

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. H. McArthur,
Regional Road Design Engineer,
North Bay.

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

DATE: May 5, 1966

OUR FILE REF.

IN REPLY TO

JUN 24 1966

SUBJECT:

- FOUNDATION INVESTIGATION REPORT
For

Proposed New Alignment of Hwy. #63
Between Sta. 84+50 and Sta. 86+50,
2.5 Miles East from North Bay City
Limits, District No. 13, North Bay.
W.J. 65-F-119B -- W.P. 270-62

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. H. McArthur (2)
D. W. Farren
G. Martens
E. R. Saint

Foundations Office
Gen. Files

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed New Alignment of Hwy. #63
Between Sta. 84+50 and Sta. 86+50,
2.5 Miles East from North Bay City
Limits, District No. 13, North Bay.
W.J. 65-F-119B -- W.P. 270-62

1. INTRODUCTION:

A memo dated July 6, 1965, from Mr. E. R. Saint, Regional Materials Engineer, Northern Region, requesting a soils investigation at the above site, was received by this Section.

Subsequently, a foundation investigation consisting of 4 boreholes and 3 dynamic cone penetration tests was carried out at the site in October 1965. This work was summarized and reported in W.J. 65-F-119. A review of the subsoil conditions and stability problems indicated the need for additional information. In view of this, another investigation consisting of 17 boreholes and 6 dynamic cone penetration tests was performed in March 1966.

Presented in this report are the results of both investigations, together with our recommendations pertaining to the design of the proposed embankments.

2. DESCRIPTION OF SITE:

The site is located some 2.5 miles east of the east limits of the City of North Bay. In the area in question, Hwy. #63 closely follows the shoreline of Trout Lake. Immediately to the north of the highway, a hill rises quite sharply. To the south, the bed of Trout Lake drops off rather steeply. The area is partially built-up with the settlement consisting of summer-resort type establishments.

The site is located in an area known as the Pre-Cambrian Shield.

3. FIELD AND LABORATORY WORK:

The borings in the field were carried out by means of a diamond drill adapted for soil sampling purposes.

Samples were recovered at the required depths by means of a 2-in. O.D. split-spoon sampler and by 2-in. I.D. Shelby tube samplers. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. In-situ vane tests were carried out wherever possible, in order to determine the undrained shear strength of the cohesive deposits.

The locations and elevations of all boreholes, including the ones drilled during the initial investigation, are shown on the accompanying borehole log sheets included in the Appendix of this report. The borehole elevations, as well as the original ground sections were provided by a Department of Highways survey crew from Engineering Surveys, Northern Region, and are based on geodetic datum.

Samples were visually examined and identified in the laboratory as well as in the field. Laboratory tests were performed on a number of selected samples to determine:

- 1) Natural moisture contents.
- 2) Atterberg limits.
- 3) Bulk densities.
- 4) Undrained shear strengths.
- 5) Grain-size distributions.
- 6) Organic contents (for organic soil only).

Laboratory test results are summarized and are included in the Appendix.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists of a deposit of silty sand, followed by deposits of layered clay and silty sand with gravel and occasional boulders.

The boundaries of the deposits as determined in the field, are shown on the accompanying borelog sheets, and the estimated stratigraphical sections contained in Dwg. 65-F-119B, are based on this information.

4.2) Silty Sand:

A surface layer of silty sand was observed in all boreholes except boreholes #2, #16 and #17. The thickness of the layer varies irregularly from 5 ft. in borehole #6 to 16 ft. in borehole #12. In boreholes #7, #8, #14 and #15, irregularly spaced layers of organic silt were found. These layers, which occurred to a maximum thickness of 6 in. were generally located in the lower half of the deposit. The average grain-size distribution for the stratum is as follows: Gravel 2%, sand 88%, silt 7%, clay 3%.

The relative density of the deposit is generally very loose to loose with 'N' values generally ranging from 1 blow/18 in. to 10 blows/ft. However, in a limited number of boreholes, occasionally high 'N' values, ranging up to 38 blows/ft. were observed.

4.3) Layered Clay:

Underlying the surface deposit of silty sand, the above cohesive stratum was encountered in all boreholes except boreholes #2, #16 and #17. The thickness of the deposit tends to taper off towards the lake, and ranges from 2 ft. in borehole #14 to 11 ft. in borehole #12. The deposit is generally irregularly layered.

It was possible to distinguish five different constituent layer materials within this deposit. These were a dark grey clay, a light grey clay, a brown clay, a grey clayey silt to silt, and grey sand. The first three materials were high plasticity clays

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

4.3) Layered Clay: (cont'd.) ...

generally in the CI to CH range. The fourth constituent material was found to be in the CL to ML range. These ranges are graphically represented on a Plasticity Chart attached to this report. The fifth constituent material was a uniform medium sand. These layers generally do not exceed 2 in. in thickness, the majority being in the order of 1/4 to 1/2 inch in thickness.

The Atterberg limits for the various cohesive layers are as follows:

<u>Type</u>	<u>Liquid Limit</u> <u>(W_L%)</u>	<u>Plastic Limit</u> <u>(W_p%)</u>	<u>Moisture Content</u> <u>(W%)</u>
Dark Grey Clay	40% - 62%	20% - 27%	42% - 63%
Light Grey Clay	31% - 48%	20% - 25%	20% - 44%
Brown Clay	43% - 57%	19% - 27%	41% - 59%
Grey Clayey Silt to Silt.	21% - 30%	19% - 22%	23% - 34%

Field and laboratory shear strength measurements and Standard Penetration tests gave the following results:

Field Vane	380 p.s.f.	-	>2000 p.s.f.
Quick Triaxial	240 p.s.f.	-	1110 p.s.f.
Unconfined Compression ..	200 p.s.f.	-	1500 p.s.f.
Laboratory Vane	205 p.s.f.	-	1710 p.s.f.
Vane	270 p.s.f.	-	840 p.s.f.
Standard Penetration ...	1 blow/30 in.	-	12 blows/ft.

The above table shows an extremely wide scatter of test results, and in order to arrive at a realistic value for the average undrained shear strength for the overall clay deposit, it is necessary

cont'd. /5 ...

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

4.3) Layered Clay: (cont'd.) ...

to investigate the validity of various types of tests. The deposit consists of cohesive layers of clayey silt, silty clay, clay and non-cohesive layers of silt and sand. The presence of non-cohesive layers results in disturbance during sampling and in handling thereafter, and the final effect is the lowering of the undrained strength of the sample. In consequence, the laboratory unconfined shear strength tests are likely to give greatly reduced values. Due to the nature of the test, the above effect would be much less severe for triaxial tests. In the case of in-situ field vane tests, the presence of non-cohesive layers would tend to increase the strength of the actual soil under test due to the consolidation effect which takes place almost immediately.

In the light of the foregoing, all shear strength test results have been reviewed with regard to validity. The following table has been prepared as a result of this review, and shows the estimated undrained shear strength range of various locations, together with the recommended values to be used for design purposes.

Section Location	B.H. Applicable	Estimated Range of Shear Strength (p.s.f.)	Design Shear Strength
Sta. 84+56	1, 6 and 7	335 to 1100	400
Sta. 85+00	15, 17 and 18	320 to 1000	400
Sta. 85+50	2, 5, 8, 9 and 14	330 to 850	350
Sta. 86+00	13 and 19	500 to 1040	500
Sta. 86+50	3, 4 and 10	450 to 1200	500
Sta. 87+00	11 and 12	400 to 1200	450

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

4.4) Silty Sand with Gravel and Boulders:

The third deposit found at the site consists of silty sand with gravel and occasional boulders. Maximum penetration into this deposit occurred in borehole #11 where it was investigated to a thickness of 27 ft. Gravel and boulder content in the stratum was quite irregular, varying sharply in the various boreholes. Maximum thickness of boulders encountered was about 8 - 9 in. Average grain-size distribution results for the stratum were as follows: Gravel 20%, sand 62%, silt 14%, clay 4%. Standard Penetration Test (N) results varied from 2 blows/ft. to 62 blows/1 in., indicating a relative density of very loose to very dense.

5. GROUND WATER:

During the foundation investigation, water level observations were carried out in the boreholes. The observed levels varied irregularly, ranging from ground level to 3.5 ft. below ground level. The exact water levels are recorded on the appropriate borelog sheets as well as on Dwg. 65-F-119B.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to reconstruct Hwy. #63 from the North Bay city limits to some 8 miles east. Approximately 2.5 miles east of the city limits this necessitates the realignment of the centre-line to within 25 ft. of the edge of Trout Lake (Delaney Bay). Subsoil at this site consists of deposits of very loose to loose silty sand (containing occasional thin layers of organic silt), very soft to firm layered clay and very loose to very dense silty sand with gravel and occasional boulders.

cont'd. /7 ...

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

Stability analyses in terms of total stresses, have been carried out on sections of the highway as proposed by the North Bay Regional Road Design office as shown on their cross sections with the following assumptions:

Roadway Width - 44 feet.

Fill Material

Rock fill side slopes 1-1/4:1

Bulk Density γ = 120 p.c.f.

ϕ = 45°

(Taking into account the strength of the fill)

Natural Material

i) Silty sand γ = 115 p.c.f.

ϕ = 30°

ii) Silty clay C = Variable - depending upon the section.

γ = 115 p.c.f.

Note: The boundaries of various soils strata are shown on the cross sections appended in this report.

The results of the stability analyses indicated that berms would be required on the lake side to ensure the stability of the embankment, between Sta. 84+50 and Sta. 86+00. Dwg. 65-F-119B shows the details of the required berm section and the transition from zero berm to full berm width.

The foregoing recommendations have already been summarized in a memo to Mr. H. McArthur, Regional Road Design, Northern Region, dated April 21, 1966, by Mr. A. G. Stermac, Principal Foundation Engineer.

cont'd. /8 ...

7. SUMMARY:

A foundation investigation at the site of the proposed embankment between Sta. 84+50 and Sta. 86+50 on Hwy. #63, 2.5 miles east of North Bay city limits is reported.

Subsoil at the site consists of deposits of loose silty sand and layered clay, the details of which are given in the bulk of the report.

It is recommended that berms be constructed to ensure the stability of the proposed fill section between Sta. 84+50 and Sta. 86+00.

8. MISCELLANEOUS:

The field work was performed in October, 1965, by Mr. A. Barsvary, Project Foundation Engineer, and in March 1966, by Mr. R. Magi, Project Foundation Engineer. The preparation of this report was undertaken by Mr. R. Magi. The investigations were carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Canadian Longyear Ltd. of North Bay.

May 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 84/56, 11' Rt.

W. P. 270-62

BORING DATE Oct. 26, 1965

DATUM Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

FOUNDATION SECTION

ORIGINATED BY A.B.

COMPILED BY A.B.

CHECKED BY

[illegible]

FOUNDATION SECTION

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	BLOVS / FOOT		SHEAR STRENGTH P.S.F.	WP W WL 				
663.7	Water Level											
0	Water					660						
						650						
645.2												
18.5	Silty Sand with Gravel		1	SS	1/18"	640						
			2	SS	5							
			3	SS	8							
	Loose to V. Dense		4	SS	90	630						
624.2												
39.5	End of Borehole											

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

W. P. 270-62

DATUM Geodetic

RECORD OF BOREHOLE NO. 3

LOCATION Sta. 86/50, 40' Rt.

BORING DATE October 28, 1965

BOREHOLE TYPE Washboring & Cone Penetration

FOUNDATION SECTION

ORIGINATED BY A.B.

COMPILED BY A.B.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY Y P.C.F.	REMARKS						
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W								
							20		40	60			80	100	WP	W	WL	
							+ Field Vane						WATER CONTENT %					
							250		500	750			1000	1250	20	40	60	
664.5	Groundlevel																	
0	Silty Sand					660												
	V. Loose		1	SS	3													
654.5			2	SS	1													
10	Layered Clay		3	TW	P													
			4	TW	P													
			5	TW	P	650												
			6	TW	P													
645.0	Firm to Stiff		7	TW	P													
19.5			8	TW	P													
642.5	Silty Sand Loose		9	SS	7													
22	End of Borehole					640												
						630												

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.4

FOUNDATION SECTION

JOB 65-F-119

LOCATION Sta. 86+50, 30' Lt.

ORIGINATED BY R.M.

W.P. 270-62

BORING DATE March 4, 1966

COMPILED BY R.M.

DATUM Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

CHECKED BY SR

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		
671.8	Ground Level															
0	Silty Sand					670										
			1	SS	5											
	V. Loose to Loose					660										
			2	SS	2											
658.3																
13.5	Layered Clay		3	SS	2											
			4	SS	2											
			5	SS	2											
	Soft to Stiff		6	SS	3	650										
			7	SS	2											
647.3			8	SS	4											
645.8	Silty Sand with Gravel		9	SS	6											
26			10	SS	50/1"											
	End of Borehole															

Gr-2%
Sa-91%
Si&Cl-7%

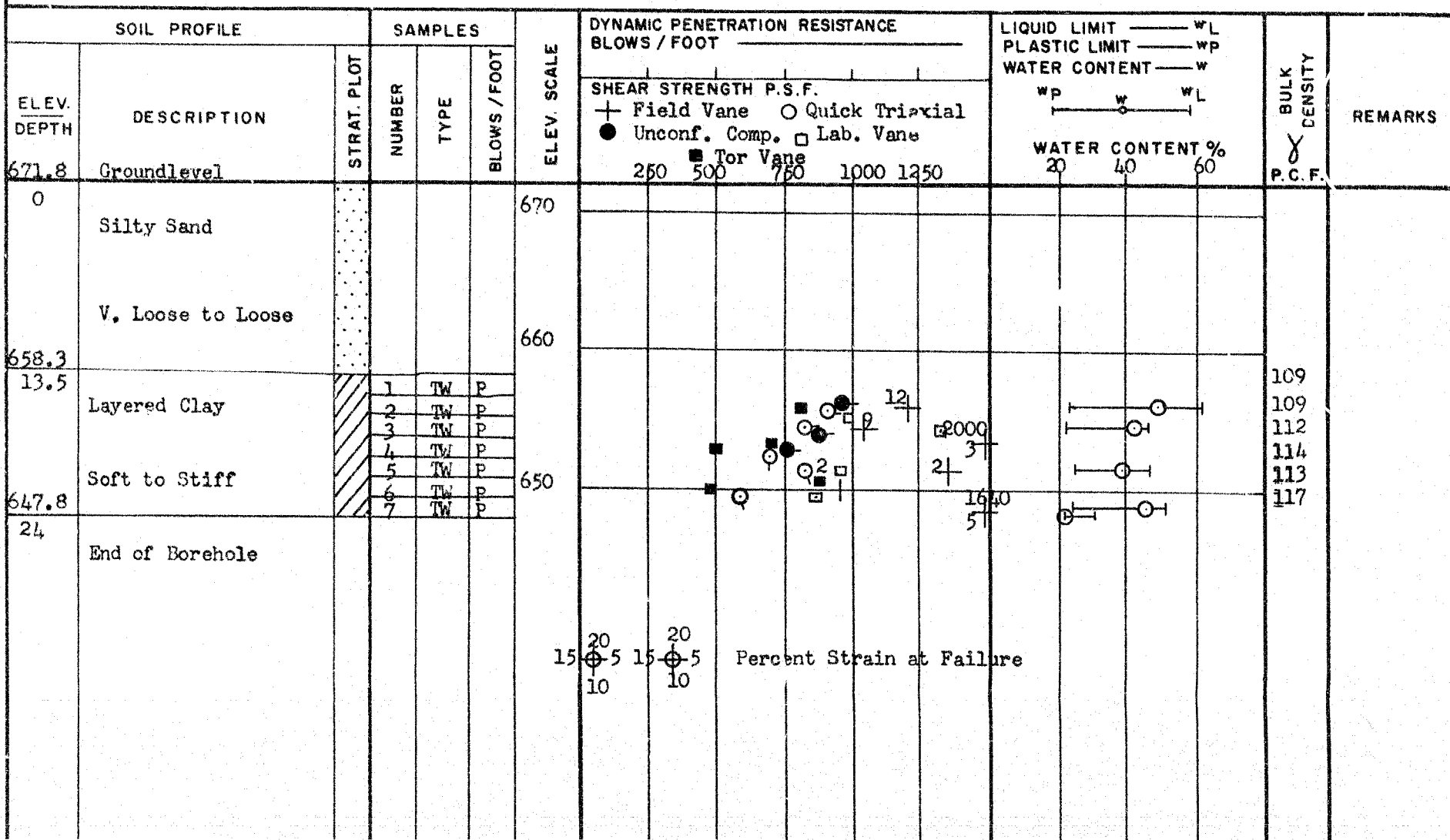
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4A

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 86+50, 30' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 7, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HR



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.5

FOUNDATION SECTION

JOB 65-F-119

LOCATION Sta. 85/50 E

ORIGINATED BY RM

W. P. _____ 270-62

BORING DATE October 29, 1965

COMPILED BY RM

DATUM _____ Geodetic

BOREHOLE TYPE Washboring

CHECKED BY MR

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	FOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane O Quick Triaxial ● Unconf. Comp	w p ——— w ——— WL 20 40 60				
							250 500 750 1000 1250					
666.5	Ground level											
0	Silty Sand	[Pattern]				660						
656.0												
10.5	Layered Clay	[Pattern]	1	TW	P							
648.0	Soft to Firm	[Pattern]				650						
18.5	Silty Sand with Gravel	[Pattern]										
641.5												
25	End of Borehole					640						

FOUNDATION SECTION

JOB	65-F-119	LOCATION	Sta. 84/60, 35' Lt.	ORIGINATED BY	R.M.
W.P.	270-62	BORING DATE	Feb. 28, 1966	COMPILED BY	R.M.
DATUM	Geodetic	BOREHOLE TYPE	Washboring & Cone Penetration	CHECKED BY	<i>[Signature]</i>

[illegible]

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 84/60 35' Lt. ORIGINATED BY R.M.
W.P. 270-62 BORING DATE March 1, 1966 COMPILED BY R.M.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY [Signature]

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 84/60 35' Rt.

ORIGINATED BY R.M.

W. P. 270-62

BORING DATE March 1, 1966

COMPILED BY R.M.

DATUM Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

CHECKED BY *[Signature]*

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

[illegible]

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 84/60 35' Rt. ORIGINATED BY R.M.
W.P. 270-62 BORING DATE March 1, 1966 COMPILED BY R.M.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY [Signature]

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		SHEAR STRENGTH P.S.F. + Field Vane ○ Triaxial Test ● Unconf. Comp. □ Lab. Vane Tor. Vane		WATER CONTENT % WP — W — WL								
663.4	Waterlevel						250	500	750	1000	1250	20	40	60			
661.6	Water																
1.8	Silty Sand with occ. Layers of Org. Silt Very Loose					660											
649.9						640											
13.5	Layered Clay		1	TW	P												
			2	TW	P												
644.4	V. Soft to Firm		3	TW	P												
19	End of Borehole					650											
							15	20	15	20							
							5	10	5	10							
							Percent Strain at Failure										

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 85+50 30' RT.

