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DIST. 4 REGION

W.P. No. 40-74-12

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. B.S.A.R

LOCATION RETAINING WALLS

BETWEEN MURRAY ST & COLBORNE ST East

No. OF PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Memorandum

40 P1-70

GEOCRES No.

To: Mr. G.C.E. Burkhardt (3)
Reg. Structural Planning Engineer
Central Region
3501 Dufferin Street, Downsview

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Attention:

Date: June 23, 1975

Our File Ref.

In Reply to

JUN 24 1975

Subject:

FOUNDATION INVESTIGATION REPORT

For

Proposed Retaining Walls
Along The Brantford Southern Access Road
City of Brantford
District No. 4 (Hamilton)
W.P. 40-74-12

Between Murray Street & Colborne St. E.

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

K.G. Selby

K.G. SELBY
Supervising Engineer

c.c. E.J. Orr
B.R. Davis
B.J. Giroux
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FOUNDATION INVESTIGATION REPORT

For

Proposed Retaining Walls
Along The Brantford Southern Access Road
City of Brantford
District No. 4 (Hamilton)
W.P. 40-74-12

1. INTRODUCTION

A field investigation was carried out by the Soil Mechanics Section along the R.O.W. of the former Lake Erie and Northern Railroad between Lynwood Drive and the Mohawk Canal to determine the subsurface conditions.

This report contains the result of the investigation and the recommendations pertaining to the design of the retaining walls and foundations.

2. DESCRIPTION OF THE SITE

The site of the proposed retaining walls is located in the city of Brantford along the right-of-way of the former Lake Erie and Northern Railroad between Lynwood Drive and the Mohawk Canal. The land drops gently from the plain at Lynwood Drive (elev. 700) to the edge of the Grand River Flood Plain at the canal (elev. 660).

Physiographically the site is a deltaic deposition of varved silts and clayey silts deposited in Lake Whittlesey and later covered by silts deposited in Lake Warren.

3. FIELD AND LABORATORY INVESTIGATION

The field work consisted of 18 boreholes, 3 of which were advanced to bedrock, and of 29 dynamic cone penetration resistance tests. The boreholes were drilled with a hollow stem continuous flight auger mounted on a bombardier rig.

Disturbed samples were obtained by means of standard split-spoon sampler; the energy used in driving it conformed to the requirements of the Standard Penetration Test.

'Undisturbed' samples were recovered using 2-inch O.D. Shelby Tubes.

Wherever possible, in situ field vane tests were carried out.

All the samples were visually examined and identified both at the site and in the laboratory. Further laboratory tests were carried out on representative samples to determine the following properties:

Atterberg Limits

Natural Moisture Content

Grain Size Distribution

Undrained Shear Strength

Bulk Density

All tests results are summarized in the record of borehole sheets.

All boreholes and cone holes were surveyed by personnel from the Central Region Engineering Surveys. The location and elevations of the borings are shown on Drawing #407412-A & B.

4. SOIL CONDITIONS

4.1 General

As can be seen in the borehole log sheets in Appendix 1 the subsoil conditions are very irregular both in the limits of the different strata and within the strata itself.

Fill material or topsoil exists in most boreholes for several feet below the surface. It is usually a loose sandy type fill material with some gravel. Thicker deposits of fill exist in the vicinity of boreholes 242 and 228 to 234 where the material is up to 18 feet thick. Another exception is in the vicinity of borehole 210 where a 10' thick layer of dense sand and gravel is at the surface.

Beneath this fill and topsoil material there are generally three main strata of subsoils.

- 1) layers of clayey silt and silt with traces of sand--generally stiff to very stiff.
- 2) silt to sandy silt--compact to dense.
- 3) irregular layers of clayey silt, silty-clay and silt--firm to stiff. Similar to the first layer although more irregular and softer with slightly higher clay content.

There is also a layer of sandy silt to silt in the vicinity of boreholes 210 and 236 to 238.

A brief description of the main strata of subsoils is given below.

4.2 Layers of Clayey Silt and Silt

Under the surface material which was normally fill material or topsoil, cohesive deposits of layers of clayey silts and silts were recorded in most boreholes except those east of station 173+00. The thickness of this stratum varied considerably. Thicknesses up to 40' were recorded but generally the layer extended to a geodetic elevation of 688 feet.

This deposit had a consistency ranging from firm to hard corresponding to penetration "N" values of 4 to 31 blows/ft. Because of the considerable variation of properties and irregular stratification of these layers, average values for the physical properties would be misleading. However the natural moisture content generally ranged from 20 to 25%. The undrained shear strengths were in most cases greater than 2000 p.s.f. except in the vicinity of borehole 221 where it was only 1100 p.s.f.

The material was generally found to be a more uniform clayey silt nearer the surface and becoming more irregular with increasing depth.

4.3 Silt to Sandy Silt

Below the clayey silt stratum, a stratum ranging from silt to sandy silt was encountered in most boreholes. It was also encountered above the clayey silt stratum in boreholes 210 and 236 to 238. These soils are essentially non-cohesive granular deposits. The thickness of this stratum ranged from approximately ten to fifteen feet.

The grain size analyses resulted in curves mainly in the silt to sandy-silt size range with the percentage of sand increasing with depth. Some of the tests indicated almost pure silt-size grains and others indicated traces of clay content.

The relative density of this stratum was in nearly all locations compact to dense corresponding to penetration "N" values of 10 to 40 blows/ft.

4.4 Irregular Layers of Clayey-Silt, Silty Clay and Silt

As mentioned previously in this report, this stratum was quite similar to the upper clayey-silt to silt stratum but considerably more irregular in layering. The layers were generally horizontal with thicknesses ranging anywhere from 1/8" to 6" or more. The clay content was also slightly higher in this lower stratum. This stratum appeared to be 60 or more feet thick, extending to, or almost to, the bedrock.

The deposit had a consistency ranging from firm to very stiff, corresponding to penetration "N" values of 8 to 27 blows/ft. although the majority of the material was of a firm consistency.

4.5 Bedrock

Bedrock was proven by diamond drilling in B.H.'s #235 and 243 and by augering in B.H. #240. The surface of the rock was established at elevation 606.7 in the location of B.H. #240, at elevation 593.3 in the location of B.H. #243 and at elevation 574.9 in the location of B.H. #235. The rock surface therefore appears to be sloping upwards with increasing chainage from northwest to southeast. Some seven ft. thickness of rock was drilled in B.H. #243 with approximately 57% recovery, and

4 ft. thickness of rock was drilled in B.H. #235 with 100% recovery. The cores were identified to be dolomites of the Lockport formations.

4.6 Groundwater Conditions

As can be seen on the borehole log sheets, the groundwater levels varied considerably in elevation between different boreholes. The levels ranged from a few feet below the surface to 60 or more feet below the surface. However several of the water levels near the surface could have been the result of a perched water table above the cohesive stratum. Water was not encountered in many of the boreholes.

