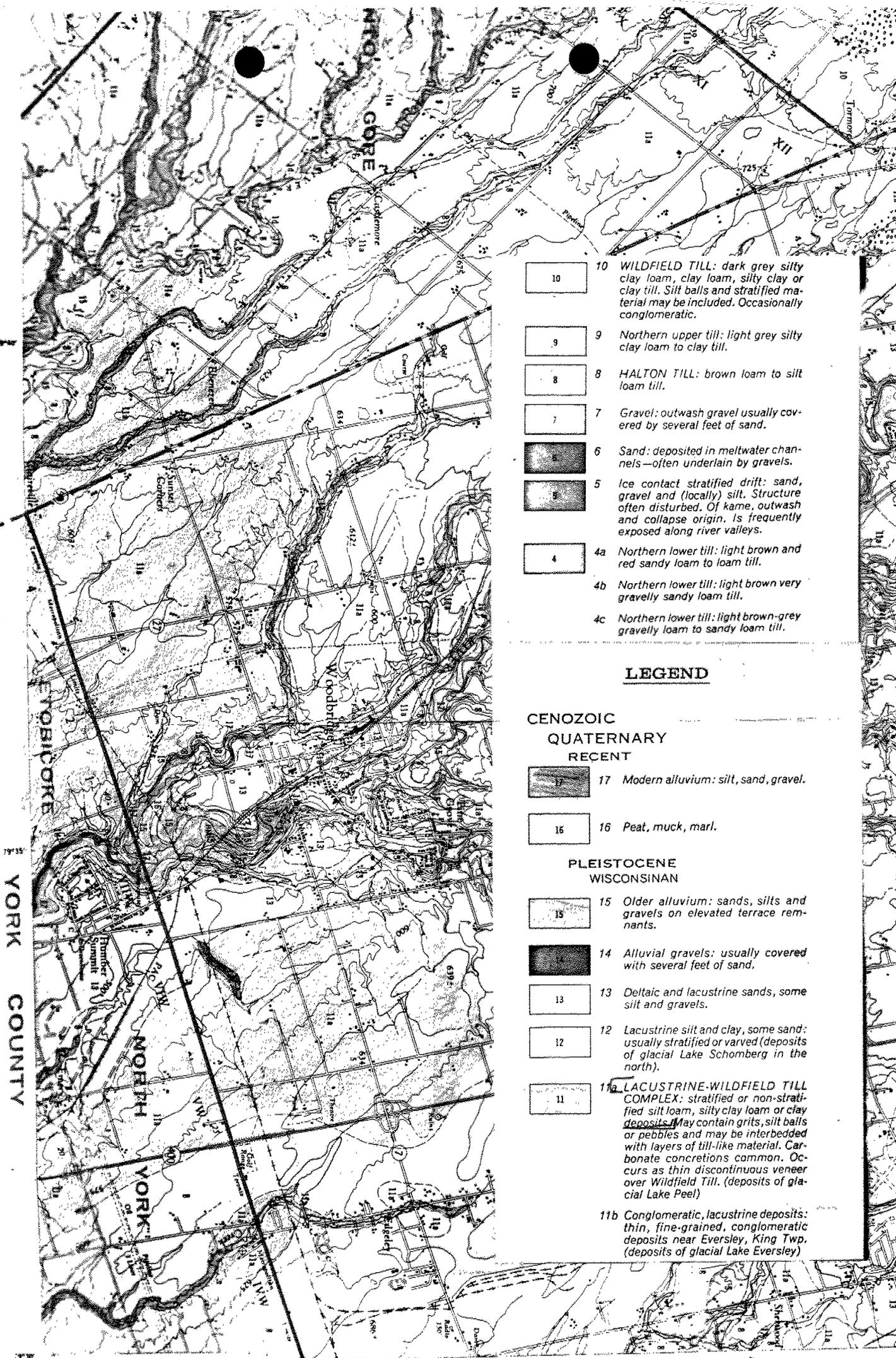
Spread Footings: Pier of Abutments Max. Allowable Load in Excess of 2.5 to 3.0 tsf.

Short End-Bearing Piles: Piers or Abutments Estimated Pile Tip Elev. 30-50' Below Ground Level
Max. Allowable Load Per Pile

Long End-Bearing Piles: Piers of Abutments Estimated Pile Tip Elev. 80-140' Below Ground Level
Max. Allowable Load Per Pile

Friction Piles: Piers or Abutments 45' Long #14 Timber Piles @ Load 30 tons/pile

OVERSIZE DRAWING



- 10 **WILDFIELD TILL:** dark grey silty clay loam, clay loam, silty clay or clay till. Silt balls and stratified material may be included. Occasionally conglomeratic.
- 9 Northern upper till: light grey silty clay loam to clay till.
- 8 **HALTON TILL:** brown loam to silt loam till.
- 7 Gravel: outwash gravel usually covered by several feet of sand.
- 6 Sand: deposited in meltwater channels—often underlain by gravels.
- 5 Ice contact stratified drift: sand, gravel and (locally) silt. Structure often disturbed. Of kame, outwash and collapse origin. Is frequently exposed along river valleys.
- 4a Northern lower till: light brown and red sandy loam to loam till.
- 4b Northern lower till: light brown very gravelly sandy loam till.
- 4c Northern lower till: light brown-grey gravelly loam to sandy loam till.

LEGEND

**CENOZOIC
QUATERNARY**

- RECENT**
- 17 Modern alluvium: silt, sand, gravel.
 - 16 Peat, muck, marl.
- PLEISTOCENE
WISCONSINAN**
- 15 Older alluvium: sands, silts and gravels on elevated terrace remnants.
 - 14 Alluvial gravels: usually covered with several feet of sand.
 - 13 Deltaic and lacustrine sands, some silt and gravels.
 - 12 Lacustrine silt and clay, some sand: usually stratified or varved (deposits of glacial Lake Schomberg in the north).
 - 11a **LACUSTRINE-WILDFIELD TILL COMPLEX:** stratified or non-stratified silt loam, silty clay loam or clay deposits. May contain grits, silt balls or pebbles and may be interbedded with layers of till-like material. Carbonate concretions common. Occurs as thin discontinuous veneer over Wildfield Till. (deposits of glacial Lake Peel)
 - 11b Conglomeratic, lacustrine deposits: thin, fine-grained, conglomeratic deposits near Eversley, King Twp. (deposits of glacial Lake Eversley)

SOURCES OF INFORMATION

Geology by O. L. White and assistants, 1963 1:24
 8-17-1965 by D. F. Karrow and assistants, 1:24

APPENDIX A

GEOCON LTD.