ORIGINATED BY RM

W.P. 270-62

BORING DATE March 2, 1966

COMPILED BY _____

DATUM _____ Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

CHECKED BY

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— w _L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— w _p	WATER CONTENT ——— w		
663.4	Waterlevel											
661.6	Water											
1.8	Silty Sand with layers of Org. Silt		1	SS	2	660						Gr=3% Sa=25% Si=12% 8.0% Org's 8.0% Org's 6.4% Org's 6.2% Org's
			2	SS	3/18"							
			3	SS	1/18"							
	V. Loose		4	SS	P	650						
648.4			5	SS	2/18"							
15			6	SS	4							
	Layered Clay		7	SS	2							
	Soft to stiff		8	SS	3							
			9	SS	3							
641.1			10	SS	2/18"	640						
22.3			11	SS	5							
	Silty Sand with Gravel and Occ. Boulders		12	SS	55							Gr=1% Sa=47% Si=41% Cl=11%
633.9	Loose to V. Dense		13	SS	50/1"							
29.5	End of Borehole					630						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8A

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+50 30' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 2, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY SR

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		SHEAR STRENGTH P.S.F. + Field Vane O Triaxial Test ● Unconf. Comp □ Lab Vane ■ Tor. Vane					WATER CONTENT % WP W WL				
663.4	Ground Level						250	500	750	1000	1250	20	40	60		
661.6	Water					660										
1.8	Silty Sand with Layers of Org. Silt															
	V. Loose		1	TW	P											
648.4			2	TW	H	650										
15	Layered Clay		3	TW	P											
			4	TW	P											
641.4	Soft to Stiff		5	TW	P											
22			6	TW	P											
			7	TW	P	640										
	End of Borehole															

20
15 — 5
10

Percent Strain at Failure

110
121
110

21.2% Org's

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.9

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+50 23' Lt. ORIGINATED BY R.M.
W.P. 270-62 BORING DATE March 3, 1966 COMPILED BY R.M.
DATUM Geodetic BOREHOLE TYPE Washboring & Cone Penetration CHECKED BY SR

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		
671.3	Ground Level															
0	Silty Sand					670										
	Loose to Compact		1	SS	4											
658.8			2	SS	38	660										
12.5	Layered Clay		3	SS	2/18"											
653.0	V. Soft to Stiff		4	SS	2/18"											
18.3			5	SS	1/18"											
			6	SS	12											
	Silty Sand with Gravel and occ. Boulders					650										
644.2	very dense		7	SS	100/5"											
27.1	End of Borehole		8	SS	50/1"											

34% Org's

Gr-1%
Sa-79%
Si-15%
Cl-5%

Gr-45%
Sa-37%
Si-14%
Cl-4%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9A

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85450 23 It. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 3, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY [Signature]

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION _____ Sta. 86450 b

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 7, 1966

COMPILED BY RM

DATUM Geodetic

BOREHOLE TYPE Washboring and Cone Penetration

CHECKED BY

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

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					Wp w WL				
							SHEAR STRENGTH P.S.F.					WATER CONTENT % 20 40 60				
669.2	Ground Level															
0	Silty Sand		1	SS	22	660										
	Compact															
658.2	Layered Clay		2	SS	4											
11			3	SS	2											
			4	SS	2											
			5	SS	2											
			6	SS	3											
649.7	Silty Sand with Gravel and occ. Boulders		7	SS	2/18"	650										
19.5		8	SS	8												
		9	SS	9												
667.7	Loose to Dense				640											
31.5	End of Borehole	10	SS	31												

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		SHEAR STRENGTH P.S.F. + Field Vane O Triaxial Test • Unconf. Comp. □ Lab. Vane		WATER CONTENT % 20 40 60			
669.2	Ground Level											
0	Silty Sand Compact											
658.2												
11	Layered Clay Soft to Hard		1	TW	P							
			2	TW	P							
			3	TW	P							
650.2			4	TW	P							
19	End of Borehole		5	TW	P							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION

Sta. 87400

30' Rt.

W. P. 270-62

BORING DATE

March 8, 1966

DATUM Geodetic

BOREHOLE TYPE

Washboring & Cone Penetration

ORIGINATED BY RM

COMPILED BY R.M

CHECKED BY

FOUNDATION SECTION

RECORD OF BOREHOLE NO. 11

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		SHEAR STRENGTH P.S.F.	WP	WL		
668.2	Ground Level										
0	Silty Sand										
659.7	Loose		1	SS	10						
8.5			2	SS	2						
	Layered Clay		3	SS	2						
			4	SS	2/18"						
			5	SS	2/18"						
650.2	Soft to Stiff		6	SS	2						
18			7	SS	2						
			8	SS	5						
			9	SS	3						
	Silty Sand with Gravel and occ. Boulders										
			10	SS	8						
			11	SS	6						
			12	SS	85/6"						
			13	SS	18						
			14	SS	30/T ⁿ						
622.8	Loose to V. Dense		15	KC	-						
45.4	End of Borehole		16	SS	75/2"						

[illegible]

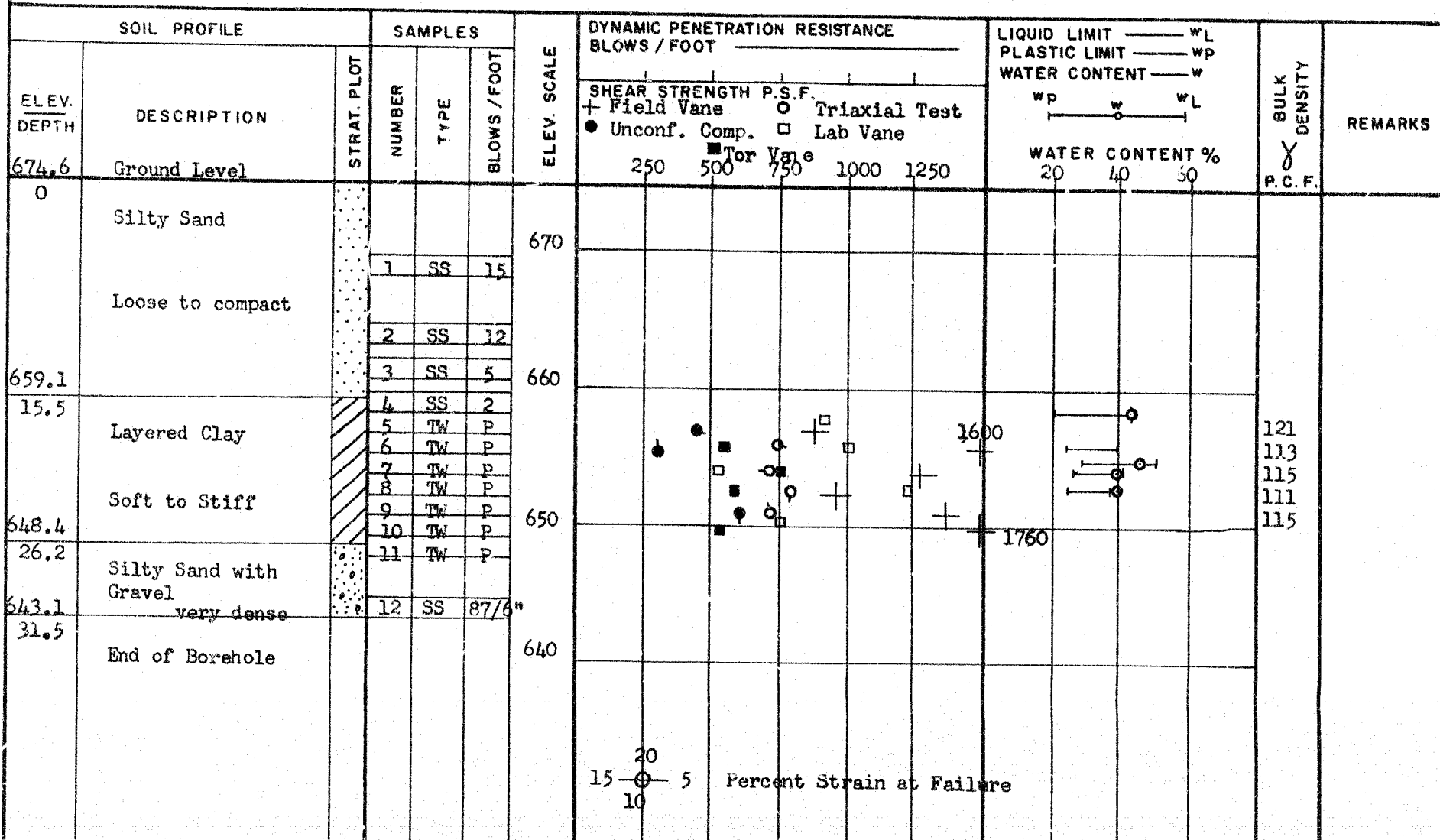
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 87+00 25' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 9, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY RL



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 86+00 50' Rt.

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 10, 1966

COMPILED BY RM

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY _____

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+50 50' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 10, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HL

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		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							+ Field Vane	• Unconf. Comp.	□ Lab Vane	■	250	500	750	1000		
663.4	Waterlevel															
0	Water					660										
653.9																
9.5	Silty Sand with occ. layers of Org. Silt					650										
	Very Loose		1	SS	2											
			2	TW	P											
642.4			3	TW	P											
			4	SS	2											
640.4	Layered Clay		5	TW	P	640										
23	Silty Sand with Gravel and occ. Boulders		6	TW	P											
	Very dense															
631.9			7	SS	152											
31.5	End of Borehole					630										
							15	20	5	Percent Strain at Failure						
								10								

5.1% Org's.

123

15 — 20 — 5
10
Percent Strain at Failure

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 25

FOUNDATION SECTION

JOB 65-F-119

LOCATION Sta. 85+00 35' Rt.

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 11, 1966

COMPILED BY RM

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY HR

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		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							+ Field Vane		○ Triaxial Test							
							□ Lab Vane		■ Tor Vane							
							250	500	750	1000	1250					
663.4	Water Level															
0	Water					660										
659.9																
3.5	Silty Sand with Layers of Org, Silt															
	Very Loose		1	SS	2, 18"											
			2	TL	P	650										
			3	TL	P											
646.9			4	TW	P											
16.5	Layered Clay Soft to Stiff		5	TW	P											
642.8			6	TW	P											
641.3	Silty Sand		7	TW	P											
22.1	End of Borehole		8	TW	P											
			9	SS	34	640										

20

15

10

5

PERCENT STRAIN AT FAILURE

6.5% Org's

6.1% Org's

8.1% &

14.5% Org's

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.16

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 84+60, 60' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 11, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER ONTENT — W				BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					<div>WP W WL</div> WATER CONTENT %					
663.4	Waterlevel																
0	Water					660											
647.9						650											
15.5	Silty Sand with Gravel and occ. Boulders		1	SS	3	640											
			2	SS	46												
	V. Loose to V. dense		3	SS	21	630											
628.5			4	SS	50/1												
34.9	End of Borehole															Gr. 57% Sa. 39% Si&Cl 4% Gr. 1% Sa 86% Si&Cl 13%	

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.17

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+00 70' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 15, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY SR

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 18

FOUNDATION SECTION

JOB 65-P-119 LOCATION Sta. 85+00 12' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 16, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane O Triaxial Test ● Unconf. Comp. □ Lab Vane ■ Tor Vane					wp	w	wL		
669.5 0	Ground Level						250	500	750	1000	1250	20	40	60		
658.5 11	Silty Sand Loose to Compact		1	SS	11	660										
			2	SS	6											
	Layered Clay		3	TW	P											
			4	TW	P											
			5	TW	P											
			6	TW	P											
649.7 19.8	V. Soft to Stiff		7	TW	P	650										
			8	TW	P											
646.0 2.5	Silty Sand with Gravel Dense		9	SS	36											
	End of Borehole															

PERCENT STRAIN AT FAILURE

$C_c = 0.46$

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

W. P. 270-62

DATUM Geodetic

LOCATION Sta. 86,400 19' Lt.

BORING DATE March 16, 1966

BOREHOLE TYPE Washboring

ORIGINATED BY RM

COMPILED BY R.M.

CHECKED BY AK

RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

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		SHEAR STRENGTH P.S.F. + Field Vane ○ Triaxial Test ● Unconf. Comp. □ Lab Vane		WATER CONTENT % WP W WL							
669.7	Ground Level						250	500	750	1000	1250	20	40	60		
0	Silty Sand		1	SS	35	660										
	V. Loose to Dense		2	SS	3											
655.2			3	TW	H											
14.5	Layered Clay		4	TW	P	650										
			5	TW	P											
647.8	Firm to Stiff		6	TW	P											
21.9	Silty Sand with Gravel & occ. Boulders V. Dense		7	TW	P	640										
25.8	End of Borehole		8	TW	P											
			9	SS	68/11"											
			10	SS	50/11"											

20
15 — 5
10

PERCENT STRAIN AT FAILURE

Gr 2%
Sa 91%
Si&Cl 7%

Sa 93%
Si&Cl 7%

107
110
114
112
117

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 83475 65' Rt.

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 17, 1966

ORIGINATED BY _____
COMPILED BY _____ R.M

DATUM ~~Geodetic~~

BOREHOLE TYPE Washboring

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT _____ WL PLASTIC LIMIT _____ wp WATER CONTENT _____ w			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane o Triaxial Test					WATER CONTENT % wp w WL				
							250	500	750	1000	1250					
663.4	Waterlevel															
661.9 185	Water					660										
	Silty Sand		1	SS	3											
	V. Loose to Compact		2	SS	15	650										
648.2 15.2	Layered Clay		3	SS	2/18"											
643.9 19.5	Soft to Firm		4	TW	P											
	Silty Sand with Gravel		5	TW	H											
	Compact to Dense		6	SS	27	640										
636.9 26.5	End of Borehole		7	SS	38											

20
15
10

5

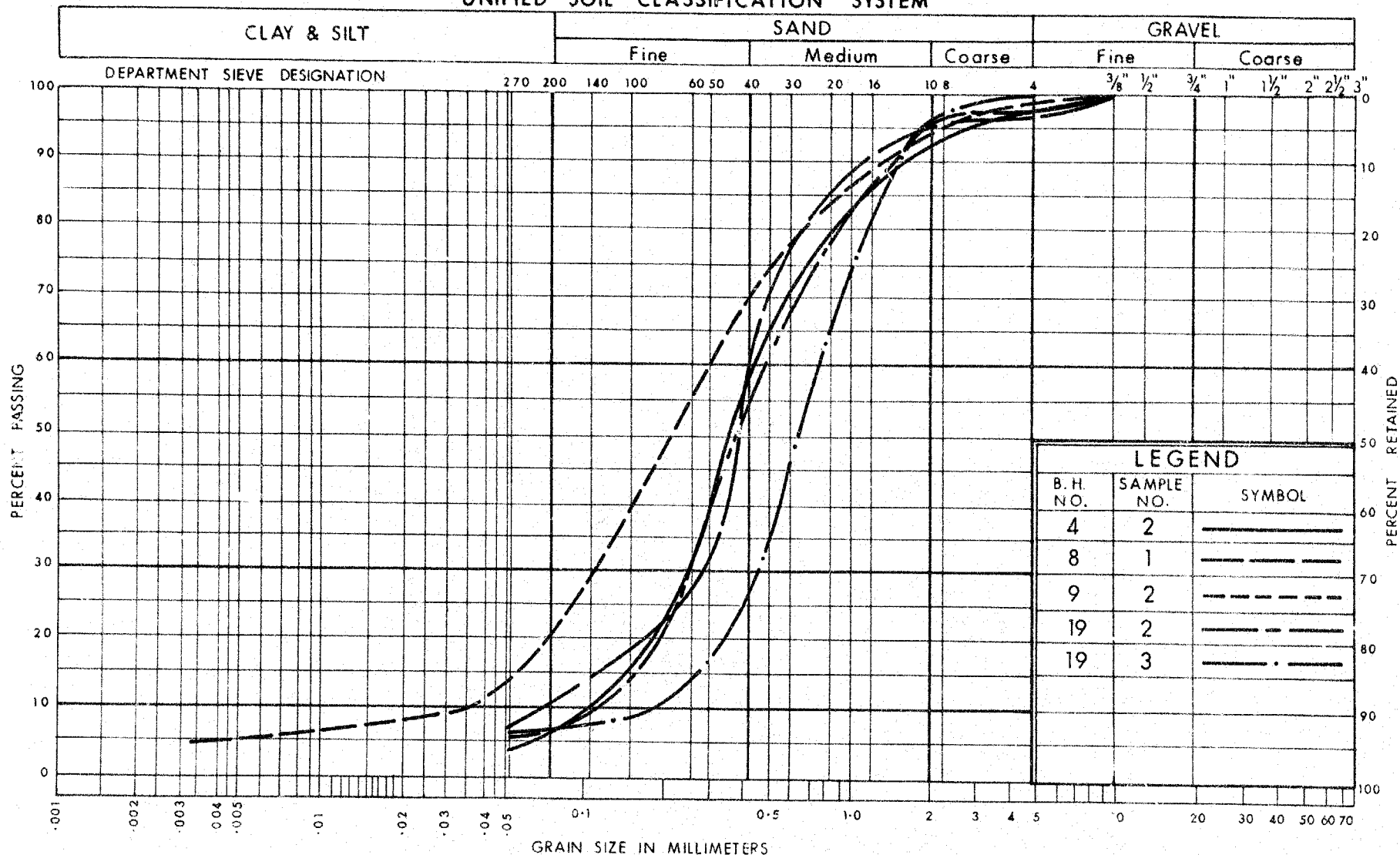
PERCENT STRAIN AT FAILURE

FOUNDATION SECTION

CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							+ Field Vane O Unconf. Comp.					w_p w w_L				
							250	500	750	1000	1250					
663.4	Waterlevel															
661.9	Water					660									 	
1.5	Silty Sand															
657.2	V. Loose		1	SS	2											
6.2	Layered Clay		2	TW	P											
654.4	Soft to Firm		3	TW	P											
9	Silty Sand with Gravel and Occ. Boulders		4	SS	80/6"											
		Compact to V. Dense	5	SS	29	650										
641.9		6	SS	41	640											
21.5	End of Borehole															

