

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: January 30, 1969

OUR FILE REF:

IN REPLY TO FEB - 4 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at
Mountain View Rd. and the Q.E.W.
Twp. of Clinton -- Co. of Lincoln
District No. 4 (Hamilton)
W.J. 68-P-81 -- W.P. 223-63

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure 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.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
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W. S. Melinyshyn
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Foundations Files
Gen. Files

A. G. Stermac
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PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at
Mountain View Rd. and the Q.E.W.
Twp. of Clinton -- Co. of Lincoln
District No. 4 (Hamilton)
W.J. 68-F-81 -- W.P. 223-63

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the above mentioned site. The request was contained in a memo from the Bridge Office - (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated October 30, 1968. The memo also contained requests for additional investigations at two other sites near Grimsby, Ontario. Subsequently, an investigation was carried out by this Section at the above site, concurrently with investigations at the two other sites, in order to determine the subsoil conditions.

This report contains the results of the investigation, together with our recommendations for the design of foundations for the proposed structure as well as the stability of the approaches.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about 3 miles east of the Town of Grimsby in Clinton Twp., County of Lincoln. At this location Mountain View Rd. intersects the Q.E.W. at a level crossing. Thirty Mile Creek at this site is channelled into a 14' x 8' concrete box culvert which traverses diagonally below the Q.E.W. in a south-west to north-east direction. The Q.E.W. grade is at about elevation 280, some 12 ft. above the average ground surface elevation of the southern portion of the site. The ground surface at the site slopes in a south-easterly direction.

2. DESCRIPTION OF THE SITE AND GEOLOGY: (cont'd.) ...

The general area lies within the Niagara Fruit Belt which forms a portion of the Iroquois Plain physiographic region. According to available information, the site was inundated by Lake Iroquois during the Pleistocene Period, resulting in the present relatively flat topography. The overburden consists of glacial till overlying Queenston shale of the Ordovician Period.

3. FIELD AND LABORATORY WORK:

A total of 9 boreholes, each accompanied by a dynamic cone penetration test, was carried out at the site by means of a standard diamond drill rig adapted for soil sampling purposes. In addition, one borehole (No. 10), put down previously at this site under W.J. No. 65-F-28, has been incorporated into the present study.

Samples were recovered at the required depths in a 2-inch O.D. split-spoon sampler which was hammered into the soil, or in 2-inch I.D. Shelby tubes which were manually pushed into the soil. The method of driving the split-spoon sampler conformed to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Field vane tests were carried out, where possible, in the cohesive portion of the overburden, in order to determine the undrained shear strength characteristics. Bedrock was proven in 5 boreholes (B.H. No's 1, 2, 3, 4 and 9) by core drilling a minimum of 10 ft. in each borehole in AXT or BXL size.

Surveying was carried out by the personnel from the Central Region Engineering Surveys Section. The elevations given in this report are referenced to geodetic datum.

The locations and elevations of all borings are shown on Drawing 68-F-81A, together with the estimated stratigraphical profile across the site.

3. FIELD AND LABORATORY WORK: (cont'd.) ...

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory, following which tests were carried out on selected samples to determine the following physical properties:

Natural Moisture Contents
Atterberg Limits
Bulk Densities
Grain-Size Distributions
Undrained Shear Strengths

The results of these tests are plotted on the individual Record of Borelog sheets and are summarized on the Figures in the Appendix to this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Underlying an average thickness of overburden of about 30 ft. is a sound shale bedrock, encountered at between elevations 242 and 252 across the site. The overburden consists of 5 to 12 ft. of fill material overlying a 4 to 11 ft. thickness of clayey silt with a trace of sand and gravel which, in turn, is underlain by a glacial till deposit extending to the bedrock surface. A thin layer of weathered rock is present between the glacial stratum and the sound bedrock.

4.2) Fill Material:

Fill material, consisting of a brown silty sand to sandy silt with a trace of clay, was encountered in all the boreholes. The thickness of this stratum ranged from 5 ft. at Borehole 6 to 12 ft. at Borehole 9, averaging about 9 ft. across the site. The grain-size distribution characteristics of the fill material are shown on Figure 1 in the Appendix. The moisture content of this material averaged about 16%. Standard Penetration Test 'N' values

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

4.2) Fill Material: (cont'd.) ...

were found to vary between 3 and 27 blows/ft. Generally, the 'N' values averaged 5 blows/ft. at Boreholes 1, 2, 4 and 7, and about 15 blows/ft. at the other boreholes. On the basis of these 'N' values, the fill stratum is considered to be loose to compact.

4.3) Silt to Clayey Silt with a Trace of Sand and Gravel:

At all the borehole locations, the fill material was found to be underlain by a thin layer of topsoil followed by 3 to 10 ft. of silt to clayey silt with a trace of sand and gravel, which is inferred to represent the original surficial soil stratum at the site. The base of this stratum was found to extend to an average elevation of 260 across the site.

The physical properties of this stratum are summarized in the table below as well as on the figures in the Appendix.

	<u>Range</u>	<u>Average</u>
Natural Moisture Content (W) %	14 - 33	18
Liquid Limit (W_L) %	21 - 37	26
Plastic Limit (W_p) %	17 - 20	18
Bulk Density (γ) PCF	118 - 140	135
Undrained Shear Strength (C_u) PSF	800 - 1900	1300
Standard Penetration Resistance		
'N' Values - Blows/ft.	5 - 36	15

It is estimated, on the basis of the 'N' values and the undrained shear strengths, that the consistency of the deposit ranges from stiff to very stiff.

