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DIST. 4 REGION

W.P. No. 46-74-37

CONT. No. 77-02

W. O. No.

STR. SITE No. 1

HWY. No. 406

LOCATION Detours & Preloading
Geneva St.

No. of Pages - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 46-74-37 DIST. 4

HWY. N/A STR. SITE N/A

1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive

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Ministry of Transportation and Communications
Ontario

Memorandum

To: Mr. G.C.E. Burkhardt
Regional Structural Planning Engineer
Central Region
3501 Dufferin Street, Downsview

Attention:

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Date: July 29, 1976

Our File Ref.

In Reply to

Subject: W.P. 46-74-37
1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive
District 4, Hamilton

INTRODUCTION

This report contains results of a foundation investigation carried out by this Section at the following sites:

1. 24" Watermain at Downing St. and Carlisle St.

2. 24" Sanitary Sewer at Downing St. and South Drive.

Also contained in this report are recommendations for the foundations of the above mentioned utilities.

SITE DESCRIPTION

The proposed watermain crosses the Geneva-Glenridge Valley, where the Old Welland Canal is located, at approximately 1200 feet east of the Glenridge Fill. The area in concern is bounded to the north by Park St. and to the south by Downing St. At this locale the valley is about 650 feet wide, flanked by moderate slopes of 60 to 70 feet high. The valley, in general, is grass covered but sparsely treed. At this particular area, the old channel of the canal has been filled in and the canal has been relocated to a 3 cell box culvert.

The site of the sanitary sewer is just south of the watermain site and is also in a valley where Downing St. intersects with South Drive. This valley is proposed to be spanned by the future Westchester Crescent, by means of a fill. The slopes of the valley are about 50 to 65 feet high, not steeper than 2.5:1 overall, and at present are covered with trees. Residential developments are the major land use of the areas.

SUBSURFACE CONDITIONS

A total of seven sampled boreholes (No. 1 to 5, and No. 61 to 62 inclusive) were put down during the period of April 13 to April 22, 1976. Results of another four boreholes (No. 13, 14, 115 and 311) previously put down for feasibility study of Hwy. 406 are also incorporated here.

Locations of the boreholes, together with the inferred subsoil stratigraphy, are shown in Dwg. No. 467437-A and B. Details of the borehole results are also presented in the Borehole Record Sheets which are included in the Appendix to this report. A description of the various subsoil types is given below.

In general, subsoil at these sites consists of a thick deposit of clayey silt, underlain by a deposit of silty sand. In the vicinity of the three cell box culvert, the clayey silt is overlain by a layer of mixed fill.

Clayey Silt

The clayey silt is the predominant deposit in the area and is intercepted in all boreholes. This deposit generally exists from ground surface to elev. 247±, except in the neighborhood of the Old Welland Canal where it is overlain by a layer of mixed fill. According to the consolidation test results, the clayey silt is an overly consolidated material. Inferred from the 'N' values of the Standard Penetration Test and undrained shear strengths, this material is classified as stiff to firm in consistency. The Atterberg Limits and moisture contents, as determined by our lab tests, have the following ranges of values:

Liquid Limits (LL)	37% to 50%
Plasticity Limits (PL)	18% to 22%
Moisture Contents (W_n)	25% to 35%

A plot of the liquid limits and the plasticity indices on the Plasticity Chart shows that the material is medium to low in plasticity. Lab tests have also been carried out to determine the PH values, concentration of SO_3, and organic contents. This information is for choosing a corrosive resistant material for the watermain. The test results, which are reported in the Borehole Log Sheets, show that the clayey silt is generally slightly basic and contains an SO_3 concentration from 50 ppm to 2750 ppm.

Sandy Silt to Silty Sand

Underneath the clayey silt is a deposit of sandy silt/silty sand, the lower boundary of which, due to the purpose of the present investigation, is not fully determined. In Borehole 311, the silty sand is found to be underlain by a glacial till at elev. 203±. On the basis of the 'N' values, the relative density of this deposit is in the range of compact to very dense. Results of grain size analyses show that this material contains 35% to 60% silt and the sand component is predominantly fine grained. This deposit also contains trace of clay and fine gravel. Typical grain size distribution curves are shown in the Appendix.

Mixed Fill

In the area between Sta. 4+50 and Sta. 8+00, the site is covered with a layer of cohesive fill. Thickness of this material increases towards the Old Welland Canal, extending to elev. 268± near Sta. 5+50 and Sta. 7+00 for a maximum thickness of about 23 ft. Although it is composed of mainly clayey silt, due to inclusions of organic matters, cinders, etc., its composition is very heterogeneous and its consistency is very non-uniform, ranging from stiff to very soft. Some Atterberg Limits, moisture contents, and chemical contents determined for this material are included in the Borehole Log Sheets.

GROUNDWATER CONDITIONS

Groundwater levels were observed in the open boreholes during our field investigation and they reflected the prevailing conditions at the time of observation. Our observations showed that groundwater generally existed within 5 feet of ground surface at the watermain site and it drained into the three cell box culvert. In the slope of the sewer site, groundwater was observed at 10 to 20 feet below ground surface.

RECOMMENDATIONS

Placement of the Hwy. 406 fill has necessitated the existing underground utilities to be relocated. Because of the presence of the mixed fill in the vicinity of the culvert, concern has been expressed over the large differential settlements anticipated for the mixed fill. Concern has also been expressed over the stability of the existing slope in which the new sewer is to be constructed.

Based on our subsoil information, the following recommendations are given:

(a) With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a subdrain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.

(b) The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This back fill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

Station	Estimated Settlements
1 + 00	0"
1 + 70	3"
2 + 20	10"
3 + 30	10"
3 + 90	4"
5 + 00	8"
5 + 50	20"
7 + 00	20"
7 + 70	3"
9 + 30	0"

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches.

To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect' trench at least 6 feet in depth (minimum) above the bedding for the watermain.

MISCELLANEOUS

The recent fieldwork was carried out during the period of April 13 to April 22, 1976, under the supervision of Mr. B. Ly. The drilling equipment was owned and operated by Atcost Drilling Company. This report was prepared by Mr. B. Ly and reviewed by Mr. K. Selby, Supervising Engineer.

B. Ly

B. Ly, P. Eng.
Senior Engineer

K.G. Selby

K.G. Selby, P. Eng.
Supervising Engineer

KGS/gs
July, 1976

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

WP 46-74-37 (A) LOCATION Co-ords. 1,069,226 E.; 15,680,477 N; ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 13, 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
307.1	Ground Level					
0.0	Clayey silt - low to medium plasticity containing some sand		1	SS	12	
			2	SS	14	
			3	SS	18	
	Very stiff, brown and fissured		4	SS	15	
			5	SS	5	
	Grey and					
	Firm		6	TW	PM	
			7	SS	7	
			8	SS	7	
	Stiff		9	SS	16	
	containing some sand					
	and fine gravel sizes		10	SS	23	
			11	SS	13	
239.1	becoming very sandy		12	SS	110/10"	
68.0	End of Borehole					

Note: 1. BH open to El. 297.6 April 20/76

2. Water level not established

3. Chemical tests

Sample	Organic	PH	SO_3
SS-3	--	8.22	240 ppm

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ P.C.F.

REMARKS % GR SA SI CL

120

32 26 30 12

15 20 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 2

WP 46-74-37 (A) LOCATION Co-ords. 1,069,170 E; 15,680,710 N. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 20, 21, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
293.1	Ground Level					
0.0	Fill - heterogeneous mixture of sand, clay & cinder, some organic		1	SS	10	290
			2	SS	9	
			3	SS	3	
283.6			4	SS	5	
9.5	Clayey Silt Grey, Firm to Stiff low to medium plasticity, traces of sand		5	SS	11	
			6	SS	12	
			7	SS	12	280
			8	SS	7	
			9	TW	PH	
			10	SS	4	
			11	TW	PH	270
			12	SS	14	
			13	SS	12	
						260
			14	SS	8	
250.1						250
43.0	Silty Sand Fine Compact to Dense		15	SS	23	
						240
231.6			16	SS	38	
61.5	End of Borehole					

Note:

Chemical test results

Sample	Organic	PH	SO_3	
SS-2	2.25%	8.25	440	ppm
SS-4	3.76%	8.15	430	ppm

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

+ 1.7

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ

120

REMARKS

% P.C.	GR	SA	SI	CL
	0	73	(27)	

20
15 ◇ 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,813 N. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 15, 20, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
289.0	Ground Level					
0.0	Clay Fill					
	homogeneous & stiff		1	SS	17	
			2	SS	13	
282.0			3	SS	9	
			4	SS	8	
7.0	Mixed Fill - mainly sand, silt, some clay and organic, Black		5	TW	PH	280
			6	TW	PH	
			7	SS	62	
274.0			8	SS	12	
			9	SS	9	
15.0	Clay Fill - some sand and organic		10	SS	9	
			11	SS	8	270
268.0	Soft		12	SS	12	
21.0	Clayey silt, grey, stiff to firm, with traces of sand, low to medium plasticity		13	SS	20	
			14	SS	14	
			15	SS	8	260
			16	SS	7	
	becoming more sandy, some fine gravel					
249.0						
40.0	Silty Sand		17	SS	33	
	Fine and Dense, occasional clay seams		18	SS	N/A	240
	becoming denser		19	SS	N/A	
229.0						230
60.0	End of Borehole					

Note:
Chemical test results

Sample	Organic	PH	SO_4
SS-3	2.86%	7.85	550 ppm
TW-6	1.04%	8.34	180 ppm
SS-8	3.05%	8.05	250 ppm
water	--	7.77	22 ppm

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

/10"

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ

REMARKS	% GR	SA	SI	CL
	6	26	36	32
	0	13	40	47
	0	12	48	40
	0	24	58	18

20
15 ◇ 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

WP 46-74-37 (A) LOCATION Co-ords. 1,069,155 E; 15,681,013 N; ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
294.4	Ground Level					
0.0	Fill - mixture of clay & sand with some gravel, some organic		1	SS	12	290
			2	SS	10	
285.4			3	SS	7	
9.0	Clayey Silt Very Stiff to Stiff fissured, containing traces of sand		4	TW	PH	
			5	SS	21	
			6	SS	13	
			7	TW	PH	280
			8	SS	19	
			9	SS	14	
			10	SS	10	
			11	SS	9	
			12	SS	12	270
			13	SS	16	
262.9			14	SS	14	
31.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

▲ 2000

▲ 2000

1.1

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ

REMARKS

% GR SA SI CL

Note :

Chemical Test Results

Sample	Org.	PH	SO3
SS-2	2.39%	8.08	550 ppm
Water	-	8.10	375 ppm

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 5

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,910 N ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 13, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
289.7	Ground Level					
0.0	Fill					
	Silty Clay		1	SS	23	
	Very Stiff		2	SS	18	
281.7			3	SS	11	
8.0	Fill: clayey, some sand & organic		4	TW	PH	
			5	TW	PH	
	Firm to Very Stiff		6	SS	12	
			7	TW	PH	
267.7	becoming very sandy		8	SS	15	
22.0	Clayey silt - grey, stiff, low to medium plasticity, some sand and fine gravels		9	SS	22	
			10	SS	13	
			11	SS	10	
			12	SS	45	
243.2	becoming very sandy		13	SS	44	
46.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 · 40 · 60 · 80 · 100)

SHEAR STRENGTH: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (400 800 1200 1600 2000)

LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W (W_P — W — W_L)

WATER CONTENT % (20 40 60)

UNIT WEIGHT γ

280 270 260 250

+ 2.0 + >2000 + >2000

REMARKS

% GR	SA	SI	CL
11	23	53	13
1	23	61	15

Note :

Chemical test results

Sample	Organic	PH	SO_3
SS-3	0.77%	8.0	2750 ppm
TW-5	1.66%	8.07	130 ppm
SS-8	0.38%	8.31	40 ppm
water	--	8.14	70 ppm

20 15 ◇ 5 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 115

WP 46-74-(A) LOCATION Co-ords. 15,680,606 N; 1,069,219 E. ORIGINATED BY PK

DIST 4 HWY — BORING DATE November 3-4, 1971 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY —

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F.	REMARKS % GR SA SI CL
299.1	Ground Level									
0.0	Clayey silt, traces of sand and gravel		1	SS	15					
			2	SS	15					
			3	SS	10	290				
			4	TW	PH		≥2000		121	
			5	TW	PH				119	
						▼ 280				
	Very Stiff to Stiff		6	TW	PH				118	
			7	SS	19		≥2000			
			8	TW	PH	270			130	
	Brown and Grey		9	SS	15					
			10	TW	PH	260			133	
			11	TW	PH				113	
			12	TW	PH	250			123	
242.1			13	TW	PH				116 135	
57.0	Silty sand, some clay, Very Dense		14	SS	100/10"	240				
			15	SS	97					0 31 58 11
227.6			16	SS	27	230				0 64 (36)
71.5	End of Borehole									

15 20/10 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 311

WP 46-74-37 (A) LOCATION Co-ords. 15,680,844N; 1,069,120 E. ORIGINATED BY Golder

DIST 4 HWY ____ BORING DATE October 22 - 24, 1963 COMPILED BY MW

DATUM Geodetic BOREHOLE TYPE Washboring HX & BX Casing CHECKED BY ____

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P — W — W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F	REMARKS / % GR SA SI CL
288.6	Ground Level					ELEV				
0.0	Very stiff brown becoming a mixture of soft to firm silty clay, cinders & pieces of brick and gravel below about 4' depth (Fill)		1	SS	18					WL in pipe @ El. 283. Oct.25/63
			2	SS	6		+ s=6			
			3	TW	PM	280				
			4	SS	11		+s=5.5		127	
267.6			5	SS	9	270				
21.0	Firm, brown or grey, brown silty clay with some random sand and gravel size particles few small (generally less than 1/8" size) silt pockets		6	TW	PM		2000			
			7	TW	PM	260	+ s=4.5		136	
			8	TW	PM		2000			
	becoming very sandy		9	SS	54	250			126	
244.1										
44.5	Compact to very dense grey silty sand or sand, trace of silt, with very occasional thin (app. 1/4") silty clay layers		10	SS	58					
			11	SS	33	240				
			12	SS	43					
			13	SS	37	230				
			14	SS	21					
			15	SS	44	220				
			16	SS	61					
			17	SS	35	210				
202.6										
86.0	Dense grey and red silty sand & gravel (Till)		18	SS	35	200				
197.1										
91.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 1

WP 46-74-37 (B) LOCATION Co-ords. 1,069,226 E. 15,680,477 N; ORIGINATED BY BL

DIST 4 HWY 406 BORING DATE April 13 & 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P W W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F	REMARKS % GR SA SI CL
307.1	Ground Level									
0.0	Clayey silt: low to medium plasticity containing some sand		1	SS	12					
			2	SS	14	300				
	Very Stiff		3	SS	18					
	Brown & fissured		4	SS	15					
			5	SS	5	290	+ 2.4			
	Grey & Firm		6	TW	PM		+2.4		120	
			7	SS	7	280				
			8	SS	7		+ 2.0			
			9	SS	16	270				
	Stiff containing some sand and fine gravel sizes		10	SS	23	260				
						250				
			11	SS	13					
239.1	becoming very sandy		12	SS	110/10"					32 26 30 12
68.0	End of Borehole									

Note: 1. BH open to El. 297.6 April 20/76

2. WL not able to determine.

3. Chemical tests

Sample	Organic	PH	SO_3
SS-3	--	8.22	240 ppm

20
15 ○ 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 13

WP 46-74-37 (B) LOCATION Co-ords. 680,499 N; 69,277 E. ORIGINATED BY PK

DIST 4 HWY 406 BORING DATE November 2-3, 1971 COMPILED BY ABK

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ	REMARKS % GR SA SI CL
296.1	Ground Level									
0.0	Fill									
	Cinder, gravel, organics		1	SS	3					
289.1	Very Loose		2	SS	7	290				
7.0			3	TW	PH		+ > 2000		126	
	clayey silt, traces		4	SS	9					
			5	TW	PH		+ > 2000		115	
	of sand and gravel									
			6	TW	PH				119 123	
			7	TW	PH	270			129	
			8	SS	10					
			9	TW	PH	260			126	
	Firm to Very Stiff		10	SS	12					
			11	TW	PH	250			117	
			12	TW	PH					
	sand and gravel						+ > 2000			
	Hard		13	SS	100	240				
237.1	Reddish Brown									
59.0	Sandy silt with		14	SS	100/9"					
	some clay.		15	SS	88	230				
	Very Dense to Dense		16	SS	37					0 4 72 24
	Grey and Brown		17	SS	16	220				1 38 52 9
214.6			18	SS	31					
81.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 14

WP 46-74-37 (B) LOCATION Co-ords. 680,017 N; 69,409 E. ORIGINATED BY DM

DIST 4 HWY 406 BORING DATE November 15, 1971 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
309.5	Ground Level					
0.0 / 306.0	Organic Topsoil					
3.5	Clayey silt, random pockets of silt		1	TW	PM	
			2	TW	PM	
			3	TW	PM	
			4	TW	PM	
	Firm to Stiff		5	SS	6	
			6	TW	PM	
			7	TW	PM	297.0
	Greyish Brown		8	TW	PM	
			9	SS	15	
			10	TW	PM	
			11	TW	PM	
			12	TW	PM	
243.5			13	TW	PM	
66.0	Silt to silty sand, traces of clay		14	SS	50	
			15	SS	116	
	Hard		16	SS	104	
	Reddish Brown					
228.0			17	SS	91	
81.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL × LAB VANE

400 800 1200 1600 2000

ELEV: 300 290 280 270 260 250 240 230

LIQUID LIMIT w_L

PLASTIC LIMIT w_P

WATER CONTENT w

w_P w w_L

WATER CONTENT %

20 40 60

UNIT WEIGHT γ	REMARKS	% GR SA SI CL
119		
118		
113		
118		
115		
118		
126		
131		
112		
123		

OFFICE REPORT ON SOIL EXPLORATION

20
15 ⊙ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 61

WP 46-74-37 (B) LOCATION Co-ords. 15,680,430 N; 1,069,097 E. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 22 & 23, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (400 800 1200 1600 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ	REMARKS	% GR SA SI CL
343.5	Ground Level										
0.0	Clayey silt										
	Brown, stiff, and fissured, medium plasticity		1	SS	32						
			2	SS	27					PH 8.1	SO_3 1440ppm
			3	SS	22						
	Grey, stiff to firm, medium to low plasticity containg some sand and fine gravel		4	SS	20						
			5	SS	22					PH 8.24	SO_3 1100ppm
			6	SS	15						
			7	SS	12						
			8	SS	12						
			9	SS	22						
			10	SS	14						
			11	SS	18						
	containing more coarse sand particles		12	SS	36						
247.0			13	SS	18						
96.5	End of Borehole										
	Not. W.L. not established										