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
SILTY SAND



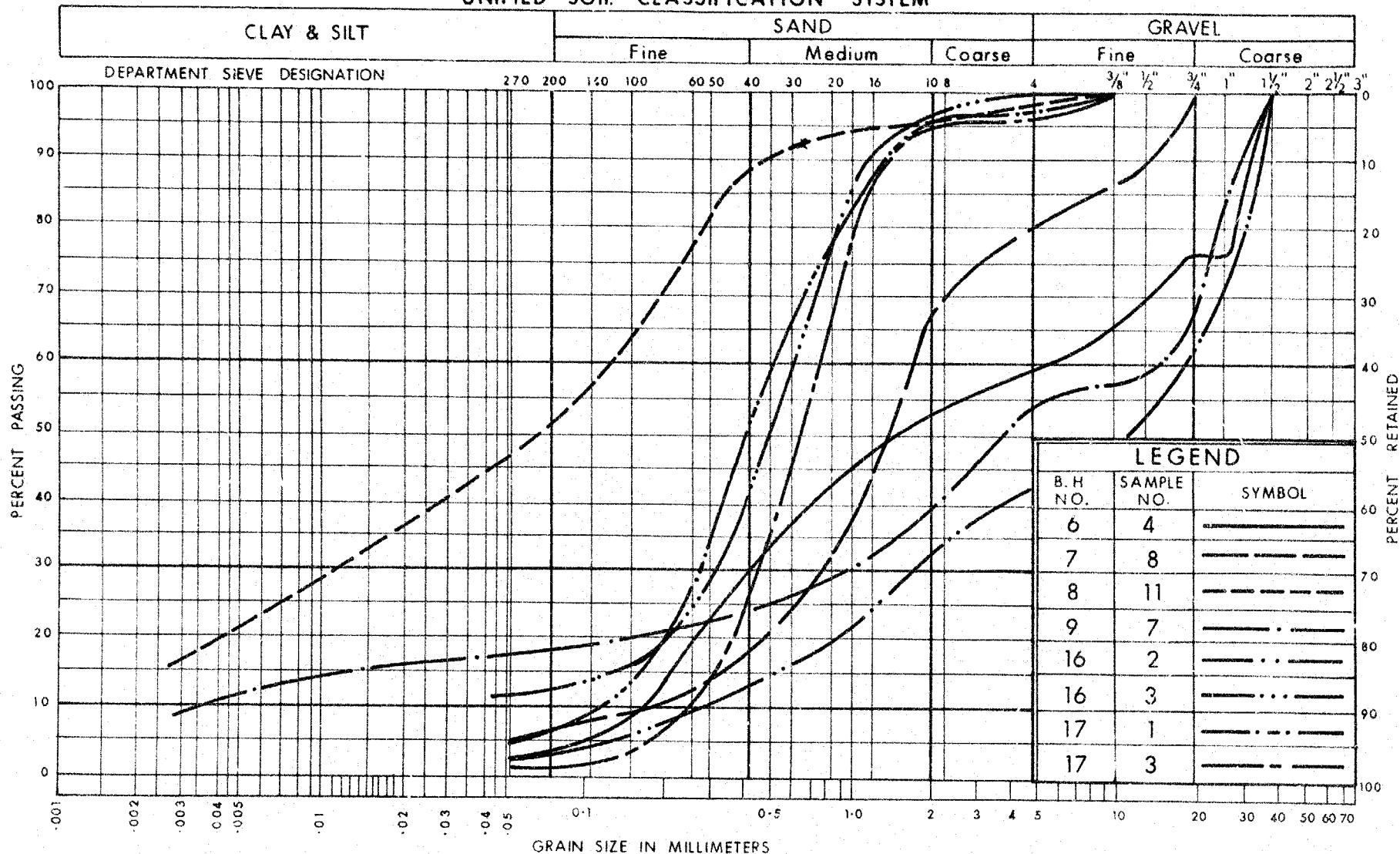
ONTARIO

DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

W.P. No. 270-62

JOB No. 65-F-119

UNIFIED SOIL CLASSIFICATION SYSTEM



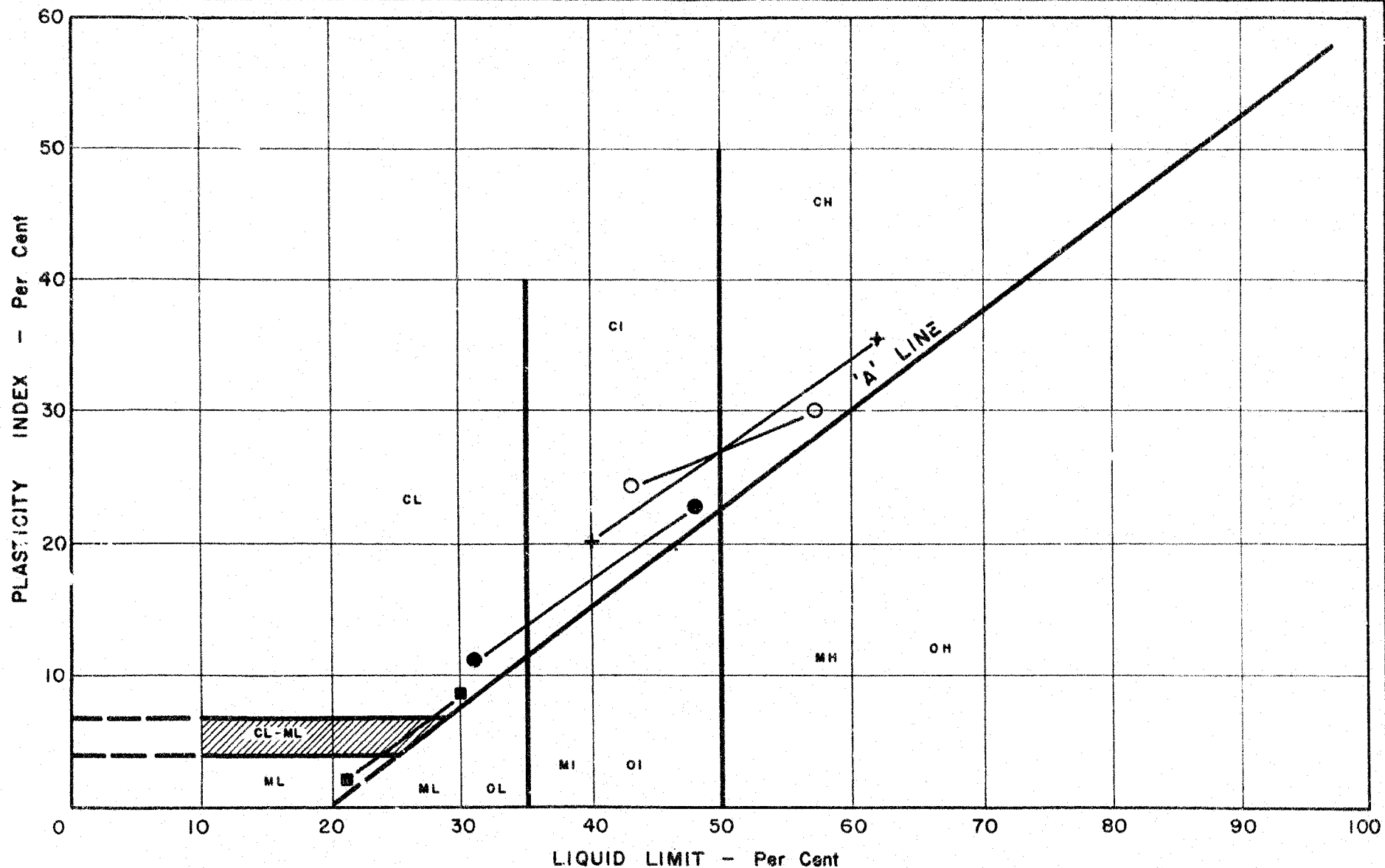
ONTARIO

DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH OCC. GRAVEL & BOULDERS

W.P. No. 270-62

JOB No. 65-F-119



- NOTES
- RANGE OF BROWN CLAY
 - RANGE OF SILTY CLAY
 - RANGE OF CLAYEY SILT
 - + RANGE OF DARK GREY CLAY

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIAL AND TESTING DIVISION
PLASTICITY CHART

Job No. 65-F-119 W.P. No. 270-62

Location Hwy. 63 at Trout Lake

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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_i	SENSITIVITY

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

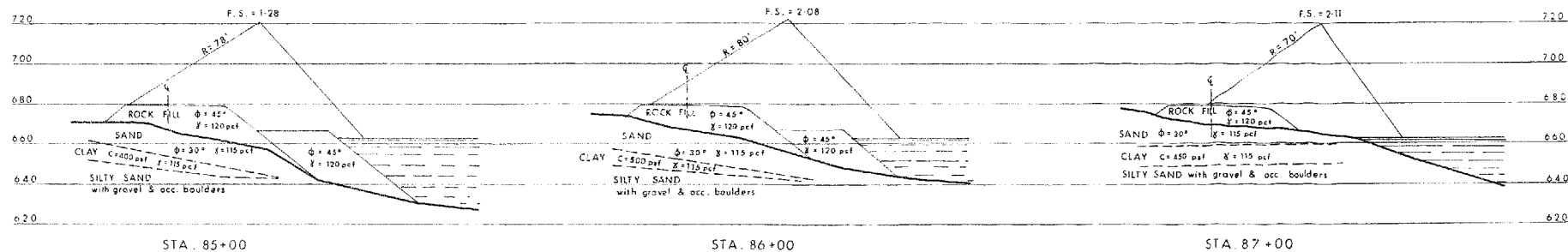
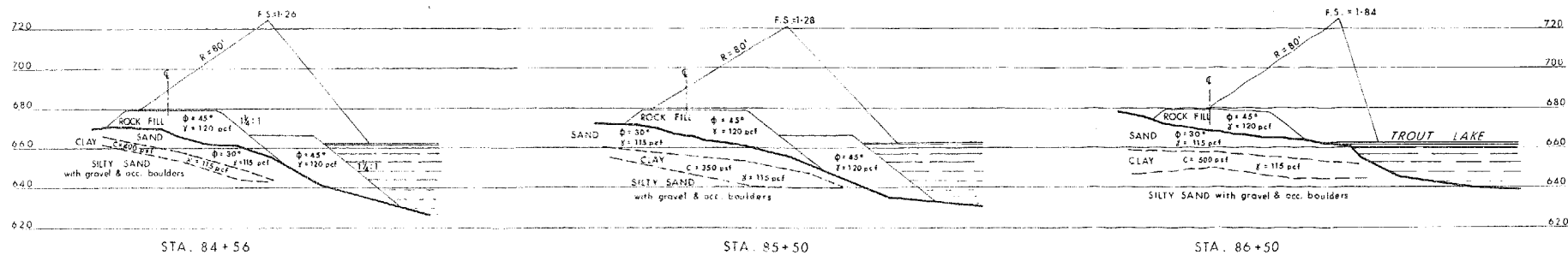
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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



SCALE FOR SECTIONS
 1 in = 40 ft.

 DEPARTMENT OF HIGHWAYS MATERIALS AND TESTING DIVISION ONTARIO	HIGHWAY 63 - EMBANKMENT STABILITY	
	TROUT LAKE CROSS-SECTIONS	
DATE 15 JUNE 1966	WP 270-62	DIST. 13
APPROVED <i>[Signature]</i>	JOB 65-F-119C	
DRAWING NO.		65-F-119C

STABILITY OF SECTIONS

Sta.	Length & Height of Berm	C	F. S.
84+56	No Berm	350	0.73
	" "	400	0.78
	" "	450	0.83
	" "	500	0.86
84+50	Extends to 70' from g. ht. at W.L.	350	1.15
		400	1.21
		450	1.26
		500	1.31
85+00	Extends to 70' from g. ht. at W.L.	350	1.21
		400	1.26
85+50	Extends to 80' from g. ht. 3' above W.L.	350	1.43
85+50	Extends to 75' from g. ht. 3' above W.L.	350	1.28
85+50	Extends to 70' from g. ht. at W.L.	350	0.91
		400	0.98
		450	1.05
		500	1.12
86+00	Extends to 70' from g. ht. at W.L.	500	2.04
86+00	No Berm	500	1.35
86+50	No Berm (circle 1)	200	1.21
		250	1.27
		300	1.33
		350	1.38
		400	1.44
		450	1.49
		500	1.52
86+50	No Berm (circle 2)	200	0.95
	" " "	250	1.10
	" " "	300	1.24
	" " "	350	1.38
	" " "	400	1.54
	" " "	450	1.69
	" " "	500	1.84

STABILITY OF SECTIONS (cont'd)

Sta.	Length & Height of Berm	C	F.S.
87+00	No Berm	200	1.15
	" "	250	1.30
	" "	300	1.46
	" "	500	2.11

BOREHOLE No. 6A

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB VANE			TOR VANE			FIELD VANE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 1	5'-6" - 5'-11"	1500 (1)	mainly E & B some C	5'-11" - 6'-4"	1110 (1)	mainly B some E & C	6'-4 1/2" - 7'-11"	525 155	1/3 E 2/3 B 1/2 E 1/2 B	6'-5 1/4"	480	B	640 "
Tw 2				7'-5" - 7'-10"	410 (1)	mainly B & E some sand some of C							380 "
BOREHOLE 7A													
Tw 2	16'-6" - 16'-11"	335 (1)	mainly B & E also a middle thin seams sand	16'-11" - 17'-4"	530 (1)	2/3 B 1/3 E several thin seams of sand	17'-5" - 18'-10 1/2"	205 125	E B	17'-5 3/4" - 18'-11 1/4"	480 270	A E	800 "
Tw 3				17'-11" - 18'-4"	240 (1)	mainly B & E seams of sand 3 seams C							700 "
BOREHOLE 1													
LAB SHEAR STRENGTH TESTS													

16

LAB

SHEAR

STRENGTH

TESTS

Sample
65-F-119

65-F-119

SECTION STA 85+00
(BH-15, 17, 18)

- + FIELD VALUE
- o TRIAXIAL TEST
- * UNCONF. CORR.
- LAB VALUE
- TOR VALUE

670

665

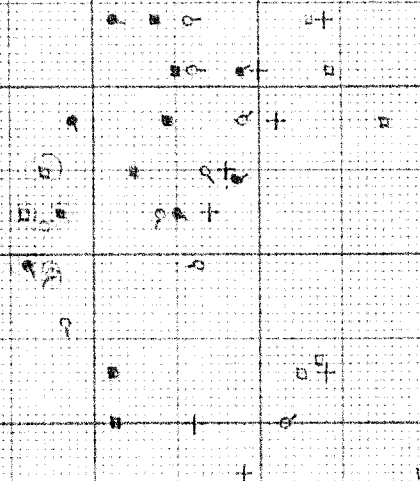
660

655

650

645

640



BOREHOLE No. 15

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB VALUE			TOR VANE			FIELD VALUE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 3	13.7 - 14.0	235 (2)	Org. silt	14.0 - 14.5	320 (2)	Org. silt							
Tw 4				15.1 - 15.6	340 (2)	Org. silt							
Tw 5							16.10 3/4 17.5"	300 375	A & C C & A	16.11 3/4 17.5 3/4	360 440	B C & A	360 12
Tw 6				17.7 - 17.11	360 (2)	mainly B layers of A & C	18.11"	1135	1/3 C 2/3 B	18.11 3/4	440	B	640 8

BOREHOLE No. 18

Tw 3	12.0 - 12.5	445 (2)	mainly B layers of A, C, E & sand	12.5 - 12.10	625 4	mainly B layers of A & C	12.11"	320	B	12.11 3/4	530	A	360 12
Tw 4	13.3 - 13.8	760 (3)	mainly A & B some C & E	13.2 - 14.1	640 5	mainly A & B layers of E	14.5"	375	C & A	14.5 3/4	600	C	300 8
Tw 5	14.11 - 15.4	345 (2)	layers E all top rest B with some A & C	15.4 - 15.9	760 3	A, B, & C some sand	15.11"	1105	A, B & E	15.11 3/4	580	C & A	240 11
Tw 6	16.6 - 16.11	740 (3)	B with layers of A & C	16.11 - 17.4	670 2	1/3 B, rest in A, C, E & sand	17.5"	280	B	17.5 3/4	500	B	720 7
Tw 7	17.7 - 18.0	595 (2)	A, B & C with layers of E & some sand	18.5 - 18.10	560 12	1/3 B, 1/3 E, rest in A & C	18.11"	230	B, C, A	18.11 3/4	320	E	680 5
Tw 8	19.0 - 19.5	240 (3)	mainly B layers of E some A & sand	19.5 - 19.10	650 14	mainly B, some E layers of sand							

200 400 600 800 1000 1200 1400 1600

65-F-19

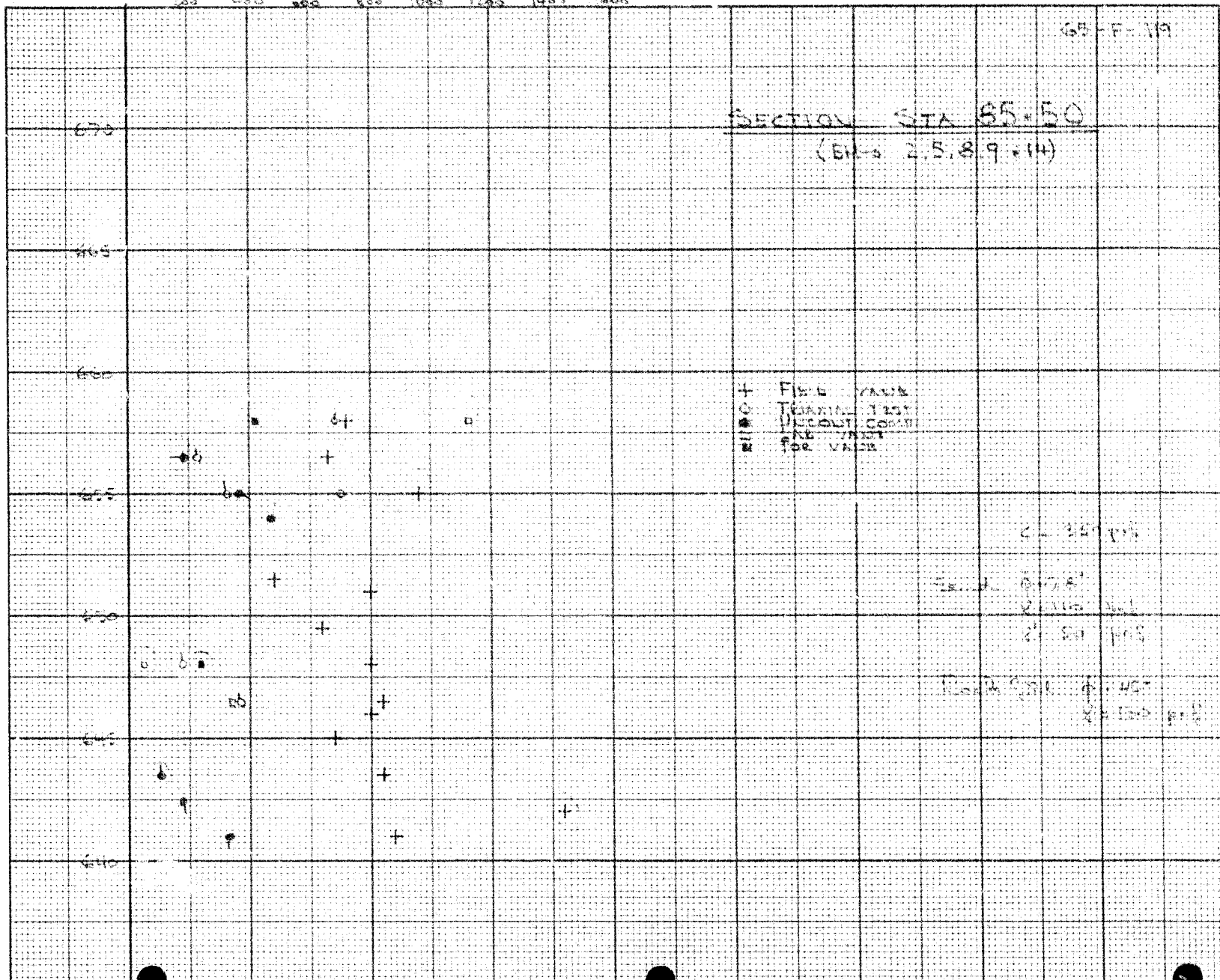
SECTION STA 85.50
(EM-2 2.5.89.14)

+ FIELD VALUE
O TRIAXIAL TEST
● DISCOUNT CORRECTION
■ FOR VALUE

CL 250 PM

Emul 0.75%
2.115 Vol
2.50 PM

Block 500 g. 407
2.120 PM



BOREHOLE No. 8A

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB. VANE			TOR. VANE			FIELD VANE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 3				15'-8" - 16'-0"	180 (19)	A, B & C	15'-11"	50	A, B & C	15'-11 3/4"	240	A, B & C	800 7
Tw 4				17'-0" - 17'-4"	370 (19)	B with C & D 2 in. clay	17'-5"	360	2/3 C 1/3 sand	17'-5 3/4"	320	B & C	840 7
Tw 6	19'-11" - 20'-3"	106 (20)	milky of A, B, C & D										840 7
BOREHOLE No. 5													
Tw 1	12'-11" - 13'-3"	480 (1)	A, B & C seam of sand	12'-6" - 12'-11"	700 (2)	A, B & C							
BOREHOLE No. 9A													
Tw 1				13'-2" - 13'-6"	690 (1)	B & A seam of sand	13'-11"	1130	B	13'-11 3/4"	420	B	720 12
Tw 2	14'-6" - 14'-11"	185 (17)	milky of B, C & E. some sand	14'-11" - 15'-4"	235 (20)	mainly B some E & C							660 7
Tw 3	15'-9" - 16'-1"	375 (2)	mainly B layers of E. some A & C	16'-1" - 16'-6"	335 (18)	mainly B. Three layers of E.							960 4
BOREHOLE No. 14													
Tw 2							17'-11"	335	org. silt	17'-11 3/4"	380	Org. silt	800 2
Tw 3	18'-9" - 19'-2"	180 (9)	Org. silt										
Tw 5	22'-6" - 22'-10"	330 (10)	mainly B layers of sand & layers of C										880 7