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

4.4) Glacial Till:

Extending from about elevation 260 down to the bedrock, a deposit of glacial till was encountered at all the boreholes. The thickness of this deposit averages about 15 ft. and can be divided, on the basis of composition, into two portions. The upper portion, some 9 ft. in thickness, consists of a clayey silt with some sand and gravel, whereas the lower portion consists chiefly of non-cohesive silty sand to sandy silt with some gravel, and averages 6 ft. in thickness. At Borehole 2, only the non-cohesive glacial till was encountered, whereas at Borehole 7, only the cohesive glacial till was encountered. Physical properties of the deposit are summarized below:

	<u>Glacial Till</u>			
	Cohesive		Non-Cohesive	
	Range	(Avg.)	Range	(Avg.)
Natural Moisture Content (W) %	9 - 11	(10)	9 - 11	(10)
Liquid Limit (WL) %	20 - 23	(21)	--	
Plastic Limit (Wp) %	12 - 15	(15)	--	
Undrained Shear Strength (Cu) PSF	>2000		--	
Standard Penetration Resistance 19 - 196 (>100) 'N' Values - Blows/ft.			146 - 100/6"	--

The 'N' values in the upper 5 ft. of the deposit were generally less than 100 blows/ft. (range 19 - 56), whereas below about elevation 255 the 'N' values were greater than 100 blows/ft., indicating the deposit to be very stiff to hard or very dense. Typical grain-size distribution curves for the glacial till are included in the Appendix to this report.

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

4.5) Bedrock:

A red shale bedrock, with occasional grey mottling, was encountered between elevations 244 and 252. The upper 6 inches to 3 ft. of the bedrock was found to be weathered, consisting of shale fragments in a clayey silt matrix. Sound bedrock was encountered generally between elevations 242 to 247 at Boreholes 1 to 9 and at elevation 252 at Borehole 10. The core recoveries were 100% throughout, with the exception of Borehole 10, where 60% recovery was obtained. The rock contains occasional gypsum inclusions and is jointed along horizontal bedding planes.

5. GROUNDWATER CONDITIONS:

Water level observations in the open boreholes, upon completion of the field work, indicate the groundwater level to be between elevations 266 and 269 - i.e., some 10 ft. below the ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to reconstruct the existing Q.E.W. as a controlled access highway from Stoney Creek to St. Catharines. In addition to widening of the highway, 2-lane service roads are to be constructed on either side of the Q.E.W. At the crossing of Mountain View Rd. and the Q.E.W., grade separation is to be provided by means of an underpass. Present proposals call for a 4-span (83'-78'-78'-83') structure having a width of about 35 ft. with approach fills in the order of 25 ft. in height. The existing Q.E.W. grade will be raised by about 1 to 2 ft.

The proposed alignment of the new structure is located roughly along the existing Mountain View Rd. centre-line. However, in view of the existence of the concrete box culvert (which carries Thirty Mile Creek below the Q.E.W. at this location),

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.1) General: (cont'd.) ...

it may be necessary to shift the proposed alignment some 20 ft. towards the east. Since the existing culvert is believed to be in a satisfactory condition, it may be preserved and extended at both ends to accommodate the proposed service roads, provided it meets the hydrologic requirements.

The site, in the immediate vicinity of the proposed crossing, is underlain in sequence, by strata of loose to compact fill material, stiff to very stiff clayey silt, and a hard glacial till. Bedrock is encountered at a depth of about 30 ft. below the ground surface.

6.2) Structure Foundations:

The subsoil conditions at the site are not favourable for the support of the structure foundations on spread footings located at a relatively shallow depth. It is therefore recommended that the entire structure be supported on end-bearing steel H-piles driven to practical refusal within the lower, non-cohesive portion of the glacial till deposit, or to bedrock. For estimating purposes, it is assumed that the piles will encounter refusal at between elevations 250 and 245. The design load will depend on the pile section chosen; for example, 12 BP 73 piles may be designed for up to 90 tons/pile.

No major dewatering problems are anticipated for the construction of the pile caps in view of the relatively impermeable nature of the subsoil below the surficial fill stratum.

The pile caps should be provided with a minimum of 4 ft. of soil cover in order to satisfy the frost protection requirements in the area.

6.3) Approach Fills:

No stability problems are anticipated for the proposed approach fills constructed with standard 2:1 slopes. Minor settlement of the proposed fills is expected due to the compression

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Approach Fills: (cont'd.) ...

of the existing surficial, loose to compact fill material and the underlying clayey silt stratum. However, such settlements will be realized immediately upon completion of the structure.

7. MISCELLANEOUS:

The field work, performed during the period November 26 - December 13, 1968, was carried out by Mr. V. Korlu, Project Foundation Engineer.

Preparation of the report was undertaken by Mr. C. Mirza, Project Foundation Engineer.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed the report.

Equipment used was owned and operated by Canadian Longyear Limited.

January 1969

APPENDIX I

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

JCB 68-F-82

LOCATION Sta. 31 + 71 @ Mountain View Rd. o/s 8.5' Lt.