340 330 320 310 300 290 280 270 260 250

15 20 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 62

WP 46-74-37 (B) LOCATION Co-ords. 15,680,078 N. 1,069,092 E. ORIGINATED BY BL

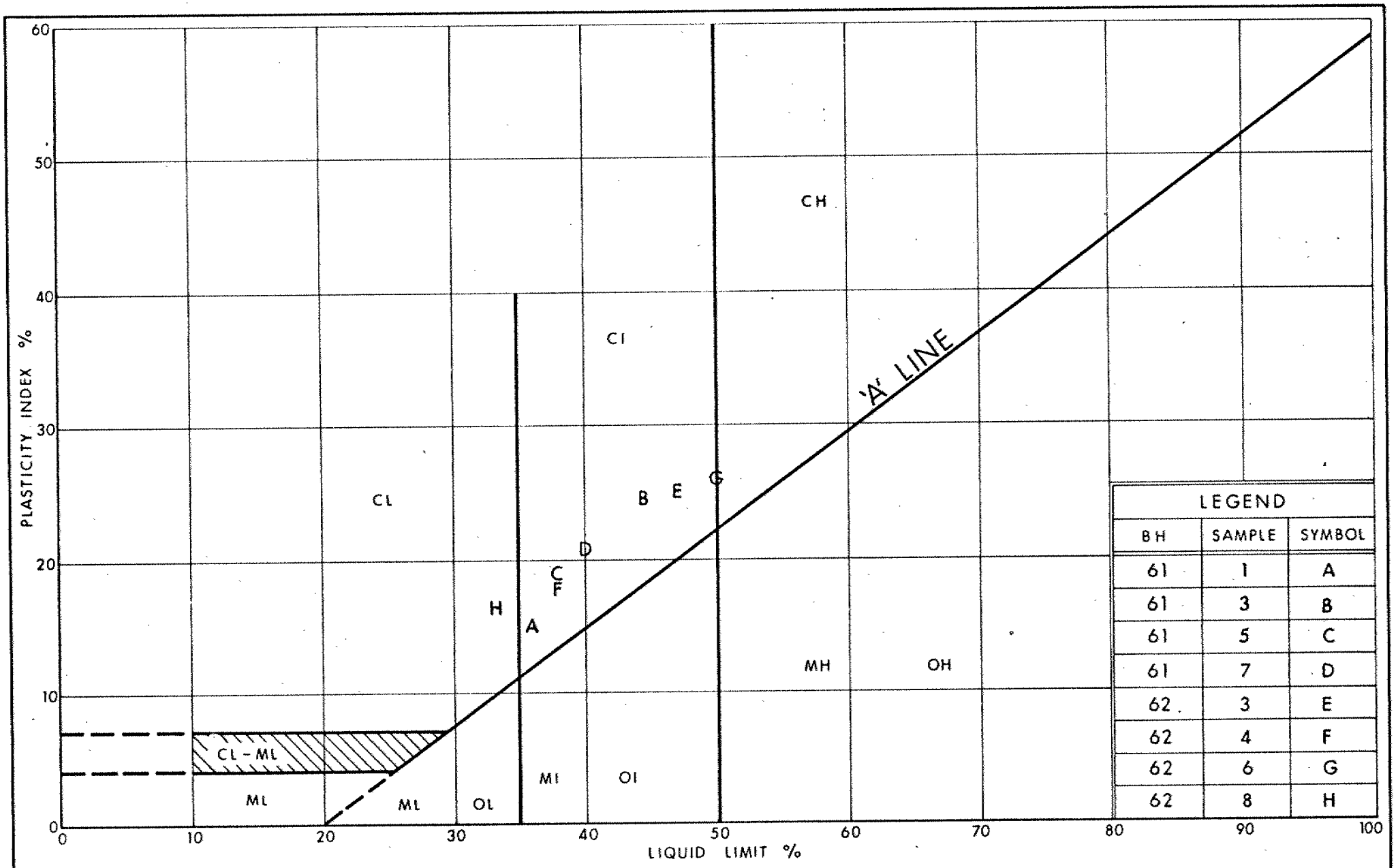
DIST 4 HWY 406 BORING DATE April 20-22, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P W W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ	REMARKS
333.0	Ground Level					ELEV				% GR SA SI CL
0.0	Clayey Silt Brown, very stiff, oxidized & fissured		1	SS	21	330				PH SO_3
			2	SS	31		○ > 2 tsf			8.34 120ppm
			3	SS	29		○ > 2 tsf			
			4	SS	23					8.18 680ppm
						320				
			5	SS	26					
	Grey, stiff to firm low to medium plasticity, trace of sand		6	SS	22	310				
			7	SS	13		○			
			8	SS	12		○ + 2			
						300				
			9	SS	8		○ + 2.5			
						290				
						280				
			10	SS	13		○ + 2.3			
						270				
261.5			11	SS	23		○			
71.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ S % STRAIN AT FAILURE
10