200 sample

200 400 600 800 1000 1200 1400 1600 1800

65-F-119

SECTION DIA 86+00

(BH-5 13 + 19)

+ FIELD VANE
o TRIAXIAL TEST
● WUCOF COMP
□ LNC VANE

670

665

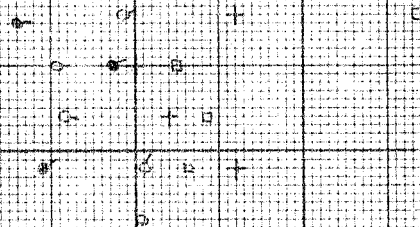
660

655

650

645

640



650

65-119

670

200 400 600 800 1000 1200 1400 1600 1800 2000

665

SECTION STA 86+50

(BH = 3.4 : 10)

660

655

650

645

2000 y. 2 V

BOREHOLE No. 4A

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB VANE			TOR VANE			FIELD VANE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 2	15'-6" - 15'-11"	970 ③	Mainly A+B Some C Thin seam of sand	16'-1" - 16'-6"	920	mainly A+B Some of B, trace seam of sand	16'-0"	950	A	15'-11 1/4"	800	B	1200 12
Tw 3	17'-0" - 17'-5"	890 ④	mainly A+B. Some C+E, thin seam of sand	17'-5" - 17'-10"	845 ④	mainly A+B Some C+D	17'-10 1/2"	1320	1/3 C, 2/3 B regimented by thin seam of sand	17'-11 1/4"	720	A	1040 9
Tw 4	18'-6" - 18'-11"	760 ④	B, C+D in imag. pattern	18'-11" - 19'-4"	710 ④	mainly B+C seam of sand. Bries.	19'-4 1/2"	1710	1/3 C 2/3 A	19'-5 3/4"	480	D	2000 3
Tw 5				20'-5" - 20'-10"	837 ④	mainly A+B Some C, seam of E. Occ. C	20'-10 1/2"	950	1/3 D 2/3 B	20'-11 1/4"	840	B	1360 2
Tw 6				21'-2" - 21'-7"	605 ④	B, out 1/2" seam of E	22'-5"	845	B	21'-5 3/4"	460	E	960 2

BOREHOLE No. 10A

Tw 1				12'-7" - 13'-0"	670 ④	mainly A+B thin seam of Occ. C				12'-11 3/4"	600	C	960 12
Tw 2	13'-3" - 13'-8"	550 ④	mainly B. Layers of A, C, E and sand	13'-8" - 14'-1"	635 ④	mainly B thin seam of E	14'-5"	310	sand	14'-5 3/4"	480	E	1040 9
Tw 3	15'-0" - 15'-5"	670 ④	layers of A, B C, E + sand	15'-5" - 15'-10"	800 ④	thin layer sand layers of A, B, C, E	15'-11"	1105	2/3 B 1/3 C + sand	15'-10 1/4"	620	B	760 7
Tw 4				16'-3" - 16'-8"	765 ④	1/2 B, rest in layers of A, C, E + sand	17'-1"	1290	1/3 A 2/3 B	15'-11 3/4"	580	C	
Tw 5	18'-0" - 18'-5"	650 ④	mainly B. layers of A, C, E, seams of sand	18'-5" - 18'-10"	755 ④	1/2 B, 1/3 E 1/2 A+C	17'-2 1/4"	780	B	17'-2 1/4"	780	B	>2000
							18'-11"	740	B	18'-11 3/4"	560	B	1440 3

BOREHOLE No. 3A

Tw 4	12'-6" - 12'-11"	150	A, B+C. layers of E + sand	12'-1" - 12'-6"	240	A, B, C. layers of E + sand							560 14
Tw 5	14'-0" - 14'-5"	130	A, B, C. layers of E + sand	13'-7" - 14'-0"	210	A, B, C. layers of E + sand							640 16
Tw 6	15'-11" - 16'-4"	180	A, B, C+D layers of sand	15'-6" - 15'-11"	195	A, B, C+D layers of sand							520 20

65-F-119

SECTION STA 87+00
(BH's H=12)

+ FIELD VALUE
O TRIAXIAL TEST
● UNCONF. COMP
□ LAB. VALS
■ TOR. VALS

$\sigma = 40.5$

670

665

660

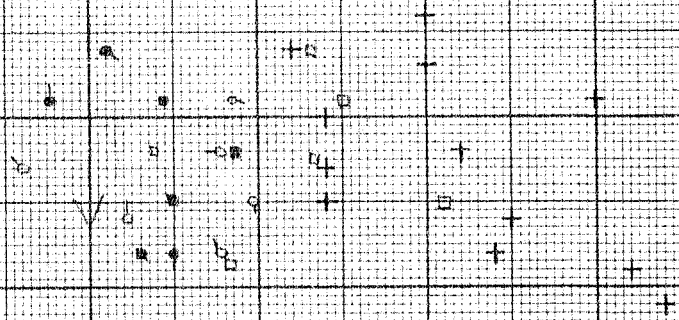
655

650

645

640

200 400 600 800 1000 1200 1400 1600 1800



BOREHOLE No. 11 A

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB VANE			TOR VANE			FIELD VANE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 1													1200 9
Tw 2													1200 1
Tw 3													960 8
Tw 4													960 6
Tw 5													1400 3
Tw 6													1680 7

BOREHOLE No 12

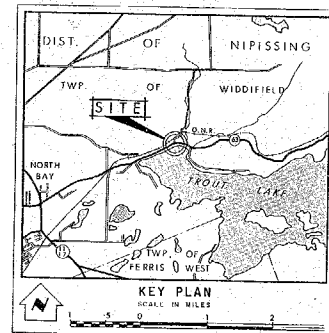
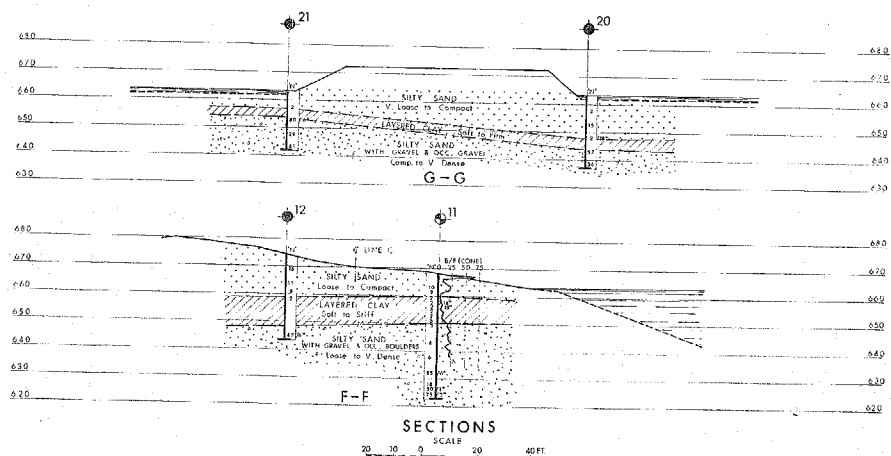
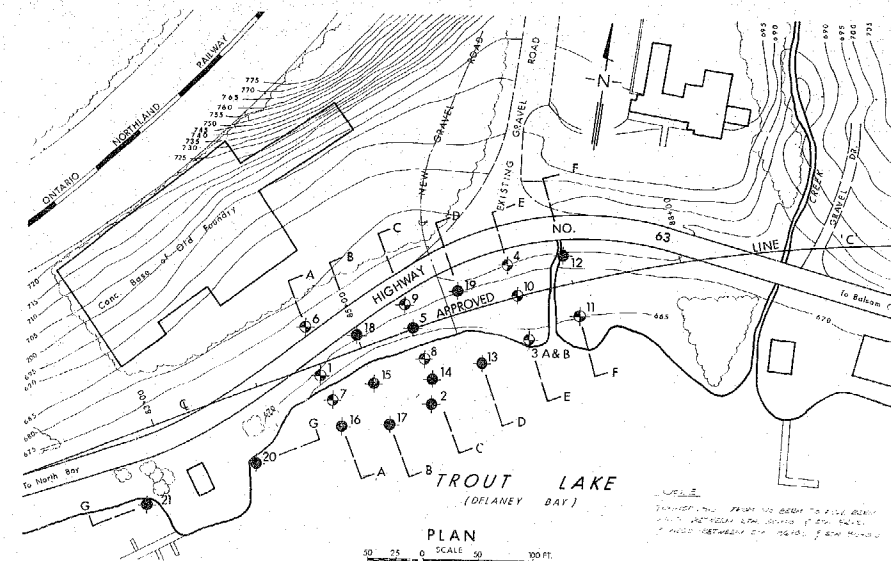
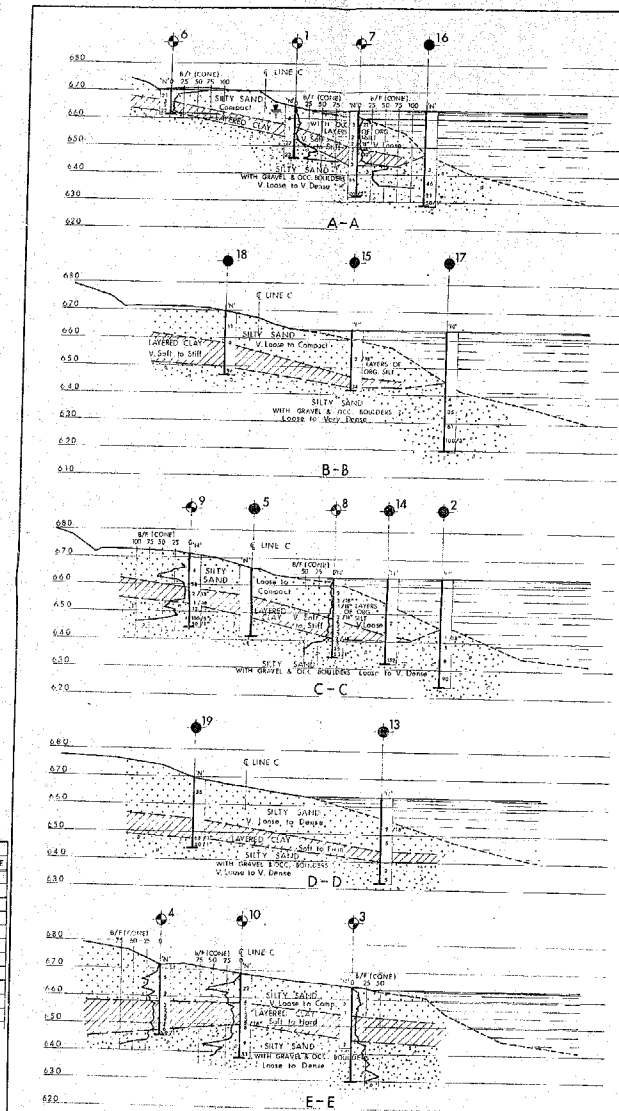
Tw 5	17'-2" - 17'-7"	440 ⑦	one side (1/3) sand in sand. Ref (4) B seam of C				17'-11"	895	B				880 8
Tw 6	18'-1" - 18'-6"	305 ⑥	A & B mottled Trace of E & sand	19'-1" - 19'-6"	740 ⑤	mainly B, seams of	19'-5"	1000	1/3 A 2/3 B	19'-5 3/4"	580	B	1600 4
Tw 7				20'-5" - 20'-10"	710 ⑤	layers of B, E & C seam of sand	20'-11"	555	thin layers of B, C & A	20'-11 3/4"	480	B	1280 4
Tw 8				21'-2" - 21'-7"	790 ⑤	mainly E & B some A thin seam of C	22'-5"	1240	1/3 sand 1/3 A 1/3 B	19'-8 1/2"	720	C	
Tw 9	22'-11" - 23'-4"	600 ⑥	mainly B thin layers of A & C	23'-4" - 23'-9"	710 ⑤	mainly E & B some A & C	23'-0"	725	1/3 A 2/3 E	22'-5 1/4"	600	B	960 6
Tw 10										26'-3"	480	B	1360 7
										26'-4 1/2"	520	B	1760 5

65-F-119B

W.P. # 270-62

Hwy. # 63

ε TROUT LAKE



LEGEND

More Hole

Cone Penetration Hole

Water & Cone Penetration Hole

Bare Levels established at time of field investigation. OCT. 1965

NO.	ELEVATION	STATION	OFFSET
1	665.0	84+50	11' 11"
2	665.7	85+40	7' 3"
3	665.4	85+50	40' 42"
4	665.4	85+50	10' 12"
5	665.0	85+50	E
6	667.0	85+50	2' 11"
7	665.0	85+50	35' 32"
8	665.0	85+50	5' 09"
9	667.1	86+80	27' 11"
10	666.0	87+00	7' 02"
11	665.12	87+00	30' 31"
12	665.0	87+00	25' 11"
13	663.4	87+00	8' 00"
14	663.4	87+00	30' 08"
15	663.4	87+00	3' 11"
16	663.4	88+60	60' 07"
17	663.4	88+60	7' 02"
18	666.5	92+00	12' 11"
19	665.7	93+00	10' 11"
20	663.4	93+75	65' 05"
21	665.7	94+00	65' 05"

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

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

EMBANKMENT STABILIZATION
TROUT LAKE

KING'S HIGHWAY NO. 63 LINE 'C' DIST. NO. 13
CO. NIPISSING
TWP. WIDDIFIELD LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBMITT. R. M.	CHECKED <i>P. H. H.</i>	W.P. NO. 270-62	M.B.T. DRAWING NO.
DRAWN S. O.	CHECKED <i>HC</i>	JOB NO. 65-F-119	65-F-119 E
DATE 14 JUNE 1966		SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>A. B. Thomas</i>		CONT. NO.	

MEMORANDUM

GEN. FILES

23-66-290

W.P. 270-62

TO: Mr. H. McArthur,
Regional Road Design Engineer,
North Bay.

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

DATE: May 5, 1966

OUR FILE REF.

IN REPLY TO

JUN 24 1966

SUBJECT:

- FOUNDATION INVESTIGATION REPORT
For

Proposed New Alignment of Hwy. #63
Between Sta. 84+50 and Sta. 86+50,
2.5 Miles East from North Bay City
Limits, District No. 13, North Bay.
W.J. 65-F-119B -- W.P. 270-62

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. H. McArthur (2)
D. W. Farren
G. Martens
E. R. Saint

Foundations Office
Gen. Files

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE.
 3. FIELD AND LABORATORY WORK.
 4. SUBSOIL CONDITIONS:
 - 4.1) General.
 - 4.2) Silty Sand.
 - 4.3) Layered Clay.
 - 4.4) Silty Sand with Gravel and Boulders.
 5. GROUND WATER.
 6. DISCUSSION AND RECOMMENDATIONS.
 7. SUMMARY.
 8. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT
For
Proposed New Alignment of Hwy. #63
Between Sta. 84+50 and Sta. 86+50,
2.5 Miles East from North Bay City
Limits, District No. 13, North Bay.
W.J. 65-F-119B -- W.P. 270-62

1. INTRODUCTION:

A memo dated July 6, 1965, from Mr. E. R. Saint, Regional Materials Engineer, Northern Region, requesting a soils investigation at the above site, was received by this Section.

Subsequently, a foundation investigation consisting of 4 boreholes and 3 dynamic cone penetration tests was carried out at the site in October 1965. This work was summarized and reported in W.J. 65-F-119. A review of the subsoil conditions and stability problems indicated the need for additional information. In view of this, another investigation consisting of 17 boreholes and 6 dynamic cone penetration tests was performed in March 1966.

Presented in this report are the results of both investigations, together with our recommendations pertaining to the design of the proposed embankments.

2. DESCRIPTION OF SITE:

The site is located some 2.5 miles east of the east limits of the City of North Bay. In the area in question, Hwy. #63 closely follows the shoreline of Trout Lake. Immediately to the north of the highway, a hill rises quite sharply. To the south, the bed of Trout Lake drops off rather steeply. The area is partially built-up with the settlement consisting of summer-resort type establishments.

The site is located in an area known as the Pre-Cambrian Shield.

3. FIELD AND LABORATORY WORK:

The borings in the field were carried out by means of a diamond drill adapted for soil sampling purposes.

Samples were recovered at the required depths by means of a 2-in. O.D. split-spoon sampler and by 2-in. I.D. Shelby tube samplers. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. In-situ vane tests were carried out wherever possible, in order to determine the undrained shear strength of the cohesive deposits.

The locations and elevations of all boreholes, including the ones drilled during the initial investigation, are shown on the accompanying borehole log sheets included in the Appendix of this report. The borehole elevations, as well as the original ground sections were provided by a Department of Highways survey crew from Engineering Surveys, Northern Region, and are based on geodetic datum.

Samples were visually examined and identified in the laboratory as well as in the field. Laboratory tests were performed on a number of selected samples to determine:

- 1) Natural moisture contents.
- 2) Atterberg limits.
- 3) Bulk densities.
- 4) Undrained shear strengths.
- 5) Grain-size distributions.
- 6) Organic contents (for organic soil only).

Laboratory test results are summarized and are included in the Appendix.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists of a deposit of silty sand, followed by deposits of layered clay and silty sand with gravel and occasional boulders.

The boundaries of the deposits as determined in the field, are shown on the accompanying borelog sheets, and the estimated stratigraphical sections contained in Dwg. 65-F-119B, are based on this information.

4.2) Silty Sand:

A surface layer of silty sand was observed in all boreholes except boreholes #2, #16 and #17. The thickness of the layer varies irregularly from 5 ft. in borehole #6 to 16 ft. in borehole #12. In boreholes #7, #8, #14 and #15, irregularly spaced layers of organic silt were found. These layers, which occurred to a maximum thickness of 6 in. were generally located in the lower half of the deposit. The average grain-size distribution for the stratum is as follows: Gravel 2%, sand 88%, silt 7%, clay 3%.

The relative density of the deposit is generally very loose to loose with 'N' values generally ranging from 1 blow/18 in. to 10 blows/ft. However, in a limited number of boreholes, occasionally high 'N' values, ranging up to 38 blows/ft. were observed.

4.3) Layered Clay:

Underlying the surface deposit of silty sand, the above cohesive stratum was encountered in all boreholes except boreholes #2, #16 and #17. The thickness of the deposit tends to taper off towards the lake, and ranges from 2 ft. in borehole #14 to 11 ft. in borehole #12. The deposit is generally irregularly layered.

It was possible to distinguish five different constituent layer materials within this deposit. These were a dark grey clay, a light grey clay, a brown clay, a grey clayey silt to silt, and grey sand. The first three materials were high plasticity clays

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

4.3) Layered Clay: (cont'd.) ...

generally in the CI to CH range. The fourth constituent material was found to be in the CL to ML range. These ranges are graphically represented on a Plasticity Chart attached to this report. The fifth constituent material was a uniform medium sand. These layers generally do not exceed 2 in. in thickness, the majority being in the order of 1/4 to 1/2 inch in thickness.