5. DISCUSSION AND RECOMMENDATIONS

5.1 General

The proposed Brantford Southern Access Road will follow the R.O.W. of the former Lake Erie and Northern Railroad from the Mohawk Canal to Lynwood Drive. Because of the differences in elevation between the new roadway and existing ground, retaining walls will be required along nearly the entire right side and two shorter walls along locations on the left side of the roadway.

The right side retaining walls will be 1090 ft., 740 ft., and 1200 ft. long for walls B, D and E, respectively. The left side retaining walls will be 475 ft. and 260 ft. long for walls A and C, respectively.

The heights of the proposed retaining walls and the soil conditions vary considerably throughout the site. Alternative design values for both spread footings, bin walls and piled foundations are thus given in the following paragraphs.

5.2 Foundations

a) Spread Footings

Due to the considerable differences in soil conditions

throughout the site, the bearing capacities for the proposed footings will be quite varied. The estimated allowable bearing capacities and the corresponding coefficients of friction or adhesion values for sliding resistance are as follows:

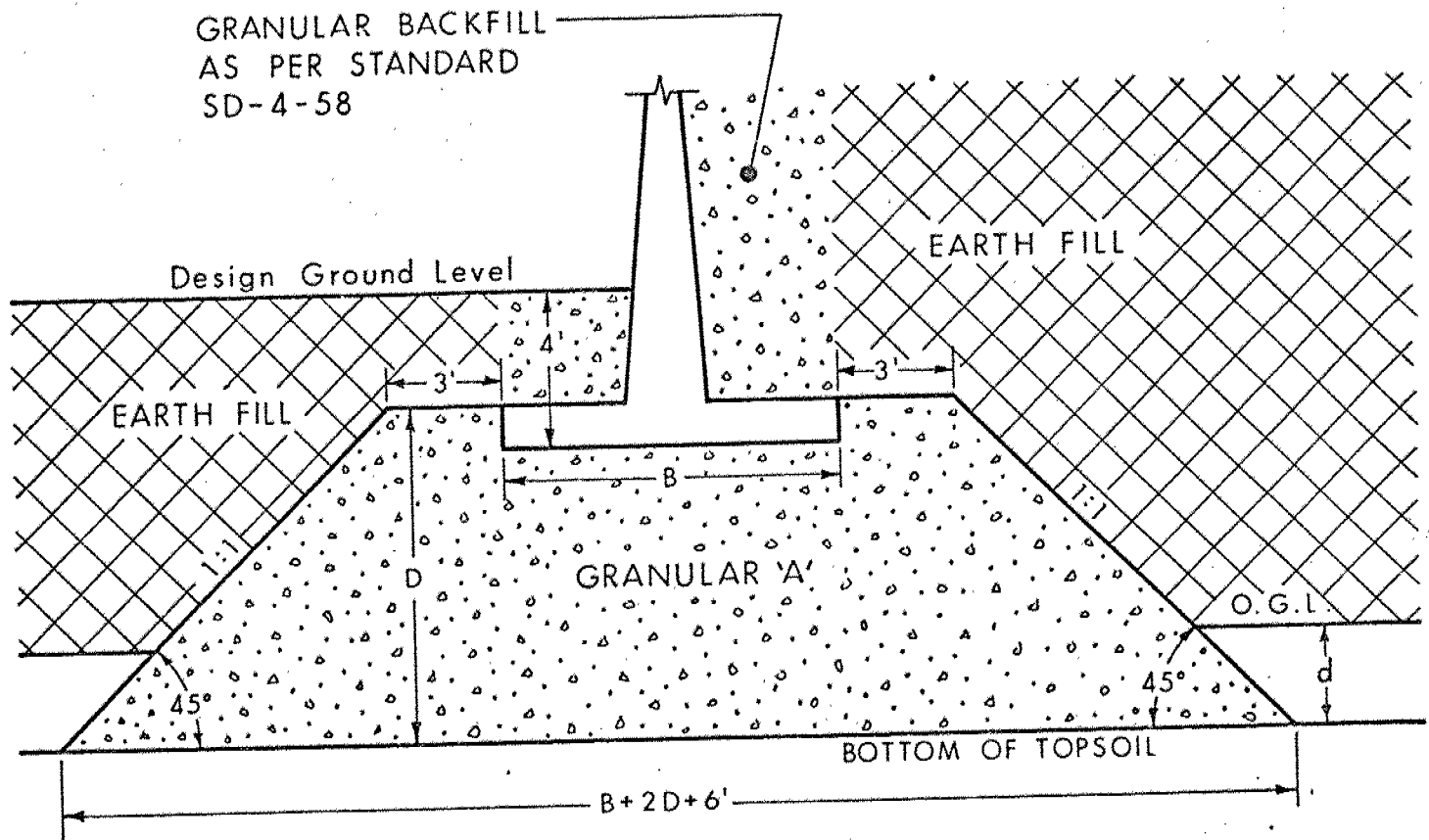
<u>Location</u>	<u>Allowable Bearing Capacity</u>	<u>Sliding Resistance</u>
Sta 170+20 to 172+00	3.00 TSF	0.55
Sta 172+00 to 174+00	2.00 TSF	0.55
Sta 174+00 to 179+00	1.75 TSF	0.55
Sta 179+00 to 181+10	1.50 TSF	0.45
Sta 182+10 to 185+00	1.00 TSF	0.55
Sta 185+00 to 189+50	1.75 TSF	1000 psf
Sta 191+00 to 191+80	1.75 TSF	1000 psf
Sta 191+80 to 194+50	1.75 TSF	0.45
Sta 194+50 to 195+50	1.25 TSF	750 psf
Sta 195+50 to 200+00	2.50 TSF	0.40
Sta 200+00 to 201+50	2.50 TSF	1500 psf
Sta 201+50 to 204+10	1.50 TSF	0.40

The stability of the walls supported on spread footings should be checked against sliding along the base of the wall, caused by lateral earth pressure.

In computing the resistance to lateral pressures for walls placed within the in situ non-cohesive materials or on compacted granular backfill, the coefficients of friction, $\tan \phi$, are used. For walls placed in the cohesive layers, the adhesion between the base and the soil, which is related to the cohesive strength of the deposit, is used for computing horizontal resistance. These values for friction coefficients or adhesion are given in the above table under the general heading "Sliding Resistance".

If spread footings are utilized it will become necessary to excavate the organic and fill material in several locations and backfill with granular "A" material compacted to 100% Procter density, in order to obtain the above bearing capacities. The method of construction of the granular fill is shown in Figure #1 together with the recommended sequence of operations.