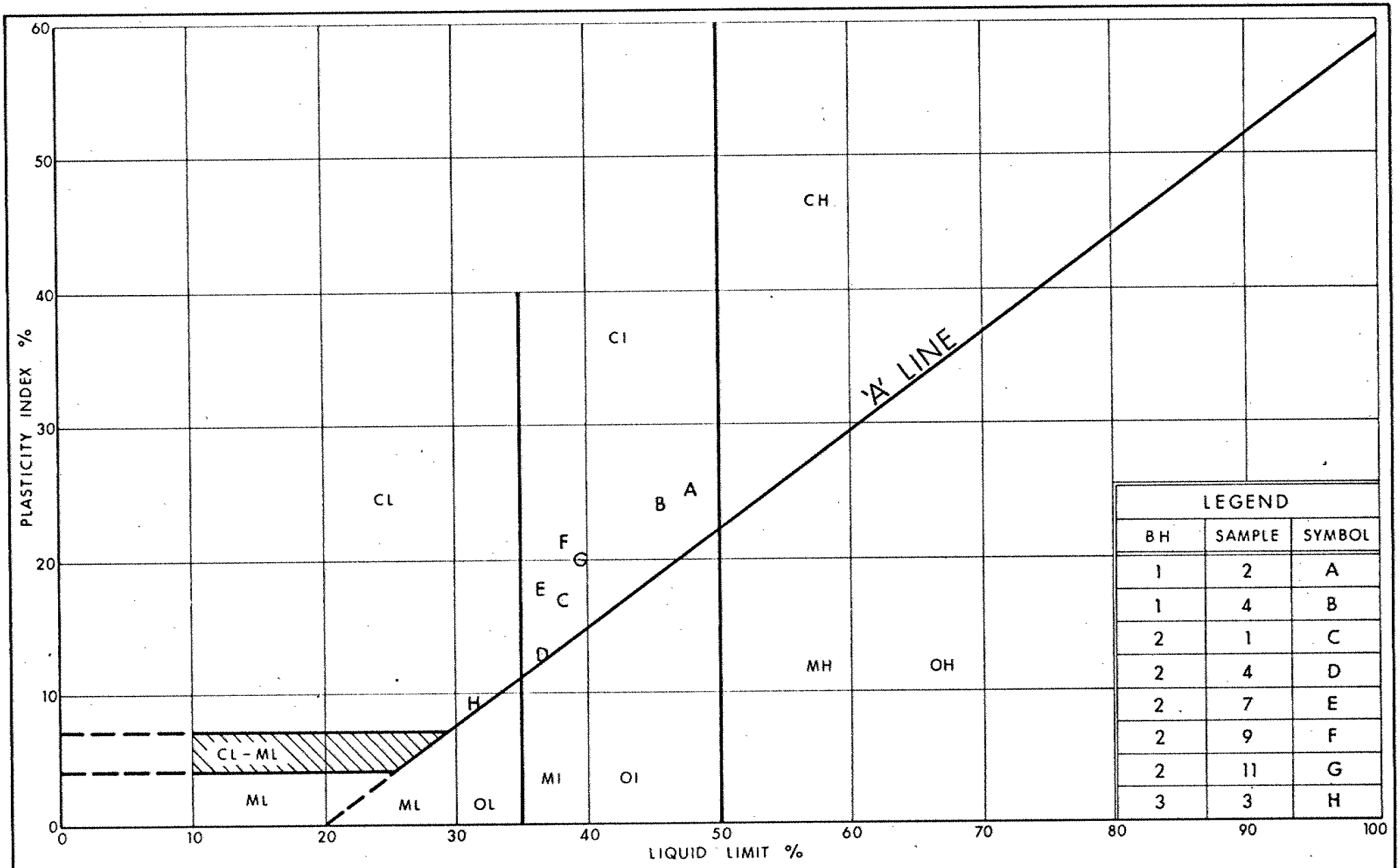


LEGEND		
BH	SAMPLE	SYMBOL
61	1	A
61	3	B
61	5	C
61	7	D
62	3	E
62	4	F
62	6	G
62	8	H

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT

FIG No 1
WP 46-74-37 B

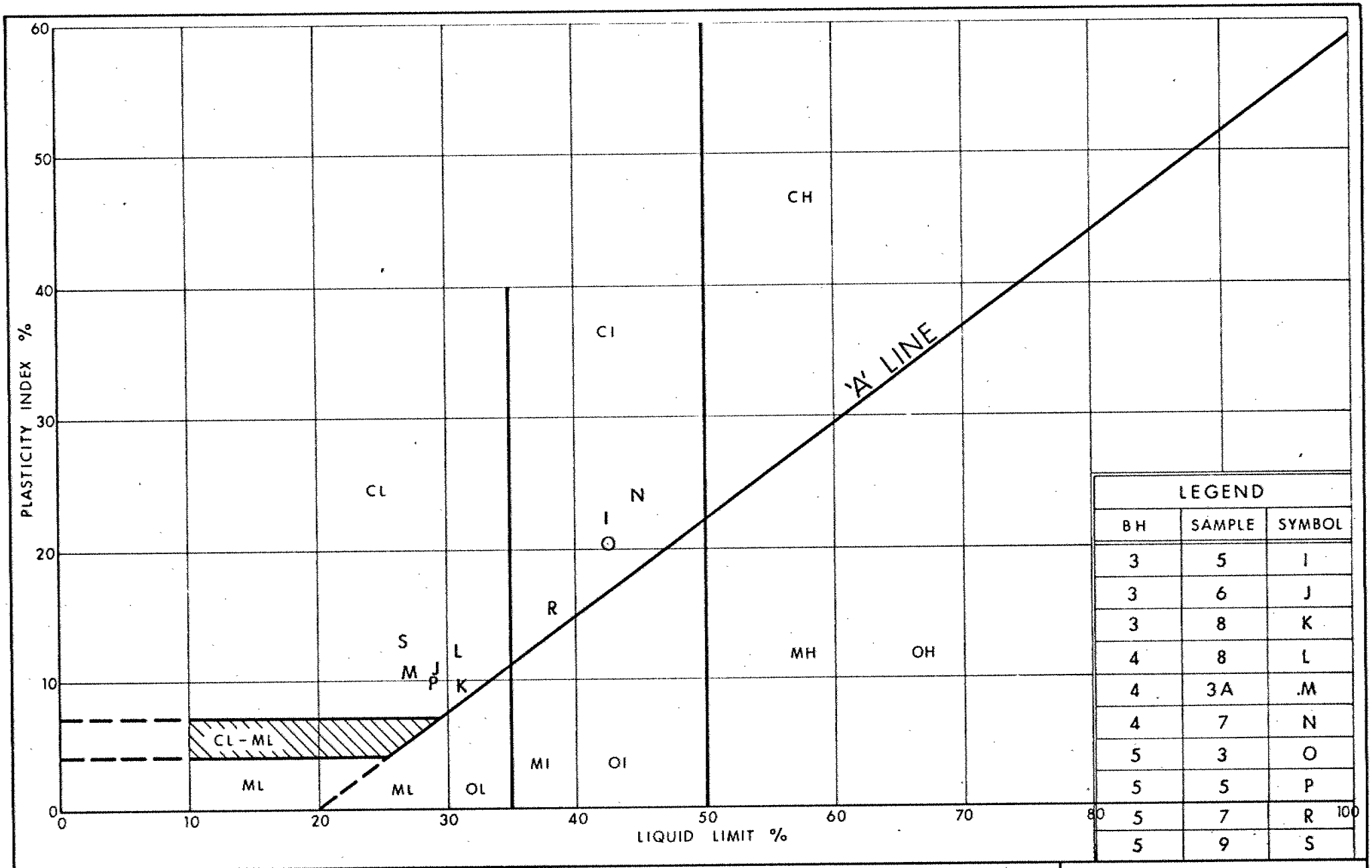


LEGEND		
BH	SAMPLE	SYMBOL
1	2	A
1	4	B
2	1	C
2	4	D
2	7	E
2	9	F
2	11	G
3	3	H

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT

FIG No 1 A
WP 46-74-37 A



LEGEND		
BH	SAMPLE	SYMBOL
3	5	I
3	6	J
3	8	K
4	8	L
4	3A	M
4	7	N
5	3	O
5	5	P
5	7	R
5	9	S

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

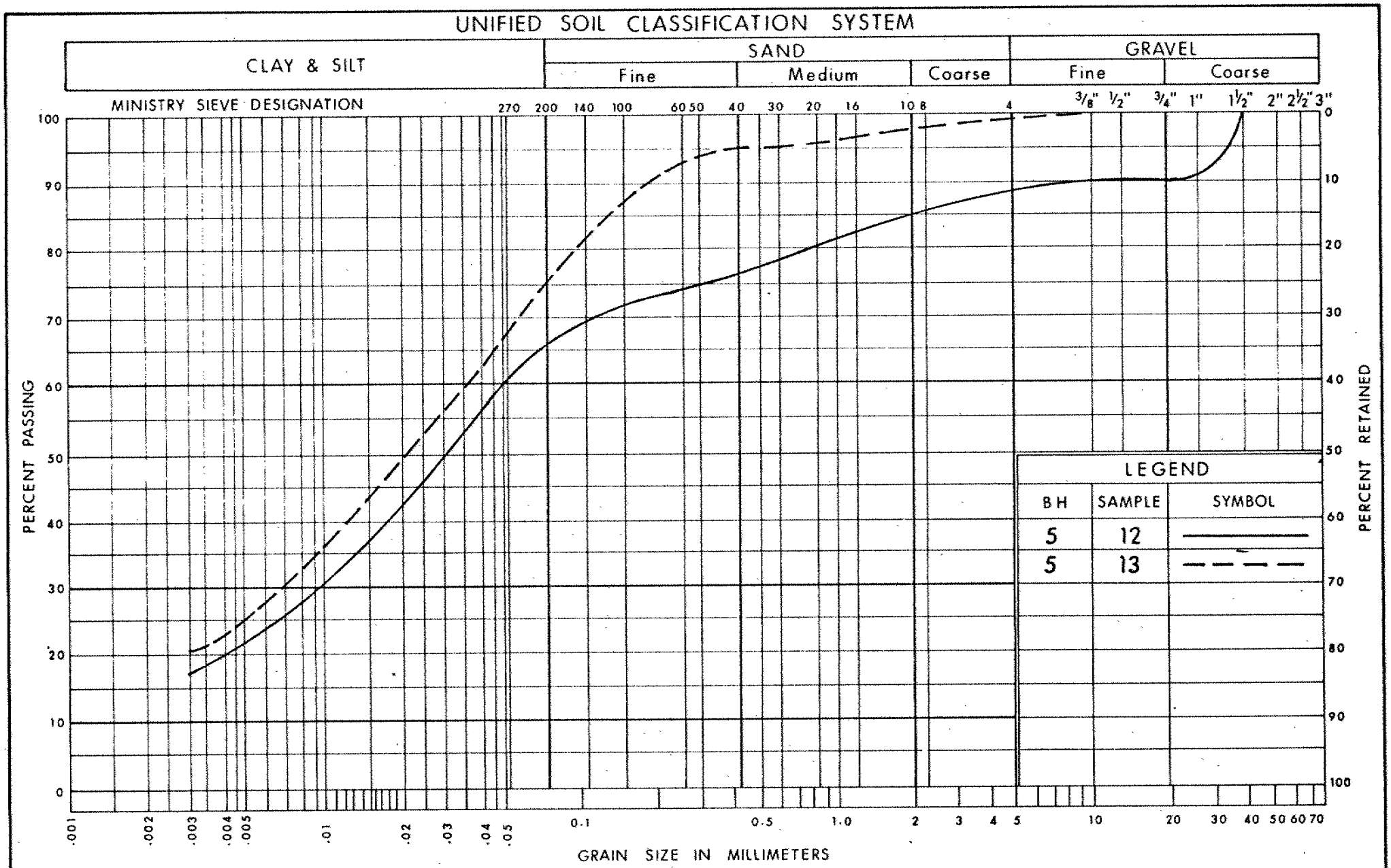
PLASTICITY CHART
CLAYEY SILT

FIG No 1B
W P 46-74-37 A

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
SILTY SAND

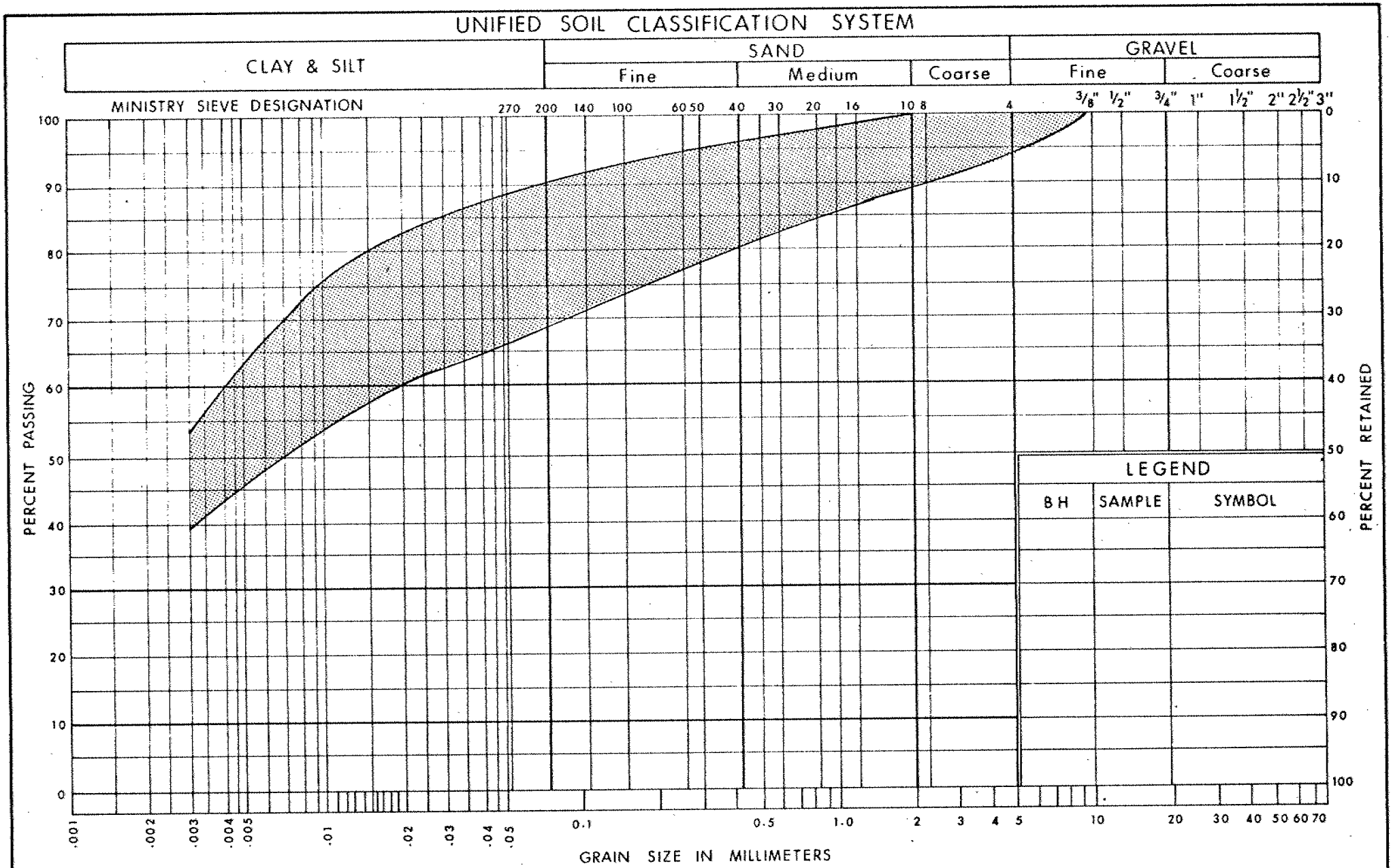
FIG No 2
WP 46-74-37 A



Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
CLAYEY SILT

FIG No 3
W P 46-74-37 A



Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

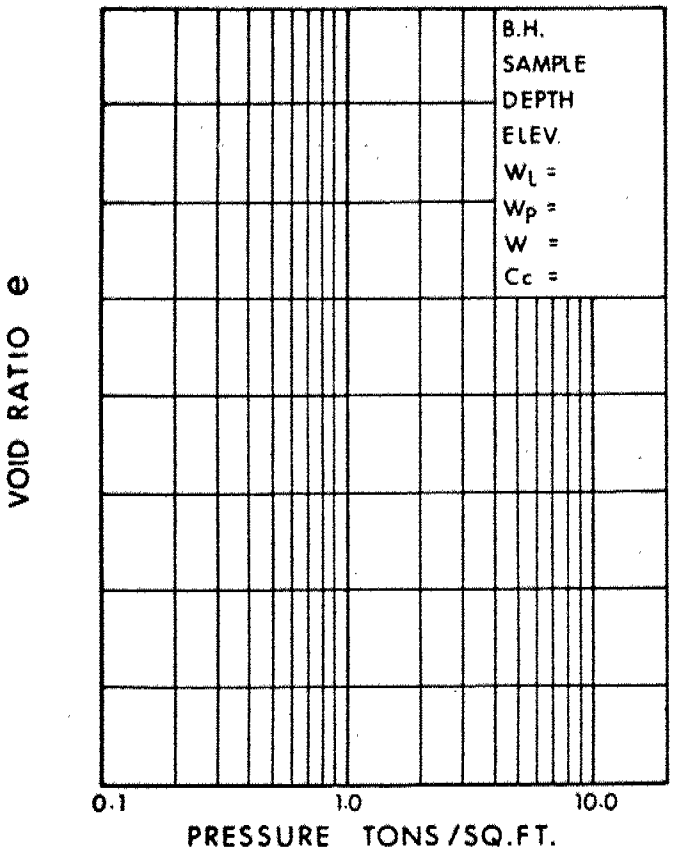
GRAIN SIZE DISTRIBUTION
CLAYEY FILL

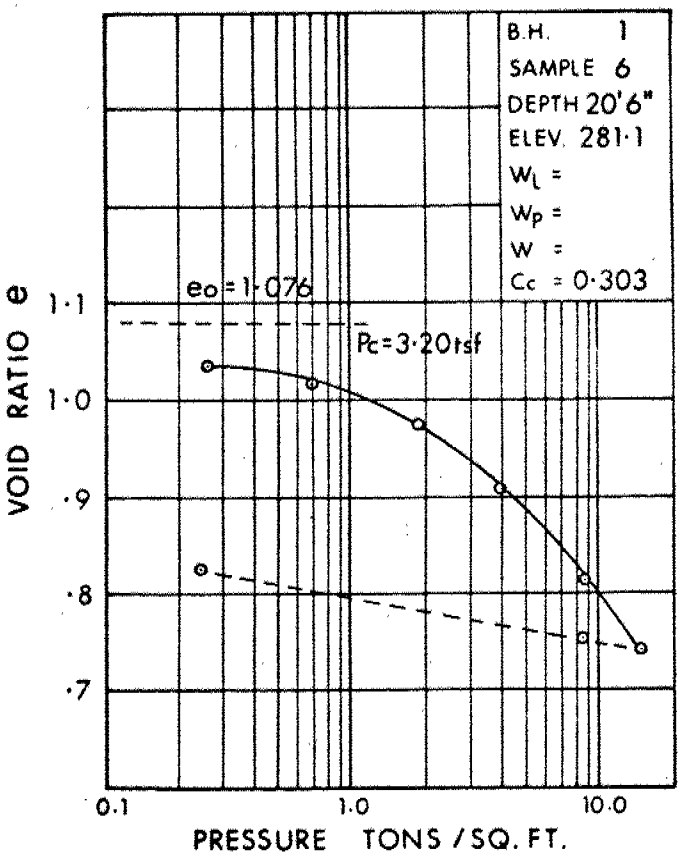
FIG No 4

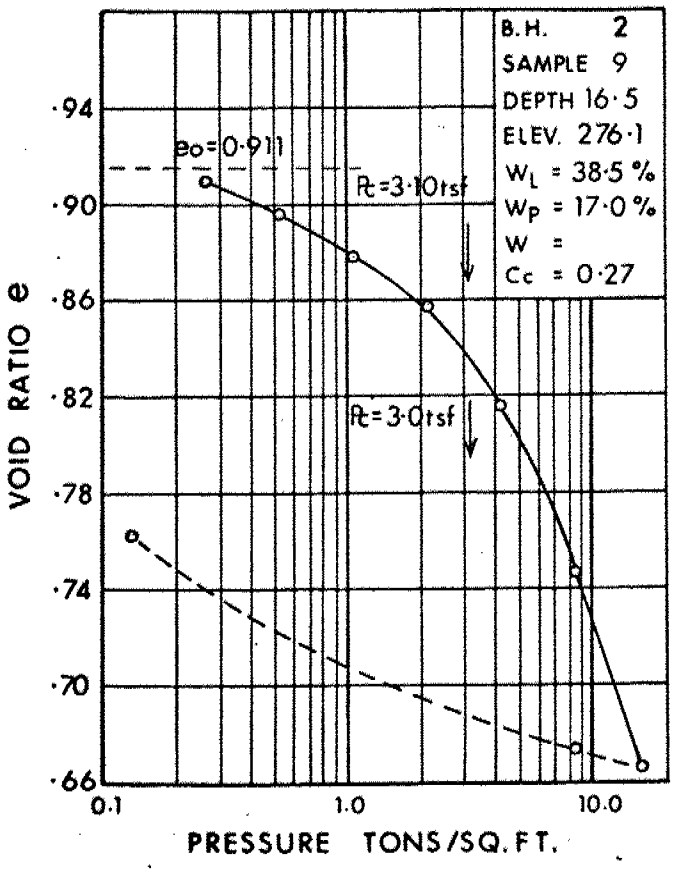
W P 46-74-37 A

VOID RATIO – PRESSURE CURVES

W. P. 46–74–37 A







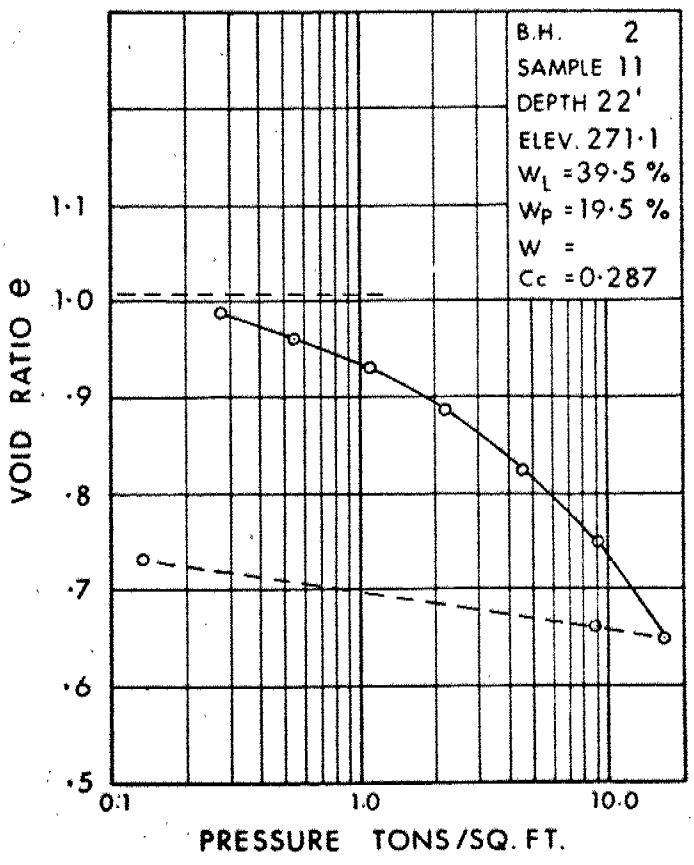
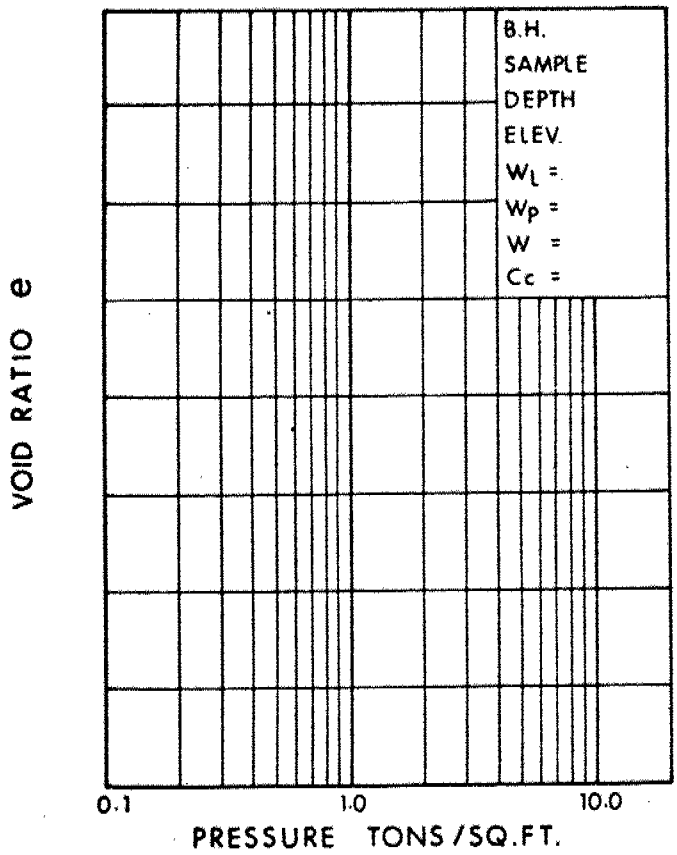
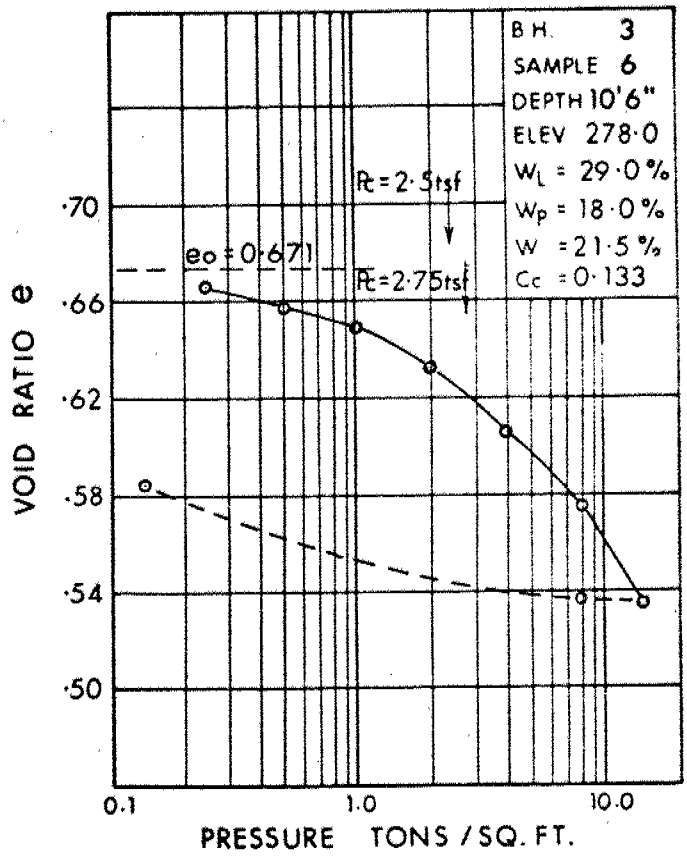


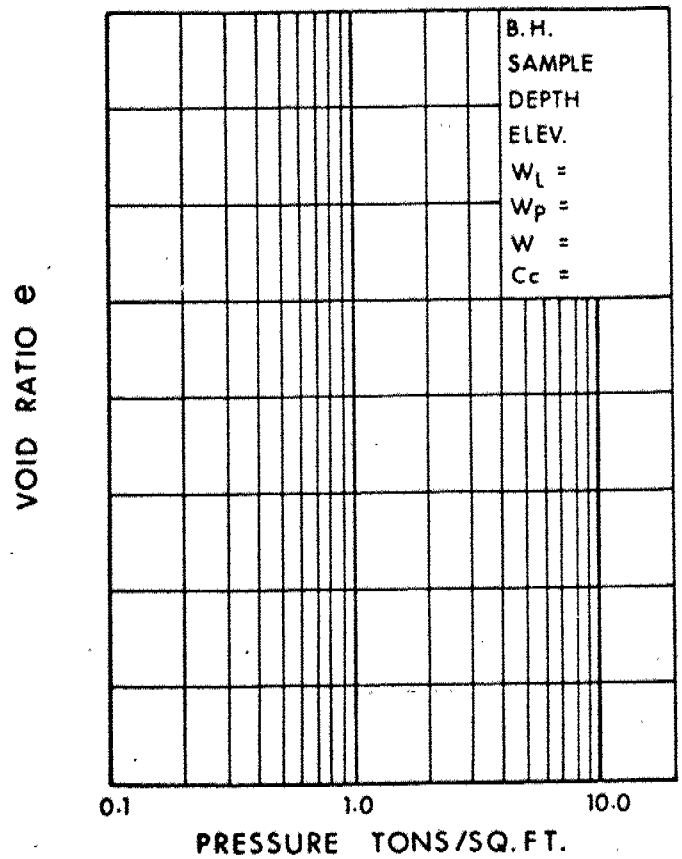
FIG. 5

VOID RATIO – PRESSURE CURVES

W.P. 46–74–37 A







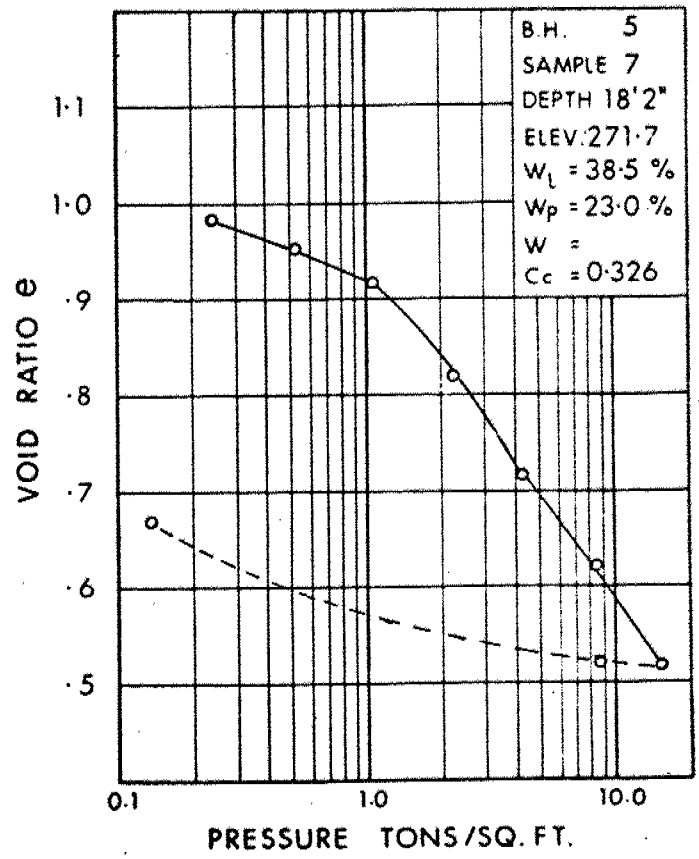
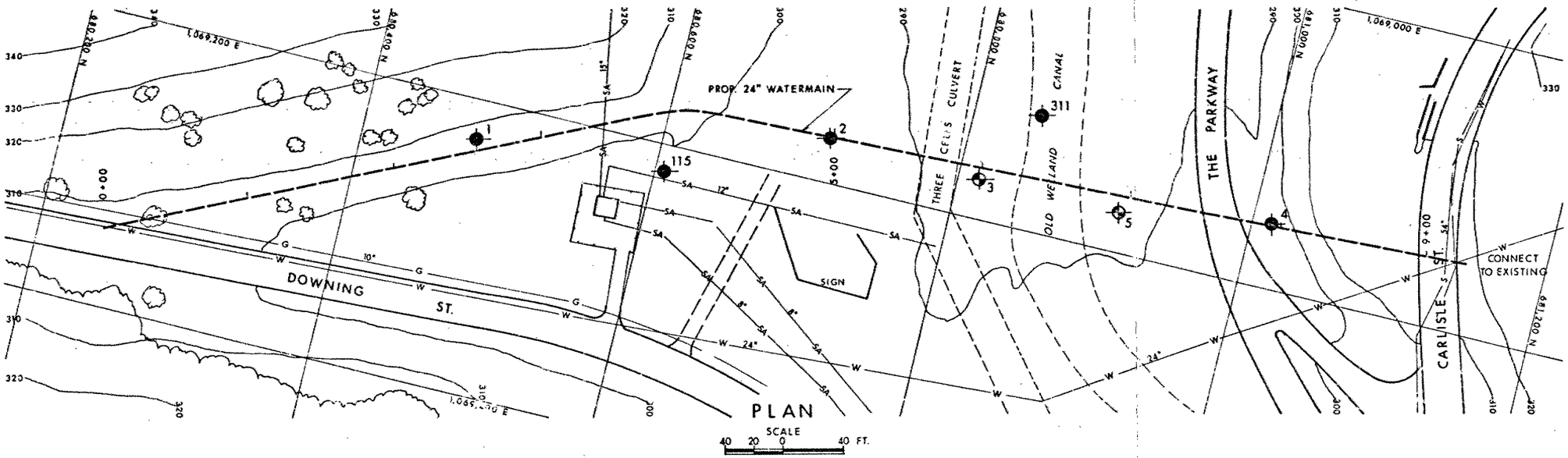


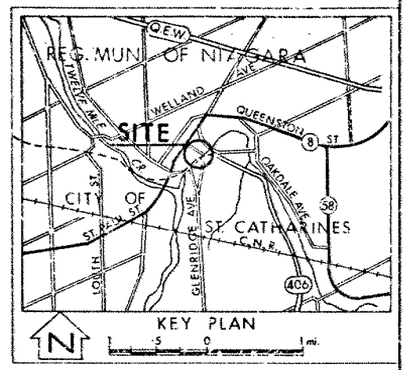
FIG. 6

CONT No
WP No 46-74-37(A)

24" WATER MAIN
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

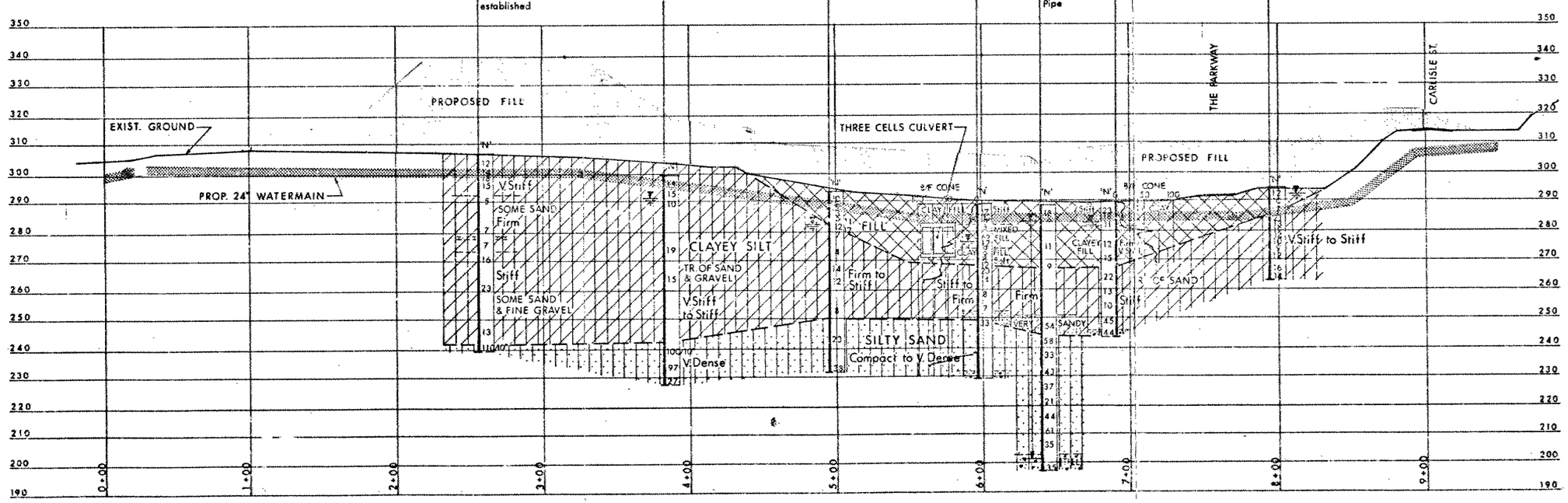




LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation
  B.H. No. 2, 3, 4 & 5 APR. 1976
  B.H. No. 115 NOV. 1971
  B.H. No. 311 OCT. 1963

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	307·1	680,477	069,226
2	293·1	680,710	069,170
3	289·0	680,813	069,172
4	294·4	681,013	069,155
5	289·7	680,910	069,172
115	294·1	680,606	069,219
311	288·6	680,844	069,120