ORIGINATED BY VK

W. P. 223-63

BORING DATE November 26, 1968

COMPILED BY _____ CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	Liquid Limit ——— WL Plastic Limit ——— WP Water Content ——— W	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100	WP W WL WATER CONTENT % 10 20 30		
275.4	Ground Level									Gr.Sa.Sl.Cl
0.0	(Fill Material)									
	Silty sand, trace clay		1	SS	3	270				0 51 45
	Very loose to loose		2	SS	4					∇ 266.4
265.9	Brown									
9.5	Silt and silty		3	SS	12					
261.4	sand, some clay		4	SS	19					
	Compact.									
14.0	(Glacial Till)		5	SS	56	260				
	Clayey silt, some sand									
	and gravel.		6	SS	196					6 22 57 15
251.1	Hard. Grey.									
24.0	Sandy silt, some		7	SS	100	250				
	gravel. Very dense.									
247.4	Red - Brown									
28.0	(weathered)		8	SS	200	247"				Drill with
244.2										Tricone Bit
30.5	(Sound)		9	BXL	100%					
				RC	Rec					
	Shale Bedrock		10	BXL	100%	240'				
				RC	Rec.					
236.1										
39.3	End of Borehole									
						230				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 68-F-81

LOCATION Sta. 30 + 75 1/2 Mountain View Rd. o/s 24.5' Rt.

ORIGINATED BY VK

W.P. 223-63

BORING DATE November 27, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %				
							20 40 60 80 100					10 20 30				
							SHEAR STRENGTH P.S.F.					WP — W — WL				
276.0	Ground Level															
0.0	(Fill Material)															
	Sandy silt, trace of clay.		1	SS	3	270										
	Very loose to loose		2	SS	5											
267.0	Brown															
9.0	Topsoil and clayey silt with sand.		3	SS	10											
	Firm		4	SS	5											
260.0	Brown to Black		5	SS	7	260										
16.0	(Glacial Till)															
	Sandy silt, some gravel; trace of clay.		6	SS	14.5											
	Very dense.															
	Red Brown - Brown		7	SS	160/9"250											
246.0			8	SS	100/11"											
30.0	(sound)		9	BXL	100%											
	Shale Bedrock			RC	Rec											
			10	BXL	100%	240										
				RC	Rec											
			11	BXL	100%											
				RC	Rec											
234.0																
42.0	End of Borehole					230										

Drill with
Tricone Bit

FOUNDATION SECTION

CHECKED BY

[illegible]

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 68-F-81

LOCATION Sta. 28 + 24 @ Mountain View Rd. o/s 22' Rt.

ORIGINATED BY VK

W. P. 223-63

BORING DATE December 5, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	WATER CONTENT — W	WATER CONTENT %			
277.4	Ground Level											
0.0	(Fill Material)											
271.4	Silty sand - sandy silt		1	SS	5							
6.0	Loose. Brown		2	SS	16							
	Silt to clayey silt		3	SS	8							
	trace sand & gravel.		4	TW	PH							
	Firm to stiff.		5	TW	PH							
260.4	Grey											
17.0	(Glacial Till)		6	SS	138							
	Clayey silt, some sand											
	and gravel.											
252.4	Hard. Grey		7	SS	1076"							
25.0	Silt with some sand,											
248.4	trace clay, occ. gravel.											
29.0	Very dense. Red-Brown		8	SS	1004"							
30.5	(weathered)		9	BXL	100%							
	(sound)			RC	Rec							
	Shale Bedrock		10	BXL	100%							
				RC	Rec							
236.9												
40.5	End of Borehole											

15 0 5 % strain at failure
10

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 68-F-81

LOCATION Sta. 28 + 29 @ Mountain View Rd. o/s 11' Lt.

ORIGINATED BY VK

W. P. 223-63

BORING DATE December 6, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	wp	w	wL		
277.5	Ground Level															Gr. Sa. Si. Cl.
0.0	(Fill Material)															
	Silty sand with trace clay and gravel.		1	SS	11											
	Loose - compact.		2	SS	5	270										
	Brown		3	SS	9											
265.5			4	SS	8											
12.0	Clayey silt, trace sand, gravel, organics.		5	TW	PH											
260.0	Firm-Stiff. Red-Brown.		6	SS	28	260										
17.5	(Glacial Till)															
255.0	Clayey silt, some sand & gravel. Very stiff															
22.5	Sandy silt with gravel and trace of clay.		7	SS	190/10"	250										
245.5	Weathered shale bedrock		8	SS	100/2"											
32.0	End of borehole Probably bedrock					240										refusal to tricone bit
							SHEAR STRENGTH P.S.F. + Field Vane o Unconfined					WATER CONTENT % 10 20 30				
							500 1000 1500 2000 2500									
							+10 +2,000									
							15 0 5 % strain at failure 10									

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-81

LOCATION Sta. 29 + 08 @ Mountain View Rd. o/s 18¹ Rt.