The approximate extent of this excavation and backfill requirement will be as follows:



LEGEND

- B = BREADTH OF FOOTINGS
- D = DEPTH OF GRANULAR 'A' BACKFILL
- d = DEPTH OF TOPSOIL

SEQUENCE OF OPERATION

- 1 - STRIP TOPSOIL
- 2 - CONSTRUCT GRANULAR 'A' TO FULL HEIGHT AS SHOWN
- 3 - CONSTRUCT REMAINDER OF FILL TO CONVENIENT HEIGHT
- 4 - RE-EXCAVATE FOR RETAINING WALL FOOTING

TYPICAL SECTION OF A RETAINING WALL SUPPORTED ON
SPREAD FOOTINGS WITHIN THE FILL MATERIAL

FIG. 1

W.P. 40-74-12

Sta 170+20 to 172+00	to elevation 652.0
Sta 172+00 to 173+00	from 652.0 at 172+00 to 674.0 at 173+00
Sta 173+00 to 179+00	from 674.0 at 173+00 to 685.0 at 179+00
Sta 182+10 to 184+00	from 686.0 at 182+10 to 690.0 at 184+00
Sta 184+00 to 187+00	from 690.0 at 184+00 to 692.0 at 187+00
Sta 187+00 to 189+50	from 692.0 at 187+00 to 700.0 at 189+50
Sta 191+80 to 193+00	from 713.0 at 191+80 to 711.0 at 193+00
Sta 193+00 to 194+70	from 711.0 at 193+00 to 722.0 at 194+70

The above limits will result in extensive excavation for retaining wall "B". They should, however, require only a few feet of excavation below the bottom of the footings for the remaining walls.

b) Bin Walls

In many locations the use of bin walls may be more economical than cantilever walls on spread footings, due to the low height of the retaining walls. The allowable bearing capacities for spread footings as given in Section 5.2 a) should be reduced by 1/3 if bin walls are utilized, in order to make allowance for stress concentrations. The coefficients of sliding friction ($\tan \phi$) and the adhesion values given in 5.2 a) can be used for bin wall design. The excavation of the fill material and the backfill requirements will be the same as those for the spread footings.

c) Footings on Piles

In some locations it may be more economical to utilize piled foundations due to the low bearing capacity or the fill excavation and backfill required for spread footings and bin walls. In these situations friction piles are recommended.

No. 14 timber piles could be used with a design load of 27 tons per pile for a 45 foot length.

If friction piles were used, excavation of the sandy fill material would not be required.

The lateral pressures on the walls for piled foundations should be resisted by battering the piles.

d) Expansion Joints

A vertical expansion joint is recommended between the footings on natural ground and those on compacted fill.

Also a vertical expansion joint is recommended between any foundations on spread footings and those on piles

e) Frost Protection

A cover of four ft. should be provided for the spread footings and the pile caps above the footing base, for frost protection.

f) Retaining Wall Backfill

Whether the walls are constructed within the fills or within earth excavations, the backfilling of the walls should comply with M.T.C. Standard No. SD-4-58.

6. MISCELLANEOUS

The field work was carried out during the periods: March 14, April 8 to 18 and May 12 to 20, 1975, under the supervision of Mr. G. Cautillo, Project Engineer.

The equipment used for part of the field work was owned and operated by the Atcost Soil Drilling Co., Concord, Ontario, and for the remaining part by the Canadian Longyear Co., North Bay, Ontario.

This report was written by Mr. G.R. Bardell, Project Engineer.
Mr. K.G. Selby, Supervising Foundation Engineer, reviewed the report.

G. R. Bardell
for G. R. BARDELL
Project Engineer

K. G. Selby
K. G. SELBY
Supervising Engineer

June, 1975

APPENDIX

RECORD OF BOREHOLE NO 210

W.P. 40-74-12 LOCATION Co-ords. 15,674,851 N., 803,528 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE March 14, 1975 COMPILED BY OJ GC
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY CP.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
731.9	Ground Level															GR. SA. SI. CL.
0.0	Sand and gravel Traces of Silt and Clay Compact to Dense		1	SS	25	730										46 46 (8)
722.4			2	SS	45											
9.5	Silt Traces of Sand Compact to Dense		3	SS	16	720										
712.9			3A	SS	40											
19.0	Irregular Layers and Pockets of Clayey Silt and Silt Some Sand Stiff to Very Stiff		4	SS	23	710										0 1 64 35
			5	SS	11											
			6	SS	15	700										
			7	SS	12											
			8	SS	11	690										
			9	SS	10											
683.9			10	SS	38											0 13 77 10
48.0	Silt to Sandy Silt															
680.4	Dense															
51.5	End of Borehole															

RECORD OF BOREHOLE NO 217

W.P. 40-74-12

LOCATION Co-ords. 15,674,780 N., 803,419 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 2, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Cone Test Only

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
731.9	Ground Level					730				
0.0						720				
						710				
707.9										
24.0	End of Cone Test									

W.P. 40-74-12

LOCATION Co-ords. 15,674,715 N., 803,325 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 4, 1975

COMPILED BY GC GB

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Hollow Stem Augers

CHECKED BY J.

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 219

W.P. 40-74-12 LOCATION Co-ords. 15,674,224 N., 802,652 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE April 8, 1975 COMPILED BY GC
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS % GR.SA.SI.CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
716.4	Ground Level									
0.0										
						710				
						700				
						690				
						680				
678.4										
38.0	End of Cone Test									

RECORD OF BOREHOLE NO 220

W.P. 40-74-12

LOCATION Co-ords. 15,674,162 N., 802,582 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 8, 1975

COMPILED BY GC GB

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
717.2	Ground Level															
715.2	Topsoil & org.															
2.0	Clayey silt to silt		1	SS	5											
	Traces of Sand		2	SS	18											
	Firm to V. Stiff		3	SS	28											
			4	SS	14											
			5	TW	PH											
			6	SS	8											
			7	SS	4											
689.2			8	TW	PH											
28.0	Silt to Sandy Silt		9	SS	22											
	Trace of Clay															
	Loose to Compact		10	SS	6											
674.2			11	SS	20											
43.0	Irregular Layers of Clayey Silt and Silt		12	SS	8											
	Firm to Stiff		13	TW	PH											
655.7			14	SS	11											
61.5	End of Borehole															

RECORD OF BOREHOLE NO 221

W.P. 40-74-12

LOCATION Co-ords. 15,674,051 N.; 802,390 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 9, 1975

COMPILED BY GC, GB

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Hollow Stem Augers

CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ P.C.F.	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
708.8	Ground Level															
0.0	Fill Material Mixture of Gravel, Sand Silt and Org. Very Loose to Loose		1	SS	3	WL Dry										0 9 85 6
698.3			2	SS	9	700										
10.5	Irregular Layers of Clayey Silt and Silt Firm to Very Stiff		3	SS	23											
			4	SS	24											
686.8			5	TW	PH											114
			6	SS	8											0 0 (100)
22.0	Silt to Sandy Silt Compact		7	SS	12											
677.8			8	SS	27											
31.0	Irregular Layers of Silty Clay Clayey Silt and Silt Firm to Stiff		9	SS	11											
			10	SS	10											
			11	TW	PH											125
			12	TW	PH											0 0 (100)
			13	SS	6											
			14	SS	7											
			15	SS	11											
642.8																
66.0	Silt to Sandy Silt Compact															
637.3			16	SS	20											0 5 90 5
71.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE № 222