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

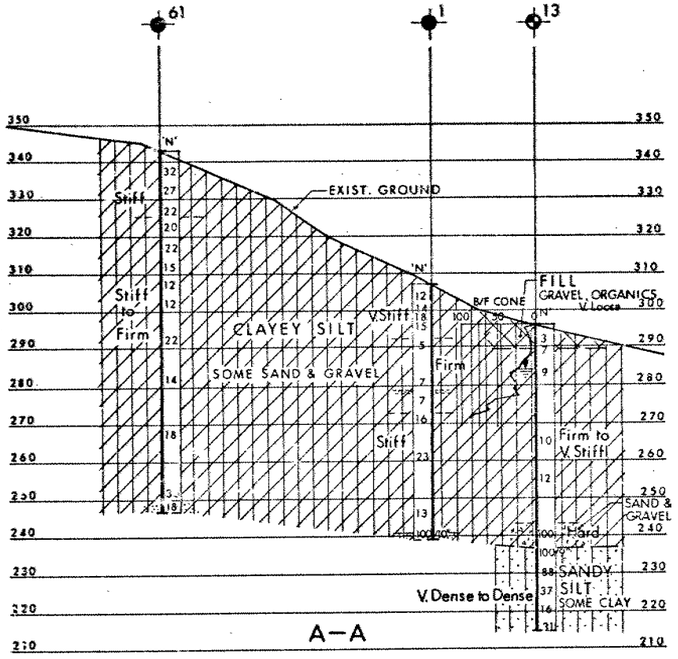
REVISIONS			
	DATE	BY	DESCRIPTION

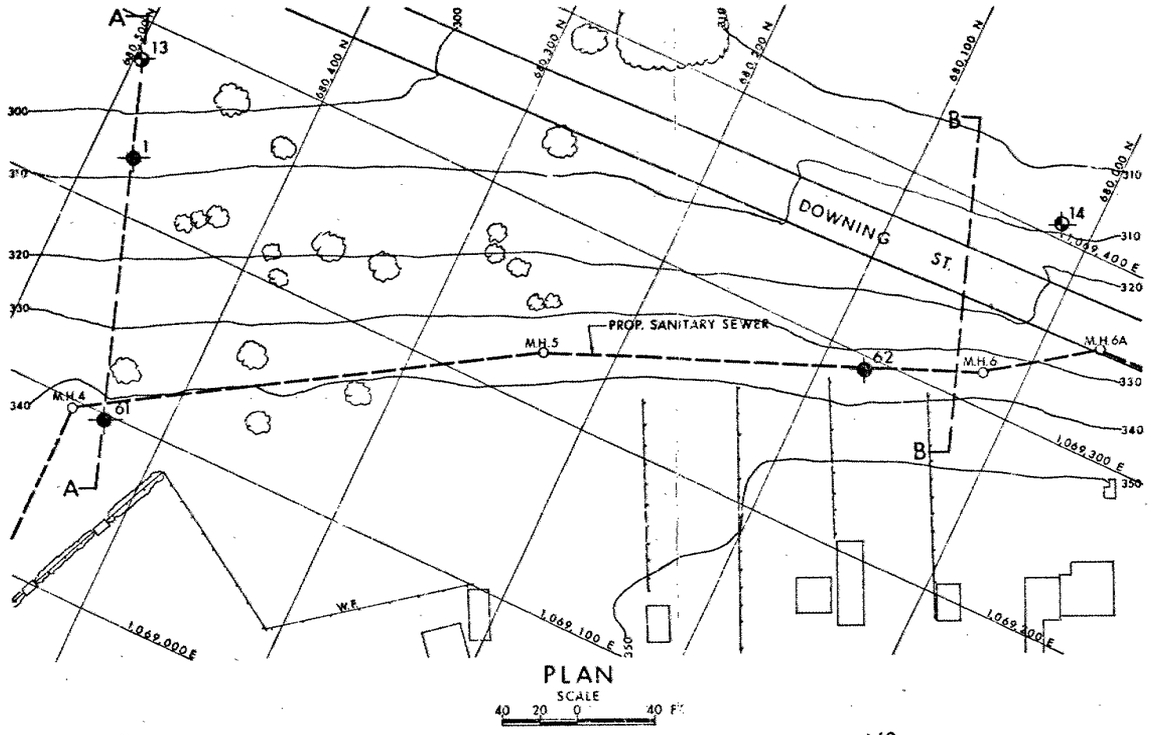
HWY No. CITY OF ST CATHARINES DIST 4
DRAWN B. L. CHECKED DATE 17 MAY '76 SITE
DRAWN O.J. CHECKED DWG 467637 A

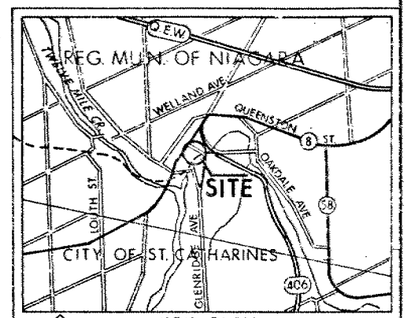
CONT No
WP No 46-74-37(B)

SANITARY SEWER
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



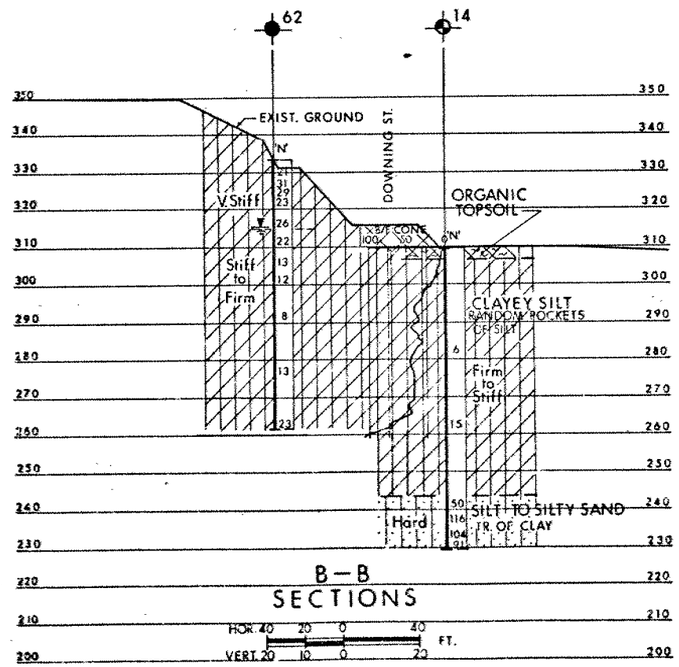


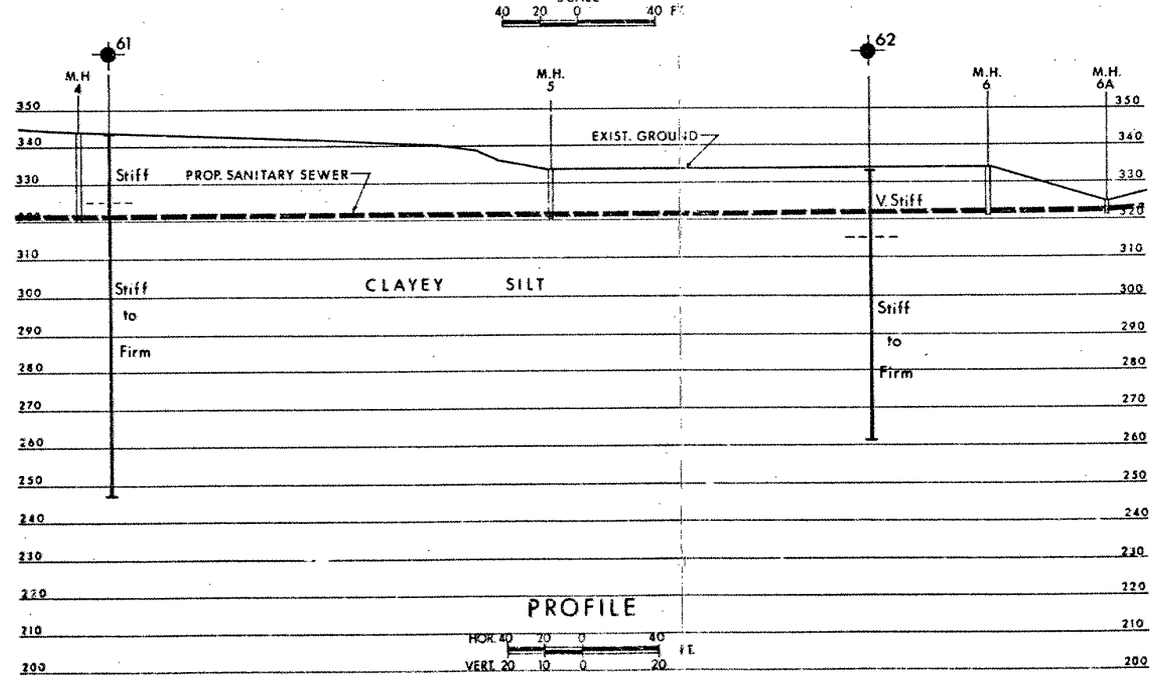


LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L at time of investigation
  B.H. No. 13 NOV. 1973
  B.H. No. 62 APR. 1976
  NO W.L. established B.H. 1, 61, 14

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	307·1	680,477	069,226
13	296·1	680,499	069,277
14	309·5	680,017	069,409
61	343·5	680,430	069,097
62	333·0	680,078	069,092





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

REVISIONS			
DATE	BY	DESCRIPTION	

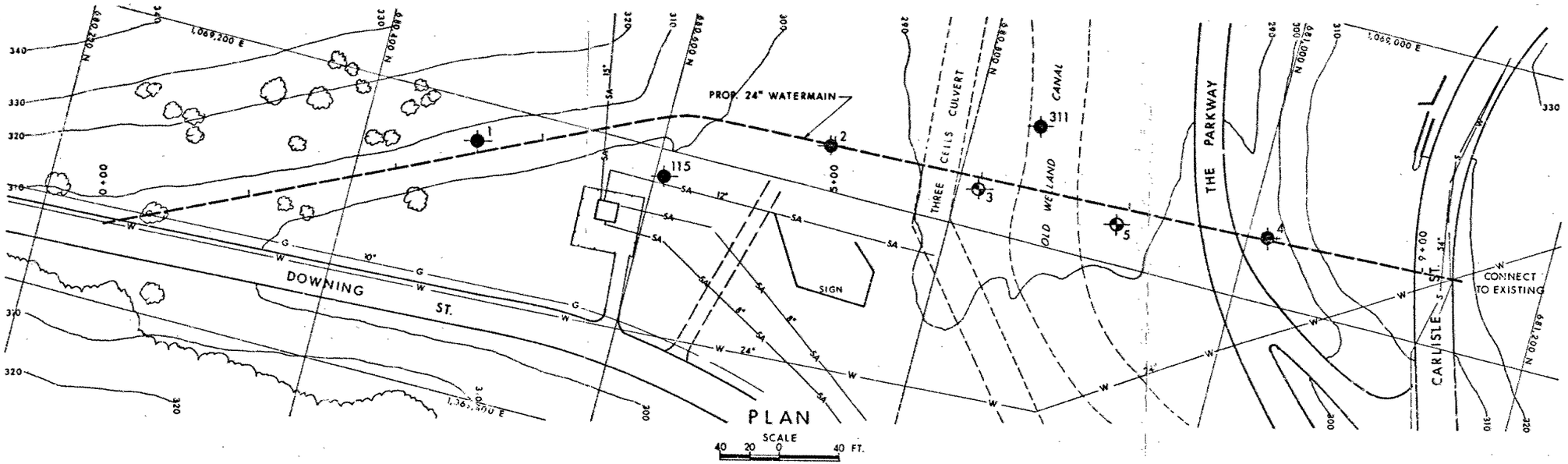
PRJ'T No.	CITY OF ST. CATHARINES	DIST.	A
SUBMD'D L.	CHECKED	DATE 17 MAY '76	SCALE
DRAWN O.	CHECKED	APPROVED	DWG 467437 B

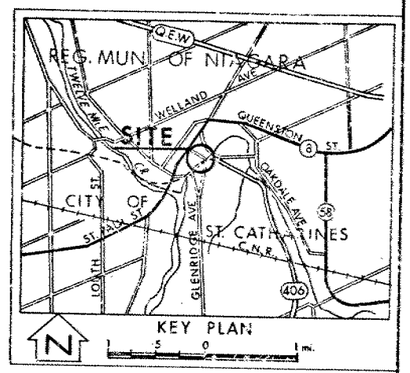
CONT No
WP No 46-74-37(A)

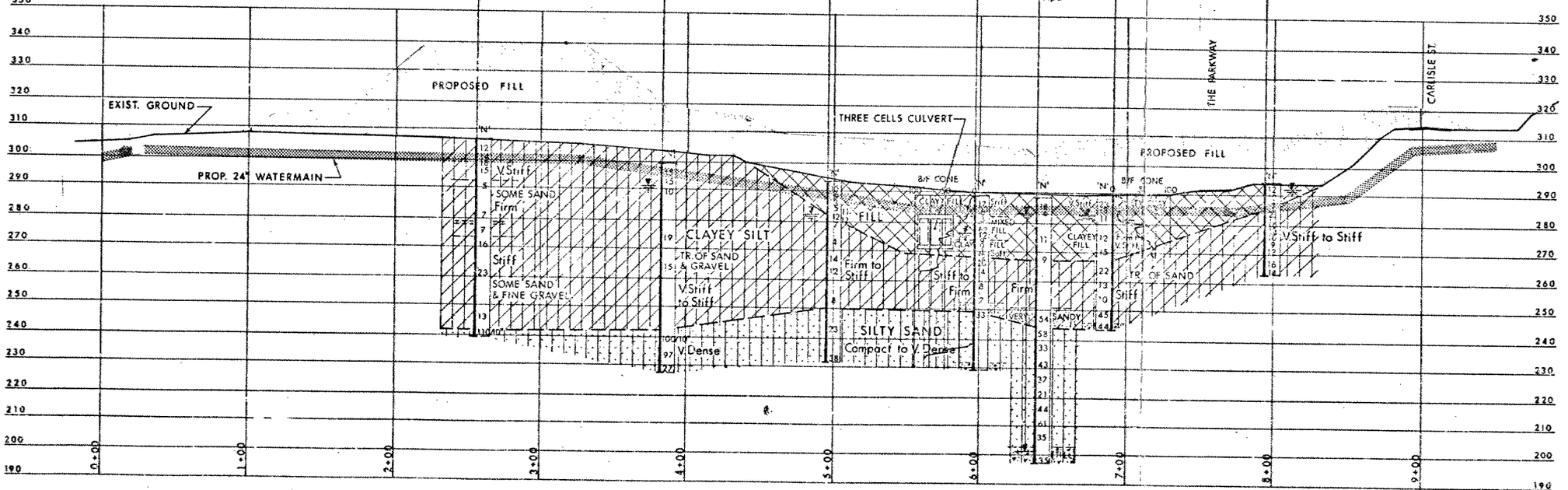
24" WATER MAIN

BORE HOLE LOCATIONS & SOIL STRATA

SHEET







PROFILE

SCALE

HOR. 40 20 0 40 FT.

VERT. 20 10 0 20

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)
- W.L at time of investigation
  B.H. No. 2, 3, 4 & 5 APR. 1976
  B.H. No. 115 NOV. 1971
  B.H. No. 311 OCT. 1963

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	307·1	680,477	069,226
2	293·1	680,710	069,170
3	289·0	680,813	069,172
4	294·4	681,013	069,155
5	289·7	680,910	069,172
115	29x·1	680,606	069,219
311	288·6	680,844	069,120

-NOTE-

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

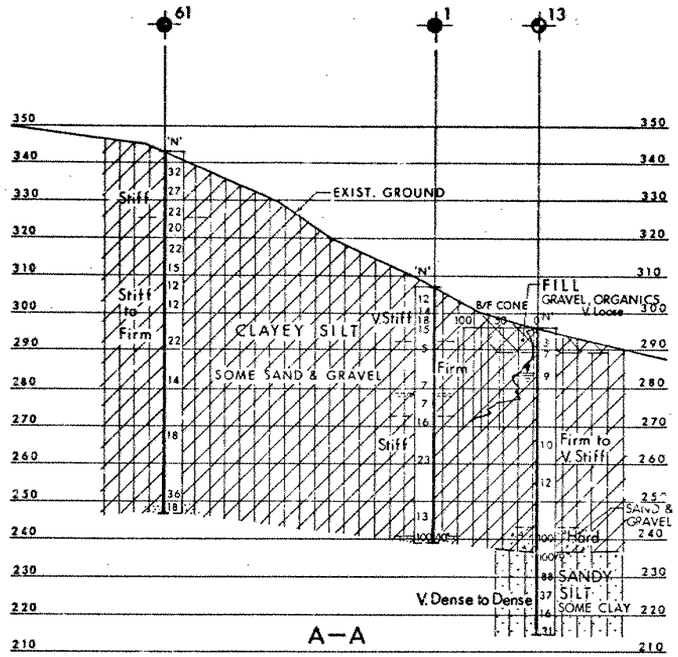
REVISIONS		
DATE	BY	DESCRIPTION

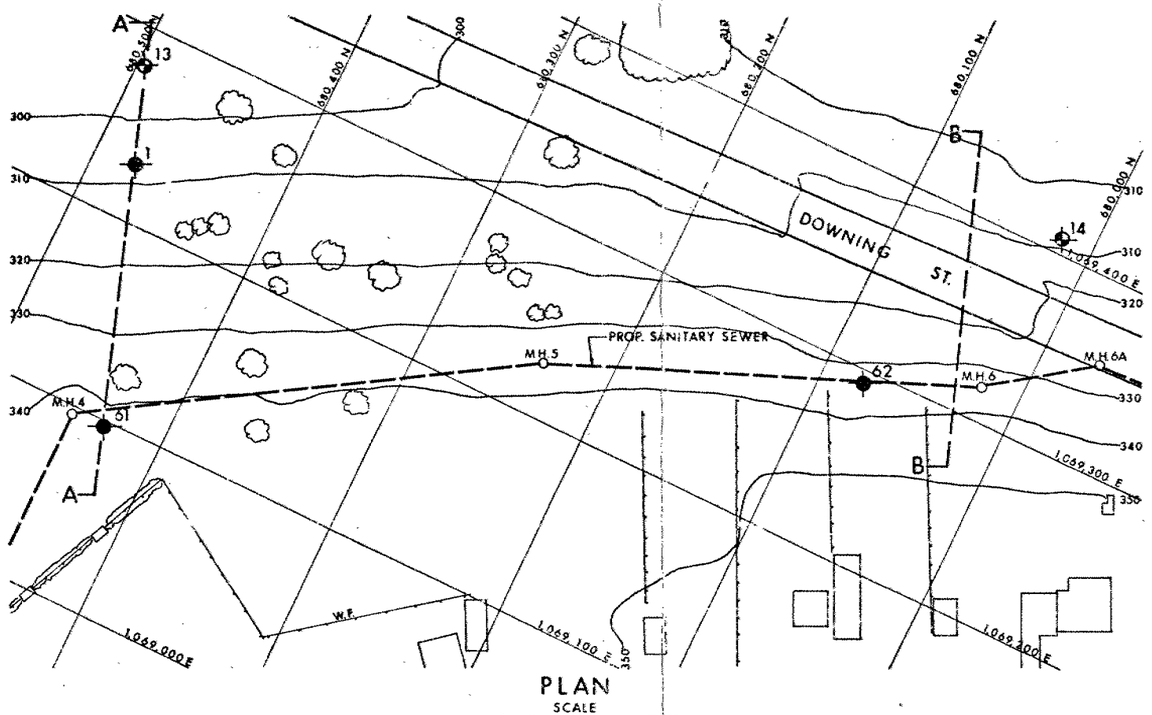
R.W.Y. No	CITY OF ST. CATHARINES	DIST.	4
SUBM'D B. L.	CHECKED	DATE 17 MAY '76	SITE
DRAWN D. J.	CHECKED	APPROVED	DWG 46-74-37 A

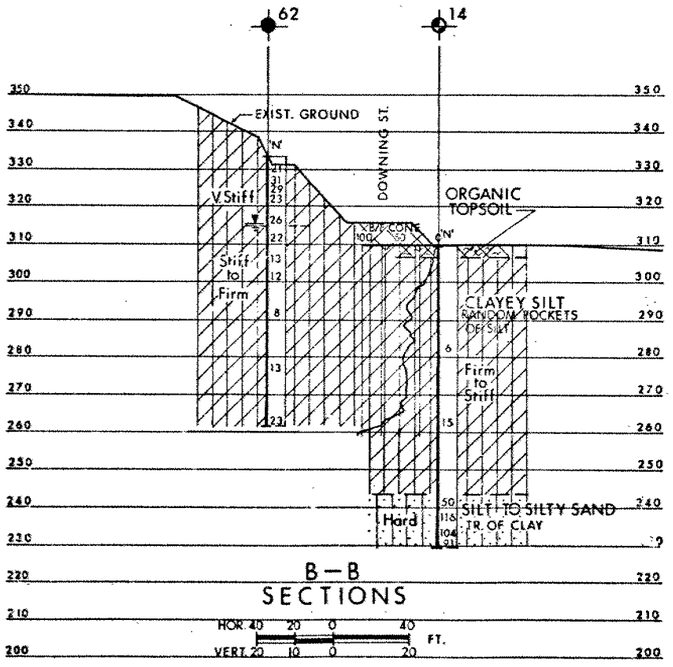
CONT No
WP No 46-74-37(B)

