

## MEMORANDUM

To: Mr. R. G. Burnfield,  
Regional Functional  
Planning Engr.,  
Central Region,  
Admin. Bldg.

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

DATE: April 21, 1966

OUR FILE REF.

IN REPLY TO

APR 25 1966

SUBJECT:

PRELIMINARY  
FOUNDATION INVESTIGATION REPORT FOR  
Functional Study for Connecting Link  
Between City of Welland and Future  
Hwy. #406, District #4 (Hamilton).  
W.J. 65-F-115      --      W.P. (Nil)

In order to provide the necessary information for the functional study, we are forwarding to you, three (3) copies of our Preliminary Foundation Investigation Report on subsoil conditions existing at the above site.

We believe that the factual data and recommendations contained therein, although preliminary in nature only, will prove adequate for your present requirements.

Should there be any queries regarding this report, please do not hesitate to contact our Office.

AGS/MdeF  
Attach.

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

cc: Messrs. R. G. Burnfield (3)  
B. R. Davis  
G. K. Hunter (2)  
H. Greenland  
T. J. Kovich

Foundations Office  
Gen. Files

## TABLE OF CONTENTS

1. INTRODUCTION.
  2. DESCRIPTION OF SITE AND GEOLOGY.
  3. FIELD AND LABORATORY WORK.
  4. SUBSOIL CONDITIONS.
    - 4.1 General.
    - 4.2 F.F. (Mixture of Clayey Silt, Sand & Rubble).
    - 4.3 Organic Silt-Clay.
    - 4.4 Clayey Silt to Clay.
    - 4.5 Silty Sand or Sandy Silt with Gravel.
    - 4.6 Dolomitic Shale Bedrock.
    - 4.7 Groundwater Conditions.
  5. DISCUSSION AND RECOMMENDATIONS.
  6. MISCELLANEOUS.
-

PRELIMINARY  
FOUNDATION INVESTIGATION REPORT FOR  
Functional Study for Connecting Link  
Between City of Welland and Future  
Hwy. #406, District #4 (Hamilton.  
W.J. 65-F-115                      --                      W.P. (Nil)

1. INTRODUCTION:

It is proposed to span the Welland River near the Northern end of the City of Welland. This crossing is to be in conjunction with the proposed tunnel under the Welland Canal approximately 1 mile to the south-east. The purpose of the two structures is to facilitate the movement of traffic from the centre of Welland to future Hwy. #406.

A verbal request for a foundation investigation at the Welland River site was received from the Central Regional Office of the Functional Planning Branch.

Subsequently, a foundation investigation consisting of 21 boreholes was carried out at the proposed site. Presented in this report are the results of this investigation, together with our preliminary recommendations pertaining to the stability of the future embankment.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site of the proposed Welland River Structure is located in the physiographic region known as the Haldimand Clay Plain, which in this area is relatively flat. The area is underlain by stratified silt and clay deposits of glacial Lake Warren. The silt and clay are underlain by a thin layer of glacial drift followed by shales and dolomites of the Paleozoic era.

### 3. FIELD AND LABORATORY WORK:

The borings in the field were carried out by means of two diamond drills adapted for soil sampling purposes and one Penn auger. A raft was used for drilling the four boreholes located in the Welland River.

Samples were recovered at the required depths by means of a 2-inch O.D. split-spoon sampler and by 2-inch I.D. Shelby tube sampler. 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 are shown on the accompanying borehole log sheets, included in the Appendix of this report. The borehole elevations were supplied by a Department of Highways survey crew from the Planning Branch, Central 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

Laboratory tests are summarized and are included in the Appendix.

### 4. SUBSOIL CONDITIONS:

#### 4.1 General.

Subsoil at the site consists of deposits of fill,

cont'd. /3 .....

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

clayey silt to clay, organic silt-clay, and silty sand or sandy silt with gravel.

The boundaries of the deposits, as determined in the boreholes, are shown on the accompanying borelog sheets, and the estimated stratigraphical profile contained in Dwg. 65-F-115A is based on this information.

4.2 Fill (Mixture of Clayey Silt, Sand & Rubble).

The purpose of this fill was to raise the low north bank of the river and it was found on that side only. The fill is generally deepest (max. 7ft.) near the river's edge and it tapers off away from the river.

Standard Penetration test (N) values in the deposit ranged from 9 blows/ft. to 17 blows/ft.

4.3 Organic Silt-Clay.

With the exception of boreholes 7, 15 and 18 this stratum was found in all boreholes in the river and on the north bank. The deposit extends downward from ground surface in boreholes 4, 8, 13, 20 and 21 and from the surface fill in boreholes 2, 3, 6, 10, 11, 12, 14, 16, 17 and 19. The thickness of this stratum varies irregularly, from 3 ft. in borehole 21 to 21 ft. in borehole 4.