ORIGINATED BY VK

W.P. 223-63

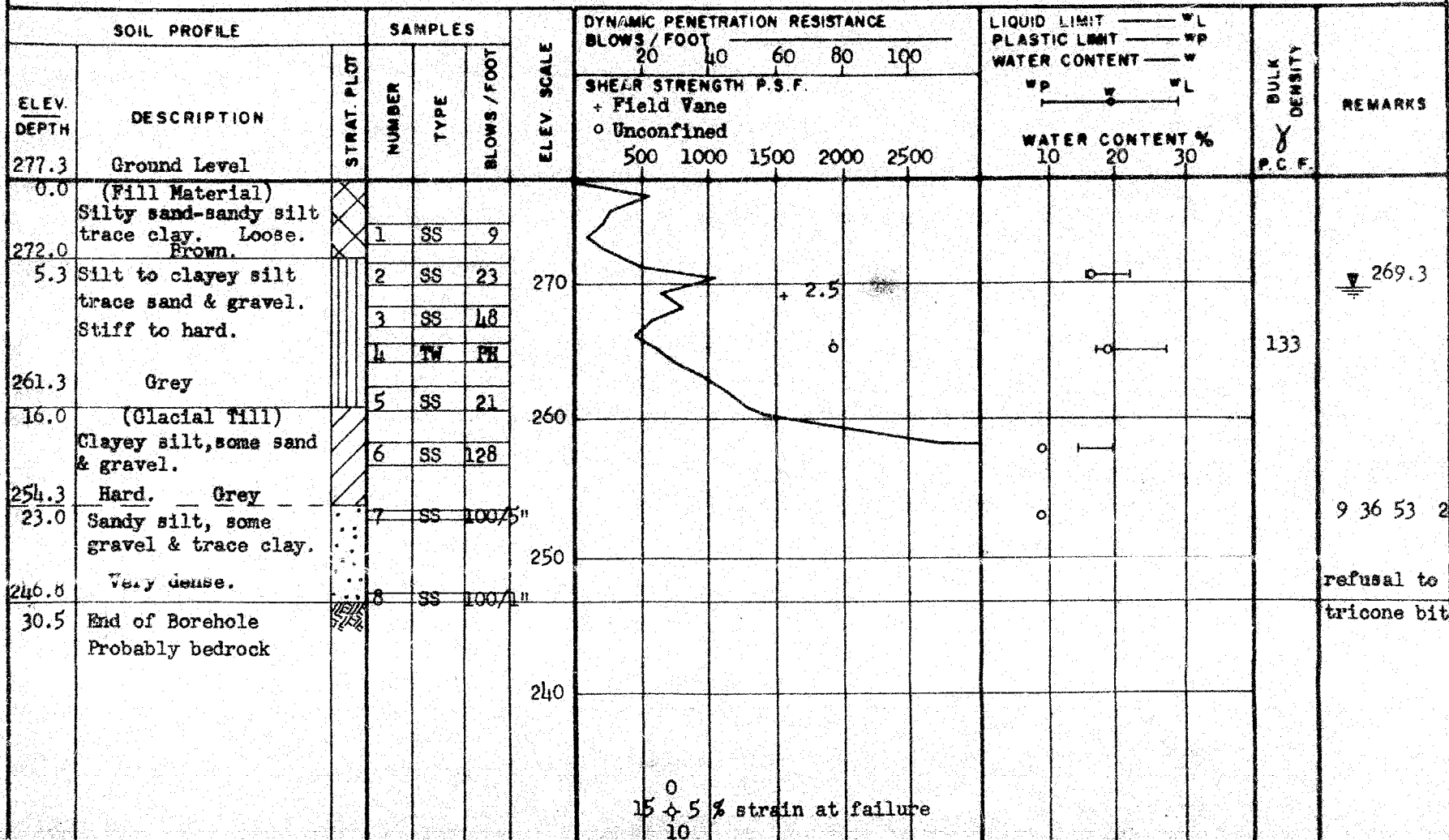
BORING DATE December 9, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-81

LOCATION Sta. 30 + 78 @ Mountain View Rd. o/s 19' Lt.

ORIGINATED BY VK

W.P. 223-63

BORING DATE December 13, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	W P		
273.1	Ground Level														
0.0	(Fill Material)														
	Silty sand to sandy silt.		1	SS	5	250									
	Loose		2	SS	5										
262.1	Brown		3	SS	5										
11.0	Topsoil & sand & gravel with clay & silt.		4	SS	6	260									
257.1	Compact		5	SS	16										
16.0	(glacial till) Clayey silt, some sand and gravel.		6	SS	118										
246.1	Hard		7	SS	100/3"	250									
27.0	Weathered shale		8	SS	110/6"										
241.6	(Red clayey silt) Very dense.														
31.5	End of Borehole Probably Bedrock					240									refusal to tricone bit

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 68-F-81LOCATION Sta. 31 + 61 @ Mountain View Rd. o/s 16' Rt.ORIGINATED BY VKW. P. 223-63BORING DATE December 10, 1968COMPILED BY CMDATUM GeodeticBOREHOLE TYPE Washboring - NX Casing; ConeCHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP — W — WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
274.9	Ground Level									
0.0	(Fill Material)									
	Silty sand.		1	SS	17					
	Compact. Brown		2	SS	26					
267.9	Topsoil and clayey silt with sand and gravel seams.		3	TW	PH					
7.0	Stiff or compact.		4	SS	10					
259.9	Red - Brown		5	TW	PH					
15.0	(Glacial Till)		6	SS	91					
	Clayey silt, occ. sand seams, gravel.		7	SS	100/6"					
251.9	Hard. Grey.									
23.0	Silt, trace sand & occ. gravel.		8	SS	140					
244.4	Very dense. Red - Brown.									
30.5	End of Borehole Probably Bedrock									refusal to tricone bit

0 56 41 3
266.9

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-81

LOCATION Sta. 30 + 05 @ Mountain View Rd. o/s 19' Lt.