CHECKED BY EF

15-20 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 223

W.P. 40-74-12 LOCATION Co-ords. 15,673,930 N., 802,230 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE April 10, 1975 COMPILED BY GC, GB
DATUM Geodetic BOREHOLE TYPE Continuous Flight Hollow Stem Auger CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
705.0	Ground Level															
0.0	Fill Material Sand and Silt Traces of Gravel & Organics Very Loose to Loose		1	SS	3	WL (Dry)										
692.0	Organics		2	SS	18											
13.0	Clayey Silt Trace of		3	SS	16											
687.0	Sand Very Stiff		4	SS	16											0 2 69 29
18.0	Silt to Sandy Silt Trace of Clay Compact		5	SS	14											
			6	SS	10											0 6 84 10
669.5			7	SS	14											
35.5	Irregular Layers of Silty Clay Clayey Silt and Silt Stiff to Very Stiff		8	TW	PH										125	
			9	SS	25											
			10	SS	12											
			11	SS	12											
633.0			12	SS	10											
72.0	End of Borehole															

RECORD OF BOREHOLE NO. 224

W.P. 40-74-12

LOCATION Co-ords. 15,673,583 N., 801,744 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 11, 1975

COMPILED BY GC, GB

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Hollow Stem Auger

CHECKED BY *GB*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
694.1	Ground Level															
0.0	Sandy Silt Traces of Gravel & Clay--Loose		1	SS	7	690										6 28 55 11
689.6			2	SS	7											
4.5	Sand & Gravel Traces of Silt and Clay		3	SS	22											19 74 (7)
681.1	Loose to Compact		4	SS	25											
13.0	Irregular Layers of Clayey Silt and Silt Firm to Very Stiff		5	SS	20											
			6	SS	6											
666.1			7	TW	PH											126.5
28.0	Silt to Sandy Silt		8	SS	12											
	Traces of Clay		9	SS	17											
	Compact		10	SS	10											0 17 76 7
			11	SS	19											
639.1			12	SS	22											
55.0	Clayey Silt															
632.6	Firm		13	SS	9											
61.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 225

W.P. 40-74-12 LOCATION Co-ords. 15,673,518 N., 801,664 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE April 14, 1975 COMPILED BY GC
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
691.0	Ground Level					690				
0.0						680				
						670				
656.0						660				
35.0	End of Cone Test									

RECORD OF BOREHOLE No 226

W.P. 40-74-12 LOCATION Co-ords. 15,673,458 N., 801,582 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE April 14, 1975 COMPILED BY GC, GB
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Hollow Stem Augers CHECKED BY GB

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_P	w	w_L		
689.5	Ground Level															
0.0	Fill Material Silty															
685.5	Sand with gr.- loose		1	SS	9											
4.0	Irregular Layers of Clayey Silt to Silt Firm to Very Stiff		2	SS	22											
			3	SS	38											
			4	SS	28											
			5	SS	8											
			6	SS	17											
			7	TW	PH											
			8	SS	6											
658.0			9	SS	12											
31.5	End of Borehole															
644.5																
45.0	End of Cone Test															

RECORD OF BOREHOLE NO 227

W.P. 40-74-12 LOCATION Co-ords. 15,673,400 N.; 801,502 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE April 14, 1975 COMPILED BY GC
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT Y	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
687.7	Ground Level									
0.0										
						680				
						670				
						660				
						650				
642.7										
45.0	End of Cone Test									

W.P. 40-74-12 LOCATION Co-ords. 15,673,342 N., 801,422 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE April 15, 1975 COMPILED BY GC,GB
DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY df.

[illegible]

20
15 ϕ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 229

W.P. 40-74-12 LOCATION Co-ords. 15,673,283 N., 801,342 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE April 15, 1975 COMPILED BY GC
DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY CP.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
684.3	Ground Level									
0.0						680				
						670				
						660				
						650				
641.3										
43.0	End of Cone Test									

RECORD OF BOREHOLE NO 230

W.P. 40-74-12 LOCATION Co-ords. 15,673,223 N., 801,260 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE April 15-16, 1975 COMPILED BY GC
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Hollow Stem Augers CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ P.C.F.	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
682.0	Ground Level															
0.0	Fill Material Mixture of Gravel, Sand, Silt V. loose to loose		1	SS	6	680										
674.5			2	SS	2											
8.5	Irregular Layers of Clayey Silt and Sand Firm to Very Stiff		3	SS	6											
			4	SS	9											
663.5			5	SS	12											
			6	TW	PH											
18.5	Silt to Sandy Silt Loose		7	SS	22											
659.0			8	SS	10											
23.0	Irregular Layers of Silty Clay, Clayey Silt and Sand Firm to Very Stiff		9	SS	15											
			10	SS	8											
			11	TW	PH											
			12	SS	12											
			13	SS	16											
			14	SS	17											
			15	SS	15											
586.0						590										
96.0	Probable Bedrock End of Borehole Note: Hole Dry															

W.P. 40-74-12

LOCATION Co-ords. 15,673,165 N., 801,180 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 16, 1975

COMPILED BY C MCK

DATUM Geodetic

BOREHOLE TYPE Cone Test Only

CHECKED BY CP.

15 ²⁰ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 232

W.P. 40-74-12

LOCATION Co-ords. 15,673,105 N., 801,100 E.

ORIGINATED BY GC

DIST. 4 HWY.B.S.A.R.

BORING DATE April 16, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Hollow Stem Auger

CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N VALUES		20	40	60	80	100	w_p	w	w_L		
674.8	Ground Level															
0.0	Fill Material Sand With Traces of Gravel and Silt Very Loose		1	SS	1	670										
			2	SS	1											
656.8			3	SS	1	660										7 85 (8)
18.0	Silty Sand to Sandy Silt Traces of Gravel & Clay Loose to Dense		4	SS	19											
			5	SS	24	650										3 68 28 1
			6	SS	5											
633.3			7	SS	37	640										
41.5	End of Borehole															0 0 96 4
614.8						630										
60.0	End of ConeTest					620										

RECORD OF BOREHOLE NO 233

W.P. 40-74-12

LOCATION Co-ords. 15,673,045 N., 801,020 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE April 17, 1975

COMPILED BY C. MCK

DATUM Geodetic

BOREHOLE TYPE Cone Test Only

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
674.6	Ground Level															
0.0																
						670										
						660										
						650										
						640										
						630										
						620										
614.6																
60.0	End of Cone Test															

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

W.P. 40-74-12 LOCATION Co-ords. 15,673,004 N., 800,958 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE April 17, 1975 COMPILED BY GB
DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY GP.