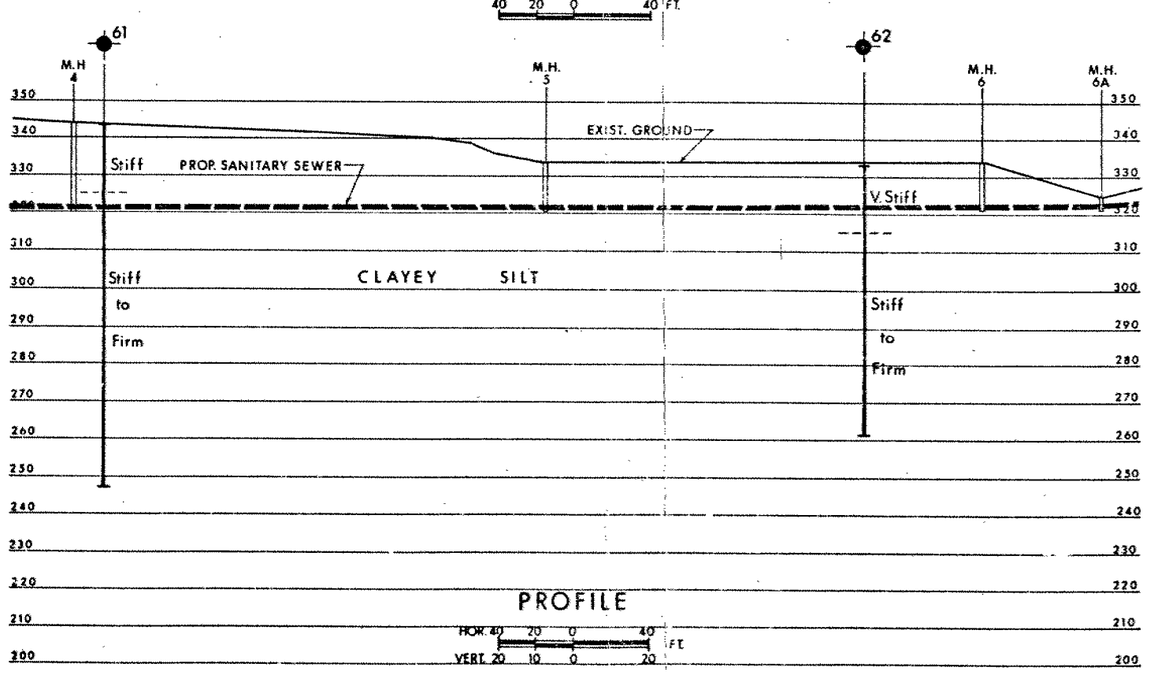
SANITARY SEWER
BORE HOLE LOCATIONS & SOIL STRATA

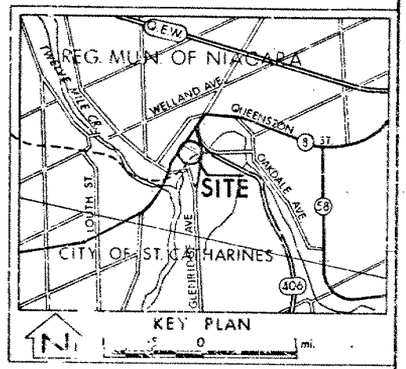
SHEET











LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L at time of investigation

B.H. No. 13 NOV. 1971
B.H. No. 62 APR. 1976
NO W.L. established B.H. 1, 61, 14

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	307·1	680,477	069,226
13	296·1	680,499	069,277
14	309·5	680,017	069,409
61	343·5	680,430	069,097
62	333·0	680,078	069,094

-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

HWY No. CITY OF ST. CATHARINES DIST. 4
SUBMITTED CHECKED DATE 17 MAY 76 SITE
DRAWN C.J. CHECKED J.P. APPROVED DWG 46-74-37 B

Mr. D.A. Waller
Construction Engineer
District #4, Hamilton

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 06 20

Re: Slope Seepage at North Approach
Fill For Geneva St., St. Catharines
Cont. 77-02, District #4, Hamilton

When the existing slope was benched in preparation for the placing of the north approach fill for the Geneva Street Structure, a seepage zone in the slope was uncovered.

During a visit to the site it was agreed by Mr. J. Castellan, Project Supervisor; Mr. K. Saarits of the Quality Assurance Section, and by the writer, that the following treatment was required.

The slope should be benched normally. A 24 inch thick blanket of free draining granular should then be placed over the seepage area so that any seepage water can drain through the granular to a 6 inch perforated pipe running across the base of the slope and out to a future Highway 406 ditch.

P.J. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

PJS/gs

cc: K. Saarits
Files
Record Services

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

Tel: (416) 248-3282

December 8, 1976

Mr. J.A. Patkowski, P. Eng.
Proctor and Redfern
75 Eglinton Avenue East
Toronto, Ontario
M4P 1H3

Dear Sir: Re: The Relocation of the Sanitary Sewer
Between Downing St. and Glenridge Avenue
W.P. 46-74-37

A review of the plan and sections provided for the installation of a sanitary sewer running above the slope between Downing St. and Glenridge Avenue, leads to the following comments:

1. The 10 foot cut to lower the ground surface before excavating for the sewer trench will flatten the slope and thereby improve its stability.

2. The 8 inch diameter perforated pipe being placed in the sanitary sewer excavation to remove seepage water should be extended from MH #15 to MH # 12.

3. The 8 inch perforated pipe should not be outlet onto the slope as this will saturate and soften it and thereby reduce its stability.

P. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

KGS/PS/gs

cc: Files
Record Services

Ministry of Transportation and Communications
Ontario

MISCELLANEOUS DETAIL SHEET

(DO NOT USE FOR GRADING QUANTITIES, ETC. OR FOR SCRATCH PAD USE)

SHEET NO. _____ OF _____ DATE _____

WORK PROJECT NO. _____ CONTRACT NO. _____ ITEM NO. _____

LOCATION OF MATERIAL, ETC. _____

WP-46-74-37

UNIT

St Catharines Unit
January 6, 1977

Mr Dennis Petsky
Proctor & Redfern

Dear Sir:

A slip failure has developed in the slope below the sanitary sewer excavation, due to the loading of the slope with the material being excavated. Lateral earth pressures from this moving mass of soil could cause structural damage to the 3-cell culvert buried at the toe of slope. It would therefore be advisable to avoid loading the slope and in this way avoid any possibility of damage to the culvert.

Yours truly,

John J. Hunt
Project Engr
Soil Mechanics Sec
Ministry of Trans. & Com.

DETAILED BY _____ CHECKED BY _____

DB-RD-76 7-74

Mr. N.D. Smith
Central Region
3501 Dufferin Street
Downsview

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

May 18, 1976

Foundation Investigation For

1. 24 Inch Sanitary Sewer - Downing St. and South Drive, St. Catharines
2. 24 Inch Watermain - Downing St. - Carlisle St., St. Catharines

W.P. 46-74-37, District 4, Hamilton

This is to provide you with a summary of our findings as a result of foundation investigations recently carried out for the above mentioned projects.

Subsoil at the site consists of a thick deposit (from ground surface to elevation 245±) of generally stiff clayey silt overlying a deposit of dense silty sand. In the old canal channel and its vicinity, a mixed fill with organics up to 23 ft. thick is also encountered.

1. With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a sub-drain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.

2. The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This backfill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

Station	Estimated Settlements
1 + 00	0"
1 + 70	3"
2 + 20	10"
3 + 30	10"
3 + 90	4"
5 + 00	8"
5 + 50	20"
7 + 00	20"
7 + 70	3"
9 + 30	0"

cont'd.....

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches. To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect 'trench at least 6 feet in depth (minimum)above the bedding for the watermain.

A meeting was held among Messrs. N. Smith, K. Selby, K. Smith, N. Huggins, P. Stuart and B. Ly, on May 11, 1976, in which the above mentioned points were discussed in detail. A complete foundation report will be sent to you in the near future.

B. Ly

B. Ly, P. Eng.
Project Engineer

For: K.G. Selby, P. Eng.
Supervising Engineer

cc: C. Robertson
R.M. Martin
T. Ellerbusch
N. Huggins
K. Smith
Files
Record Services

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M3-206

DIST. 4 REGION

W.P. No. 46-74-37

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. LOC

LOCATION WATERMAIN @ DOWNING ST & CARLISLE ST. SANITARY SEWER @ DOWNING & SOUTH DRIVE ST CATHARINES

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

30M3-206
GEOCRES No.

W.P. 46-74-37 DIST. 4

HWY. N/A STR. SITE N/A

1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive

DISTRIBUTION

G.C.E. Burkhardt (3)
R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
M.R. Ernesaks
R.D. Gunter
C.R. Robertson

R. Hore

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

Files

GEOCRES 30M3-206 DATE

Ministry of
Transportation and
Communications

Ontario

Memorandum

To: Mr. G.C.E. Burkhardt
Regional Structural Planning Engineer
Central Region
3501 Dufferin Street, Downsview

Attention:

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Date: July 29, 1976

Our File Ref.

In Reply to

Subject: W.P. 46-74-37
1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive
District 4, Hamilton

INTRODUCTION

This report contains results of a foundation investigation carried out by this Section at the following sites:

1. 24" Watermain at Downing St. and Carlisle St.

2. 24" Sanitary Sewer at Downing St. and South Drive.

Also contained in this report are recommendations for the foundations of the above mentioned utilities.

SITE DESCRIPTION

The proposed watermain crosses the Geneva-Glenridge Valley, where the Old Welland Canal is located, at approximately 1200 feet east of the Glenridge Fill. The area in concern is bounded to the north by Park St. and to the south by Downing St. At this locale the valley is about 650 feet wide, flanked by moderate slopes of 60 to 70 feet high. The valley, in general, is grass covered but sparsely treed. At this particular area, the old channel of the canal has been filled in and the canal has been relocated to a 3 cell box culvert.

The site of the sanitary sewer is just south of the watermain site and is also in a valley where Downing St. intersects with South Drive. This valley is proposed to be spanned by the future Westchester Crescent, by means of a fill. The slopes of the valley are about 50 to 65 feet high, not steeper than 2.5:1 overall, and at present are covered with trees. Residential developments are the major land use of the areas.

SUBSURFACE CONDITIONS

A total of seven sampled boreholes (No. 1 to 5, and No. 61 to 62 inclusive) were put down during the period of April 13 to April 22, 1976. Results of another four boreholes (No. 13, 14, 115 and 311) previously put down for feasibility study of Hwy. 406 are also incorporated here.

Locations of the boreholes, together with the inferred subsoil stratigraphy, are shown in Dwg. No. 467437-A and B. Details of the borehole results are also presented in the Borehole Record Sheets which are included in the Appendix to this report. A description of the various subsoil types is given below.

In general, subsoil at these sites consists of a thick deposit of clayey silt, underlain by a deposit of silty sand. In the vicinity of the three cell box culvert, the clayey silt is overlain by a layer of mixed fill.

Clayey Silt

The clayey silt is the predominant deposit in the area and is intercepted in all boreholes. This deposit generally exists from ground surface to elev. 247±, except in the neighborhood of the Old Welland Canal where it is overlain by a layer of mixed fill. According to the consolidation test results, the clayey silt is an overly consolidated material. Inferred from the 'N' values of the Standard Penetration Test and undrained shear strengths, this material is classified as stiff to firm in consistency. The Atterberg Limits and moisture contents, as determined by our lab tests, have the following ranges of values:

Liquid Limits (LL)	37% to 50%
Plasticity Limits (PL)	18% to 22%
Moisture Contents (W_n)	25% to 35%

A plot of the liquid limits and the plasticity indices on the Plasticity Chart shows that the material is medium to low in plasticity. Lab tests have also been carried out to determine the PH values, concentration of SO_3, and organic contents. This information is for choosing a corrosive resistant material for the watermain. The test results, which are reported in the Borehole Log Sheets, show that the clayey silt is generally slightly basic and contains an SO_3 concentration from 50 ppm to 2750 ppm.

Sandy Silt to Silty Sand

Underneath the clayey silt is a deposit of sandy silt/silty sand, the lower boundary of which, due to the purpose of the present investigation, is not fully determined. In Borehole 311, the silty sand is found to be underlain by a glacial till at elev. 203±. On the basis of the 'N' values, the relative density of this deposit is in the range of compact to very dense. Results of grain size analyses show that this material contains 35% to 60% silt and the sand component is predominantly fine grained. This deposit also contains trace of clay and fine gravel. Typical grain size distribution curves are shown in the Appendix.

Mixed Fill

In the area between Sta. 4+50 and Sta. 8+00, the site is covered with a layer of cohesive fill. Thickness of this material increases towards the Old Welland Canal, extending to elev. 268± near Sta. 5+50 and Sta. 7+00 for a maximum thickness of about 23 ft. Although it is composed of mainly clayey silt, due to inclusions of organic matters, cinders, etc., its composition is very heterogeneous and its consistency is very non-uniform, ranging from stiff to very soft. Some Atterberg Limits, moisture contents, and chemical contents determined for this material are included in the Borehole Log Sheets.

GROUNDWATER CONDITIONS

Groundwater levels were observed in the open boreholes during our field investigation and they reflected the prevailing conditions at the time of observation. Our observations showed that groundwater generally existed within 5 feet of ground surface at the watermain site and it drained into the three cell box culvert. In the slope of the sewer site, groundwater was observed at 10 to 20 feet below ground surface.

RECOMMENDATIONS

Placement of the Hwy. 406 fill has necessitated the existing underground utilities to be relocated. Because of the presence of the mixed fill in the vicinity of the culvert, concern has been expressed over the large differential settlements anticipated for the mixed fill. Concern has also been expressed over the stability of the existing slope in which the new sewer is to be constructed.

Based on our subsoil information, the following recommendations are given:.

(a) With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a subdrain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.

(b) The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This back fill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

Station	Estimated Settlements
1 + 00	0"
1 + 70	3"
2 + 20	10"
3 + 30	10"
3 + 90	4"
5 + 00	8"
5 + 50	20"
7 + 00	20"
7 + 70	3"
9 + 30	0"

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches.

To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect' trench at least 6 feet in depth (minimum) above the bedding for the watermain.

MISCELLANEOUS

The recent fieldwork was carried out during the period of April 13 to April 22, 1976, under the supervision of Mr. B. Ly. The drilling equipment was owned and operated by Atcost Drilling Company. This report was prepared by Mr. B. Ly and reviewed by Mr. K. Selby, Supervising Engineer.