The Atterberg limits for the various cohesive layers are as follows:

<u>Type</u>	<u>Liquid Limit</u> <u>(WL%)</u>	<u>Plastic Limit</u> <u>(WP%)</u>	<u>Moisture Content</u> <u>(W%)</u>
Dark Grey Clay	40% - 62%	20% - 27%	42% - 63%
Light Grey Clay	31% - 48%	20% - 25%	20% - 44%
Brown Clay	43% - 57%	19% - 27%	41% - 59%
Grey Clayey Silt to Silt.	21% - 30%	19% - 22%	23% - 34%

Field and laboratory shear strength measurements and Standard Penetration tests gave the following results:

Field Vane	380 p.s.f.	-	>2000 p.s.f.
Quick Triaxial	240 p.s.f.	-	1110 p.s.f.
Unconfined Compression ..	200 p.s.f.	-	1500 p.s.f.
Laboratory Vane	205 p.s.f.	-	1710 p.s.f.
Vane	270 p.s.f.	-	840 p.s.f.
Standard Penetration ...	1 blow/30 in.	-	12 blows/ft.

The above table shows an extremely wide scatter of test results, and in order to arrive at a realistic value for the average undrained shear strength for the overall clay deposit, it is necessary

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

4.3) Layered Clay: (cont'd.) ...

to investigate the validity of various types of tests. The deposit consists of cohesive layers of clayey silt, silty clay, clay and non-cohesive layers of silt and sand. The presence of non-cohesive layers results in disturbance during sampling and in handling thereafter, and the final effect is the lowering of the undrained strength of the sample. In consequence, the laboratory unconfined shear strength tests are likely to give greatly reduced values. Due to the nature of the test, the above effect would be much less severe for triaxial tests. In the case of in-situ field vane tests, the presence of non-cohesive layers would tend to increase the strength of the actual soil under test due to the consolidation effect which takes place almost immediately.

In the light of the foregoing, all shear strength test results have been reviewed with regard to validity. The following table has been prepared as a result of this review, and shows the estimated undrained shear strength range of various locations, together with the recommended values to be used for design purposes.

Section Location	B.H. Applicable	Estimated Range of Shear Strength (p.s.f.)	Design Shear Strength
Sta. 84+56	1, 6 and 7	335 to 1100	400
Sta. 85+00	15, 17 and 18	320 to 1000	400
Sta. 85+50	2, 5, 8, 9 and 14	330 to 850	350
Sta. 86+00	13 and 19	500 to 1040	500
Sta. 86+50	3, 4 and 10	450 to 1200	500
Sta. 87+00	11 and 12	400 to 1200	450

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

4.4) Silty Sand with Gravel and Boulders:

The third deposit found at the site consists of silty sand with gravel and occasional boulders. Maximum penetration into this deposit occurred in borehole #11 where it was investigated to a thickness of 27 ft. Gravel and boulder content in the stratum was quite irregular, varying sharply in the various boreholes. Maximum thickness of boulders encountered was about 8 - 9 in. Average grain-size distribution results for the stratum were as follows: Gravel 20%, sand 62%, silt 14%, clay 4%. Standard Penetration Test (N) results varied from 2 blows/ft. to 68 blows/1 in., indicating a relative density of very loose to very dense.

5. GROUND WATER:

During the foundation investigation, water level observations were carried out in the boreholes. The observed levels varied irregularly, ranging from ground level to 3.5 ft. below ground level. The exact water levels are recorded on the appropriate borelog sheets as well as on Dwg. 65-F-119B.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to reconstruct Hwy. #63 from the North Bay city limits to some 8 miles east. Approximately 2.5 miles east of the city limits this necessitates the realignment of the centre-line to within 25 ft. of the edge of Trout Lake (Delaney Bay). Subsoil at this site consists of deposits of very loose to loose silty sand (containing occasional thin layers of organic silt), very soft to firm layered clay and very loose to very dense silty sand with gravel and occasional boulders.

cont'd. /7 ...

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

Stability analyses in terms of total stresses, have been carried out on sections of the highway as proposed by the North Bay Regional Road Design office as shown on their cross sections with the following assumptions:

Roadway Width - 44 feet.

Fill Material

Rock fill side slopes 1-1/4:1

Bulk Density γ = 120 p.c.f.

ϕ = 45°

(Taking into account the strength of the fill)

Natural Material

i) Silty sand γ = 115 p.c.f.

ϕ = 30°

ii) Silty clay C = Variable - depending upon the section.

γ = 115 p.c.f.

Note: The boundaries of various soils strata are shown on the cross sections appended in this report.

The results of the stability analyses indicated that berms would be required on the lake side to ensure the stability of the embankment, between Sta. 84+50 and Sta. 86+00. Dwg. 65-F-119B shows the details of the required berm section and the transition from zero berm to full berm width.

The foregoing recommendations have already been summarized in a memo to Mr. H. McArthur, Regional Road Design, Northern Region, dated April 21, 1966, by Mr. A. G. Stermac, Principal Foundation Engineer.

cont'd. /8 ...

7. SUMMARY:

A foundation investigation at the site of the proposed embankment between Sta. 84+50 and Sta. 86+50 on Hwy. #63, 2.5 miles east of North Bay city limits is reported.

Subsoil at the site consists of deposits of loose silty sand and layered clay, the details of which are given in the bulk of the report.

It is recommended that berms be constructed to ensure the stability of the proposed fill section between Sta. 84+50 and Sta. 86+00.

8. MISCELLANEOUS:

The field work was performed in October, 1965, by Mr. A. Barsvary, Project Foundation Engineer, and in March 1966, by Mr. R. Magi, Project Foundation Engineer. The preparation of this report was undertaken by Mr. R. Magi. The investigations were carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Canadian Longyear Ltd. of North Bay.

May 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 84/56, 11' Rt.

ORIGINATED BY A.B.

W.F. 270-62

BORING DATE Oct. 26, 1965

COMPILED BY A.B.

DATUM Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

CHECKED BY

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.2

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+42, 70' Rt. ORIGINATED BY A.B.
W.P. 270-62 BORING DATE October 27, 1965 COMPILED BY A.B.
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HR

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 86450, 40' Rt.

ORIGINATED BY A.B.

W. P. 270-62

BORING DATE October 28, 1965

COMPILED BY A.B.

DATUM Geodetic

BOREHOLE TYPE Washboring & Cone Penetration

CHECKED BY

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— wp	WATER CONTENT ——— w	WATER CONTENT %		
664.5	Groundlevel											
0	Silty Sand											
	V. Loose		1	SS	3							
654.5			2	SS	1							
10	Layered Clay		3	TW	P							
			4	TW	P							
			5	TW	P							
645.0	Firm to Stiff		6	TW	P							
19.5			7	TW	P							
642.5	Silty Sand Loose		8	TW	P							
22	End of Borehole		9	SS	7							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.4

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 86+50, 30' Lt. ORIGINATED BY R.M.
W.P. 270-62 BORING DATE March 4, 1966 COMPILED BY R.M.
DATUM Geodetic BOREHOLE TYPE Washboring & Cone Penetration CHECKED BY ML

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT ——— w_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
							20 40 60 80 100							
671.8	Ground Level													
0	Silty Sand					670								
	V. Loose to Loose		1	SS	5									
658.3			2	SS	2	660								
13.5	Layered Clay		3	SS	2									
			4	SS	2									
			5	SS	2									
	Soft to Stiff		6	SS	3	650								
647.3			7	SS	2									
			8	SS	4									
645.8	Silty Sand with Gravel		9	SS	6									
26	End of Borehole		10	SS	50/1"									

Gr-2%
Sa-91%
Si&Cl-7%

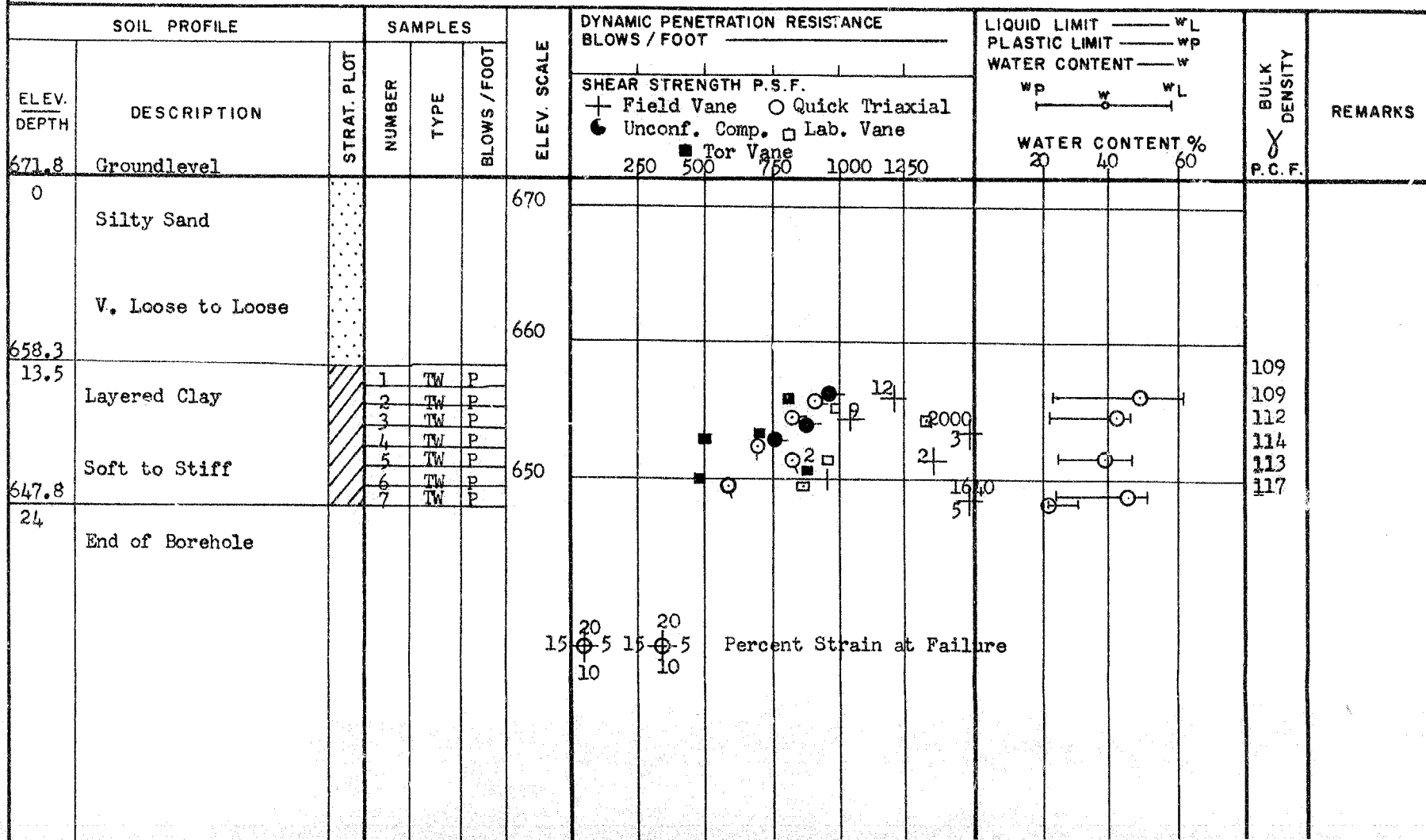
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4A

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 86+50, 30' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 7, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HL



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 85450 E

ORIGINATED BY RM

W. P. 270-62

BORING DATE October 29, 1965

COMPILED BY _____ RM

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY

RECORD OF BOREHOLE NO.5

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _p WATER CONTENT ——— w			BULK DENSITY Y P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. + Field Vane O Quick Triaxial ● Unconf. Comp					WATER CONTENT % w _p w w _L				
666.5	Groundlevel						250	500	750	1000	1250	20	40	60		
0	Silty Sand					660										
656.0																
10.5	Layered Clay		1	TW	P											
648.0	Soft to Firm					650										
18.5	Silty Sand with Gravel															
641.5																
25	End of Borehole					640										

DEPARTMENT OF HIGHWAYS - ONTARIO						RECORD OF BOREHOLE NO. 6								FOUNDATION SECTION		
MATERIALS & TESTING DIVISION																
JOB	65-F-119					LOCATION	Sta. 84+60, 35' Lt.					ORIGINATED BY R.M.				
W.P.	270-62					BORING DATE	Feb. 28, 1966					COMPILED BY R.M.				
DATUM	Geodetic					BOREHOLE TYPE	Washboring & Cone Penetration					CHECKED BY <i>[Signature]</i>				
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	WATER CONTENT % WP W WL 20 40 60				
670.6	Ground Level					670										
0	Silty Sand		1	SS	21											
666.1	compact															
4.5	Layered Clay		2	SS	3											
662.1	Soft to stiff		3	SS	5											
661.1	Silty Sand		4	SS	27	660										
9.5	End of Borehole															

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 6A

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 84/60 35' Lt.

ORIGINATED BY R.M.

W. P. 270-62

BORING DATE March 1, 1966

COMPILED BY R. M.

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY

[illegible]

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85/50 30 RT. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 2, 1966 COMPILED BY _____
DATUM Geodetic BOREHOLE TYPE Washboring & Cone Penetration CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
							20 40 60 80 100	WP	WL		
							SHEAR STRENGTH P.S.F.		WATER CONTENT % 20 40 60		
663.4	Waterlevel										
661.6	Water					660					
1.8	Silty Sand with layers of Org. Silt		1	SS	2						
			2	SS	3/18"						
			3	SS	1/18"						
	V. Loose		4	SS	P	650					
648.4			5	SS	2/18"						
15			6	SS	4						
	Layered Clay		7	SS	2						
	Soft to stiff		8	SS	3						
			9	SS	3						
641.1			10	SS	2/18"	640					
22.3			11	SS	5						
	Silty Sand with Gravel and Occ. Boulders		12	SS	55						
633.9	Loose to V. Dense		13	SS	50/1"						
29.5	End of Borehole					630					

FOUNDATION SECTION

ORIGINATED BY RM

COMPILED BY RM

CHECKED BY [Signature]

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 35+50 23' Lt. ORIGINATED BY R.M.
W.P. 270-62 BORING DATE March 3, 1966 COMPILED BY R.M.
DATUM Geodetic BOREHOLE TYPE Washboring & Cone Penetration CHECKED BY SR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.				
							20	40	60	80	100					
671.3	Ground Level															
0	Silty Sand					670									34% Org'ts Gr-1% Sa-79% Si-15% Cl-5%	
	Loose to Compact		1	SS	4											
658.8			2	SS	38	660									Gr-45% Sa-37% Si-14% Cl-4%	
12.5	Layered Clay	3	SS	2/18"												
653.0	V. Soft to Stiff	4	SS	2/18"												
18.3		5	SS	1/18"												
	Silty Sand with Gravel and occ. Boulders	6	SS	12		650										
644.2	very dense	7	SS	100/5"												
27.1	End of Borehole				50/1"											

34% Org's

Gr-1%
Sa-79%
Si-15%
Cl-5%

Gr-45%
Sa-37%
Si-14%
Cl-4%

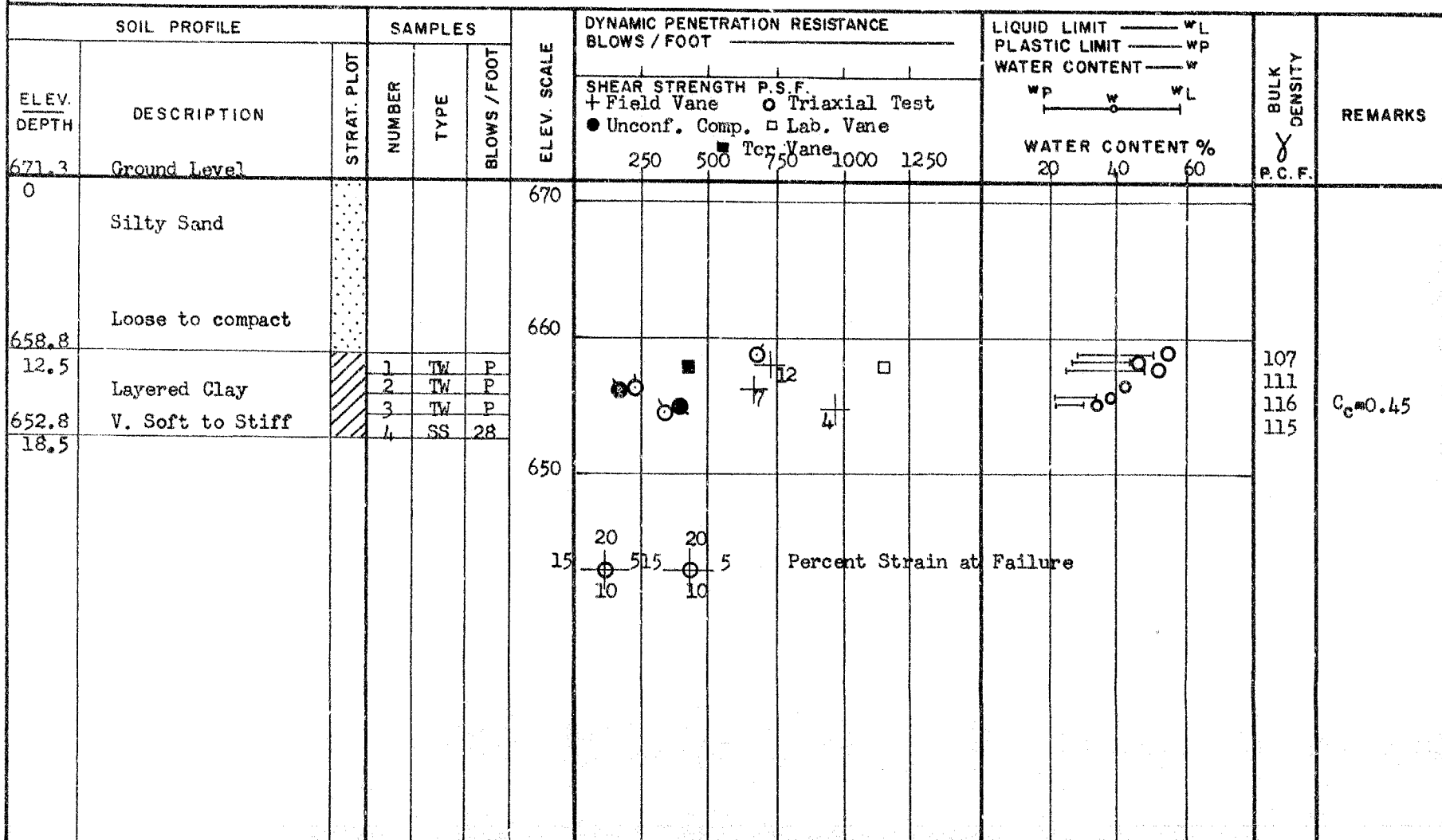
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9A

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+50 23 Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 3, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY [Signature]



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 86+50 6

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 7, 1966

COMPILED BY RM

DATUM Geodetic

BOREHOLE TYPE Washboring and Cone Penetration

CHECKED BY AK

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

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 % 20 40 60	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
669.2 0	Ground Level									
658.2 11	Silty Sand		1	SS	22	660				
	Compact									
649.7 19.5	Layered Clay		2	SS	4	650				
			3	SS	2					
			4	SS	2					
			5	SS	2					
			6	SS	3					
			7	SS	2/18"					
667.7 31.5	Silty Sand with Gravel and occ. Boulders		8	SS	8	640				
	Loose to Dense		9	SS	9					
	End of Borehole		10	SS	31					

CHECKED BY HE

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY γ P.C.F.	REMARKS				
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane o Triaxial Test ● Unconf. Comp. □ Lab. Vane		WATER CONTENT % W _P W W _L							
669.2	Ground Level						250	500	750	1000	1250	20	40	60		
0	Silty Sand Compact					660										
658.2																
11	Layered Clay		1	TW	P											
			2	TW	P											
			3	TW	P											
	Soft to Hard		4	TW	P											
650.2			5	TW	P											
19	End of Borehole					650										
							20	20								
							15	15	5							
							10	10								
										Percent Strain at Failure						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION

Sta. 87,400

30' Rt.