[illegible]OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 235

W.P. 40-74-12 LOCATION Co-ords. 15,672,875 N., 800,572 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE April 18, 1975 COMPILED BY GB
DATUM Geodetic BOREHOLE TYPE Continuous Flight Hollow Stem Auger CHECKED BY GP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
657.4	Ground Level															
0.0	Sand and Gravel Traces of Silt Dense		1	SS	35											40 54 (6)
648.4																
9.0	Irregular Layers of Silty Clay, Clayey Silt and Silt		2	SS	11											20 73 25
			3	SS	9											
			4	SS	9											
			5	TW	PH											119 00 60 40
	Stiff to Very Stiff		6	SS	14											
			7	TW	PH											
			8	SS	21											130 00 65 35
			9	SS	30											
574.9																
82.5	Dolomite sound		10	BK	100%											
570.9	Bedrock			RC												
86.5	End of Borehole															

RECORD OF BOREHOLE NO 236

W.P. 40-74-12

LOCATION Co-ords. 15,674,636 N., 803,193 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE May 12, 1975

COMPILED BY GB

DATUM Geodetic

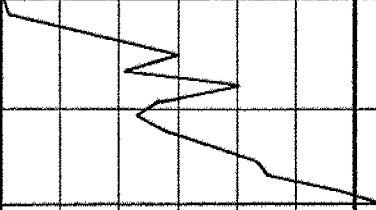
BOREHOLE TYPE Cont. Flight Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L	
729.0	Ground Level														
0.0	Silt to Sandy Silt Trace of Clay Compact to Very Dense		1	SS	65										
			2	SS	54										
			3	SS	54										
			4	SS	25										
			5	SS	41										
			6	SS	63										
710.5			7	SS	17										
18.5	Clayey Silt to Silt Traces of Sand Stiff to Very Stiff		8	TW	PH										
			9	SS	14										
			10	SS	24										
692.5			11	SS	12										
36.5	End of Borehole														

RECORD OF BOREHOLE NO 237

W.P. 40-74-12 LOCATION Co-ords. 15,674,582 N., 803,115 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE May 12, 1975 COMPILED BY GB
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY GP.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % w_p w w_L	UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES					
727.4	Ground Level									
0.0						720				
713.4										
14.0	End of Cone Test									

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 238

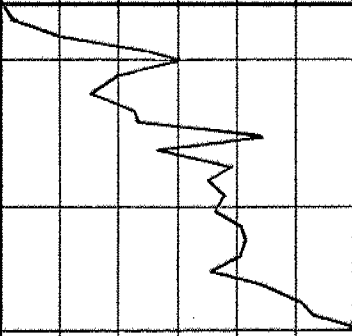
W.P. 40-74-12 LOCATION Co-ords. 15,674,522 N. 803,036 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE May 13, 1975 COMPILED BY G.B. G.C.
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS % GR.SA.SI.CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
725.4	Ground Level															
0.0	Silt to Sandy Silt Traces of Clay Compact to very dense		1	SS	32	720										0 17 79 4
			2	SS	55											
			3	SS	39											
			4	SS	24											
710.4			5	SS	51											
15.0	Irregular Layers of clayey silt and silt Stiff to Hard		6	SS	21	710										
			7	SS	22											
			8	SS	15	700										
			9	TW	PH											
			10	SS	13	690										
683.9			11	SS	27											
41.5	End of Borehole Note: Borehole dry															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 239

W.P. 40-74-12 LOCATION Co-ords. 15,674,457 N. 802,950 E. ORIGINATED BY GC
 DIST. 4 HWY. B.S.A.R. BORING DATE May 13, 1975 COMPILED BY GC
 DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
723.7	Ground Level									
0.0						720				
						710				
701.7										
22.0	End of Cone Test									

RECORD OF BOREHOLE NO 240

W.P. 40-74-12

LOCATION Co-ords. 15,674,403N. 802,871 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE May 13, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT Y	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WP	W	WL		
721.7	Ground Level															
0.0	Clayey Silt to Silt Traces of Fine Sand Stiff to Very Stiff		1	SS	11	720										0 1 72 27
			2	SS	15											
			3	SS	16											
			4	SS	18											
			5	SS	23											
			6	TW	PH											
			7	SS	14											
			8	SS	23											
688.7			9	SS	22	690										
33.0	Silt to sandy silt traces of clay dense to very dense		10	SS	30											0 20 79 1
			11	SS	45	680										
673.7			12	SS	59											0 16 80 4
48.0	Irregular layers of clayey silt silty clay and silt traces of sand Firm to Hard		13	SS	7	670										
			14	SS	9	660										
			15	TW	PH	650										127
			16	SS	54	640										
			17	SS	22	620										

104.0

(Continued)

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 240 (Continued)

W.P. 40-74-12

LOCATION Co-ords. 15,674,403 N. 802,871 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE May 13, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Hollow Stem Auger

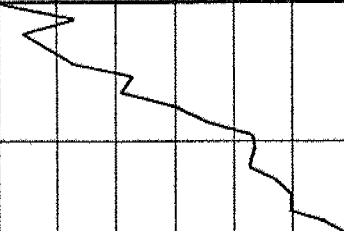
CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
617.7	Continued															
104.0	Irregular layers of clayey silt, silty clay & silt traces of sand Firm to Hard					610										
606.7	Pieces of Dolomite		18	SS	150, 1/2"											
115.0	Probable Bedrock End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 241

W.P. 40-74-12 LOCATION Co-ords. 15,674,341 N. 802,792 E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE May 16, 1975 COMPILED BY GC
DATUM Geodetic BOREHOLE TYPE Cone Test Only CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
719.6	Ground Level									
0.0						710				
703.6										
16.0	End of Cone Test									

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 242

W.P. 40-74-12

LOCATION Co-ords. 15,674,282 N. 802,713 E..

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.

BORING DATE May 16, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N° VALUES		20	40	60	80	100	w_p	w	w_L		
717.4	Ground Level															
0.0	Sand		1	SS	15											
711.4	Fill Material Compact		2	SS	10											
6.0	Irregular Layers of clayey silt and silt Stiff to Very Stiff		3	SS	18											
			4	SS	9											
			5	TW	PH											
			6	SS	21											
			7	SS	24											
			8	SS	9											
686.4			9	SS	16											
31.0	Silt to Sandy Silt Compact		10	SS	21											
680.5																
36.5	End of Borehole															

RECORD OF BOREHOLE NO 243

W.P. 40-74-12

LOCATION Co-ords. 15,673,770 N., 801,970 E.

ORIGINATED BY GC

DIST 4 HWY. B.S.A.R.

BORING DATE May 20, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Cont. Flight Hollow Stem Auger

CHECKED BY *GC*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N ^o VALUES		20	40	60	80	100	w_p	w	w_L		
699.3	Ground Level															
0.0	Fill Material Sand with Some Organics Very Loose to Loose		1	SS	10											
			2	SS	4											
689.8																
9.5	Sand & Gravel Compact		3	SS	12											
686.3			4	SS	21											
13.0	Silt to Sandy Silt Traces of Clay Compact to Dense		5	SS	40											
			6	SS	21											
677.3			7	SS	20											
22.0	Irregular layers of Clayey Silt silty clay and silt Very Stiff		8	SS	14											
			9	SS	23											
			10	SS	10											
			11	TW	PH											
			12	SS	15											
			13	TW	PH											
			14	SS	19											
			15	SS	26											
619.3																
80.0	Sandy silt with pieces of Dolomite rock fragments and trace of clay Very Dense		16	SS	109											

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 243 (Continued)

W.P. 40-74-12

LOCATION Co-ords. 15,673,770 N., 801,970 E.