B. Ly

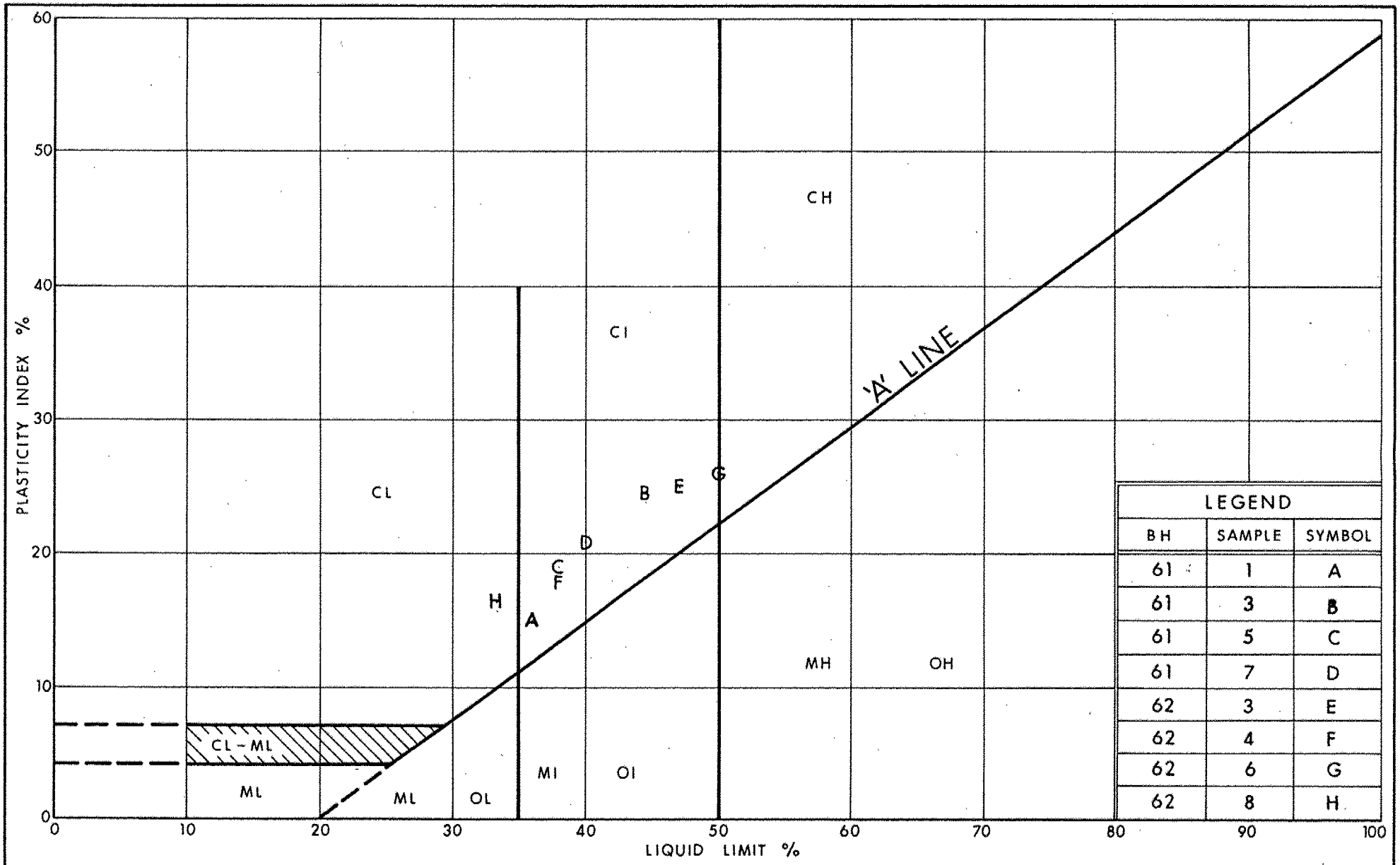
B. Ly, P. Eng.
Senior Engineer

K.G. Selby

K.G. Selby, P. Eng.
Supervising Engineer

KGS/gs
July, 1976

APPENDIX

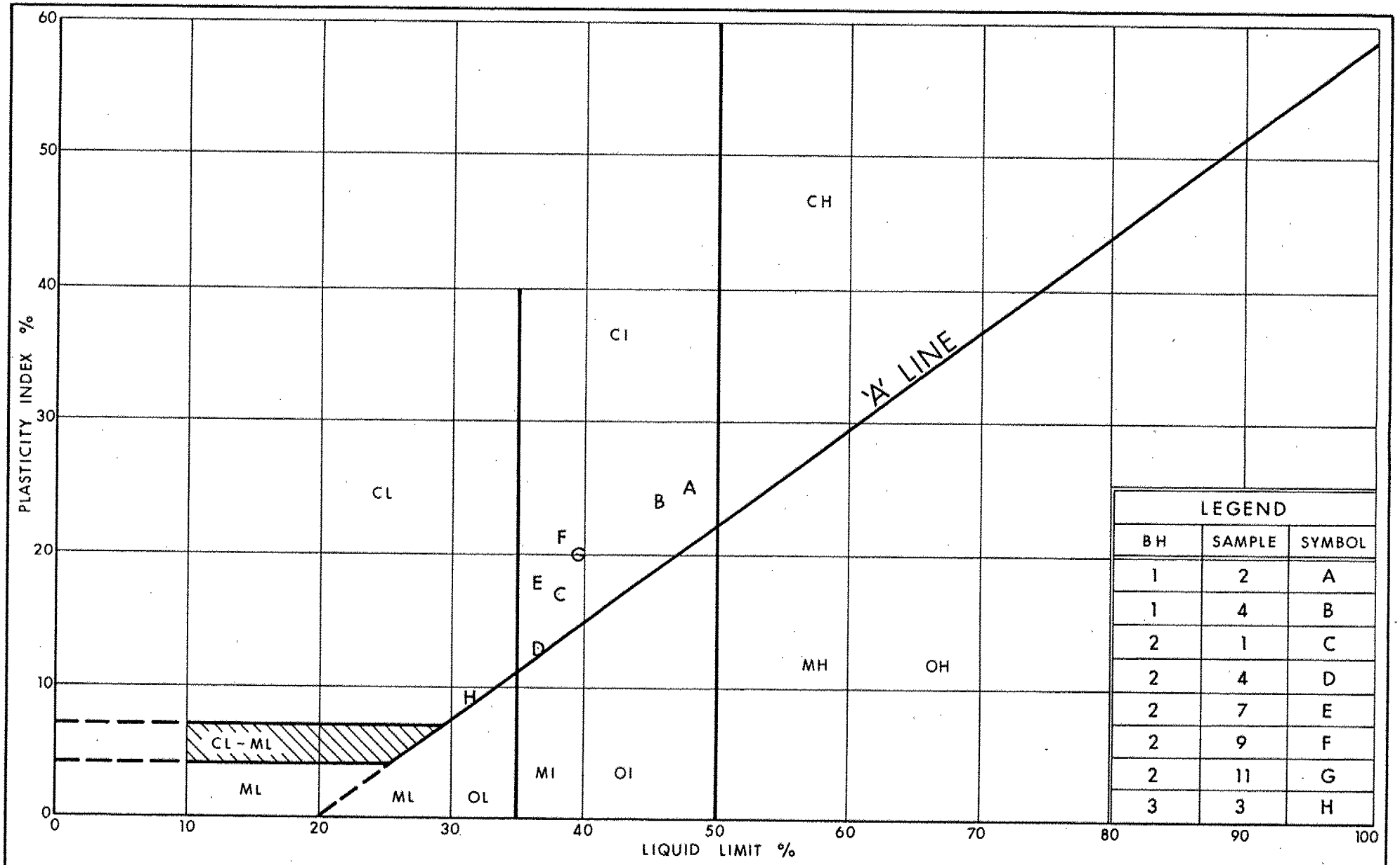


LEGEND		
BH	SAMPLE	SYMBOL
61	1	A
61	3	B
61	5	C
61	7	D
62	3	E
62	4	F
62	6	G
62	8	H

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT

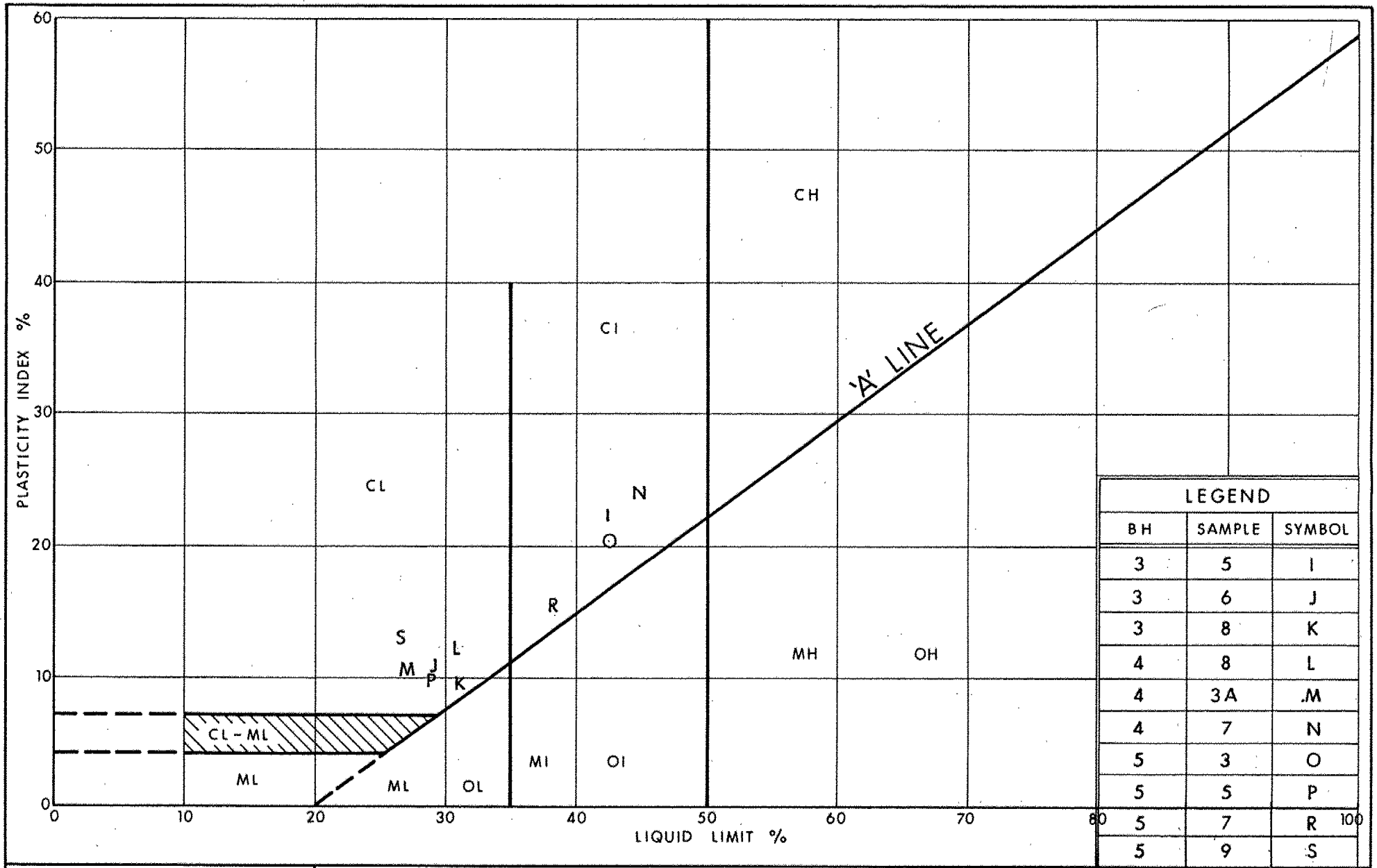
FIG No 1
WP 46-74-37 B



Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT

FIG No 1 A
W P 46-74-37 A

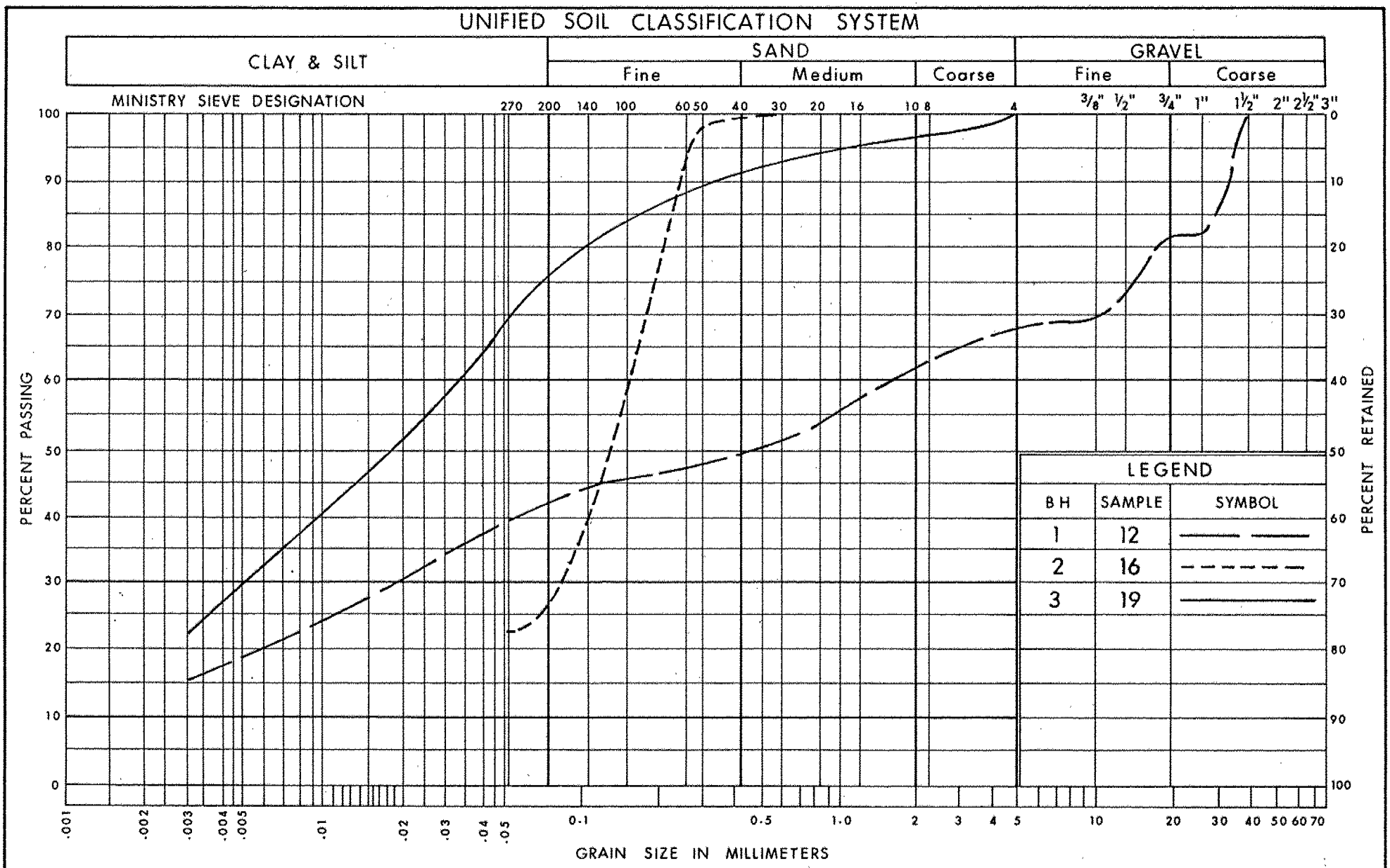


LEGEND		
BH	SAMPLE	SYMBOL
3	5	I
3	6	J
3	8	K
4	8	L
4	3A	M
4	7	N
5	3	O
5	5	P
5	7	R
5	9	S

Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

PLASTICITY CHART
CLAYEY SILT

FIG No 1B
W P 46-74-37 A

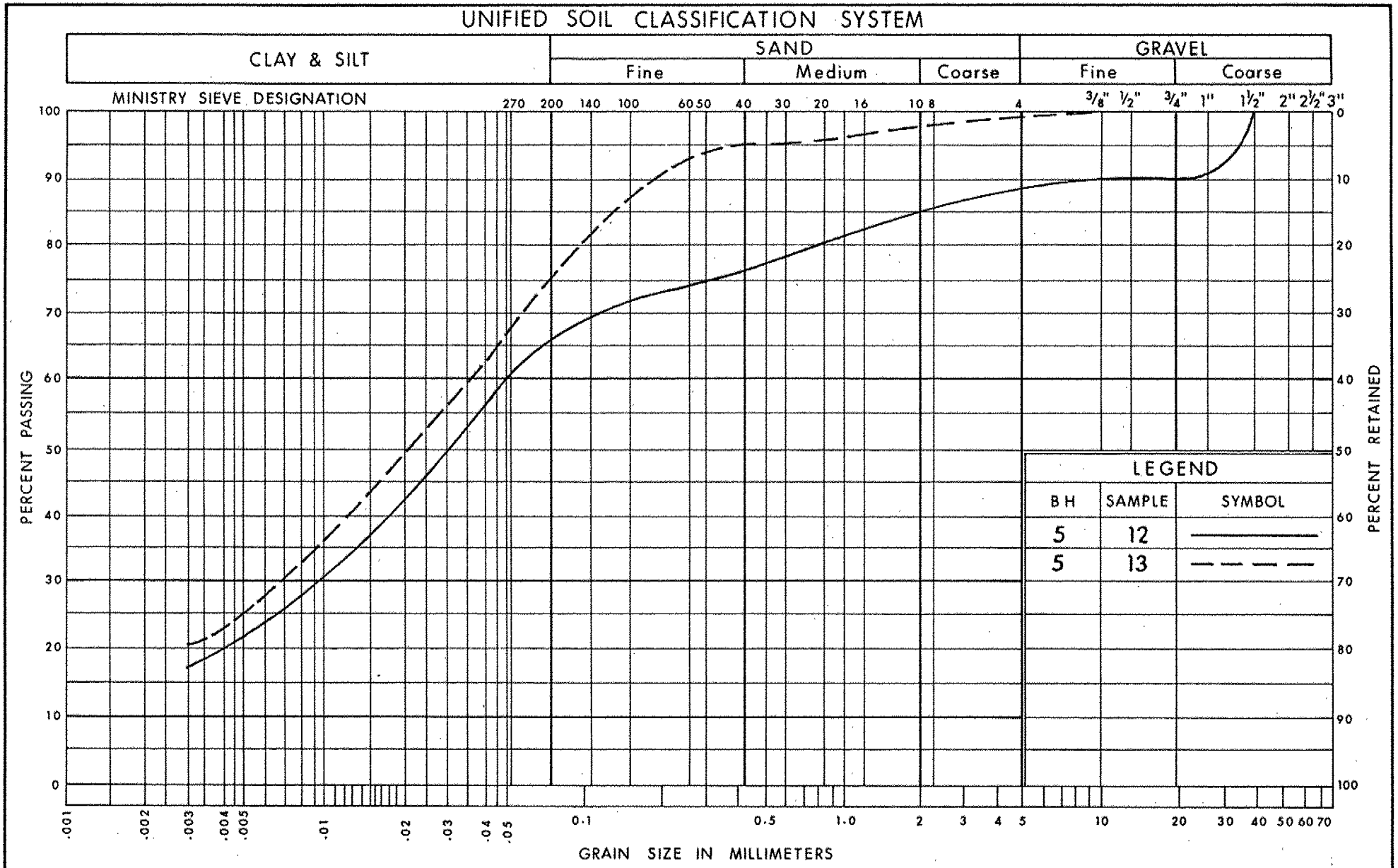


Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
SILTY SAND

FIG No 2

W P 46-74-37 A

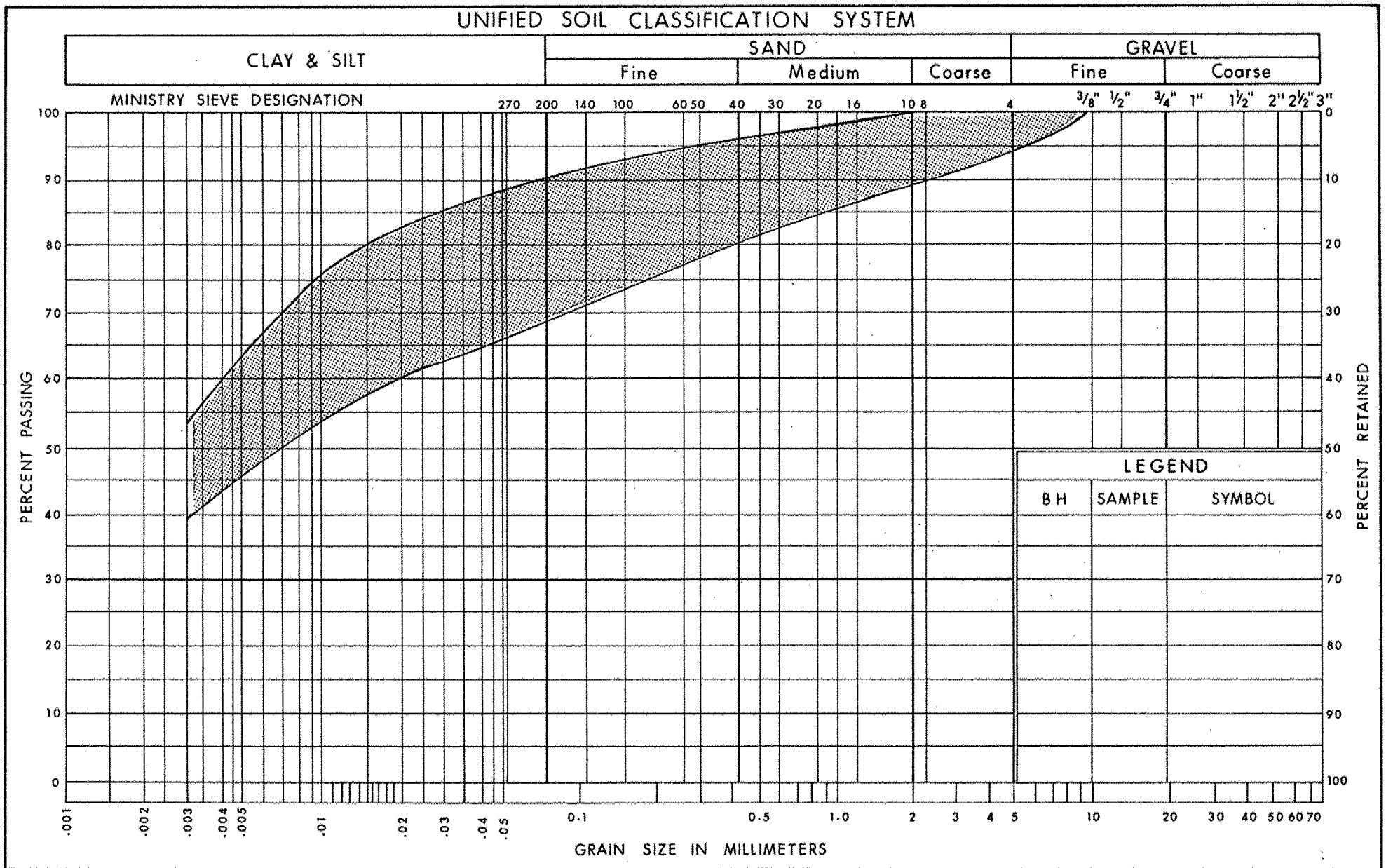


Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
CLAYEY SILT

FIG No 3

W P 46-74-37 A



Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

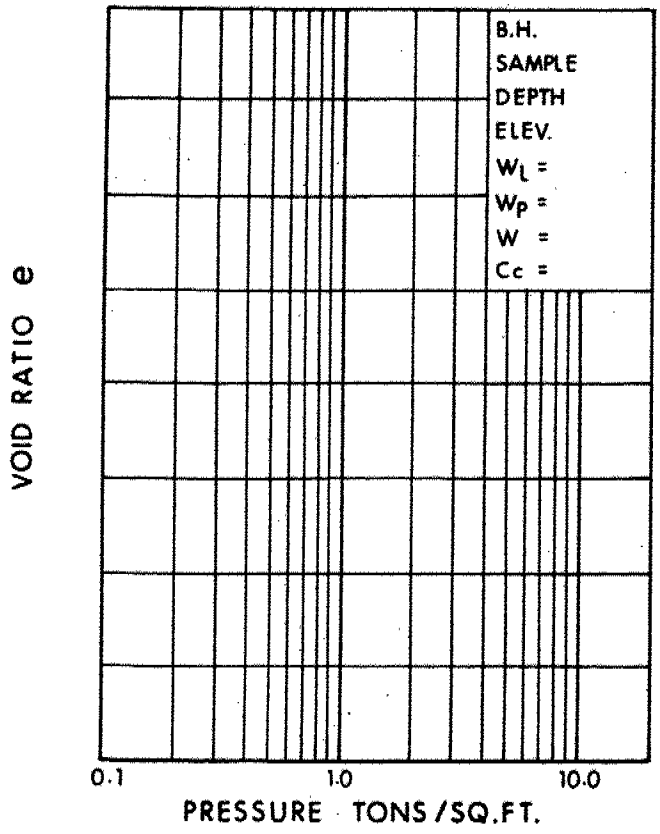
GRAIN SIZE DISTRIBUTION
CLAYEY FILL

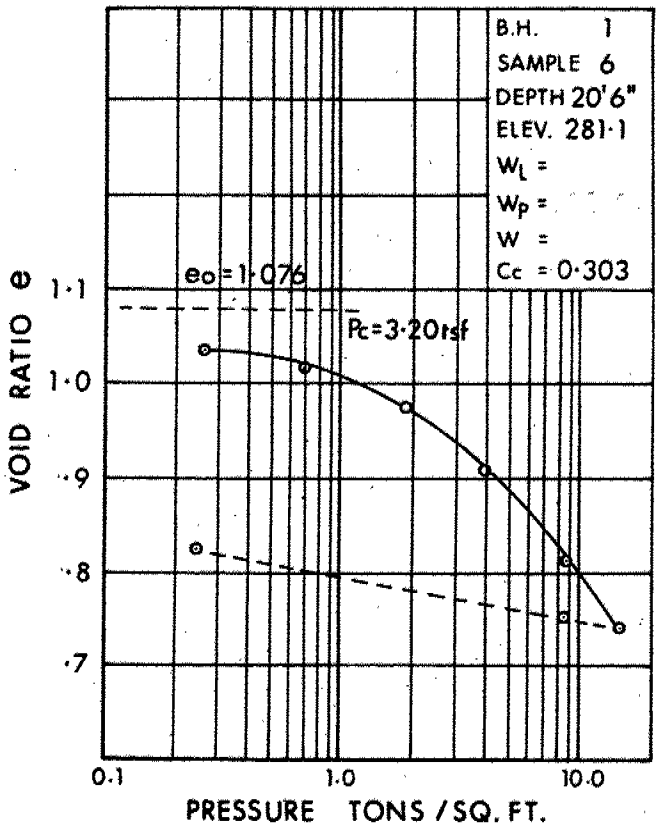
FIG No 4

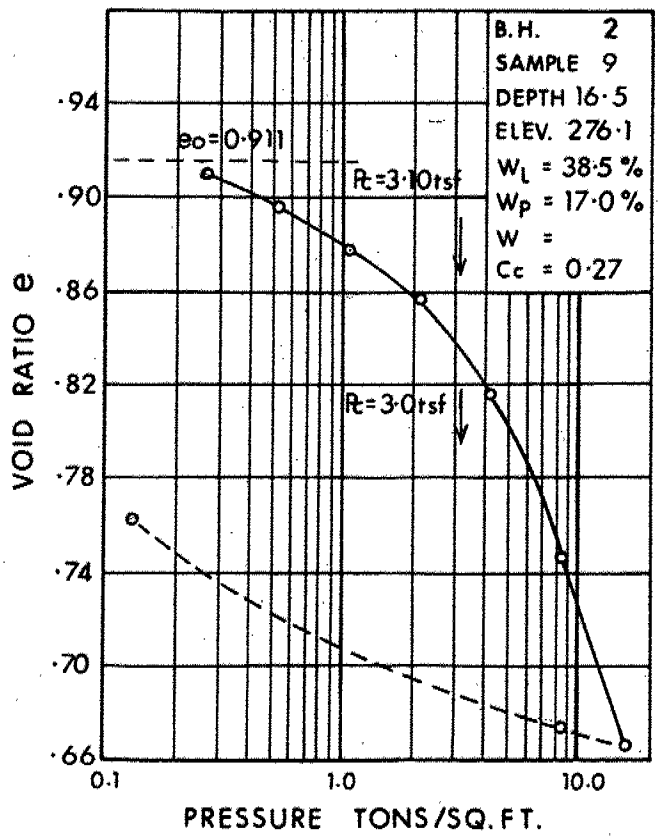
W P 46-74-37 A

VOID RATIO – PRESSURE CURVES

W. P. 46–74–37 A







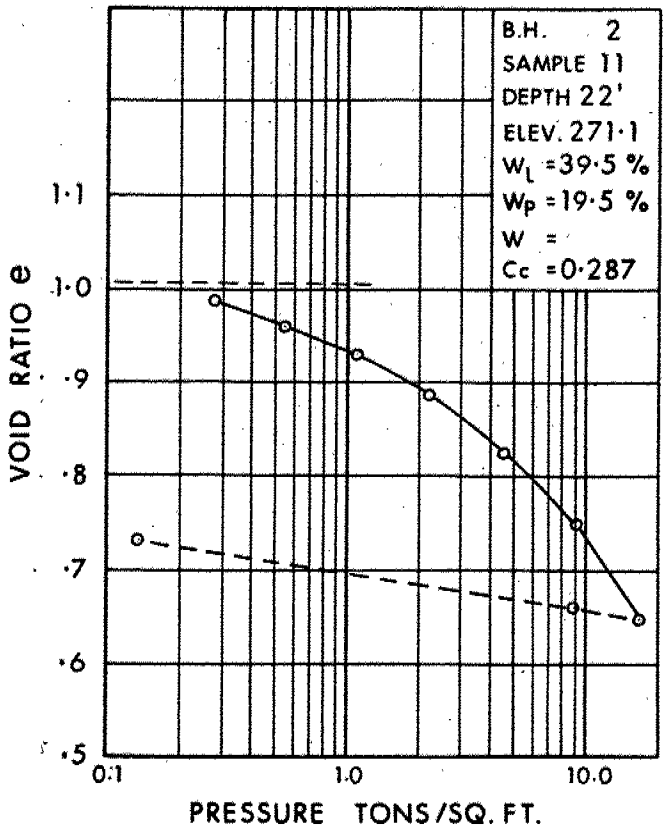
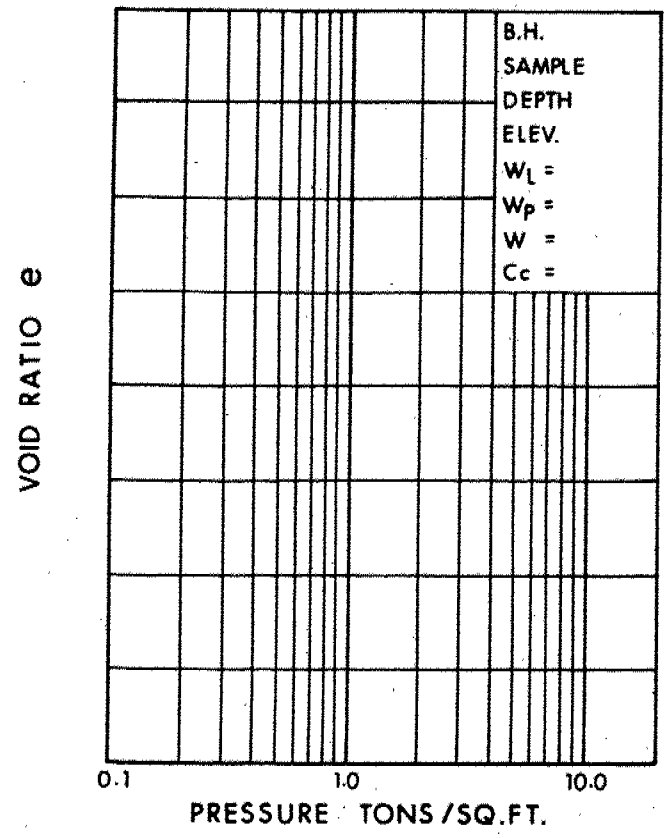
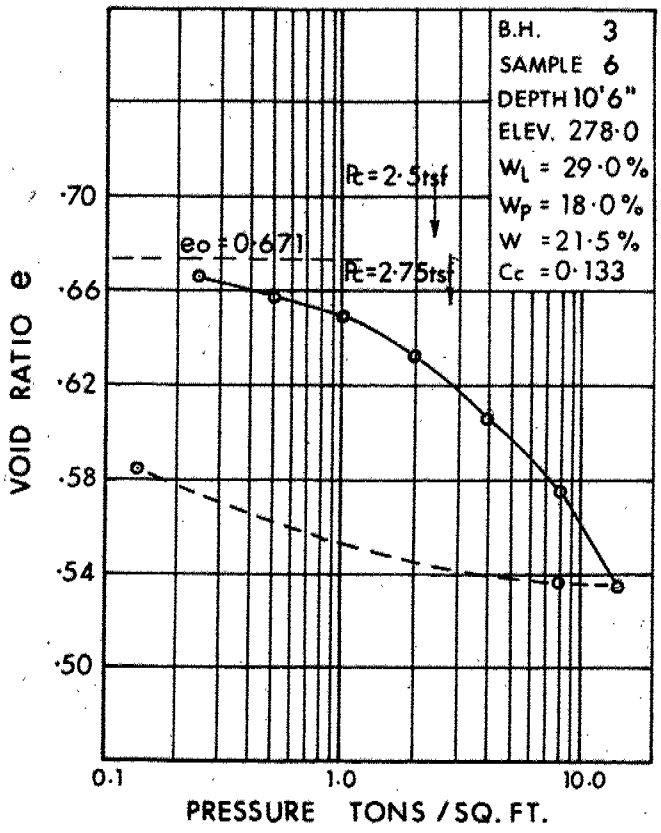


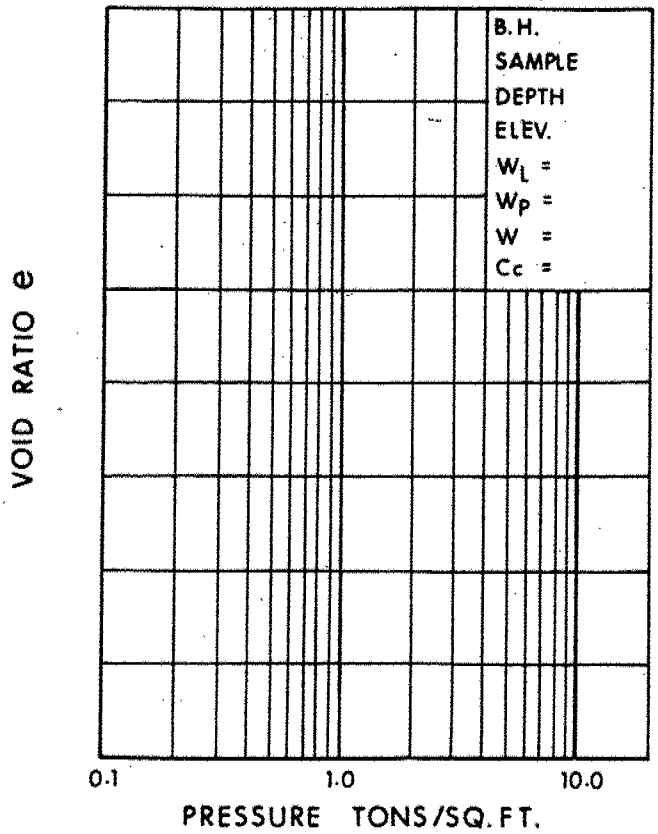
FIG. 5

VOID RATIO – PRESSURE CURVES

W.P. 46–74–37 A







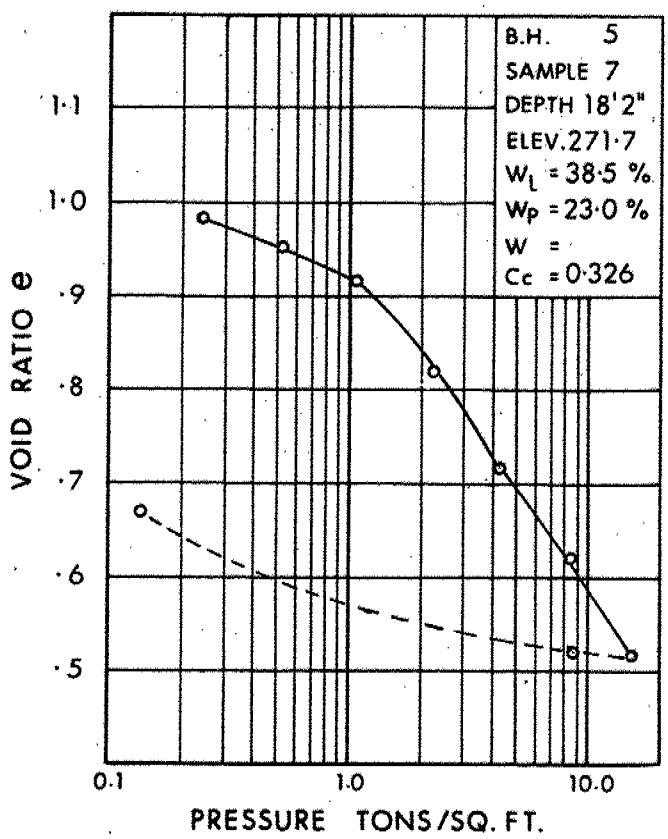


FIG. 6

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

WP 46-74-37 (A) LOCATION Co-ords. 1,069,226 E.; 15,680,477 N; ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 13, 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W	UNIT WEIGHT γ P.C.F.	REMARKS GR SA SI CL %
307.1	Ground Level						400 800 1200 1600 2000	20 40 60 WATER CONTENT %		
0.0	Clayey silt - low to medium plasticity containing some sand		1	SS	12					
			2	SS	14					
			3	SS	18	300				
	Very stiff, brown and fissured		4	SS	15					
			5	SS	5	290	+ 2.4			
	Grey and Firm		6	TW	PM		+ 2.4		120	
			7	SS	7	280				
			8	SS	7		+ 2.0			
	Stiff		9	SS	16					
	containing some sand and fine gravel sizes		10	SS	23	270				
						260				
						250				
			11	SS	13					
239.1	becoming very sandy		12	SS	110/10"	240				32 26 30 12
68.0	End of Borehole									

Note: 1. BH open to El. 297.6 April 20/76

2. Water level not established

3. Chemical tests

Sample	Organic	PH	SO_3
SS-3	—	8.22	240 ppm

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2

WP 46-74-37 (A) LOCATION Co-ords. 1,069,170 E; 15,680,710 N. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 20, 21, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
293.1	Ground Level					
0.0	Fill - heterogeneous mixture of sand, clay & cinder, some organic		1	SS	10	290
			2	SS	9	
			3	SS	3	
283.6			4	SS	5	
9.5	Clayey Silt Grey, Firm to Stiff low to medium plasticity, traces of sand		5	SS	11	
			6	SS	12	
			7	SS	12	280
			8	SS	7	
			9	TW	PH	
			10	SS	4	
			11	TW	PH	270
			12	SS	14	
			13	SS	12	
						260
250.1			14	SS	8	
43.0	Silty Sand Fine Compact to Dense		15	SS	23	250
						240
231.6			16	SS	38	
61.5	End of Borehole					

Note:

Chemical test results

Sample	Organic	PH	SO_3	
SS-2	2.25%	8.25	440	ppm
SS-4	3.76%	8.15	430	ppm

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

+ 1.7

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ P.C.F

120

REMARKS

% GR	SA	SI	CL
0	73	(27)	

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,813 N. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 15, 20, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV
289.0	Ground Level					
0.0	Clay Fill					
	homogeneous & stiff		1	SS	17	
			2	SS	13	
282.0			3	SS	9	
7.0	Mixed Fill - mainly sand, silt, some clay and organic, Black		4	SS	8	
			5	TW	PH	280
			6	TW	PH	
			7	SS	62	
274.0			8	SS	12	
15.0	Clay Fill - some sand and organic		9	SS	9	
			10	SS	9	
268.0	Soft		11	SS	8	270
21.0	Clayey silt, grey, stiff to firm, with traces of sand, low to medium plasticity		12	SS	12	
			13	SS	20	
			14	SS	14	
			15	SS	18	260
	becoming more sandy,		16	SS	7	
249.0	some fine gravel					250
40.0	Silty Sand		17	SS	33	
	Fine and Dense, occasional clay seams		18	SS	N/A	240
	becoming denser		19	SS	N/A	230
229.0						
60.0	End of Borehole					

Note:
Chemical test results

Sample	Organic	PH	SO_3	
SS-3	2.86%	7.85	550	ppm
TW-6	1.04%	8.34	180	ppm
SS-8	3.05%	8.05	250	ppm
water	--	7.77	22	ppm

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100
SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

/10"

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ

REMARKS	% GR	SA	SI	CL
	6	26	36	32
	0	13	40	47
	0	12	48	40
	0	24	58	18

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORTS ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

WP 46-74-37 (A) LOCATION Co-ords. 1,069,155 E; 15,681,013 N; ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
294.4	Ground Level					
0.0	Fill - mixture of clay & sand with some gravel, some organic		1	SS	12	290
285.4			2	SS	10	
			3	SS	7	
9.0	Clayey Silt		4	TW	PH	
			5	SS	21	
	Very Stiff to Stiff		6	SS	13	
			7	TW	PH	280
	fissured, containing		8	SS	19	
			9	SS	14	
	traces of sand		10	SS	10	
			11	SS	9	
			12	SS	12	270
			13	SS	16	
262.9			14	SS	14	
31.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
400 800 1200 1600 2000

▽ 2000

▽ 2000

*1.1

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P w w_L
WATER CONTENT %
20 40 60

UNIT WEIGHT γ

REMARKS

% GR SA SI CL

Note :