FOUNDATION SECTION

ORIGINATED BY VK

W. P. 223-63

BORING DATE December 11, 1968

COMPILED BY _____ CM

DATUM Geodetic

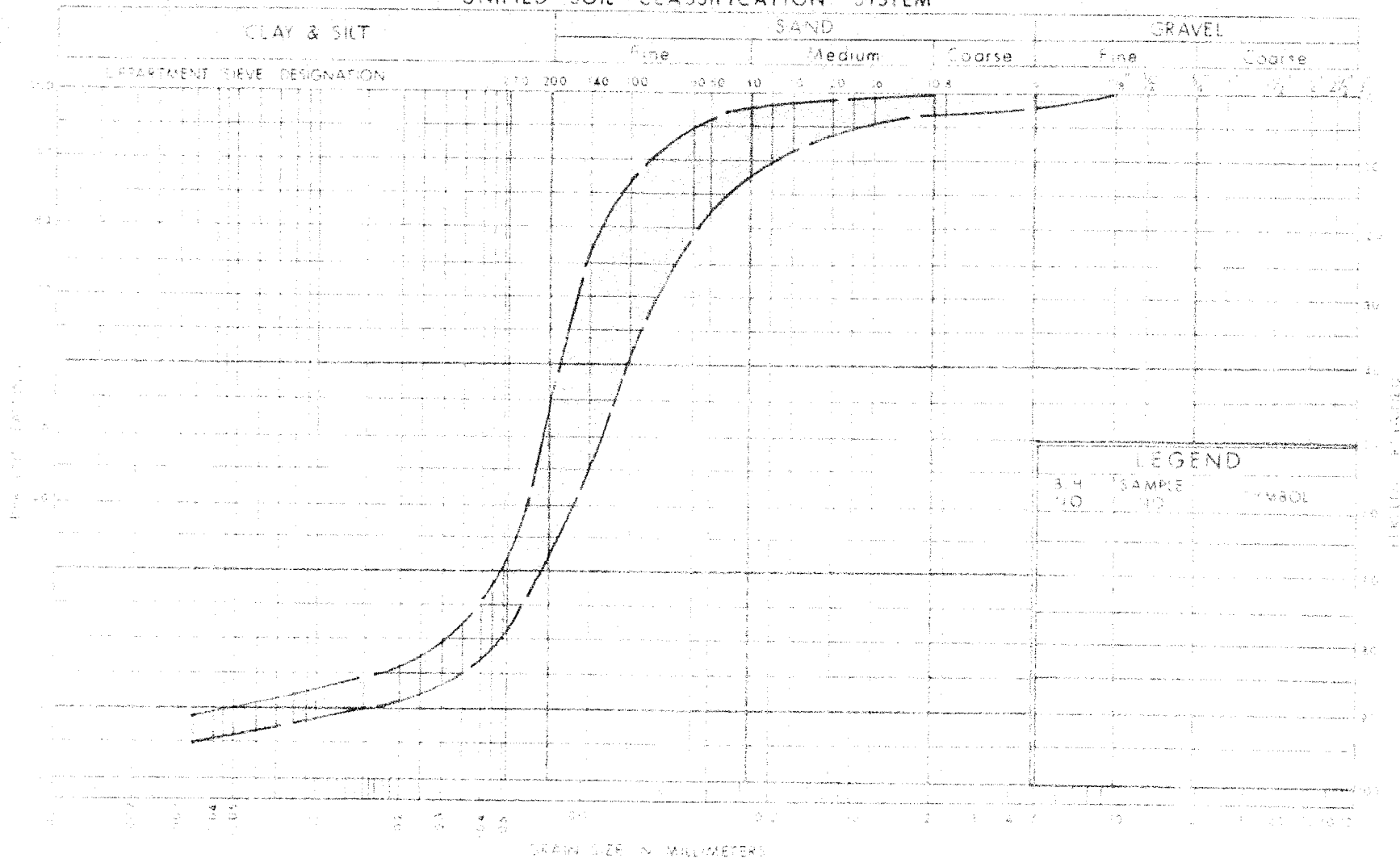
BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

[illegible]