ORIGINATED BY GC

DIST. 4 HWY. B.S.A.R.




BORING DATE May 20, 1975

COMPILED BY GC

DATUM Geodetic

BOREHOLE TYPE Continuous Flight Hollow Stem Auger

CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
	Continued															
593.3	Sandy Silt															
106.0	Dolomite		17	RC	57%	590										
586.3	Bedrock			BX												
113.0	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 244

W.P. 40-74-12 LOCATION Co-ords. 15,673,665 N., -801,855E. ORIGINATED BY GC
DIST. 4 HWY. B.S.A.R. BORING DATE May 20, 1975 COMPILED BY GC
DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS % GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
695.4	Ground Level															
0.0	Fill Material Sand Traces of Gravel & Clay		1	SS	6	690										
686.4			2	SS	21											
9.0	Sand & Gravel Compact		3	SS	18											
680.4			4	SS	10											
15.0	Irregular layers of clayey silt, silty clay and silt		5	SS	9											
			6	TW	PH											
			7	SS	6											
	Firm to Stiff															
653.9			8	SS	10											
41.5	End of Borehole					650										
645.4																
50.0	End of Cone Test															

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

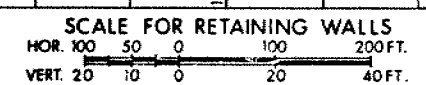
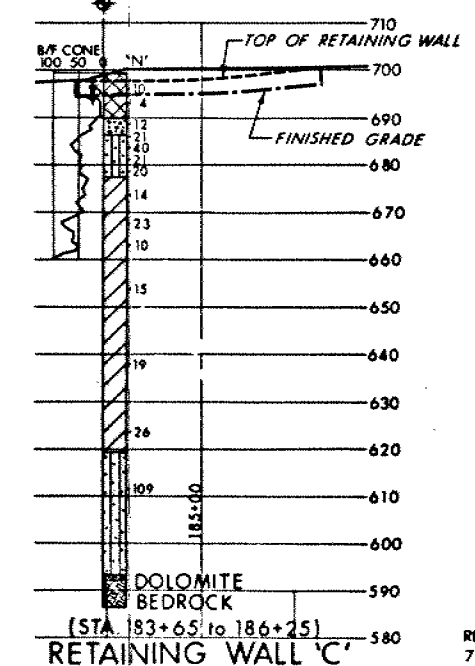
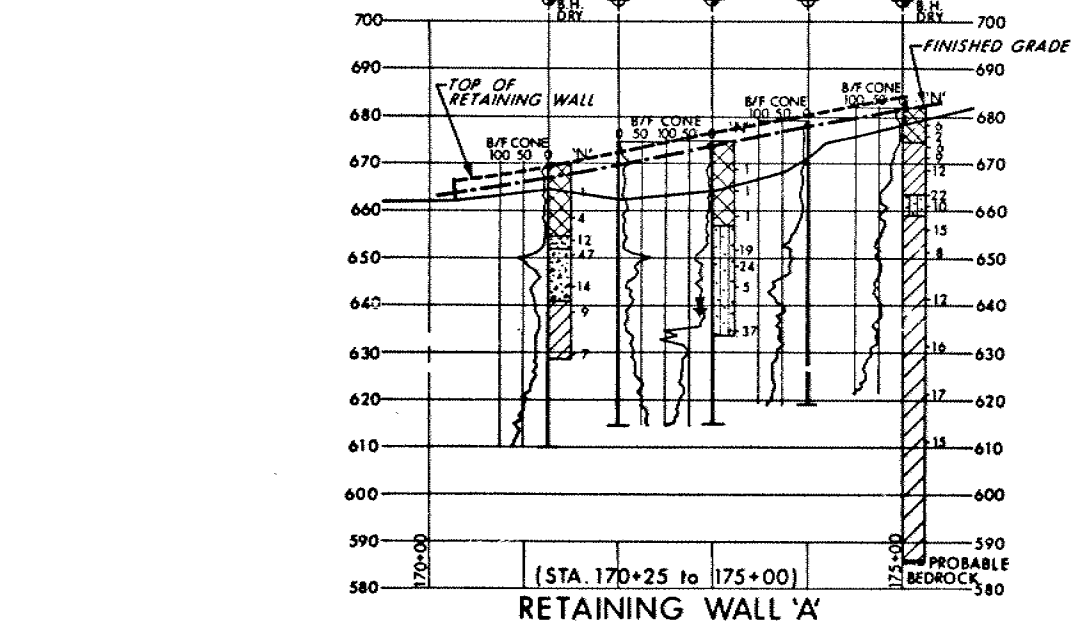
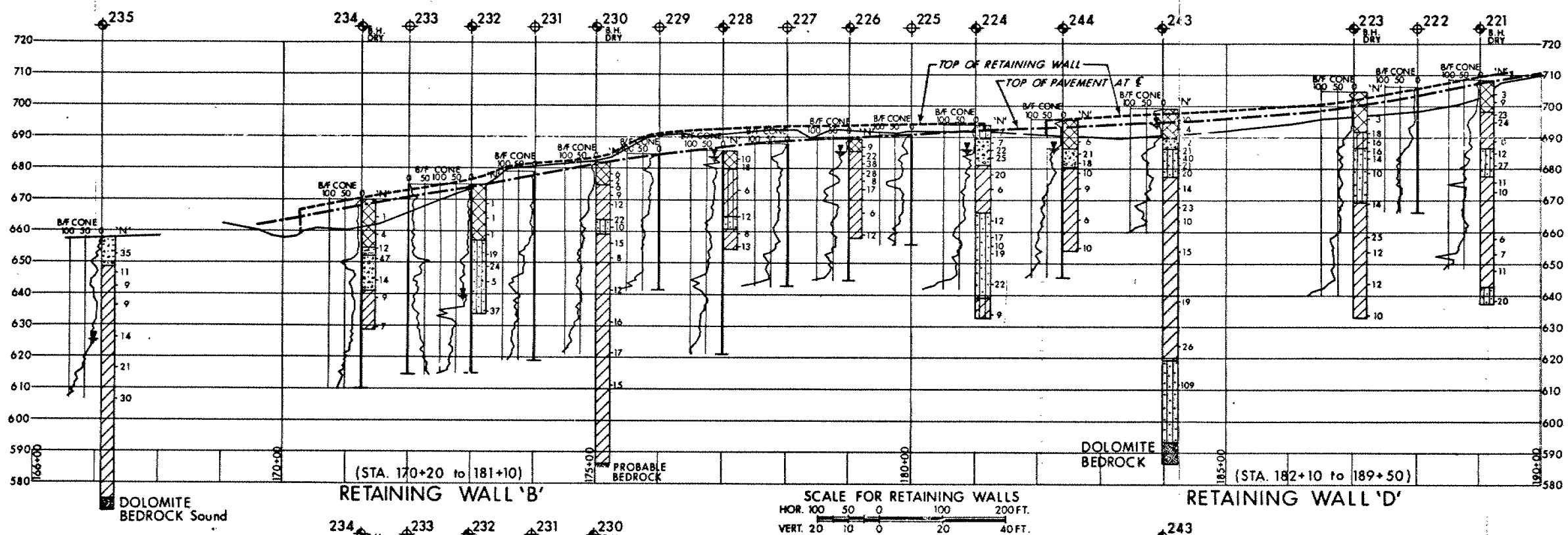
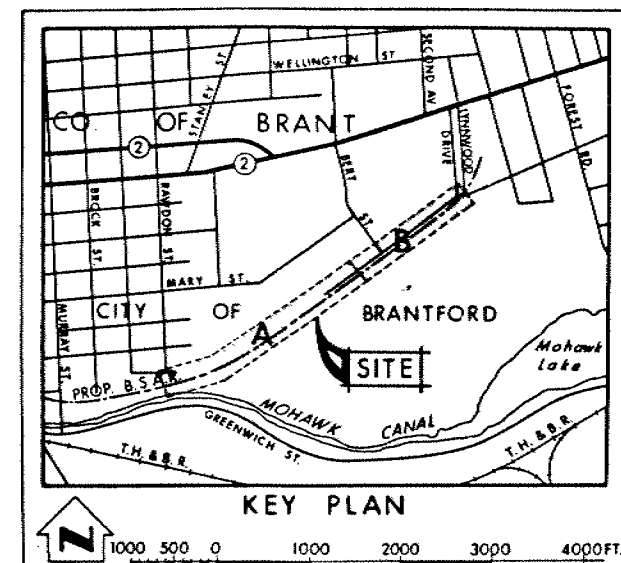
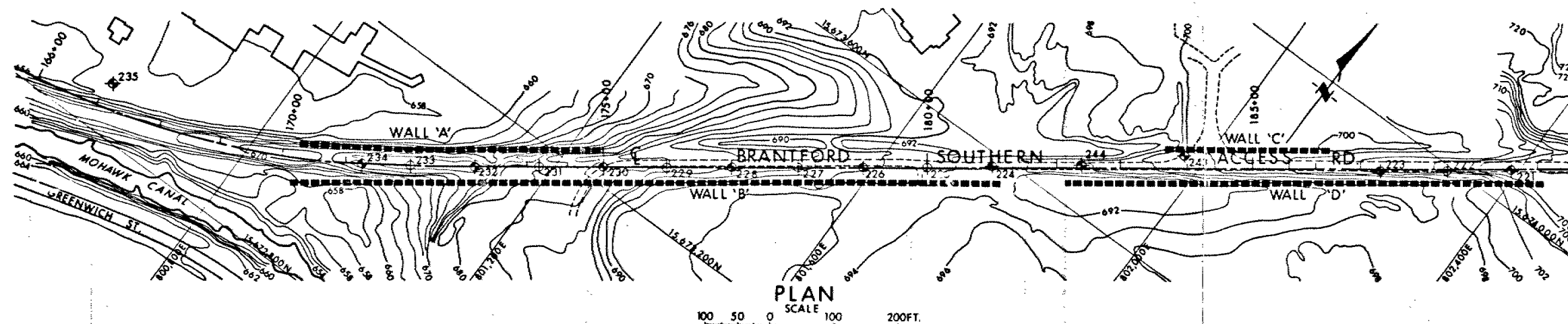
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