Chemical Test Results

Sample	Org.	PH	SO3
SS-2	2.39%	8.08	550 ppm
Water	–	8.10	375 ppm

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 5

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,910 N ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 13, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV
289.7	Ground Level					
0.0	Fill					
	Silty Clay		1	SS	23	
	Very Stiff		2	SS	18	
281.7						
8.0	Fill: clayey, some sand & organic		3	SS	11	
			4	TW	PH	
			5	TW	PH	
	Firm to Very Stiff		6	SS	12	
			7	TW	PH	
267.7	becoming very sandy		8	SS	15	280
22.0	Clayey silt - grey, stiff, low to medium plasticity, some sand and fine gravels		9	SS	22	270
			10	SS	13	260
			11	SS	10	
			12	SS	45	250
243.2	becoming very sandy		13	SS	44	
46.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (400 800 1200 1600 2000)

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL × LAB VANE

+ 2.0

+ >2000

+ >2000

LIQUID LIMIT W_L

PLASTIC LIMIT W_P

WATER CONTENT W

W_P W W_L

WATER CONTENT % (20 40 60)

UNIT WEIGHT γ

REMARKS

% GR SA SI CL

11 23 53 13

1 23 61 15

Note :

Chemical test results

Sample	Organic	PH	SO_3
SS-3	0.77%	8.0	2750 ppm
TW-5	1.66%	8.07	130 ppm
SS-8	0.38%	8.31	40 ppm
water	—	8.14	70 ppm

20
15 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 115

WP 46-74-37(A) LOCATION Co-ords. 15,680,606 N; 1,069,219 E. ORIGINATED BY PK

DIST 4 HWY — BORING DATE November 3-4, 1971 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY —

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W (W_P W W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F.	REMARKS % GR SA SI CL
0.0										
299.1	Ground Level									
			1	SS	15					
			2	SS	15					
	Clayey silt, traces					290				
	of sand and gravel		3	SS	10				121	
			4	TW	PH		2000			
			5	TW	PH				119	
						280				
			6	TW	PH				118	
	Very Stiff to Stiff		7	SS	19		2000			
						270				
			8	TW	PH				130	
	Brown and Grey		9	SS	15					
						260				
			10	TW	PH				133	
			11	TW	PH				113	
						250				
			12	TW	PH				123	
									116	
242.1			13	TW	PH				135	
57.0	Silty sand, some clay.		14	SS	100/10"	240				
	Very Dense		15	SS	97					0 31 58 11
						230				
227.6			16	SS	27					0 64 (36)
71.5	End of Borehole									

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 311

WP 46-74-37 (A) LOCATION Co-ords. 15,680,844N; 1,069,120 E. ORIGINATED BY Golder

DIST 4 HWY — BORING DATE October 22 – 24, 1963 COMPILED BY MW

DATUM Geodetic BOREHOLE TYPE Washboring HX & BX Casing CHECKED BY —

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P W W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F	REMARKS / % GR SA SI CL
288.6	Ground Level					ELEV				
0.0	Very stiff brown becoming a mixture of soft to firm silty clay, cinders & pieces of brick and gravel below about 4' depth (Fill)		1	SS	18					WL in pipe @ El. 283. Oct.25/63
			2	SS	6		+s=6			
			3	TW	PM	280				
			4	SS	11		+s=5.5		127	
267.6			5	SS	9	270				
21.0	Firm, brown or grey, brown silty clay with some random sand and gravel size particles few small (generally less than 1/8" size) silt pockets		6	TW	PM		+s=2000			
			7	TW	PM	260	+s=4.5		136	
			8	TW	PM		+s=2000			
	becoming very sandy		9	SS	54	250			126	
244.1										
44.5	Compact to very dense grey silty sand or sand, trace of silt, with very occasional thin (app. 1/4") silty clay layers		10	SS	58	240				
			11	SS	33					
			12	SS	43					
			13	SS	37	230				
			14	SS	21					
			15	SS	44	220				
			16	SS	61					
			17	SS	35	210				
202.6										
86.0	Dense grey and red silty sand & gravel (Till)		18	SS	35	200				
197.1										
91.5	End of Borehole									

20
15 ○ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

WP 46-74-37 (B) LOCATION Co-ords. 1,069,226 E. 15,680,477 N; ORIGINATED BY BL

DIST 4 HWY 406 BORING DATE April 13 & 14, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT w_L, PLASTIC LIMIT w_P, WATER CONTENT w	UNIT WEIGHT γ P.C.F	REMARKS % GR SA SI CL
307.1	Ground Level						400 800 1200 1600 2000	20 40 60 WATER CONTENT %		
0.0	Clayey silt: low to medium plasticity containing some sand		1	SS	12					
			2	SS	14	300				
	Very Stiff		3	SS	18					
	Brown & fissured		4	SS	15					
	Grey & Firm		5	SS	5	290	+ 2.4			
			6	TW	PM		+2.4		120	
			7	SS	7	280				
			8	SS	7		+ 2.0			
	Stiff		9	SS	16	270				
	containing some sand									
	and fine gravel sizes		10	SS	23	260				
						250				
			11	SS	13					
239.1	becoming very sandy		12	SS	110/10"					32 26 30 12
68.0	End of Borehole									

Note: 1. BH open to El. 297.6 April 20/76

2. WL not able to determine.

3. Chemical tests

Sample	Organic	PH	SO_3
SS-3	—	8.22	240 ppm

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 13

WP 46-74-37 (B) LOCATION Co-ords. 680,499 N; 69,277 E. ORIGINATED BY PK

DIST 4 HWY 406 BORING DATE November 2-3, 1971 COMPILED BY ABK

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ	REMARKS % GR SA SI CL
296.1	Ground Level									
0.0	Fill									
	Cinder, gravel, organics		1	SS	3					
289.1	Very Loose					290				
7.0			2	SS	7		+ > 2000			
			3	TW	PH				126	
	clayey silt, traces		4	SS	9		+ > 2000			
			5	TW	PH				115	
	of sand and gravel									
			6	TW	PH				119 123	
			7	TW	PH	270			129	
			8	SS	10					
	Firm to Very Stiff		9	TW	PH	260			126	
			10	SS	12					
			11	TW	PH	250			117	
			12	TW	PH					
	sand and gravel						+ > 2000			
237.1	Hard Reddish Brown		13	SS	100	240				
59.0	Sandy silt with		14	SS	100/9"					
	some clay.		15	SS	88	230				
	Very Dense to Dense		16	SS	37					0 4 72 24
	Grey and Brown		17	SS	16	220				1 38 52 9
214.6			18	SS	31					
81.5	End of Borehole									