REPORT

TO

JAMES F. MACLAREN ASSOCIATES

ON

SOIL CONDITIONS

PROPOSED CLAIRVILLE DAM AND RESERVOIR

CLAIRVILLE

ONTARIO

I N D E X

	<u>Page</u>
Introduction	3
Site and Geology	3
Summarized Soil Conditions	3
Discussion	4
General	4
Site Suitability	4
Available Borrow Material	4
Dam Cross-Section	5
Foundations - Control Structures	6
Phase II Investigation	6
Site Investigation	6
Borrow Investigation	6
Engineering Analyses	7
Conclusions and Recommendations	7
Personnel	7
Appendix I	
Procedure	II
Soil Conditions	II
Water Conditions	III

INTRODUCTION

Geocon Ltd has been retained by James F. MacLaren and Associates Limited under the terms of our proposal dated October 19th, 1959 and accepted October 22nd, 1959 to provide soil engineering services necessary for the design of the proposed Clairville Dam and Reservoir on the West Branch of the Humber River. The purpose of Phase I of the site investigation, the results of which are presented in this preliminary report, was to assess, in preliminary form, the relative suitability of the subsoil pattern at two proposed sites for the dam and to present the basis for preliminary design of the dam section.

SITE AND GEOLOGY

Both of the sites under consideration in this report are located approximately 3/4 miles southeast of the Village of Clairville, Ontario. One site, designated as Site I, is located on the line of the proposed Canadian National Railways Bypass. The alternative site, designated as Site II, is located about 2,000 feet downstream from Site I, and about 400 feet east of where Indian Line crosses the West Branch of the Humber River. The slopes forming the stream valley in this area rise to a height of approximately 40 to 50 feet above the elevation of the stream bed and at a generally moderate angle. A plan of the two sites is shown on Drawing S6998-1 in the pocket at the rear of this report.

From available geological information and previous work in the area, it is known that the ground surface in the area of the proposed dam is generally formed of glacial moraine of the Wisconsin period. The uppermost material of this ground moraine is basal till. In local areas the till is overlain by a thin veneer of loose silts and sands deposited by geologically recent stream action. Underlying the upper till, interglacial sands, gravels, and stratified silts are occasionally encountered. These interglacial deposits and earlier stages of Illinoian till extend to Ordovician shale and limestone bedrock at a depth of the order of 100 to 150 feet below general ground surface.

SUMMARIZED SOIL CONDITIONS

The floor of the valley at Site I is covered by about 5 to 10 feet of compact to dense brown silt and sand followed by very dense grey silty glacial till. The slopes of the valley are also composed of very dense glacial till. Underlying the till at a depth of about 60 feet below stream level is soft, interbedded shale and limestone bedrock.

At Site II the floor of the valley is underlain by about 8 feet of compact silty sand and gravel followed by soft interbedded shale and limestone bedrock. The slopes of the river valley are composed of very dense grey silty till, followed by bedrock.

Groundwater level at the time of the investigation varied from river level to about elevation 530 near the head of the valley slopes.

Detailed descriptions of the various strata encountered are given in Appendix I, and stratigraphies at the two sites are shown on Drawing S6998-1 in the pocket at the rear of the report.

DISCUSSION

General

It is understood that the principal function of the proposed earth fill dam is for flood control in the Humber Valley with a secondary function of providing a reservoir for recreational facilities. In the case of a dam at Site I, it has been proposed that the dam also serve as a river crossing for the proposed Canadian National Railways Bypass. It is further understood that the crest of the dam, about 50 to 60 feet width, would be at about elevation 559, to provide a minimum freeboard of about 4 feet above maximum pond level and that a mass concrete spillway structure about 200 feet in length would be located in the central section of the dam.

Site Suitability

Based on the results of the investigation, it is considered that either of the sites under consideration would be suitable for the construction of an earth fill dam of the type proposed. Either the very dense silty till underlying Site I or the shale and limestone bedrock underlying Site II would provide stable foundation strata for the central portion of the dam and associated control structures. Detailed consideration of the seepage losses through the foundations is beyond the scope of this report, but it is considered that, at either site, such losses would probably be minor. The possibility of piping failure through the foundations at either site would necessitate further study, but it is considered at this time that this danger is remote and that no extensive special foundation treatment, such as concrete outoff walls or grouting would be required.

Available Borrow Material

The only borrow material readily available in the area which would be suitable for the construction of an earth fill dam is the glacial till which forms the slopes of the valley.

Provided that strict engineering control is maintained over the construction, as discussed below, it is considered that the silty till would provide a satisfactory fill material for the construction of an earth fill dam.

A detailed borrow examination was not within the scope of Phase I of the investigation, but based on a general reconnaissance of exposed slopes in the area, it is considered that sufficient material for the construction of the dam could be obtained within 500 yards upstream of either site.

From the results of the reconnaissance survey, it is considered that the character of the available borrow would be similar to the very dense silty till encountered in boreholes 1 and 4. The grain size distribution would therefore be approximately that shown on Figure I of Appendix II, indicating that the median grain size of the material would be about 0.25 millimeters. The liquid limit of the borrow would be of the order of 15 percent and the plasticity index would be less than 6.

The compaction characteristics for the borrow would be similar to those shown on Figure I of Appendix III; this compaction curve was obtained from a composite sample of the till and is shown merely as an indication of the probable nature of the material. From this figure it may be inferred that in order to attain suitable compaction in the field, it would be necessary to exercise strict control over water content during construction. Furthermore, based on previous experience with the use of similar materials in dam construction, it would be necessary to place the fill at or slightly below the optimum water content it lifts of about 6 to 8 inches.

Dam Cross-Section

Based on the availability of the borrow material adjacent to the site, it is recommended that a homogeneous earth section consisting of silt till be utilized for the dam. For the preliminary design, it is suggested that an embankment slope of 3 horizontal to 1 vertical be employed for the upstream face and those portions of the downstream face subject to possible submergence during flood conditions. Portions of the downstream slope not subject to submergence may be carried up at slopes of $2\frac{1}{2}$ to 1. A suggested typical dam section for the purpose of preliminary design is shown on Drawing S6998-2 in Appendix IV; the details of this sketch are discussed below.