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

SLOPES

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



- LEGEND**
- SAND & ORGANICS
 - FILL MATERIAL
SILT, SAND & GRAVEL
TRACES OF CLAY & ORGANICS
V. Loose to Compact
 - SAND & GRAVEL
TRACES OF SILT & CLAY
Loose to Dense
 - SILT TO SANDY SILT
TRACES OF CLAY & GRAVEL
Loose to Dense
 - CLAYEY SILT
TRACE TO SOME SAND
Firm to V. Stiff
 - IRREGULAR LAYERS OF
SILTY CLAY, CLAYEY SILT & SILT
Firm to V. Stiff

LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation April 1975 For B.H. # 243 & 244, May 1975		
NO.	ELEVATION	CO-ORDINATES NORTH	EAST
221	708.8	15,674,051	802,390
222	706.5	15,673,992	802,310
223	705.0	15,673,930	802,230
224	694.1	15,673,583	801,744
225	691.0	15,673,518	801,664
226	689.5	15,673,458	801,582
227	687.7	15,673,400	801,502
228	685.8	15,673,342	801,422
229	684.3	15,673,283	801,342
230	682.0	15,673,223	801,260
231	678.7	15,673,165	801,180
232	674.8	15,673,105	801,100
233	674.6	15,673,045	801,020
234	670.0	15,673,004	800,958
235	657.4	15,672,875	800,572
243	699.3	15,673,770	801,970
244	695.4	15,673,665	801,855

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

NOTE: FOR CONTRACT DOCUMENT
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the HAMILTON District Office.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