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 14

WP 46-74-37 (B) LOCATION Co-ords. 680,017 N; 69,409 E. ORIGINATED BY DM

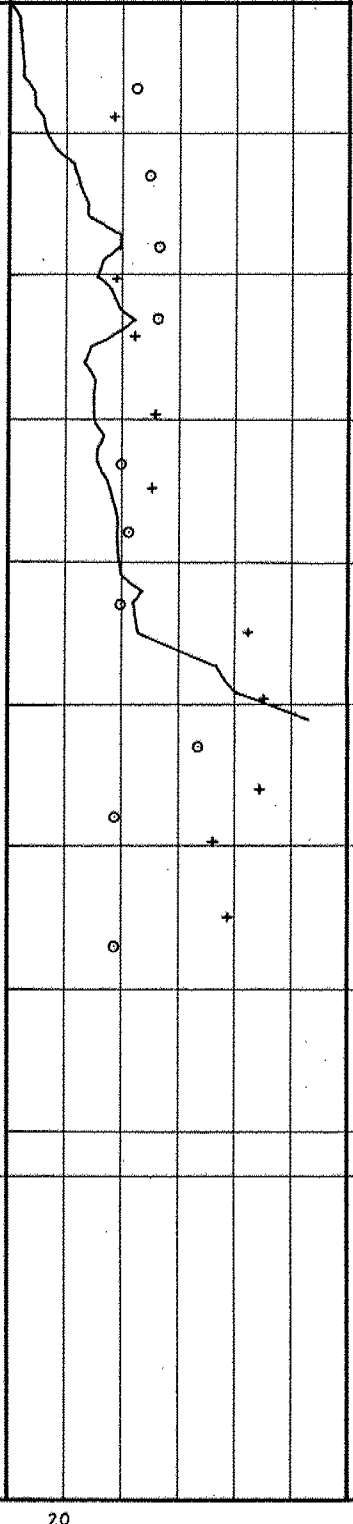
DIST 4 HWY 406 BORING DATE November 15, 1971 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

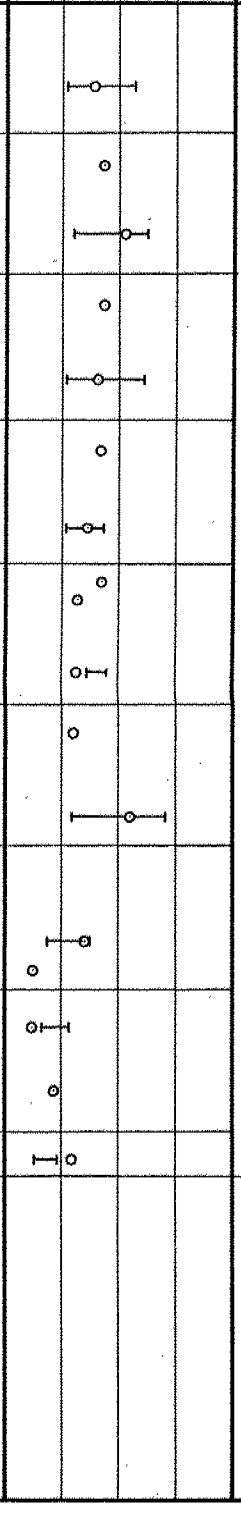
ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV
309.5	Ground Level					
0.0 / 306.0	Organic Topsoil					
3.5	Clayey silt, random pockets of silt		1	TW	PM	
			2	TW	PM	
			3	TW	PM	
			4	TW	PM	
	Firm to Stiff		5	SS	6	
			6	TW	PM	
			7	TW	PM	
	Greyish Brown					270
			8	TW	PM	
			9	SS	15	
			10	TW	PM	
			11	TW	PM	
			12	TW	PM	
243.5			13	TW	PM	
66.0	Silt to silty sand, traces of clay		14	SS	50	
			15	SS	116	
	Hard		16	SS	104	
	Reddish Brown					
228.0			17	SS	91	
81.5	End of Borehole					

DYNAMIC CONE PENETRATION RESISTANCE PLOT

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	% GR SA SI CL
119		
118		
113		
118		
115		
118		
126		
131		
112		
123		

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 61

WP 46-74-37 (B) LOCATION Co-ords. 15,680,430 N; 1,069,097 E. ORIGINATED BY MK

DIST 4 HWY 406 BORING DATE April 22 & 23, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P W W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ	REMARKS	% GR SA SI CL
343.5	Ground Level					ELEV					
0.0	Clayey silt					340					
	Brown, stiff, and fissured, medium plasticity		1	SS	32						
			2	SS	27					PH 8.1	SO_3 1440ppm
			3	SS	22	330					
	Grey, stiff to firm, medium to low plasticity containg some sand and fine gravel		4	SS	20						
			5	SS	22	320				PH 8.24	SO_3 1100ppm
			6	SS	15						
			7	SS	12	310					
			8	SS	12						
			9	SS	22	300					
			10	SS	14	290					
			11	SS	18	280					
	containing more coarse sand particles		12	SS	36	270					
247.0			13	SS	18	260					
96.5	End of Borehole					250					
	Not. W.L. not established										

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 62

WP 46-74-37 (B) LOCATION Co-ords. 15,680,078 N. 1,069,092 E. ORIGINATED BY BL

DIST 4 HWY 406 BORING DATE April 20-22, 1976 COMPILED BY MK

DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / w_P w w_L / WATER CONTENT % 20 40 60	UNIT WEIGHT γ	REMARKS % GR SA SI CL
333.0	Ground Level									
0.0	Clayey Silt Brown, very stiff, oxidized & fissured		1	SS	21	330	> 2 tsf			PH SO_3
			2	SS	31					
			3	SS	29		> 2 tsf			8.34 120ppm
			4	SS	23					
			5	SS	26	320				8.18 680ppm
	Grey, stiff to firm low to medium plasticity, trace of sand		6	SS	22	310				
			7	SS	13					
			8	SS	12	300	+ 2			
			9	SS	8	290	+ 2.5			
			10	SS	13	280	+ 2.3			
261.5			11	SS	23	270				
71.5	End of Borehole									

20
15 ◇ 5 % STRAIN AT FAILURE
10

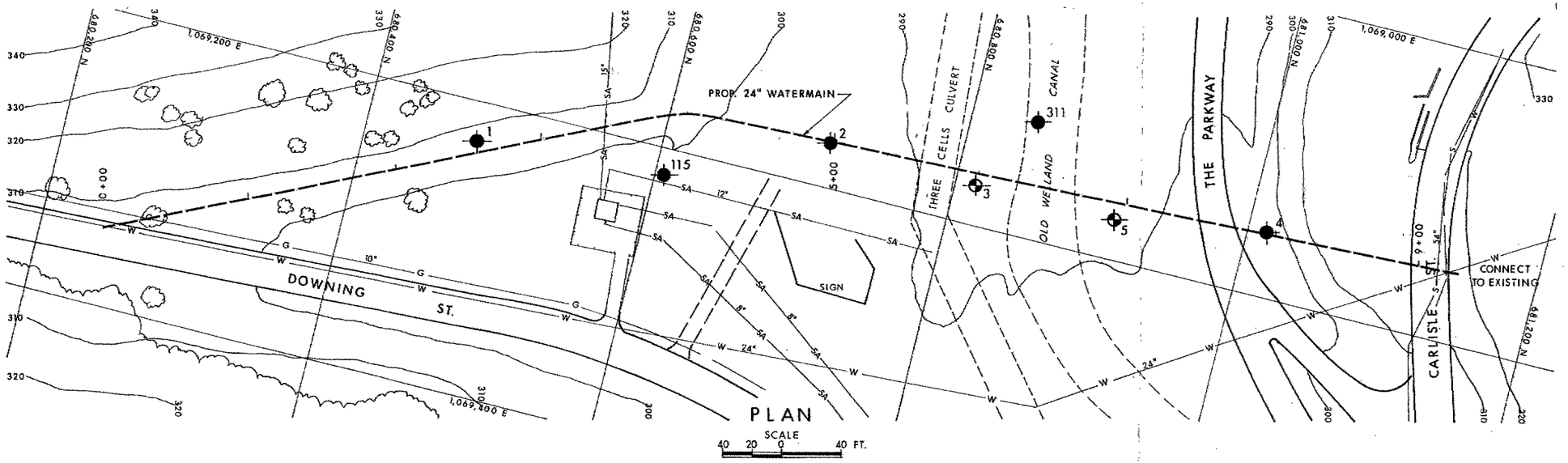
OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO MT-308 10-75

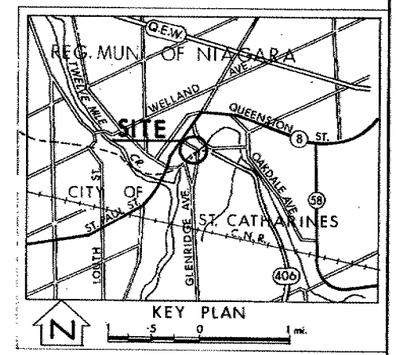
CONT No
WP No 46-74-37(A)

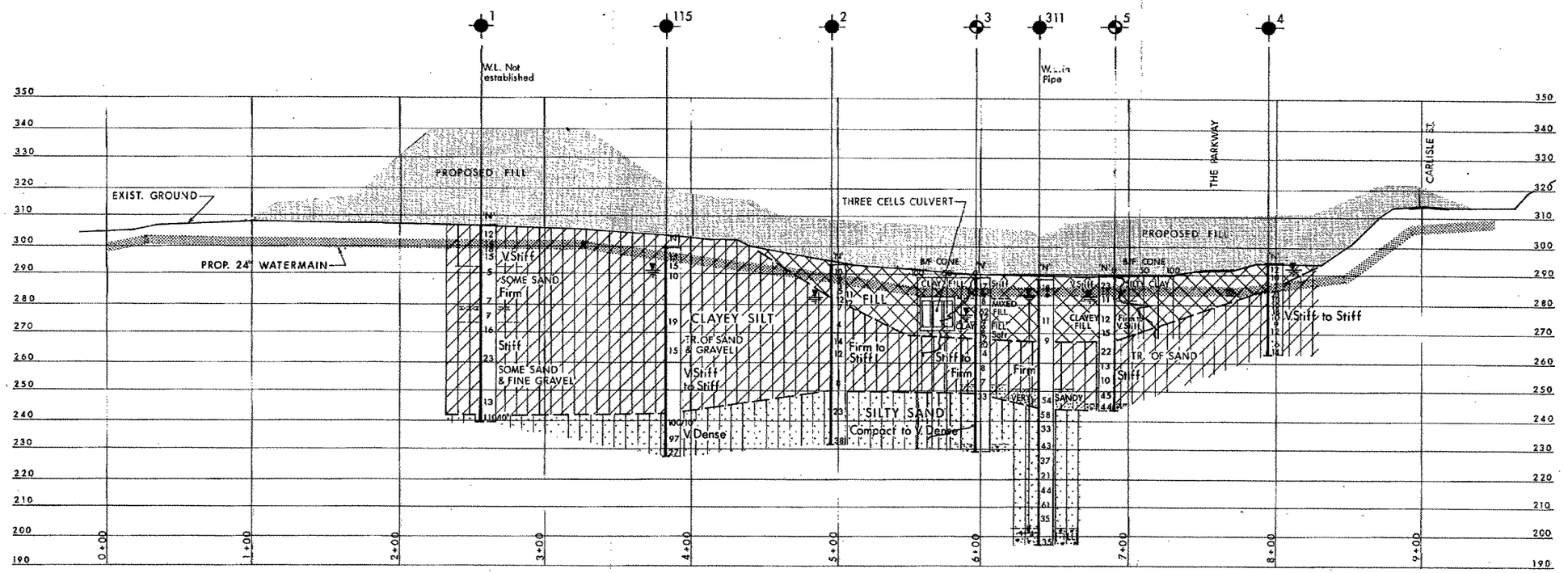
SHEET

24" WATER MAIN
BORE HOLE LOCATIONS & SOIL STRATA



PLAN
SCALE 40 20 0 40 FT.





PROFILE
SCALE
HOR. 40 20 0 40 FT.
VERT. 20 10 0 20

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation
  B.H. No. 2, 3, 4 & 5 APR. 1976
  B.H. No. 115 NOV. 1971
  B.H. No. 311 OCT. 1963

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	307·1	680,477	069,226
2	293·1	680,710	069,170
3	289·0	680,813	069,172
4	294·4	681,013	069,155
5	289·7	680,910	069,172
115	299·1	680,606	069,219
311	288·6	680,844	069,120

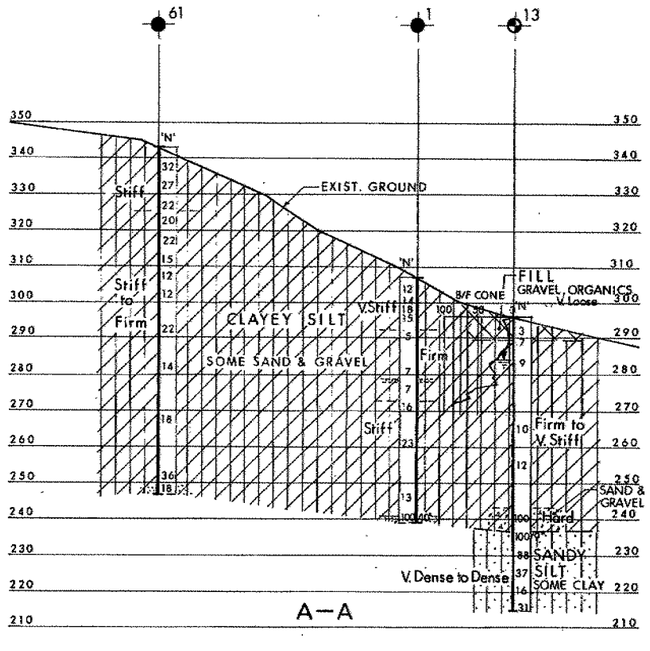
-NOTE-

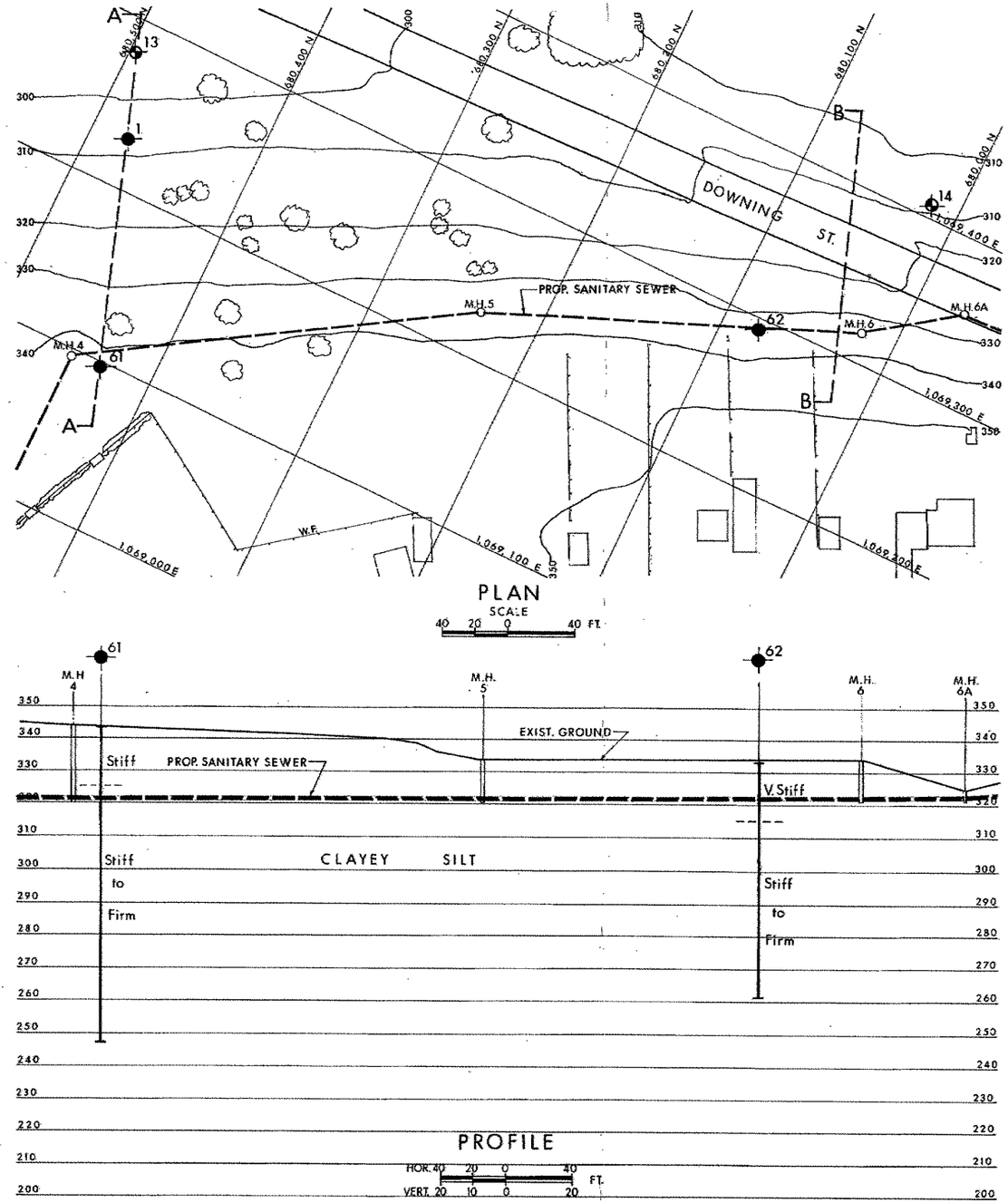
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

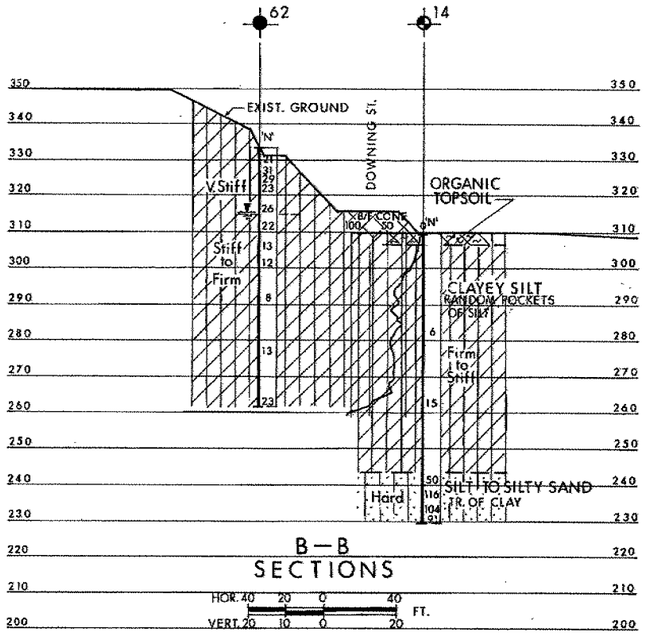
REVISIONS			
	DATE	BY	DESCRIPTION

HWY No	CITY OF ST. CATHARINES	DIST	4
SUBM'D B. L.	CHECKED	DATE 17 MAY '76	SITE
DRAWN O.L.J.	CHECKED	APPROVED	DWG 467437 A

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO MT-309 10-75



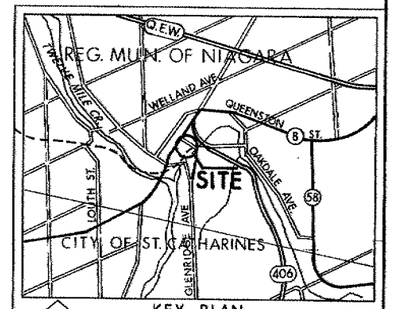




CONT No
WP No 46-74-37(B)

SHEET

SANITARY SEWER
BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L at time of investigation

B.H. No. 13 NOV. 1971
B.H. No. 62 APR. 1976
NO W.L. established B.H. 1, 61, 14

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	307·1	680,477	069,226
13	296·1	680,499	069,277
14	309·5	680,017	069,409
61	343·5	680,430	069,097
62	333·0	680,078	069,092

-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	

HWY No.	CITY OF ST. CATHARINES	DIST 4	
SUBMD B.L.	CHECKED	DATE 17 MAY '76	SITE
DRAWN OL. J.	CHECKED	APPROVED	DWG 467437 B