In order to keep the line of seepage through the dam well within the downstream slope of the dam, it would probably be necessary to provide an under drain extending from the toe to approximately $\frac{1}{3}$ of the base width. This under drain would be about 4 feet thick, constructed of clean granular material designed to provide free drainage and to prevent entrance of fines from the main dam section. Possible erosion of the toe could be prevented by a rock fill toe drain about 5 feet high.

The upstream slope may be protected by a 1 to 2 feet thick gravel blanket and about 2 feet of rip rap. The rip rap and gravel blanket should probably extend about 50 feet upstream from the junction of the embankment section with the valley slope. It is also suggested that the rip rap and gravel blanket be included on downstream slopes subject to submergence. Downstream slopes above the level of possible submergence could be protected by sodding.

At Site I the earth-fill dam section may be founded on the very dense till. This would require stripping of the overlying silty sand, the average thickness of which may be taken as 5 feet over the site for preliminary estimating.

In the case of a dam at Site II, it is recommended that the embankment section be founded directly on sound bedrock, which appears to be at a reasonable depth across the stream valley. For preliminary purposes, the average thickness of material to be stripped may be taken as 5 feet across the site; however, further definition of the soil stratigraphy would be required for final design. Where the dam embankment rests directly on bedrock, it is recommended that a core trench approximately 5 feet deep and 10 feet wide at the base be constructed in the rock. No serious difficulties in stripping are anticipated at either site, and it is considered that groundwater would be controlled easily by sumps.

At the extremities of a dam at either site where the dam meets the till valley slopes, it is recommended that the till slopes be stripped of weathered material across the width of the dam. This would probably require stripping for a horizontal distance of 10 to 20 feet at each end.

Foundations - Control Structures

The mass concrete spillway section may be founded on a concrete mat resting directly on either the till or in sound bedrock, depending on the site. At Site I, it is recommended that the base of the mat be located about 5 feet below the general base level of the earth-fill dam section which would be at about elevation 515. It is further considered that bearing pressures of up to 3.0 tons per square foot may be used for the preliminary design of the spillway structure. Under sustained contact pressure of 3 tons per square foot, it is anticipated that no significant settlement would occur.

With regard to outlet conduits, it is recommended that these be located within the abutments or piers of the spillway structure in order to eliminate the possibility of differential compaction and hence possible cracking of the earth fill sections.

PHASE II INVESTIGATION

When the final site has been selected and a preliminary design of the dam has been adopted, a detailed site and borrow investigation should be carried out to obtain the detailed information required for the final design of the dam and to ensure that no unusual site conditions exist in local areas. Based on the results discussed in this report, it is considered that the scope of the detailed investigation should include the following:

Site Investigation

- (1) Approximately 5 detailed exploratory borings in BX size would be required along the centre line spaced in order to supplement and extend the information obtained in the boreholes of the preliminary phase. These boreholes would be taken to bedrock, and soil samples would be taken at vertical intervals not exceeding 5 feet. Falling head permeability tests would also be carried out at frequent intervals in each borehole, and where rock is encountered near ground surface pressure pumping tests would be carried out in the rock.
- (2) Approximately 8 short power auger holes would be required within the area of the dam site and spaced to supplement the detailed boreholes in order to define in detail the amount of stripping of previous recent deposits.
- (3) Laboratory tests would be carried out on samples obtained in the boreholes, as required, in order to define the strength, compressibility, and permeability of the foundation strata.

Borrow Investigation

- (1) Approximately 12 power auger holes would be required to define a suitable borrow area. It is considered that these would be generally less than 30 feet in depth, and representative samples would be taken at frequent intervals for identification and laboratory determination of engineering properties.

- (2) The power auger holes would be supplemented by 3 to 5 test pits dug with a backhoe to enable detailed examination of any stratification in the borrow area and to obtain bulk samples for laboratory testing.
- (3) Laboratory testing would be carried out to define the characteristics of the borrow material, its compaction properties, and its strength and permeability properties when compacted.

Engineering Analyses

Analyses would be carried out, as required, to determine the extent of seepage losses through and under the dam, and to determine the most economical, stable dam cross-section possible under the existing conditions and with the available borrow material.

CONCLUSIONS AND RECOMMENDATIONS

1. The central portion of Site I on the line of the proposed Canadian National Railways Bypass was found to be underlain by about 1 foot of topsoil, followed by an average of about 5 feet of compact to dense silty sand, and then very dense silt till. Shale and limestone bedrock is at a depth of about 60 feet below stream level. The central portion of Site II is underlain by less than 10 feet of silty sand and gravel followed by bedrock. At both locations, the stream valley slopes are composed of very dense silty till.
2. It is concluded that either site would be suitable for the proposed dam, and that major stability or seepage problems would be unlikely.
3. It is considered that the deposits of silty till located within 500 yards of either site would be suitable for the construction of an earth fill dam as discussed in the report.
4. Based on the general properties of the available borrow material, it is recommended that the proposed dam be a homogeneous earth fill section, and pertinent preliminary design considerations for such a section are discussed in the report.
5. Recommendations are also given in the report for the preliminary foundation design of control structures for the proposed dam.
6. Detailed recommendations for the detailed site and borrow investigation which will be required to provide the data for final design of the dam are given in the report.

PERSONNEL

The field work was carried out by Mr. J. N. Beckett under the supervision of Mr. J. L. Seychuk and Mr. A. A. Gass. The report was written by Mr. A. A. Gass and reviewed by Mr. V. Milligan.

A. A. Gass, P. Eng.

APPENDIX I

Procedure

Soil Conditions

Water Conditions

Office Reports on Soil Exploration.

PROCEDURE

The field work was commenced on October 28th, 1959 and completed on November 24th 1959. Four boreholes were put down, numbers 1 and 2 at Site I and numbers 3 and 4 at Site II, to a maximum depth of 67 feet using a standard skid-mounted machine drillrig. In-situ falling head permeability tests were carried out in the cased borings at 5 foot intervals of depth. Bed-rock, where encountered was core drilled in AXT size. The location of the borings is shown on Drawing S6998-1, contained in a pocket at the rear of this report. The soil stratigraphy inferred from these borings and borings put down by others is also shown on this drawing. Detailed logs of the boring put down are given on the Office Reports on Soil Exploration in this Appendix.

The soil testing was carried out in the Toronto Soils Laboratory of Geocon Ltd and the results are plotted on the Figures in Appendices II and III. The results of the in-situ field falling head permeability tests are plotted on the Office Reports on Soil Exploration.

Elevations given in this report were supplied by James F. MacLaren Associates and are referred to the Toronto Township datum.