ORIGINATED BY RM

W. P. 270-62

BORING DATE

March 8, 1966

COMPILED BY R.M

DATUM Geodetic

BOREHOLE TYPE

Washboring & Cone Penetration

CHECKED BY

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w w_p ——— w ——— w_L WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
668.2	Ground Level									
0	Silty Sand									
659.7	Loose		1	SS	10					
8.5			2	SS	2	660				
	Layered Clay		3	SS	2					
			4	SS	2 1/8"					
			5	SS	2 1/8"					
			6	SS	2					
650.2	Soft to Stiff		7	SS	2					
18			8	SS	5	650				
			9	SS	3					
	Silty Sand with Gravel and occ. Boulders									
			10	SS	8	640				
			11	SS	6					
			12	SS	8 5/8"	630				
			13	SS	18					
			14	SS	30 1/4"					
622.8	Loose to V. Dense		15	RC	-					
45.4	End of Borehole		16	SS	7 5/2"	620				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

W. P. 270-62

DATUM Geodetic

LOCATION _____ Sta. 87+00 30' Rt.

BORING DATE March 9, 1966

BOREHOLE TYPE Washboring

RECORD OF BOREHOLE NO. 11A

FOUNDATION SECTION

ORIGINATED BY RM

COMPILED BY RM

CHECKED BY

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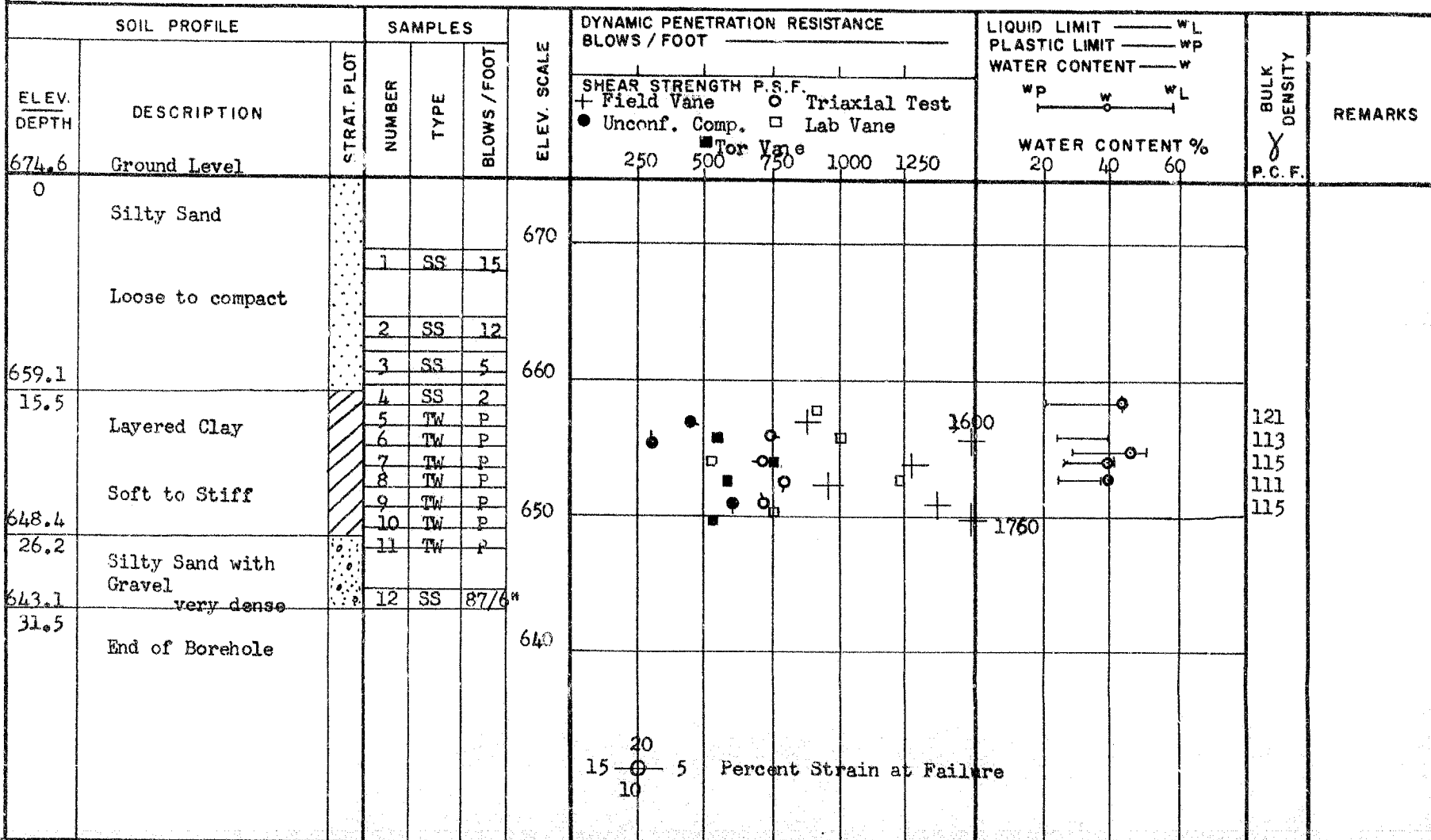
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 87+00 25' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 9, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY AL



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-119

LOCATION Sta. 86+00 50' Rt.

ORIGINATED BY RM

W. P. 270-62

BORING DATE March 10, 1966

COMPILED BY _____ RM








DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY _____

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W WP W WL WATER CONTENT %			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane ⊗ Triaxial Test ● Unconf. Comp. □ Lab Vane									
663.4	Water Level					660										
0	Water															
657.1																
6.3	Silty Sand		1	SS	2/18"	650										
	V. Loose to Loose		2	SS	5											
643.9																
19.5	Layered Clay		3	TW	P											
640.4	Soft to Firm		4	TW	P	640										
23	Silty Sand		5	SS	2											
	V. Loose to Loose		6	SS	5											
631.9																
31.5	End of Borehole					630										
							20									
							15	⊕	5	Percent Strain at Failure						
							10									

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+50 50' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 10, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HL

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		SHEAR STRENGTH P.S.F. + Field Vane • Unconf. Comp. □ Lab Vane ■	WATER CONTENT %				
663.4	Waterlevel											
0	Water					660						
653.9												
9.5	Silty Sand with occ. layers of Org. Silt					650						
	Very Loose		1	SS	2							
			2	TW	P							
			3	TW	P							
642.4			4	SS	2							
640.4	Layered Clay		5	TW	P	640						
23	Silty Sand with Gravel and occ. Boulders		6	TW	P							
631.9	Very dense		7	SS	152							
31.5	End of Borehole					630						

Percent Strain at Failure

5.1% Org's.

123

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 15

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+00 35' Rt. ORIGINATED BY RM
W.F. 270-62 BORING DATE March 11, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HR

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		SHEAR STRENGTH P.S.F. + Field Vane O Triaxial Test □ Lab Vane ■ Tor Vane 250 500 750 1000 1250						WP — W — WL WATER CONTENT %				
663.4	Water Level																
0	Water					660											
659.9																	
3.5	Silty Sand with Layers of Org, Silt																
	Very Loose		1	SS	2/18"												
			2	TW	"	650											
			3	TW	P												
646.9			4	TW	P												
16.5	Layered Clay Soft to Stiff		5	TW	P												
			6	TW	P												
642.8			7	TW	P												
641.3	Silty Sand		8	TW	P												
22.1	End of Borehole		9	SS	34	640											

20
15 — 5 PERCENT STRAIN AT FAILURE
10

92
83
106

6.5% Org's
6.1% Org's
8.1% &
14.5% Org's

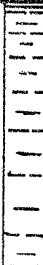
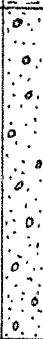
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 16

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 84+60, 60' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 11, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY AL

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		SHEAR STRENGTH P.S.F.				wp — w — WL					
							WATER CONTENT %									
663.4	Waterlevel															
0	Water					660										
647.9						650										
15.5	Silty Sand with Gravel and occ. Boulders		1	SS	3	640										
			2	SS	46											
	V. Loose to V. dense		3	SS	21	630										
628.5			4	SS	50/1'											
34.9	End of Borehole														Gr. 57% Sa. 39% S1&Cl 4% Gr. 1% Sa 86% S1&Cl 13%	

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.17

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 85+00 70' Rt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 15, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY SR

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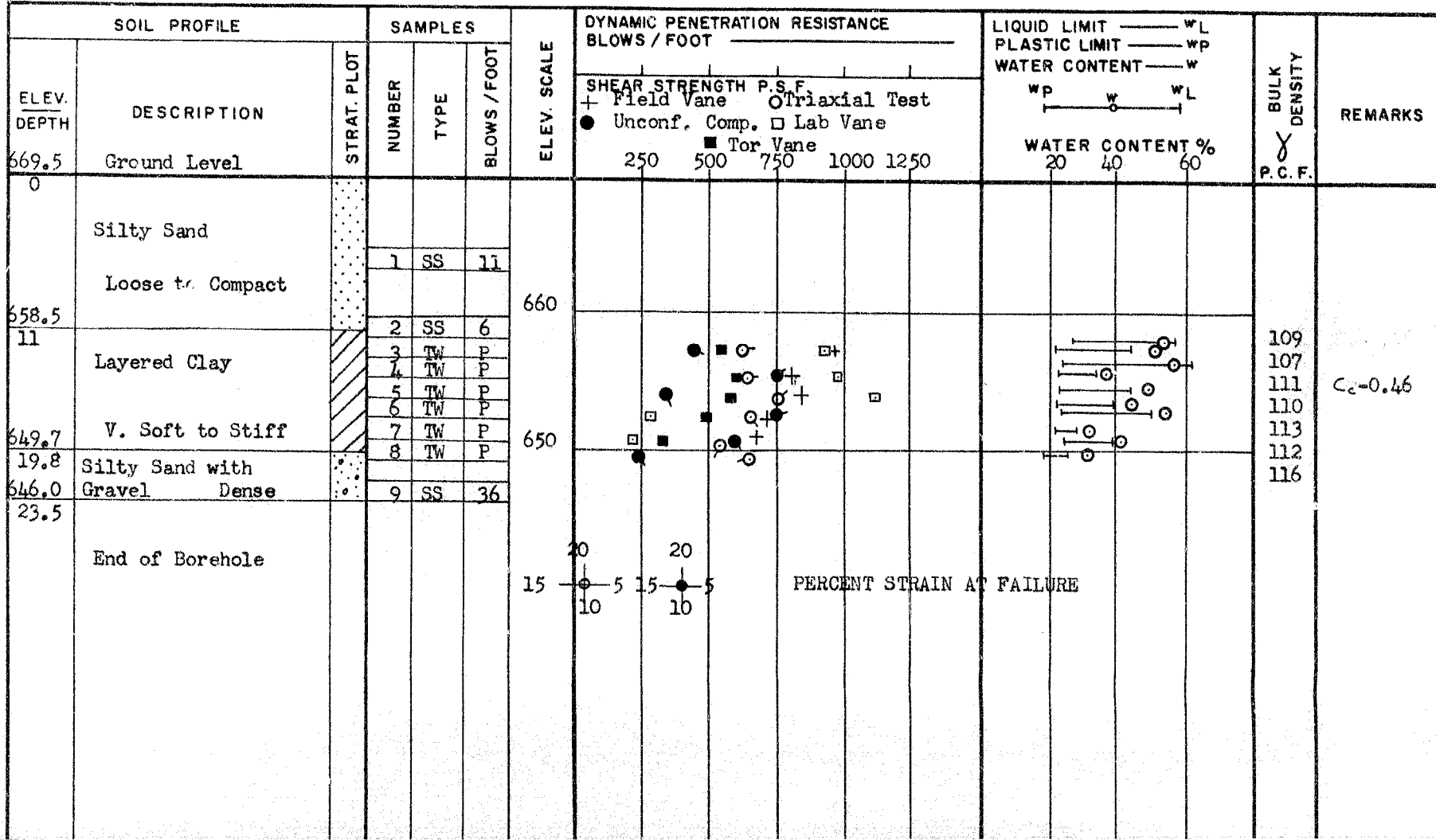
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 18

FOUNDATION SECTION

JOB 65-P-119 LOCATION Sta. 85+00 12' Lt. ORIGINATED BY RM
W.P. 270-62 BORING DATE March 16, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY HL



OFFICE REPORT ON SOIL EXPLORATION

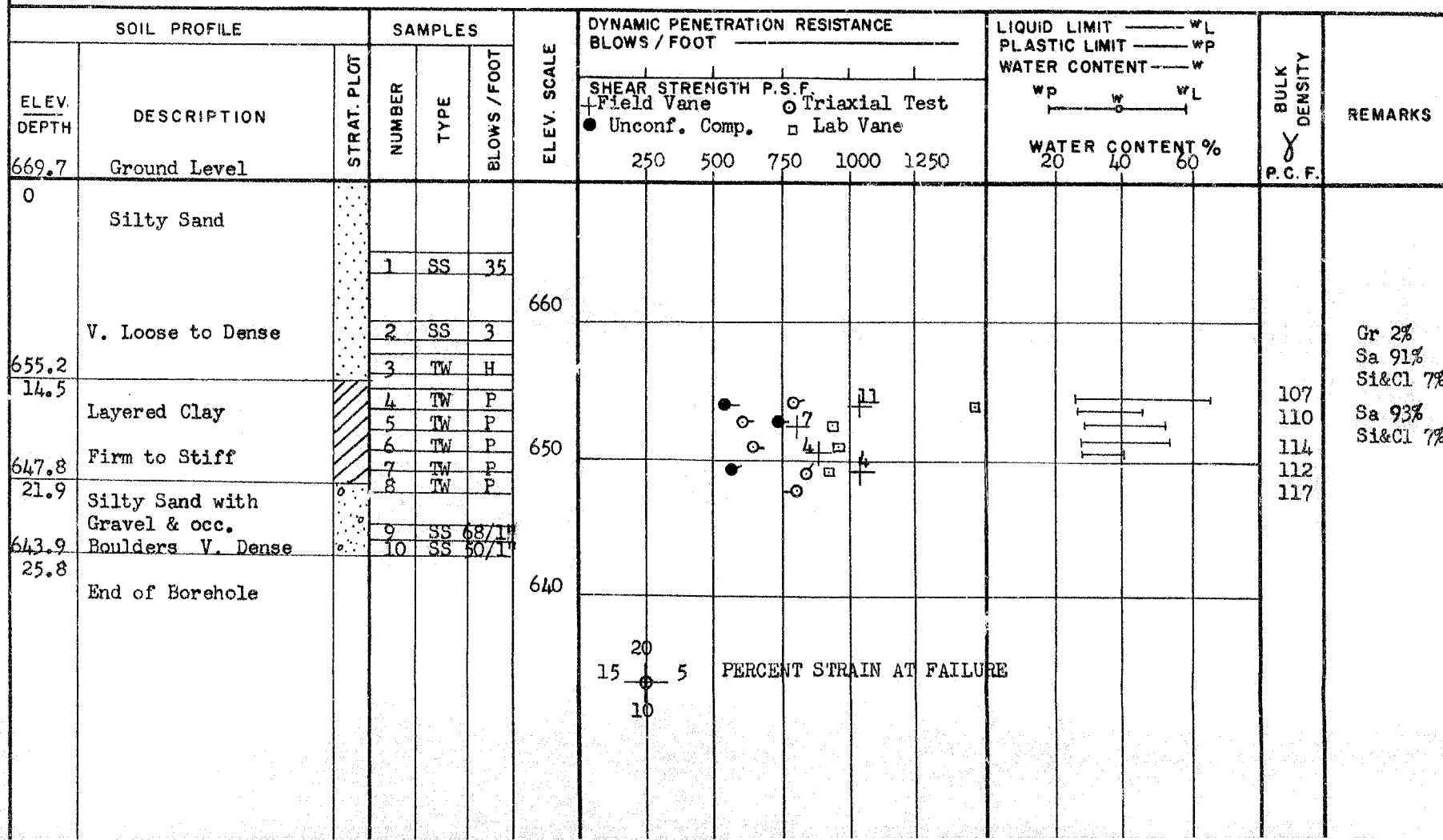
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 86+00 19' Lt. ORIGINATED BY RM
 W.P. 270-62 BORING DATE March 16, 1966 COMPILED BY R.M
 DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY SR



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 20

FOUNDATION SECTION

JOB 65-F-119LOCATION Sta. 83+75 65' Rt.ORIGINATED BY RMW.P. 270-62BORING DATE March 17, 1966COMPILED BY R.M.DATUM GeodeticBOREHOLE TYPE WashboringCHECKED BY RL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w _L PLASTIC LIMIT — w _p WATER CONTENT — w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					w _p — w — w _L WATER CONTENT %				
							+ Field Vane	o Triaxial Test								
663.4	Waterlevel							250	500	750	1000	1250				
661.9 1.5	Water					660										
	Silty Sand		1	SS	3											
	V. Loose to Compact		2	SS	15	650										
648.2 15.2	Layered Clay		3	SS	2/18"											
643.9	Soft to Firm		4	TW	P											
19.5			5	TW	H											
	Silty Sand with Gravel		6	SS	27											
636.9 26.5	Compact to Dense		7	SS	38	640										
	End of Borehole															
							20 15 — 5 10					PERCENT STRAIN AT FAILURE				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

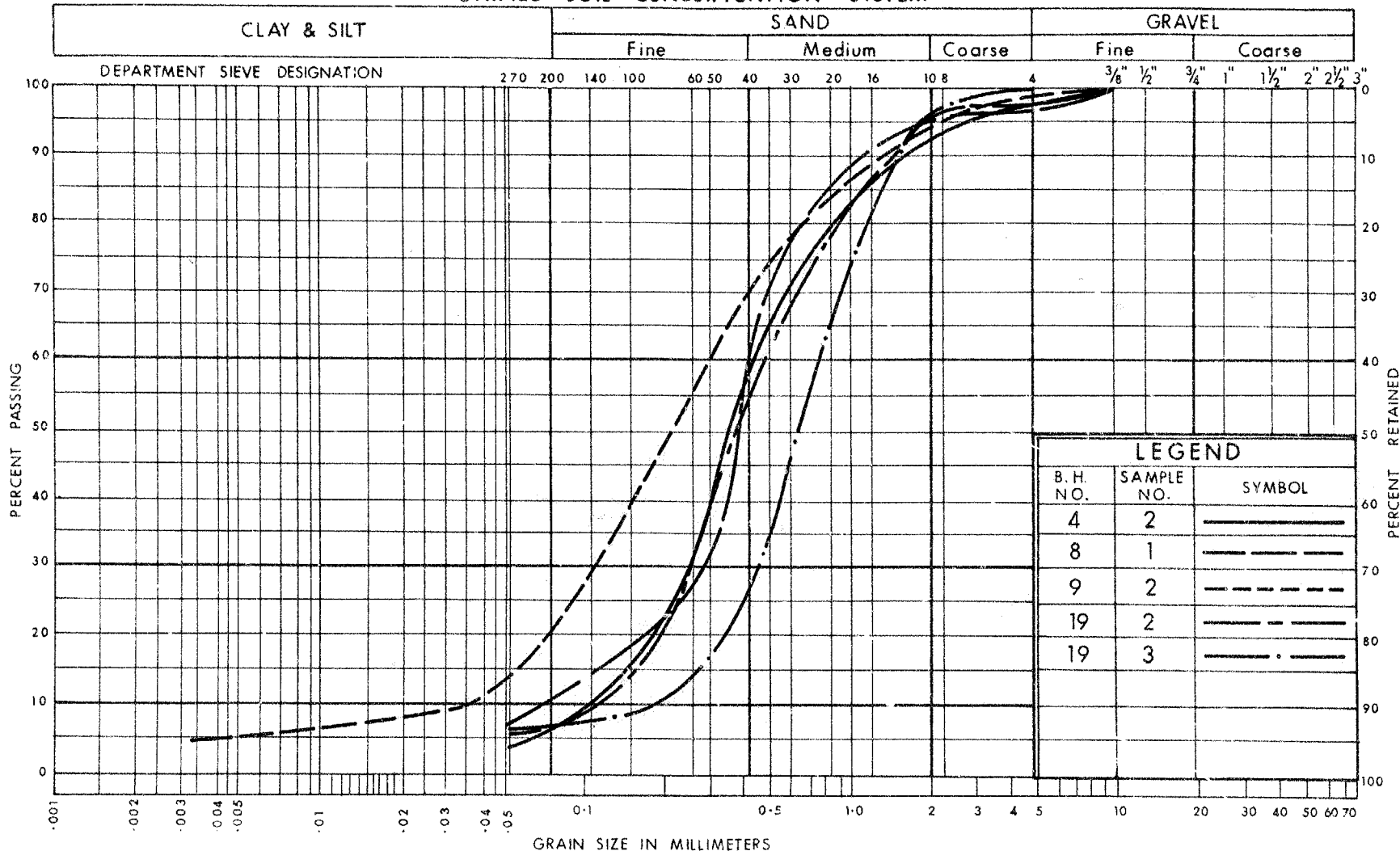
RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-F-119 LOCATION Sta. 82+70 65' Rt. ORIGINATED BY RM
W.P. 270-64 BORING DATE March 18, 1966 COMPILED BY RM
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY AK