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

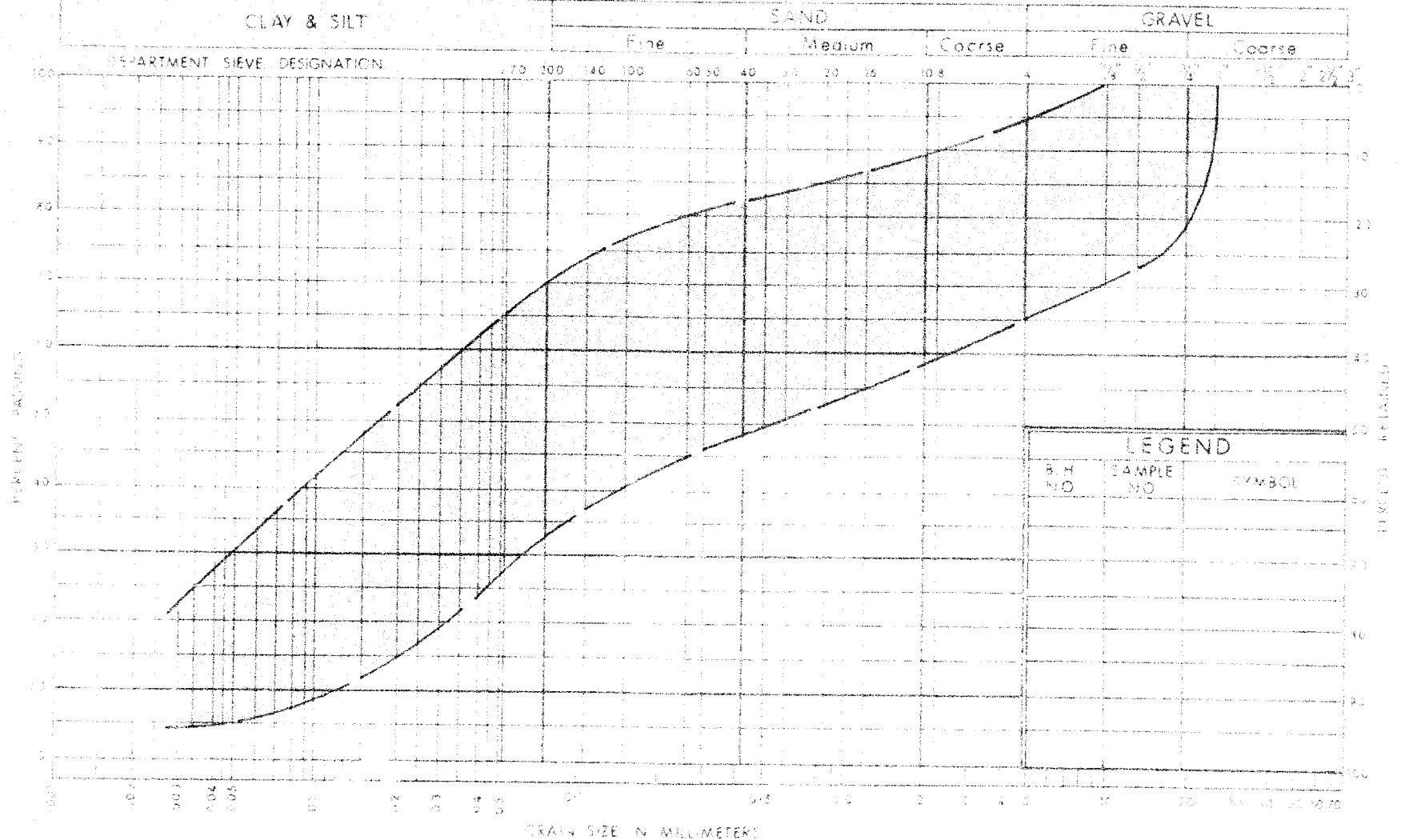
GRAIN SIZE DISTRIBUTION
SILTY SAND (FILL MATERIAL)