SOIL CONDITIONS

The main soil Strata encountered by the borings are as follows:

Topsoil

Site I and Site II are generally covered by about 1 foot of brown sandy topsoil.

Silty Sand and Gravel

Underlying the topsoil in the central portion of the river valley at Site I is a stratum of brown silty sand. The thickness of the stratum, which was encountered in borehole 2, is about 4 feet. Based on boring information supplied by others, the stratum has a maximum thickness of 7 feet. At Site II a similar stratum having a thickness of about 8 feet was encountered in borehole 3. In addition to the silt and sand as at Site I, the stratum contains an appreciable proportion of gravel. Geologically, it is considered that these strata are recent flood plain deposits.

From boring resistance and the result of a standard penetration test which gave an "N" value of 17 blows per foot, it is estimated that the stratum is compact to dense at Site I and loose to compact at Site II.

Silty Till

Underlying the recent flood plain deposits at Site I and the topsoil on the river valley slopes at both sites in a stratum of glacial silty till. The stratum generally consists of well graded gravel to silt sizes as shown in Figures 1 and 2 of Appendix II. In about the upper 20 feet in borehole 2, the stratum consists predominantly of clayey silt as shown by the grain size distribution curve for sample 4 in Figure 2, Appendix II. The individual particles of the till are generally subangular in shape.

The coefficient of permeability computed from the in-situ field falling head permeability tests varied from a value indicating a practically impermeable material to a maximum value of 5×10^{-3} centimeters per second, but generally less than 1×10^{-3} centimeters per second. Based on these results the permeability of the stratum is generally low, with the occasional higher values indicating local pockets of coarser and more pervious material within the till.

Standard penetration or "N" values obtained within the stratum were generally in excess of 100 blows per foot, confirming that the till is of very dense relative density.

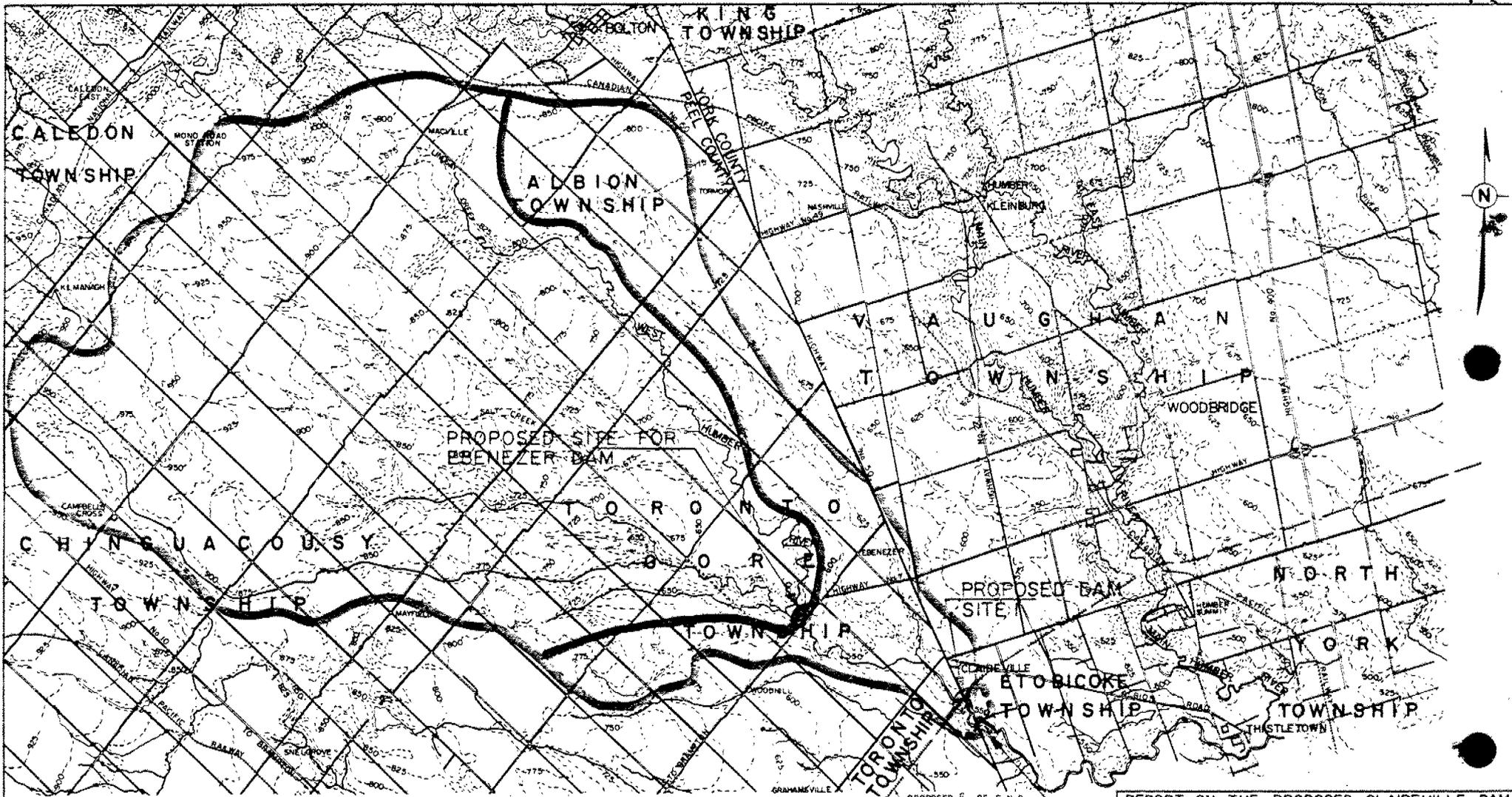
Shale and Limestone Bedrock

Bedrock underlies the silty sand and gravel at Site II and the very dense till at both sites. The rock was cored in AXT size for 5 feet in boreholes 1 and 4 and for 10 feet in borehole 3, and was found to consist of soft grey shale with bands of limestone up to about 6 inches in thickness. The shale is generally vertically fissured and the top $1\frac{1}{2}$ to 2 feet of the bedrock is weathered.

Bedrock was encountered at about elevation 468 in borehole 1, elevation 516 in borehole 3 and elevation 503 in borehole 4.

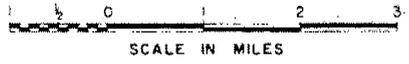
WATER CONDITIONS

Groundwater level at the time of the investigation varied from river level in the valley to about elevation 530 along the slopes of the valley at both sites.