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		SHEAR STRENGTH P.S.F. + Field Vane ° Unconf. Comp. 250 500 750 1000 1250	WATER CONTENT % WP — W — WL			
663.4	Waterlevel										
661.9	Water					660					
1.5	Silty Sand										
657.2	V. Loose		1	SS	2						
6.2	Layered Clay		2	TW	P						
654.4	Soft to Firm		3	TW	P						
9	Silty Sand with Gravel and Occ. Boulders		4	SS	80/6"						
	Compact to V. Dense		5	SS	29	650					
641.9			6	SS	41						
21.5	End of Borehole					640					

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO

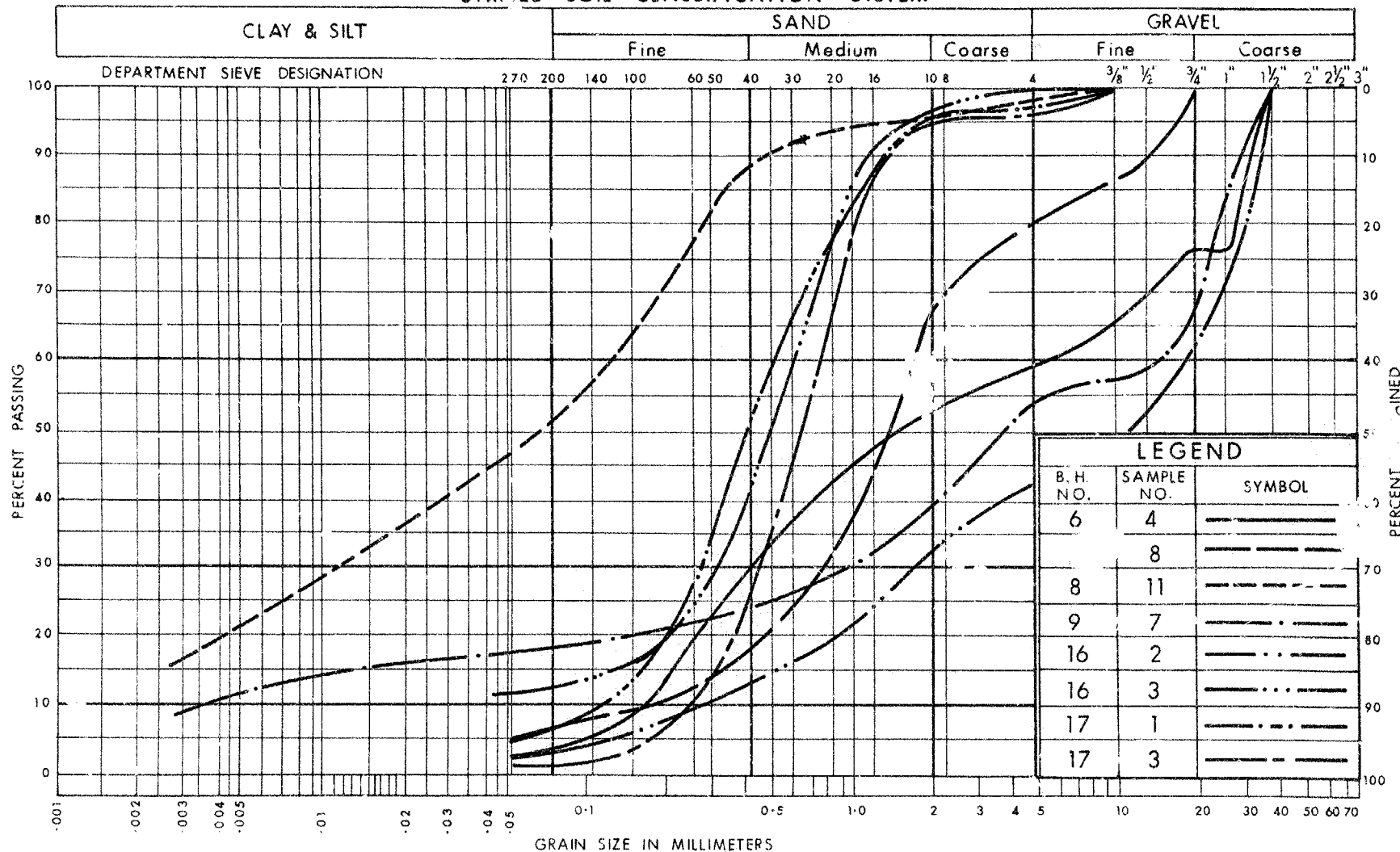
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SILTY SAND

W.P. No. 270-62

JOB No. 65-F-119

UNIFIED SOIL CLASSIFICATION SYSTEM

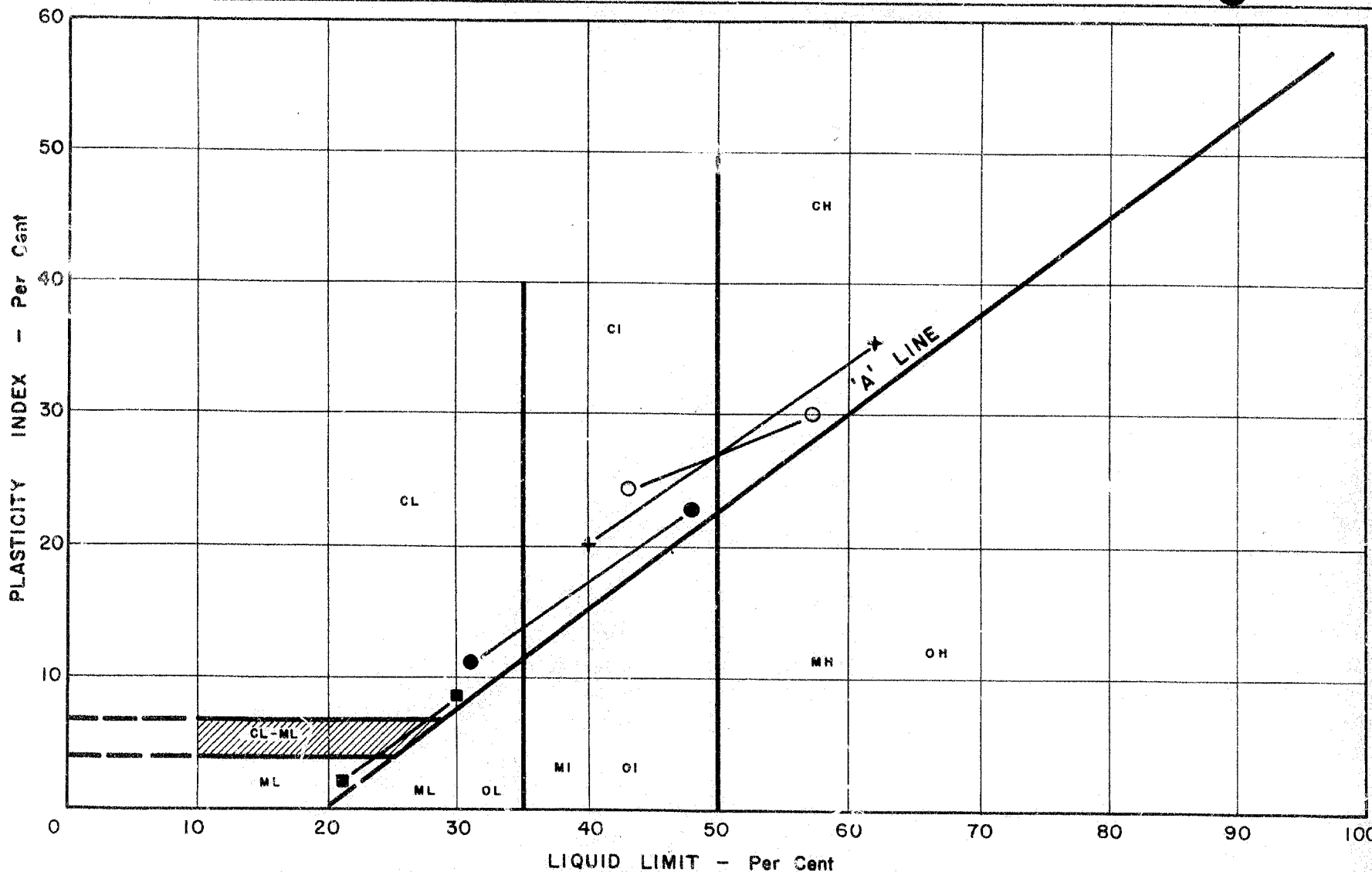


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH OCC. GRAVEL & BOULDERS

W.P. No. 270-62

JOB No. 65-F-119



NOTES

- RANGE OF BROWN CLAY
- RANGE OF SILTY CLAY
- RANGE OF CLAYEY SILT
- + RANGE OF DARK GREY CLAY

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIAL AND TESTING DIVISION
PLASTICITY CHART
Job No. 65-F-119 W.P. No. 270-62
Location Hwy. 63 at Trout Lake

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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ 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

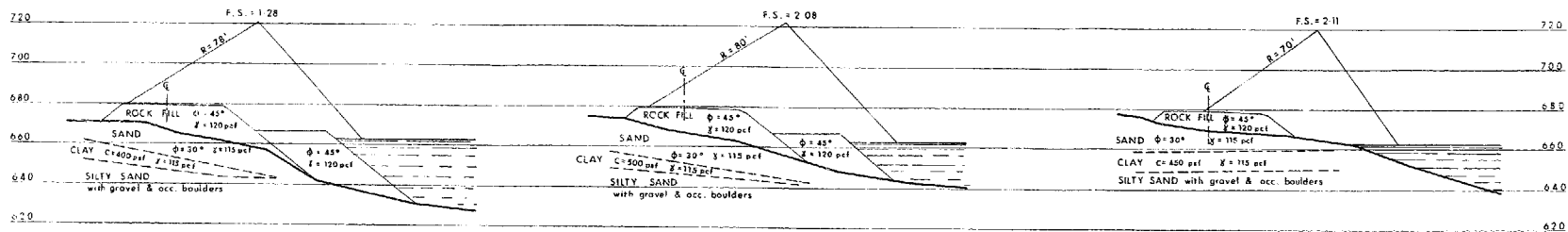
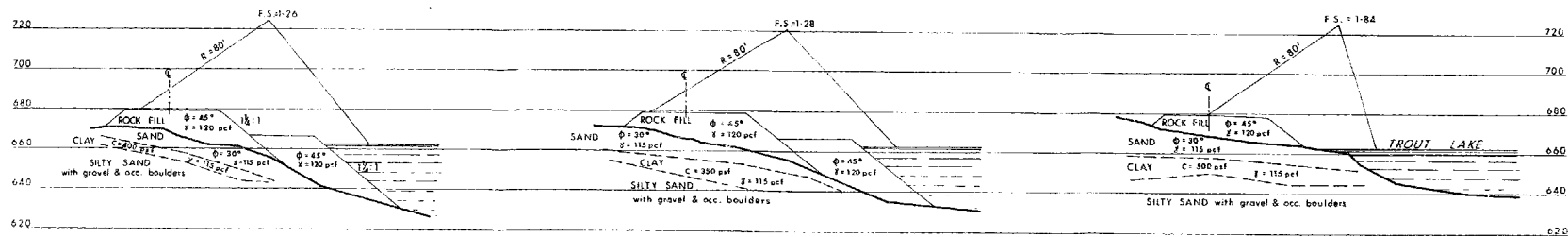
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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



SCALE FOR SECTIONS
 1 in. = 40 ft.

 ONTARIO	DEPARTMENT OF HIGHWAYS MATERIALS AND TESTING DIVISION	HIGHWAY 63 - EMBANKMENT STABILITY TROUT LAKE CROSS-SECTIONS	
	DATE 15 JUNE 1966	W.P. 270-62 APPROVED <i>[Signature]</i>	DIST. 13 JOB 65-F-119
		DRAWING NO. 65-F-119C	

STABILITY OF SECTIONS

Sta.	Length & Height of Berm	C	F. S.
84/56	No Berm	350	0.73
" "	" "	400	0.78
" "	" "	450	0.83
" "	" "	500	0.86
84/50	Extends to 70' from \bar{E} , ht. at W.L.	350	1.15
		400	1.21
		450	1.26
		500	1.31
85/00	Extends to 70' from \bar{E} , ht. at W.L.	350	1.21
		400	1.26
85/50	Extends to 80' from \bar{E} , ht. 3' above W.L.	350	1.43
85/50	Extends to 75' from \bar{E} , ht. 3' above W.L.	350	1.28
85/50	Extends to 70' from \bar{E} , ht. at W.L.	350	0.91
		400	0.98
		450	1.05
		500	1.12
86/00	Extends to 70' from \bar{E} , ht. at W.L.	500	2.04
86/00	No Berm	500	1.35
86/50	No Berm (circle 1)	200	1.21
		250	1.27
		300	1.33
		350	1.38
		400	1.44
		450	1.49
		500	1.52
86/50	No Berm (circle 2)	200	0.95
" "	" "	250	1.10
" "	" "	300	1.24
" "	" "	350	1.38
" "	" "	400	1.54
" "	" "	450	1.69
" "	" "	500	1.84

STABILITY OF SECTIONS (cont'd)

Sta.	Length & Height of Berm	C	F.S.
87+00	No Berm	200	1.15
	" "	250	1.30
	" "	300	1.46
	" "	500	2.11

200 400 600 800 1000 1200 1400 1600 1800

23-F-113

SECTION STA 84.56

(BHS 1, G&T)

+ FIELD VANE
 O TRIAXIAL TEST
 * DUCLOU COMP
 □ LAB VALUE
 ■ TOR VALUE

670

665

660

655

650

645

640

10

+

+

□

□

+

○

○

○

○

○

+

○

○

+

BOREHOLE No. 6A

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB VALUE			TOR VALUE			FIELD VALUE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 1	5'-6" - 5'-11"	1500 (1)	mainly E & B some C	5'-11" - 6'-4"	1110 (1)	mainly B some E & C	6'-4 1/2"	525	1/3 E 4/3 B	6'-5 3/4"	480	B	640 "
Tw 2				7'-5" - 7'-10"	410 (1)	mainly B & E some " sand some of C	7'-11"	155	1/2 E 1/2 B				380 "

BOREHOLE 7A

Tw 2	16'-6" - 16'-11"	335 (1)	mainly B & E some of middle then some sand	16'-11" - 17'-4"	530 (1)	1/3 B 1/3 E some of sand mainly of sand	17'-5"	205	E	17'-5 3/4"	480	A	800 "
Tw 3				17'-11" - 18'-4"	240 (1)	mainly B & E some of sand 3 seams C	18'-10 1/2"	125	B	18'-11 3/4"	270	E	700 "

BOREHOLE 1

No LAB SHEAR STRENGTH TESTS

200 400 600 800 1000 1200 1400 1600 1800 2000

65-F-119

670

SECTION STA 85+00
(BHs 15, 17, 18)

665

660

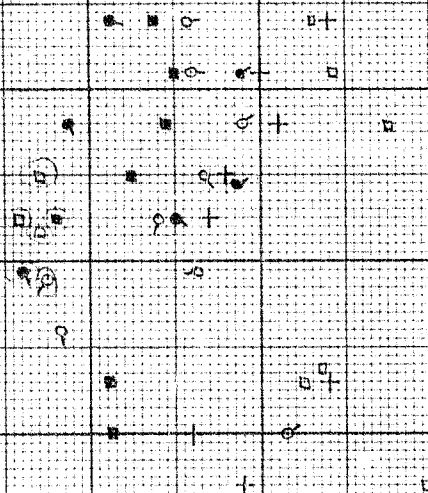
655

650

645

640

+ FIELD VALUE
o TRIAXIAL TEST
● UNCONF COMP
□ LAB VALUE
■ FOR VALUE



BOREHOLE No. 15

65-F-119

SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB. VALUE			TOR. VALUE			FIELD VALUE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 3	13'-7" - 14'-0"	235 ②	Org. silt	14'-0" - 14'-5"	320 ②	Org. silt							
Tw 4				15'-1" - 15'-6"	340 ①	Org. silt							
Tw 5							16'-10 1/4" - 17'-5"	500 575	A & C C & A	16'-11 1/2" - 17'-5 3/4"	560 440	B C & A	560 13
Tw 6				17'-7" - 17'-11"	860 ③	mainly B very clayey s.s. & A & C	18'-11"	1185	1/2 C 1/2 B	18'-11 1/4"	440	B	640 8

BOREHOLE No. 18

Tw 3	12'-0" - 12'-5"	445 ③	mainly B layers of A, C & sand mainly A & B some C & E	12'-5" - 12'-10"	625 4	mainly B layers of A & C	12'-11"	920	B	12'-11 1/4"	530	A	560 12
Tw 4	13'-3" - 13'-8"	760 ③		13'-8" - 14'-1"	640 5	mainly A & B layers of E	14'-5"	975	C & A	14'-5 3/4"	600	C	800 8
Tw 5	14'-11" - 15'-4"	345 ②	Layer E at top Rest B with some A & C	15'-4" - 15'-9"	760 5	A, B & C some mud	15'-11"	1105	A, B & E	15'-11 1/4"	580	C & A	840 11
Tw 6	16'-6" - 16'-11"	740 ③	B with layers of A & C	16'-11" - 17'-4"	670 8	1/2 B, rest is A, C, E & sand	17'-5"	280	B	17'-5 3/4"	500	B	720 7
Tw 7	17'-5" - 18'-0"	595 ⑦	A, B & C with layers of E & some of sand	18'-5" - 18'-10"	560 12	1/2 B, 1/2 E, sand in A & C	18'-11"	230	B, C, A	18'-11 1/4"	320 ③	E	680 5
Tw 8	19'-0" - 19'-5"	240 ③	mainly B layers of E some A & mud	19'-5" - 19'-10"	650 14	mainly E some layers of sand							

200 400 600 800 1000 1200 1400 1600

65-F-19

SECTION STA 85+50
(BM 2.5.8.9.14)

+ FIELD MARK
O TRIAXIAL TEST
● UNCONSOLIDATED
■ FILL MARK

C-300 p.s.f.

Found 8-78' 10-110 p.s.f.
8-50 p.s.f.