WS No. 223-63

JOB No. 68-F-81

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



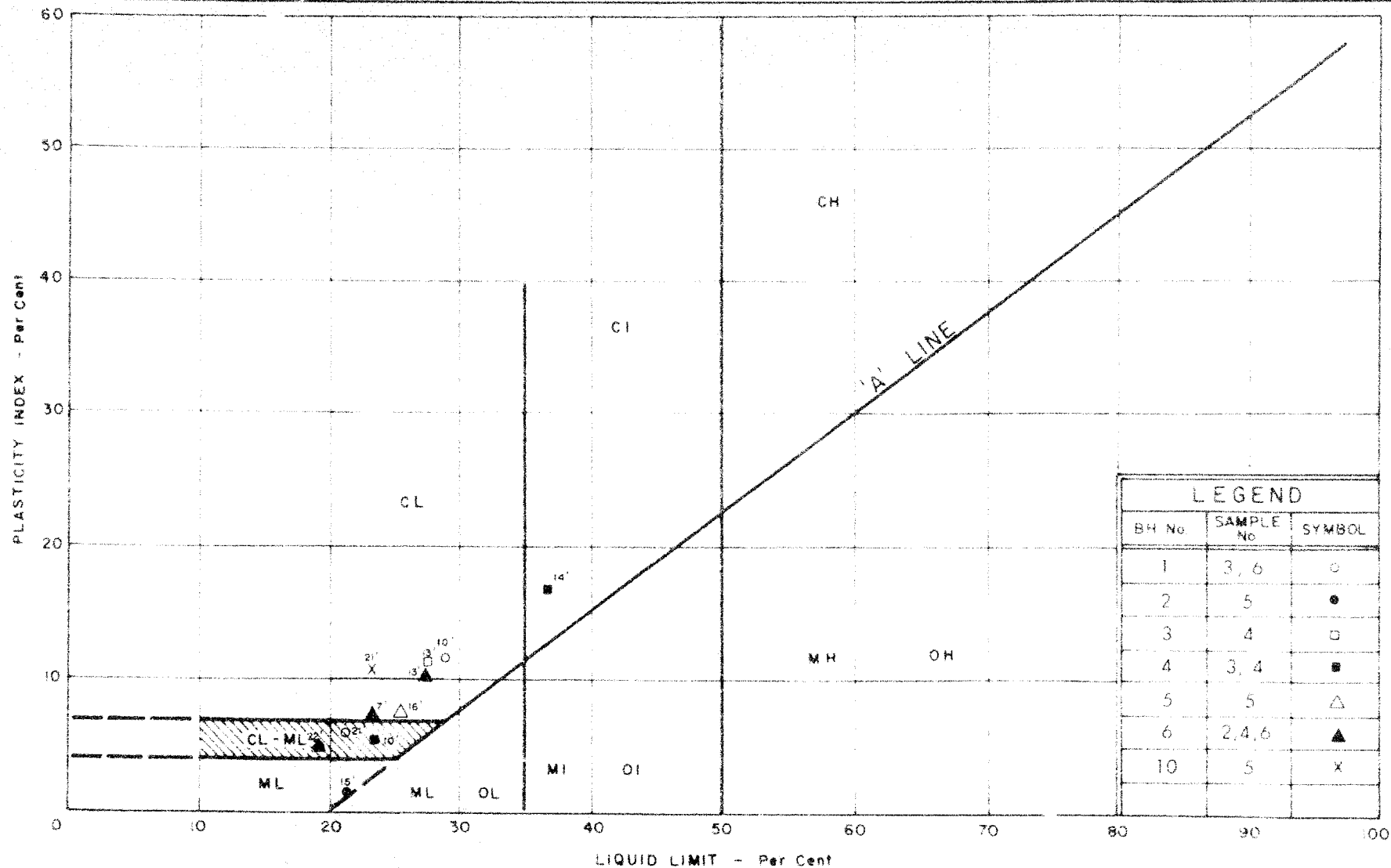
LEGEND		
B.H. NO.	SAMPLE NO.	SYMBOL



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL

W.D. No. 223-63
JOB No. 68-F-81
FIG. 2



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART CLAYEY SILT TO SILT & GLACIAL TILL

WP No. 223-63

JOB No. 68-F-81

FIG 3

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TYPE OF SAMPLE

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

SOIL TESTS

Q _u	UNCONFINED COMPRESSION	L V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	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

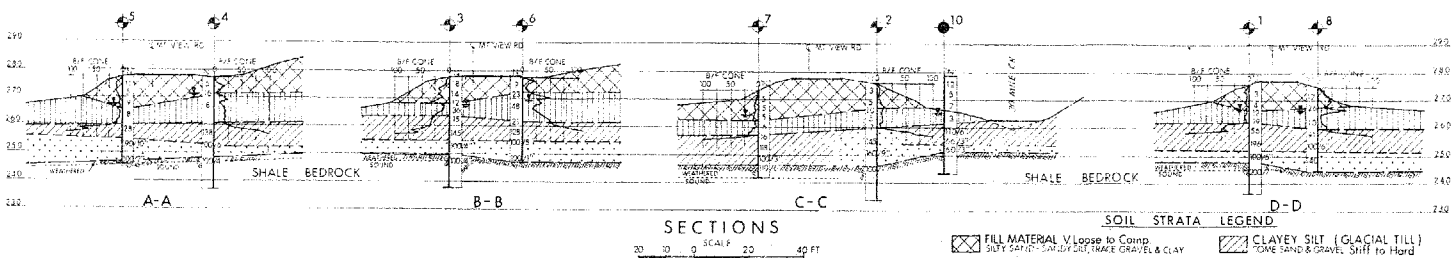
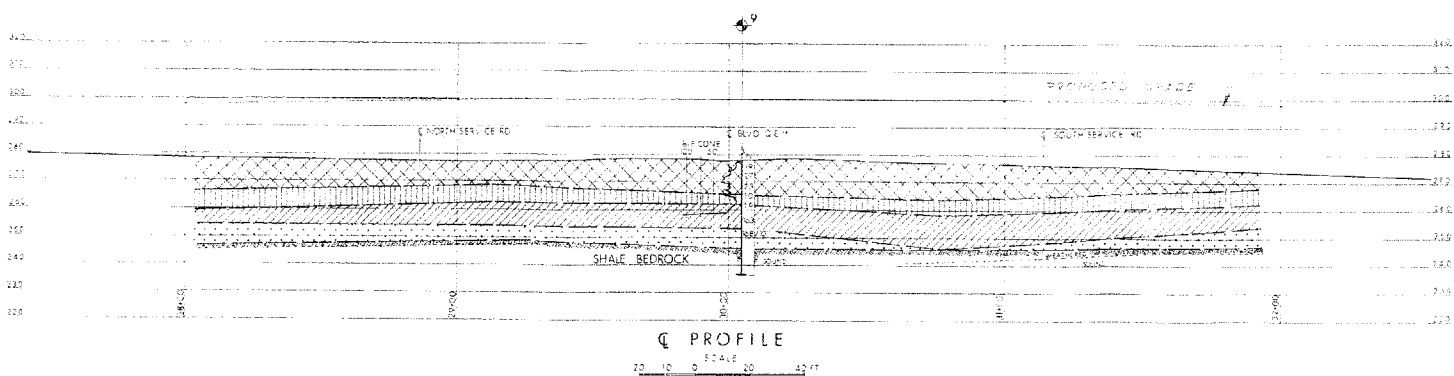
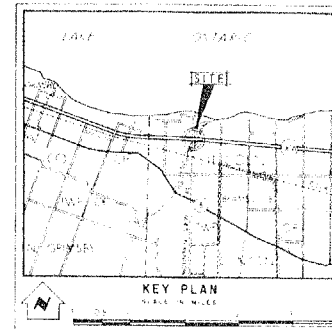
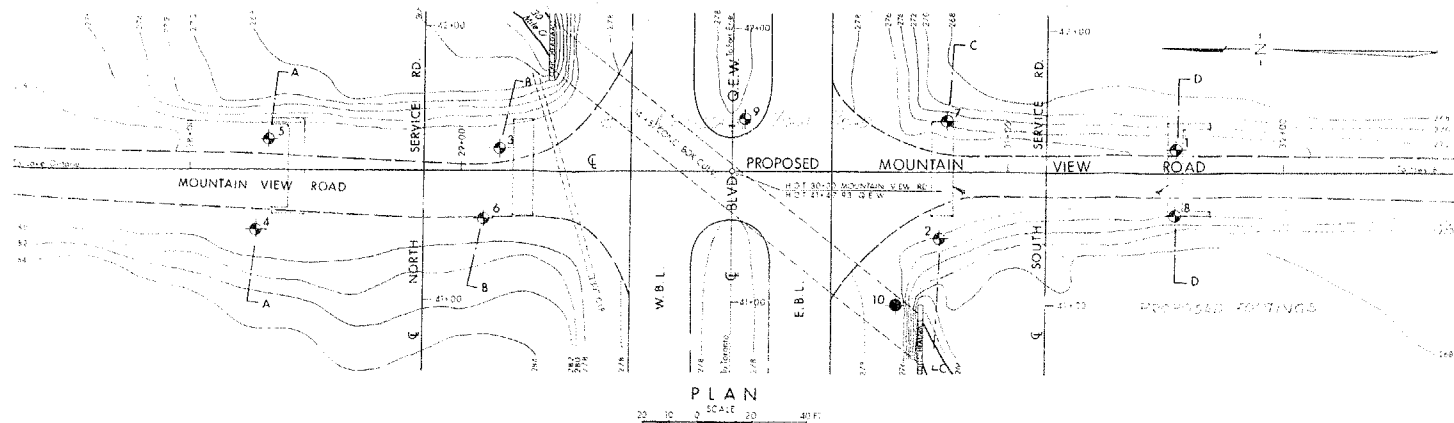
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established on time of field investigation