LEGEND

-  OUTLINE OF DRAINAGE AREA TRIBUTARY TO CLAIREVILLE DAM SITE
-  OUTLINE OF DRAINAGE AREA TRIBUTARY TO EBENEZER DAM SITE
-  STREAMS
-  RIVERS
-  RAILWAY
-  400' CONTOUR
-  TOWNSHIP LINE
-  COUNTY LINE



PROPOSED DAM SITE 2

PROPOSED C. OF CNR TORONTO TERMINAL ACCESS LINE

REPORT ON THE PROPOSED CLAIREVILLE DAM AND RESERVOIR FOR THE METROPOLITAN TORONTO AND REGION CONSERVATION AUTHORITY

GENERAL PLAN SHOWING DRAINAGE AREAS

JAMES F. MACLAREN ASSOCIATES ENGINEERS TORONTO

SCALE AS SHOWN DATE - JANUARY 1960 FIG No 1



Action Memo

Time _____ Date _____

Ontario

To murty → Malcolm

From Cam

<input type="checkbox"/> Phoned On Hold	<input type="checkbox"/> Please Call Returned Your Call	<input type="checkbox"/> Will Call Back Wishes Appointment	Telephone No.
---	---	--	---------------

<input type="checkbox"/> Waiting in Person	<input type="checkbox"/> Was Here	<input type="checkbox"/> Will Return	Message Taken By
--	-----------------------------------	--------------------------------------	------------------

- | | | | |
|--|--|---|---|
| <input type="checkbox"/> File | <input type="checkbox"/> Draft Reply For My Signature | <input type="checkbox"/> Provide More Details | <input type="checkbox"/> For Your Information |
| <input type="checkbox"/> Type Draft | <input type="checkbox"/> For Your Approval and Signature | <input type="checkbox"/> Keep Me Informed | <input type="checkbox"/> Per Discussion |
| <input type="checkbox"/> Type Final | <input type="checkbox"/> Circulate, Initial and Return | <input checked="" type="checkbox"/> Take Appropriate Action <i>please</i> | <input type="checkbox"/> Per Your Request |
| <input type="checkbox"/> Make _____ Copies | <input type="checkbox"/> Return With Comments | <input type="checkbox"/> Note and See Me | <input type="checkbox"/> Returned With Thanks |
| <input type="checkbox"/> Please Answer | <input type="checkbox"/> Investigate and Report | <input type="checkbox"/> Note and Return | <input type="checkbox"/> |

Comments:
 malcolm told me about this, maybe a Property damage report should be filled out.

Copy for the information of

C. MIRZA

Mr. H. A. Aron, Head,
Property Section,
Central Region.

Planning and Design Section,
Central Region.

1978-10-27

Highway 407, Town of Vaughan between
Kipling Avenue and Islington

As discussed with you on the telephone, I had a call from a property owner by the name of Mr. Ken McKay, who was somewhat upset that the Ministry staff had entered upon his property, cutting a fence and not replacing it. He alleged that it was a party from the Soils Office that came in with equipment to carry out boring work and was under the supervision of Mr. Malcolm Maclean, who works under Mr. Cam Mirza from Head Office. The entry was alleged to be from the old Kipling Road allowance through lands owned by the Metropolitan Conservation Authority and then cut the fence into his property to carry out the work. This property lies between Kipling and the CPR west of the Humber River. He has requested that the fence be repaired immediately.

Would you please look into this matter and arrange to either compensate or have the fence repaired.

For your information, the Highway 407 work in this area is tentatively programmed for 1981 and lands will be required from Mr. McKay for the construction of Highway 407. It is likely that we will have considerable difficulty in settling with this particular land owner as I have known him for some years. Both the CNR and the Conservation Authority had a really difficult time in settling their takings.

*Property damage report
filled out Oct 26, 78.*

*Property under concern was
understood to be under jurisdiction
of Conservation Authority and hence
no prior permission was obtained
for access M M
RGB/phw*

Original Signed by
R. G. BURNFIELD
R. G. Burnfield,
Regional Design Engineer.

- cc: W. C. Friedmann
- R. D. Gunter
- C. Mirza ✓
- G. C. E. Burkhardt
- J. G. Celmins





Ontario

ACTION REQUEST

7540-1037 (2-72)

DATE

79-03-28

TO

Mr. M. MacLean

FROM

K. Riggin

TELEPHONE NO.

- PLEASE CALL

- WISHES APPOINTMENT

- RETURNED YOUR CALL

- WILL CALL BACK

- NOTE AND FILE

- PROVIDE MORE DETAILS

- PLEASE ANSWER

- NOTE AND FORWARD

- FOR YOUR INFORMATION

- DRAFT REPLY FOR MY SIGNATURE

- NOTE AND RETURN

- FOR YOUR APPROVAL

- INVESTIGATE AND REPORT

- NOTE AND SEE ME

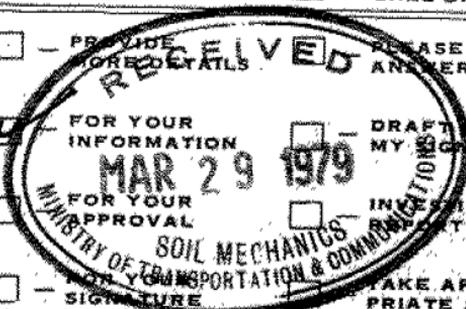
- SIGNATURE

- TAKE APPROPRIATE ACTION

- RETURN WITH COMMENTS

- PER YOUR REQUEST

- _____



COMMENTS:

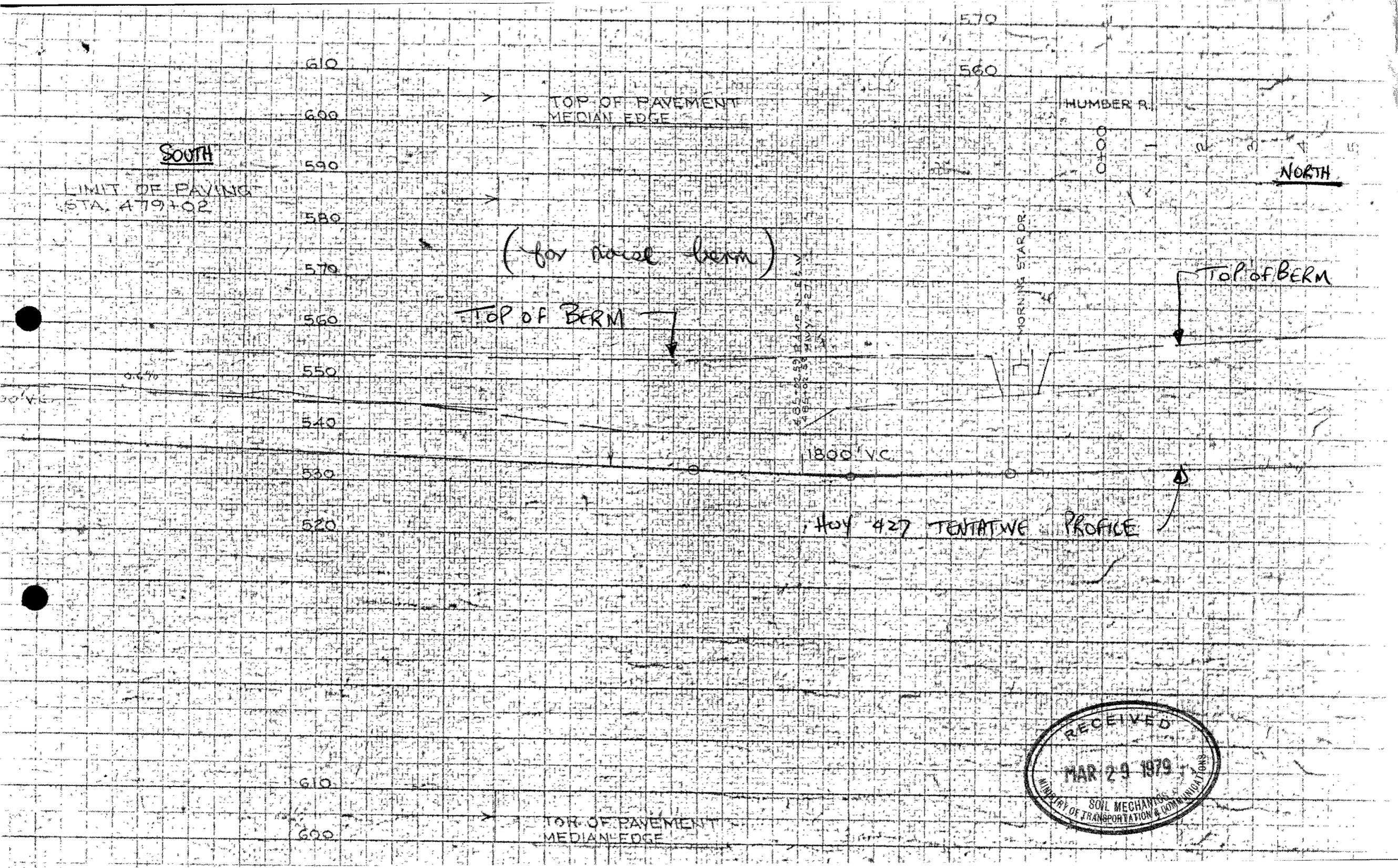
Profiles at Hwy 427 at Morningstar Drive enclosed. This is further to our letter of 79-03-28 to Proctor & Keefern.

CALL TAKEN BY:

TIME

Please take no further action if you agree with our recommendations.

6-4030



SOUTH

LIMIT OF PAVING
STA. 479+02

TOP OF PAVEMENT
MEDIAN EDGE

NUMBER R.

NORTH

(for road berm)

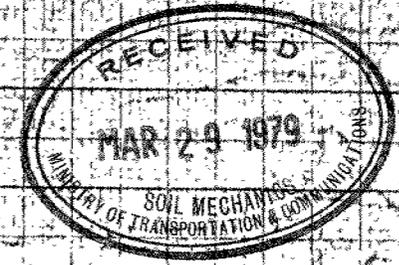
TOP OF BERM

TOP OF BERM

MORNING STAR DR

1800 VC

Hwy 427 TENTATIVE PROFILE



TOP OF PAVEMENT
MEDIAN EDGE

610

600

610

600

590

580

570

560

550

540

530

520

570

560

0+00

EXISTING PAV'T

RBT

TENTATIVE GRADE ONLY

560

CAST

400' V.C.

3.8%

500' V.C.

1.5%

550

540

530

520

MORNING STAR DR.

HIGH PRESSURE GAS LINE

50+00

590

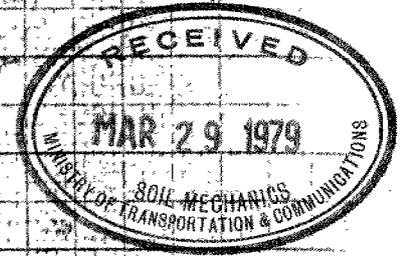
580

570

560

SPILLWAY

EXIST. PAV'T



1800' V.C.

TOP OF PAVEMENT
MEDIAN EDGE

NUMBER R.

0+00

0

0

0

0

0

October 5, 1978

Ministry of Transportation
and Communications
Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Attention: Mr. M. MacLean
Project Engineer

Re: Proposed Subsurface Investigation
Highway No. 407 Crossing Regional Roads
File: 13.04.11

Dear Sir:

We acknowledge receipt of your letter dated October 2, 1978 requesting permission to locate boreholes on the Regional Road allowance at the proposed crossing of Highway No. 407 and Jane Street, Weston Road, Pine Valley Drive and Islington Avenue.

Permission is hereby granted to carry out the work subject to the following conditions.

1. The Ministry agrees to indemnify and save harmless the Regional Municipality of York from any claims arising out of the work as outlined.
2. The Ministry shall obtain all utility stake-outs as required.
3. Any area disturbed within the road allowances will be restored upon the completion of the work.

Yours truly,

WEB/pk




W. E. Bando, P. Eng.
Operations Engineer

WPA?

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

October 2, 1978

Mr. W. Bando
Operations Engineer
Regional Municipality of York
Box 296
Newmarket, Ontario
L3Y 4X1

Dear Sir:

In response to our telephone conversation of October 2, 1978, we are hereby informing you of our intentions and request permission to carry out the required subsurface investigation.

Our work is in connection with the proposed Hwy. 407 crossing Jane Street, Weston Road, Pine Valley Drive and Islington Avenue (please find attached sketch of subject areas). The fieldwork consists of augering and sampling (6" diameter hole) through the overburden to a competent bearing stratum. Upon completion of each boring the borehole will be backfilled. At this stage in the design only one borehole is contemplated at each of the aforementioned locations.

Under our present schedule for fieldwork we intend to commence work in this area sometime within the last week in October.

The Ministry agrees to save the Region harmless from any claims arising out of the work as outlined above.