Found 8-80' 8-45' 8-100 p.s.f.

Notes recorded 8/10/89, 8/14/89

1000

65-E-19

SECTION STA 86+00

(BH's 13 & 19)

+ FIELD VALUE
 O TRINXIAL TEST
 ● THINNESS COMP.
 □ LINE VALUE

C = 0.42

BOREHOLE No. 13

65-7-119

[illegible]

65-1-119

670 200 400 600 800 1000 1200 1400 1600 1800 2000

665

SECTION STA 86+50

(BH-3.4 : 10)

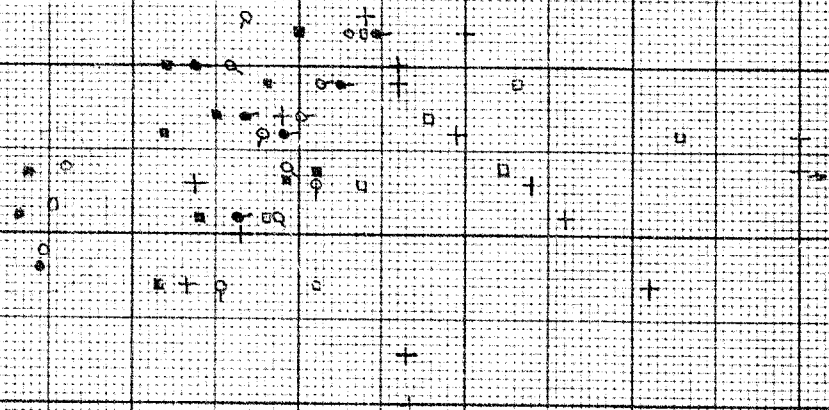
660

655

650

645

6.500 yd



BOREHOLE No. 4A

65-F-110

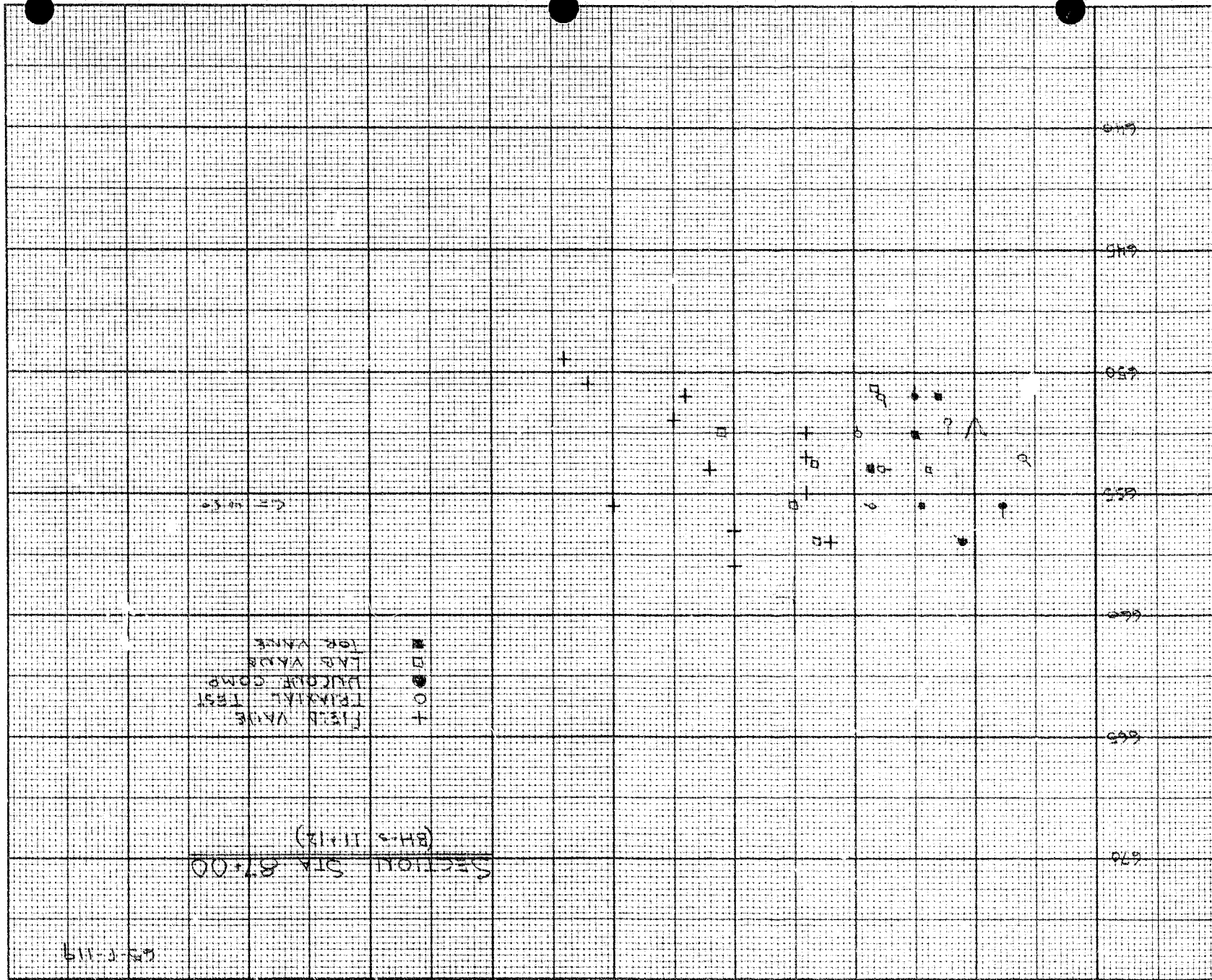
SAMPLE	UNCONFINED COMPRESSION			QUICK TRIAXIAL			LAB			TOR			FIELD VALUE
	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	DEPTH	VALUE	MATERIAL	
Tw 2	15'-6" - 15'-11"	570 ②	mainly A+B some C thin layers of sand mainly A+B sand	16'-1" - 16'-6"	520	mainly A+B some C thin layers of sand	16'-0"	950	A	15'-11 1/2"	800	B	1200 12
Tw 3	17'-0" - 17'-5"	890 ②	C+E, thin sand B, C, D in lines, pattern	17'-5" - 17'-10"	845 ②	mainly A+B some C+D	17'-10 1/2"	1320	A, C, B mainly C thin layers of sand	17'-11 1/4"	720	A	1040 9
Tw 4	18'-6" - 18'-11"	760 ②		18'-11" - 19'-4"	710 ②	mainly C+D, some B sand, C, D	19'-4 1/2"	1710	1/2 C 1/2 A	19'-5 3/4"	480	D	2000 3
Tw 5				20'-5" - 20'-10"	837 ②	mainly A+B thin layers of sand A, B, C	20'-10 1/2"	950	1/2 B 1/2 C	20'-11 1/4"	840	B	1360 2
Tw 6				21'-2" - 21'-7"	605 ②	B, only 1/2 some C, E	22'-5"	845	B	21'-5 3/4"	460	E	960 2

BOREHOLE No. 10A

Tw 1				12'-7" - 13'-0"	670 ②	mainly A+B thin layers of sand A, B, C				12'-11 3/4"	600	C	960 12
Tw 2	13'-3" - 13'-8"	550 ②	mainly B layers of A, C, E and sand	13'-8" - 14'-1"	635 ②	mainly B thin layers of sand	14'-5"	310	sand	14'-5 3/4"	480	E	1040 9
Tw 3	15'-0" - 15'-5"	670 ②	layers of A, B C, E + sand	15'-5" - 15'-10"	800 ②	thin layers of A, B C, E	15'-11"	1105	1/2 B 1/2 C + sand	15'-10 1/4"	620	B	760 7
Tw 4				16'-3" - 16'-8"	765 ②	1/2 B, rest in layers of A, C, E + sand	17'-1"	1290	1/2 A 1/2 B	15'-11 1/4"	580	C	
Tw 5	18'-0" - 18'-5"	650 ②	mainly B layers of A, C, E. some of sand	18'-5" - 18'-10"	755 ②	1/2 B, 1/2 E 1/2 A+C	18'-11"	740	B	17'-2 1/4"	780	B	22000
										18'-11 1/4"	560	B	1440 3

BOREHOLE No. 3A

Tw 4	12'-6" - 12'-11"	150	A, B, C, layers of E + sand	12'-1" - 12'-6"	240	A, B, C, layers of E + sand							560 14
Tw 5	14'-0" - 14'-5"	130	A, B, C layers of E + sand	13'-7" - 14'-0"	210	A, B, C layers of E + sand							640 16
Tw 6	15'-0" - 15'-5"	120	A, B, C, D	15'-6" - 15'-11"	110	A, B, C, D							



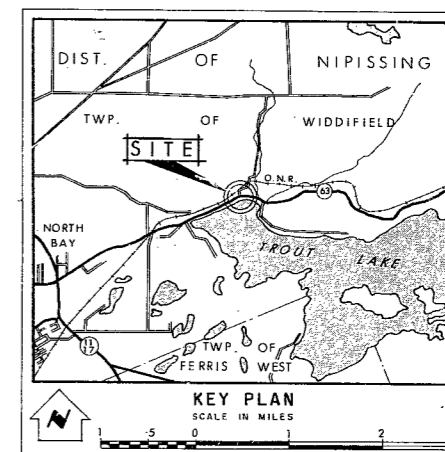
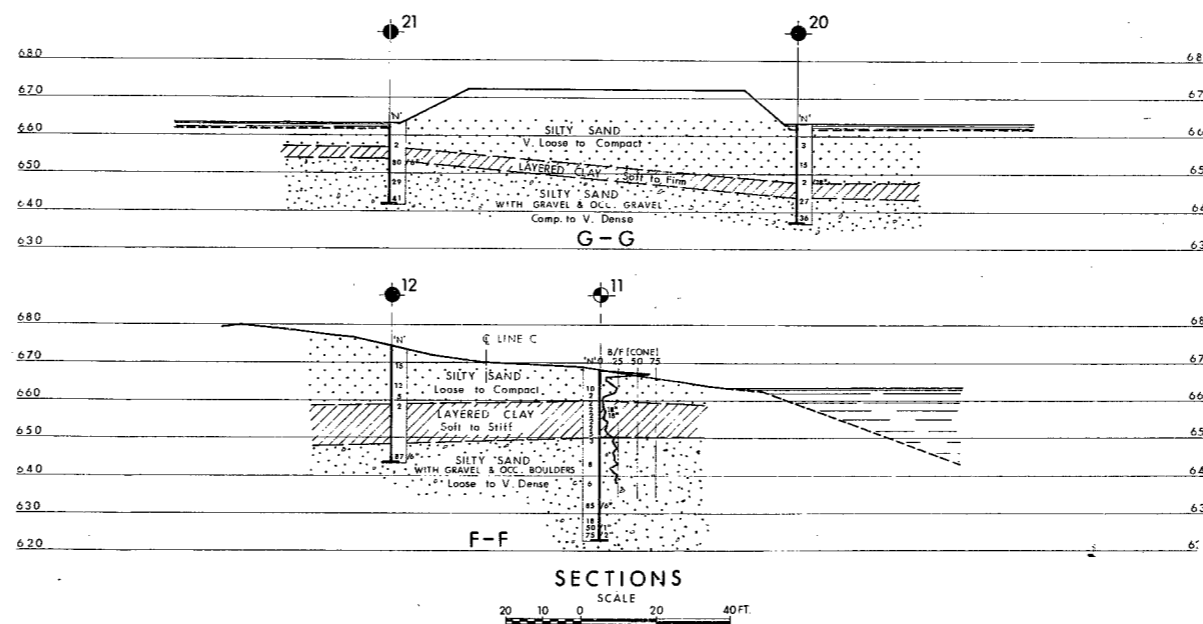
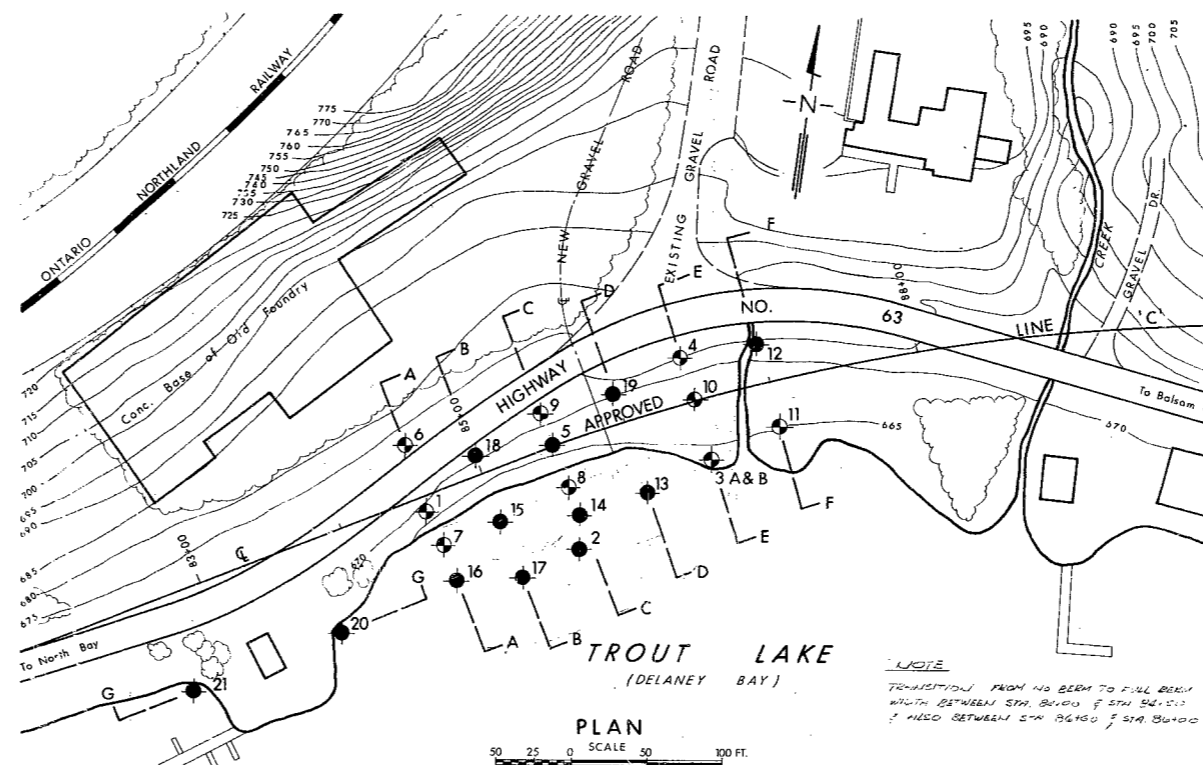
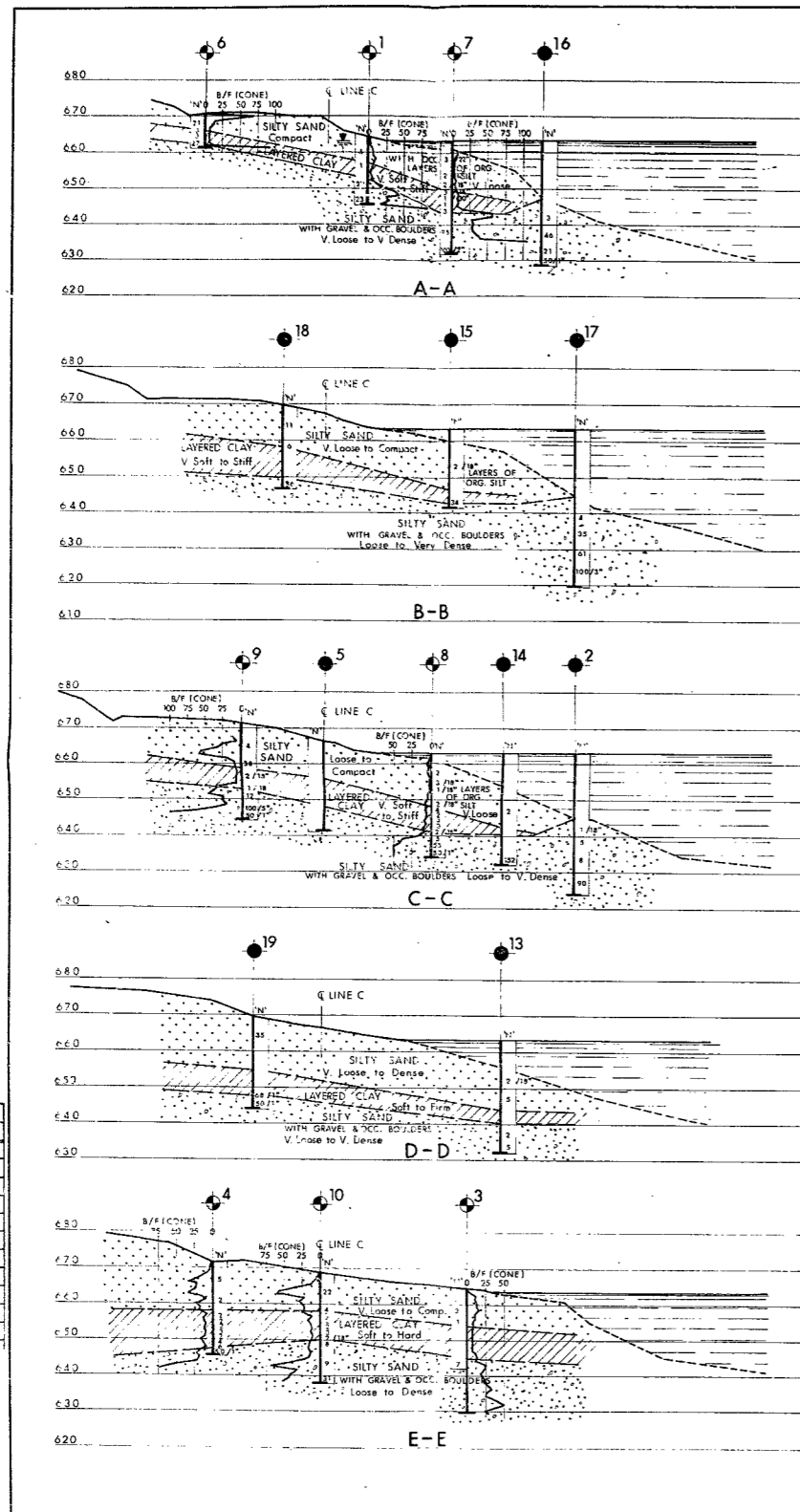
FIELD
VALE

#65-F-119B

W.P. #270-62

Hwy. #63

ε TROUT LAKE



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, OCT. 1965		

NO.	ELEVATION	STATION	OFFSET
1	665.0	84+56	11' RT.
2	663.7	85+42	70' RT.
3	664.5	86+30	40' RT.
4	671.8	86+50	30' LT.
5	666.5	85+50	6
6	670.6	84+60	35' LT.
7	663.4	84+60	35' RT.
8	663.4	85+50	30' RT.
9	671.3	85+50	23' LT.
10	669.7	86+50	5
11	668.2	87+00	30' RT.
12	674.6	87+00	25' LT.
13	663.4	86+00	50' RT.
14	663.4	85+50	50' RT.
15	663.4	85+00	35' RT.
16	663.4	84+60	60' RT.
17	663.4	85+00	70' RT.
18	669.5	85+00	12' LT.
19	669.7	86+00	19' LT.
20	663.4	83+75	65' RT.
21	663.4	82+70	65' RT.

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

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

EMBANKMENT STABILITY
TROUT LAKE

KING'S H' 4Y NO. 63 LINE 'C' DIST. NO. 13
CO. NIPISSING
TWP. WIDDIFIELD LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. R.M.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 270-62	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED <input checked="" type="checkbox"/>	JOB NO. 65-F-119	65-F-119 B
DATE 14 JUNE 1966	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		