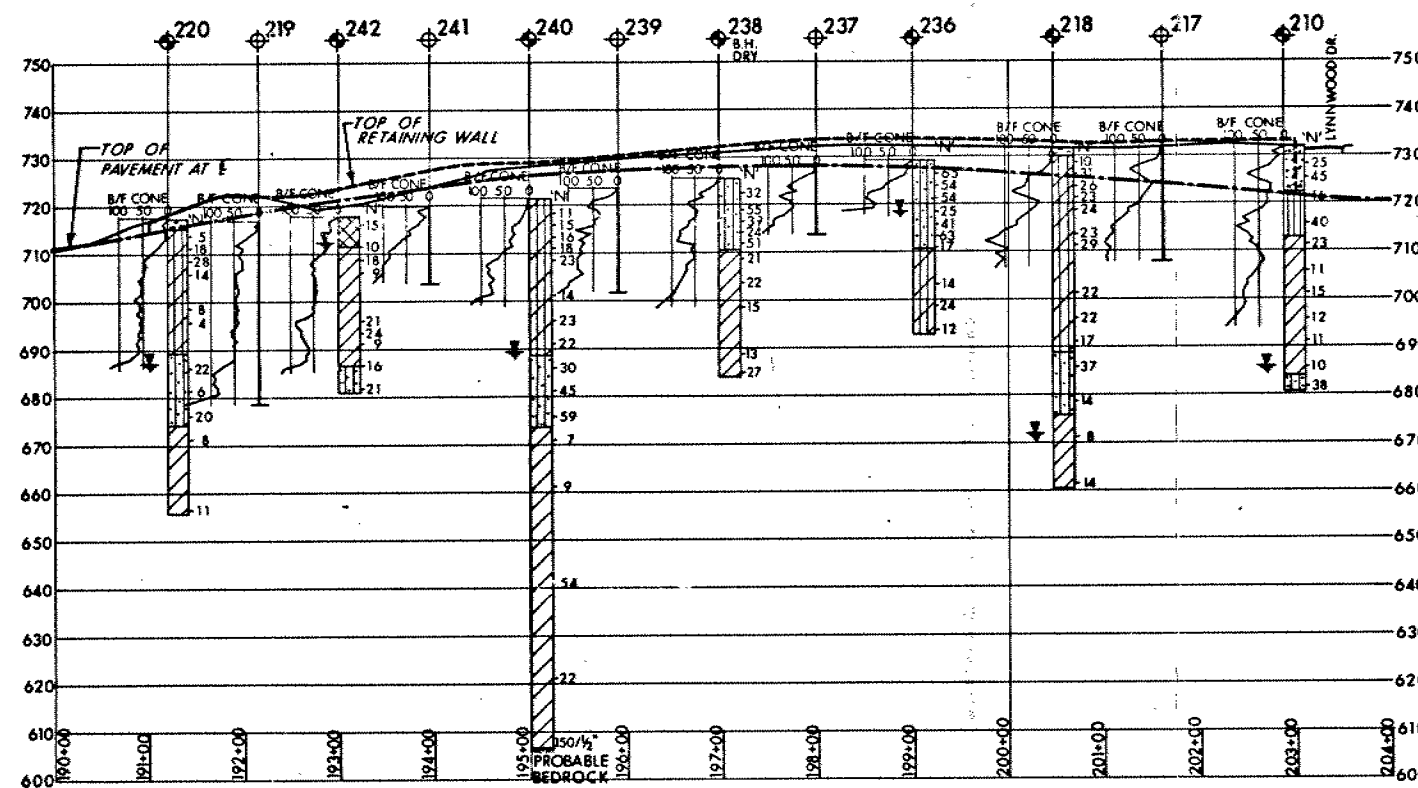
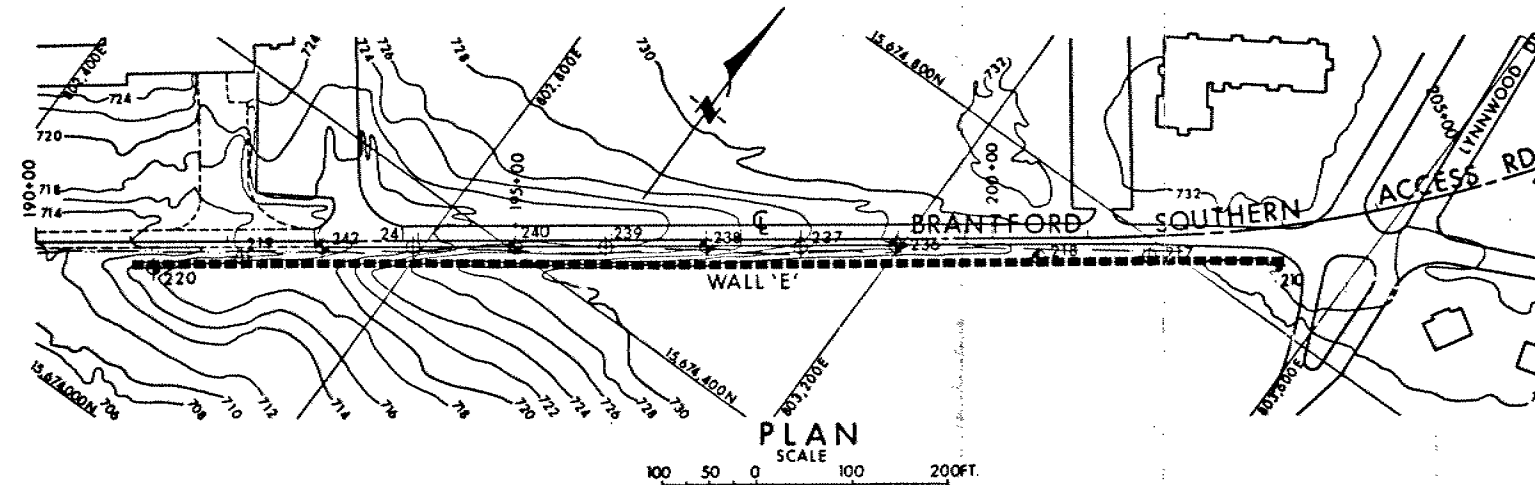
PROPOSED RETAINING WALLS 'A' 'B' 'C' & 'D'

HIGHWAY NO. Brantford Southern Access Road DIST. NO. 4
CO. BRANT City of BRANTFORD
TWP LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBNO P.P.	CHECKED	WP NO. 40-74-12	DRAWING NO.
DRAWN	CHECKED	W.C. NO.	407412-A
DATE June 16, 1975	SITE NO.		BRIDGE DRAWING NO.
APPROVED	CONT NO.		

REF. NO. DILLON CONS. ENG.'S
7301-22-1 B.S.A.R. GEOM. 75-6



PROFILE ALONG RETAINING WALL 'E'
(STA. 191+00 to 203+00)

HOR. 100 50 0 100 200 FT.
VERT. 20 10 0 20 40 FT.

- LEGEND**
- TOPSOIL & ORGANIC
 - FILL MATERIAL SAND Compact
 - SAND & GRAVEL TRACES OF SILT & CLAY Compact to Dense
 - SILT, TRACES OF SAND Compact to Dense
 - SILT TO SANDY SILT TRACES OF CLAY Loose to V. Dense
 - CLAYEY SILT TO SILT TRACES OF SAND Firm to Hard
 - IRREGULAR LAYERS OF CLAYEY SILT, SILTY CLAY & SILT TRACE TO SOME SAND Firm to Hard

SEE DWG. NO 407412-A

KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Resistance Test (B/F CONE - Blows/Ft. Cone Test (350 ft. lbs. energy/blow))
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. March, April and May 1975

NO.	ELEVATION	CO-ORDINATES NORTH	EAST
210	731.9	15,674,851	803,528
217	731.9	15,674,780	803,419
218	731.9	15,674,715	803,325
219	716.4	15,674,224	802,652
220	717.2	15,674,162	802,582
236	729.0	15,674,636	803,193
237	727.4	15,674,582	803,115
238	725.4	15,674,522	803,036
239	723.7	15,674,457	802,950
240	721.7	15,674,403	802,871
241	719.6	15,674,341	802,792
242	717.4	15,674,282	802,713

— NOTE —

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

NOTE: FOR CONTRACT DOCUMENT

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REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

PROPOSED RETAINING WALL 'E'

HIGHWAY NO Brantford Southern Access Rd. DIST NO 4
CO BRANT City of BRANTFORD
TWP LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT P.P.	CHECKED <input checked="" type="checkbox"/>	WP NO 40-74-12	DRAWING NO
DRAWN <input checked="" type="checkbox"/>	CHECKED <input checked="" type="checkbox"/>	WO NO	407412-B
DATE <u>June 18, 1975</u>	SITE NO	BROGE DRAWING NO	
APPROVED	CONT NO		

REF NO DILLON CONS. ENG'S
7301-22-1 8.5AR GEOM. 75-6