If you have any questions concerning the above please contact us. Thank you for your cooperation in this matter.

Yours truly,

M. MacLean
Project Engineer

MM/gs

Attach.

bcc: Files

367-8305
M. Gizzi

ABRAMS

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

September 29, 1978

Mr. Abrams
Department of Roads and Traffic
Municipality of Metro Toronto
30th Floor, Simpson Tower
401 Bay Street
Toronto, Ontario
M5H 2Y4

Dear Sirs:

In response to our telephone conversation of September 29, 1978, we are hereby informing you of our intentions and request permission to carry out the required subsurface investigation.

Our work is in connection with the proposed Hwy. 427 crossing Albion Road (attached please find a sketch of subject area). The fieldwork would be performed off the highway so as not to interfere with traffic and would consist of augering and sampling one hole through the overburden to establish a competent bearing stratum for the proposed structures. Under our present schedule for fieldwork we intend to commence work in this area in mid October. The duration of our work in this area is not expected to exceed two days.

The equipment used will be rented from a private soil sampling firm operating within the Toronto area and will be directly supervised by our office. Upon completion of each boring the auger hole will be backfilled.

Your cooperation in this matter is appreciated. Thank you for your trouble.

Yours truly,

M. MacLean
Project Engineer

MM/gs

ROSS L. CLARK
B.A. SC., P. ENG.
COMMISSIONER OF WORKS



ADDRESS ALL
CORRESPONDENCE
TO THE COMMISSIONER

Att'n. Mr. G.A. Kelly
TELEPHONE: 367-8286
TELEX: 06 234 72

THE MUNICIPALITY OF METROPOLITAN TORONTO

DEPARTMENT OF WORKS
PHOENIX HOUSE
439 UNIVERSITY AVE., TORONTO
M5G 1Y8

September 20, 1978

Ministry of Transportation
and Communications
Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Attention: Mr. M. MacLean
Project Engineer

THACKERAY LANDFILL SITE
OUR FILE NO. 1621.00

We acknowledge receipt of your letter dated September 14th,
and your request to carry out soil borings on the above mentioned
landfill site.

We have no objection to the proposal contained in your letter,
providing the Ministry saves the Metropolitan Corporation
harmless from any claims which may arise out of the work being
done and, further, agrees to restore any damaged areas to
their former condition.

Before proceeding with the work, please contact our Mr. Don
Duncliffe (telephone 839-9876) who will arrange for your entry
onto and through the site.

I. McKerracher, P.Eng.,
Director - Refuse Disposal Division

GAK:bs 33982



PLEASE
QUOTE OUR
FILE No.
IN REPLY

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

September 14, 1978

Mr. G.A. Kelly
Assistant Director
Refuse Disposal
Work Department of Metro Toronto
439 University Avenue
Toronto, Ontario

Dear Mr. Kelly:

In response to our conversation of September 14, 1978, we are hereby informing you of our intentions and request approval for a subsurface investigation to be carried out in the vicinity of the ThackerayLand Fill Site.

Our work is in connection with the proposed Hwy. 407 located to the north of the ThackerayLand Fill Site (attached please find a sketch of subject area and approximate locations of our work areas). The fieldwork consists of augering and sampling (6" diameter hole) through the overburden to a competent bearing stratum. At this time we are in the feasibility stage of design and hence only one borehole is contemplated at each of the locations marked. Under our present schedule for fieldwork we intend to commence work in this area sometime within the first week in October. The duration of our work here is not expected to be more than three 10 hour days.

The equipment used will be rented from a private soil sampling firm operating within the Toronto area and will be directly supervised by our office. Upon completion of each boring the borehole will be backfilled. However, subsidence may occur in the future and it is suggested the boreholes be rechecked to ensure hazards do not exist.

We would require permission to enter the ThackerayLand Fill Site to put one boring down south of the C.N.R. tracks

cont'd.....

(as shown on attached plan). Further, we would require permission to gain access to the property to the north of the C.N.R. through the Thackeray Land Fill Site.

Your cooperation in this matter is appreciated. Thank you for your trouble.

M. MacLean
Project Engineer

MM/gs

Attach.

cc: Files

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

September 14, 1978

Metropolitan Toronto and Region
Conservation Authority
5 Shoreham Drive
Downsview, Ontario
M3N 1S4

Attn: Mr. J. Agnew

Dear Sir:

Further to our telephone conversation of September 14, 1978, please find attached two plans showing the proposed boreholes located within the Claireville Conservation Area and within the Conservation Authority's property to the north of the Thackeray Land Fill site.

At this time we are in the feasibility stage of design and hence only one borehole is contemplated at each of the locations marked.

Under our present schedule for fieldwork we will be performing the work sometime within the first week in October. As requested we will contact your field personnel at the Claireville Conservation Area giving a 24 hour notice of our intention to work there.

The equipment used will be rented from a private soil sampling firm operating within the Toronto area and will be directly supervised by our office. Upon completion of each boring the borehole will be back-filled. However, subsidence may occur in the future and it is suggested that the boreholes be rechecked to ensure hazards do not exist.

cont'd.....

If you require any further information or have any further requests please contact our office.

Thank you for your trouble.

Yours very truly,

M. MacLean
Project Engineer

MM/gs

cc: Files ✓

Attach.



Memorandum

To: Mr. M. Devata,
Supervising Engineer,
Soils Mechanics Section,
Central Building, Downsview.

From: G.C.E. Burkhardt,
Structural Section,
Central Region.

Attention: Mr. M. MacLean

Date: 1978-09-11

Our File Ref.

In Reply to

Subject: RE: Feasibility Study,
Hwy. 407 - Airport Rd. to Jane St. (incl. Hwy. 400),
W.P. 88-78-00, Hwy. 427 - Finch Ave. to Hwy. 407 -
W.P. 49-71-00, District 6, Toronto

Further to our meeting of 1978-09-08, two sets of plans and profiles for the proposed section of Highway 407 from Airport Road to Jane Street, and the section of Highway 427 north of Finch Avenue were submitted to Mr. MacLean of your office today.