NO.	ELEVATION	STATION	OFFSET
1	274.4	21+00	0.0
2	274.2	21+00	0.0
3	273.8	21+00	0.0
4	273.2	21+00	0.0
5	273.0	21+00	0.0
6	272.8	21+00	0.0
7	272.6	21+00	0.0
8	272.4	21+00	0.0
9	272.2	21+00	0.0
10	272.0	21+00	0.0

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

DATE	BY	REVISION

MINISTRY OF HIGHWAYS - ONTARIO
MATERIALS TESTING DIVISION - MOUNTAIN VIEW SECTION

MOUNTAIN VIEW ROAD

KING'S HIGHWAY NO. Q.E.W. DIST NO. 4
CO. LINCOLN TWP. CLINTON LOT 208 CON. B.C. & I.

BORE HOLE LOCATIONS & SOIL STRATA

SUB-D C-11 CHECKED 10/10/68 V.P. NO. 223-65 S.A.T. DRAWING NO. 68-F-81A
DRAWN S.F. CHECKED S.F. JOB NO. 25-1-81
DATE 13 DEC 1968 DATE 10/10/68 S.A.T. NO. 10/10/68
APPROVED [Signature] (S.A.T. NO.) 10/10/68 S.A.T. NO. 10/10/68

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION:

DATE: March 16, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

Mountain View Road Underpass
W.P. 223-63, Site 18-197 --
Q.E.W., District No. 4 (Hamilton)
W.J. 68-F-81. --

We have reviewed the final bridge drawings D-6640-1 and D-6640-3 for the above structure, and submit the following comments:

The steel H-piles at certain locations, may or may not penetrate to the bedrock surface. For this reason, we have recommended in our Foundation Report W.J. 68-F-81 that the structure be supported on end-bearing piles driven to practical refusal within the lower non-cohesive portion of the glacial till deposit, or to bedrock. Accordingly, the pile lengths should be estimated taking this into consideration.

RD/EdF

M. Devata
M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie
W. S. Melinyshyn
Foundations Files
Gen. Files

Department of Highways Ontario

Copy for the information of

Foundation Office

Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

C.S. Grebski,
Bridge Office

March 5, 1970

Mountain View Road Underpass
W.P. 223-53, Site 18-197
Q.E.W., District No. 4

68-1-21

Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.

CSG:rd

C.S. Grebski,
Bridge Design Engineer

Attach.

c.c. Foundation Office



Handwritten notes:
Please refer to the drawings of the bridge
design. The foundation design is for the bridge
structure.

Handwritten notes:
Done
March 11, 1970

MEMORANDUM

To: Mr. M. Devata
Sup. Foundation Engineer

From: B. K. Glassford
Materials and Testing Office

Date: January 7, 1969

Our File Ref.

In Reply To

Subject: Q.E.W., Grimsby, Ontario
Projects: 68-F-81
 68-F-82
 68-F-83

Rock cores from these projects consists of shale rock in entirety. This shale is red in colour with a slight amount of grey mottling. Small inclusions of gypsum are present throughout. This shale appears to dehydrate quickly with subsequent crumbling and flaking along the horizontal laminations.

BKG:nm

BK Glassford
B. E. Glassford
Geologist