The following is a description of some of the areas shown on the plans. It is not known whether any soils information is available for the existing structures at areas A5 and A23:

- A5 - This area is circled for two separate structures, plus probable widening of the existing structure. The site number of the existing municipal bridge on Steeles Avenue (built 1963) is 24-160.
- A15 - The Thackeray Land fill site is located in the southeast quadrant of this area. The C.N.R. tracks would be detoured during construction, and it would be helpful if some recommendations could be provided on the detour location.
- A23 - The existing structure (Site 37-125) was built in 1950, and will be replaced.
- A25 - The existing structure (Site 37-269) was built in 1961. Soils information is available in report BA 1000, and new structures will be built for the ramps.
- A26 - No plan or profile is available for the proposed structure at Langstaff Road (approximately 1¼ miles north of Highway 7). Langstaff Road will go over Highway 400, and information on a preliminary profile will be available shortly.

A foundation investigation report W.O. 70-11099 is available for a proposed sewer in the northwest quadrant of the proposed Highway 400/407 interchange.



As agreed, please provide your preliminary recommendations for the proposed structures, indicating the feasibility of the proposed schemes. Preliminary recommendations are expected by 1979-11-01, and the final report by 1979-12-01.

Please contact this office if any further information is required.



K. Pilgrim,
Senior Structural Engineer,
for:
G.C.E. Burkhardt,
Head, Structural Section.

KP:gj

c.c. L. Dutchak
G. Norman
R.D. Gunter
P. MacLeod - Giffels

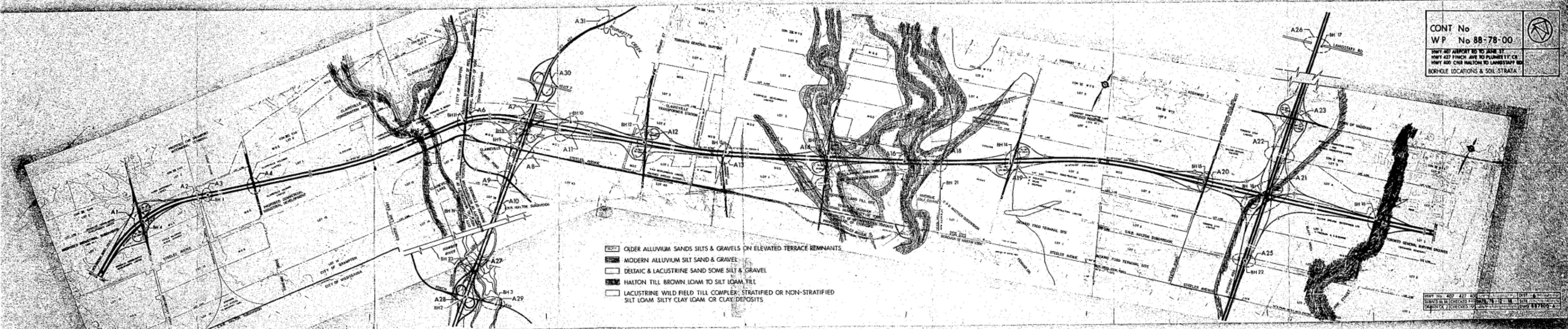
CONT No
WP No 88-78-00



HWY 407 AIRPORT RD TO JANE ST
HWY 427 FINCH AVE TO PLUMMER TT CR
HWY 400 CNR HALTON RD LANDSTAFF RD
BORHOLE LOCATIONS & SOIL STRATA

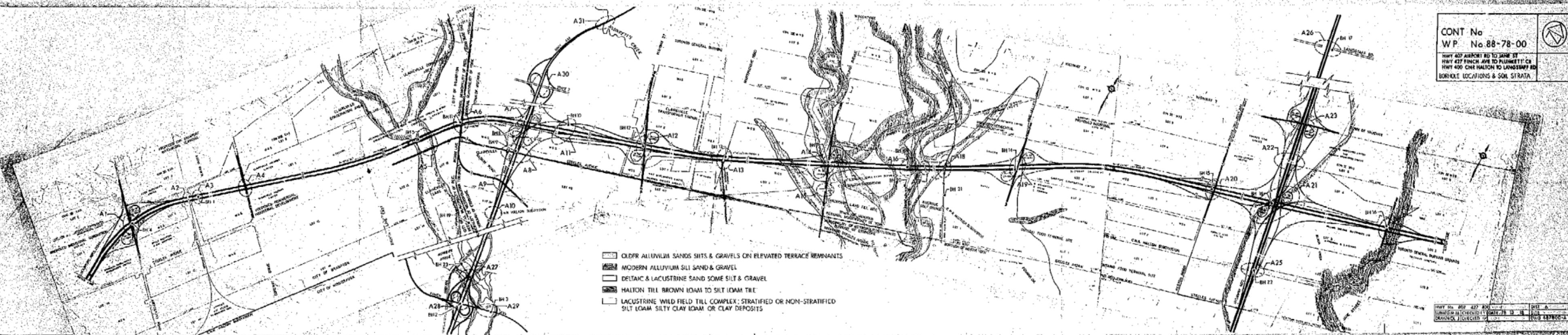
- OLDER ALLUVIUM SANDS SILTS & GRAVELS ON ELEVATED TERRACE REMNANTS
- MODERN ALLUVIUM SILT SAND & GRAVEL
- DELTAIC & LACUSTRINE SAND SOME SILT & GRAVEL
- HALTON TILL BROWN LOAM TO SILT LOAM TILL
- LACUSTRINE WILD FIELD TILL COMPLEX STRATIFIED OR NON-STRATIFIED SILT LOAM SILTY CLAY LOAM OR CLAY DEPOSITS

HWY 407 427 400
SUBV'D BY M CHECKED BY M
DATE 7/8 7/8 7/8
SITE
DRAWN BY M
CHECKED BY M
DATE 8/8/80 8/8/80 8/8/80



CONT No
 WP No. 88-78-00

HWY 407 AIRPORT RD TO JANE ST
 HWY 427 FINCH AVE TO PLUNKETT CR
 HWY 400 CNR HALTON TO LANGSHAW RD
 BORING LOCATIONS & SOIL STRATA



- OLDER ALLUVIUM SANDS SILTS & GRAVELS ON ELEVATED TERRACE REMNANTS
- MODERN ALLUVIUM SILT SAND & GRAVEL
- DELTIC & LACUSTRINE SAND SOME SILT & GRAVEL
- HALTON TILL, BROWN LOAM TO SILT LOAM TILL
- LACUSTRINE WILD FIELD TILL COMPLEX: STRATIFIED OR NON-STRATIFIED SILT LOAM, SILTY CLAY LOAM OR CLAY DEPOSITS

HWY No. 407 427 400 DIST. A
 SURVEYOR CHECKED BY DATE 78 12 18 ALL
 DRAWING CHECKED BY DATE 78 12 18 447800-3