Physical properties of the material in the deposit as determined from laboratory and field tests, are summarized as follows:

Liquid Limit (wl)	52% - 76%	(oven dried)
	63% - 109%	(air dried)
Plastic Limit (wp)	20% - 67%	(oven dried)
	33% - 81%	(air dried)
Moisture Content (w)	35% - 145%	

cont'd. /4 .....

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

Laboratory Shear Strength	120 p.s.f. - 1320 p.s.f.
Field Vane Shear Strength	160 p.s.f. - 1760 p.s.f.
'N' values	5 blows/ft. - 12 blows/ft.
Bulk Densities	81 p.c.f. - 121 p.c.f.

4.4 Clayey Silt to Clay:

The stratum of clayey silt to clay was the major deposit explored at this site. On the south side of the river the layer extends downward from ground surface and ranges in thickness from 59 ft. in borehole 9 to 72 ft. in borehole 5. On the north side the deposit extends downward from ground surface in boreholes 7 and 18 and from the stratum of organic silt-clay in the other boreholes. The thickness of the deposit north of the river ranged from 29 ft. in borehole 21 to 68 ft. in borehole 6.

Physical properties of the material in the deposit as determined from laboratory and field tests, are summarized as follows:

Liquid Limit (wl)	26% - 63%
Plastic Limit (wp)	16% - 36%
Moisture Content (w)	18% - 44%
Laboratory Shear Strength	320 p.s.f. - 3250 p.s.f.
Field Vane Shear Strength	340 p.s.f. - >2000 p.s.f.
'N' values	14 blows/ft. - 45 blows/ft.
Bulk Densities	102 p.c.f. - 146 p.c.f.

4.5 Silty Sand or Sandy Silt with Gravel:

This stratum underlies the entire site. The deposit was proved for its entire depth in boreholes 1, 2, 4, 5, 9, 13, 16, 20 and 21 while in the others the upper boundary of the stratum was determined only. The surface elevation of the deposit varies between 482 and 518.

cont'd. /5 .....

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

Standard Penetration Test (N) values in the stratum varied from 41 blows/ft. to 100 blows/3 in., indicating a relative density of dense to very dense.

4.6 Dolomitic Shale Bedrock:

Underlying the granular deposit of silty sand or sandy silt is Dolomitic Shale Bedrock. The rock is made up of buff dolomite and grey dolomitic shale. Both were found to contain nodules of gypsum and anhydrate. There were also gypsum seams and interbeddings.

The bedrock was proved by drilling 4 ft. to 7 ft. of AXT core in boreholes 1, 4, 13, 20 and 21. Boreholes 2, 5, 9, 16 and 17 were extended to bedrock. Contact elevation varied from 485 to 492.

4.7 Groundwater Conditions:

Waterlevel observations were carried out in the boreholes during the time of the investigation. These indicate that in all the boreholes on the north side of the river the ground water level in the boreholes corresponds to the water level in the river - i.e., elev. 562. In boreholes 1, 5 and 9, all located on the south bank, a weak artesian flow, originating in the silty sand or sandy silt stratum, was encountered.

5. DISCUSSION AND RECOMMENDATIONS:

It is proposed to build a new structure over the Welland River in Welland to facilitate the movement of traffic from the centre of Welland to future Hwy. #406. The purpose of the field work was to investigate a designated area with a view to locating the structure, as well as to provide information regarding foundation design and embankment stability. For this purpose, survey lines were established and designated as 220' Lt., Centre Line, 180' Rt. 380' Rt. Boreholes were generally located along these lines.

cont'd. /6 .....

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

Subsoil at the site consists of deposits of fill, organic silt-clay, clayey silt to clay, silty sand or sandy silt with gravel and dolomitic shale bedrock.

The investigation revealed that the most suitable subsoil conditions exist at the location of the 6 and 180' Rt. survey lines. At 220' Lt. and 380' Rt. the organic silt-clay stratum is considerably weaker and at 380' Rt. a contributing stream would either have to be bridged or relocated.

The future structure in this area may be supported on small-displacement end-bearing piles driven to practical refusal either in the silty sand or sandy silt stratum or on the bedrock. Allowable load per pile would then depend on the capacity of the section selected.

The presence of the organic silt-clay stratum over the entire north side of the river, may cause embankment stability problems. When the final design for the proposed structure are decided upon, it may be necessary to carry out more borings in the field. Recommendations given in this report are, therefore, to be regarded as conditional only, and as such, are subject to revision at a later date when and if new field information becomes available.

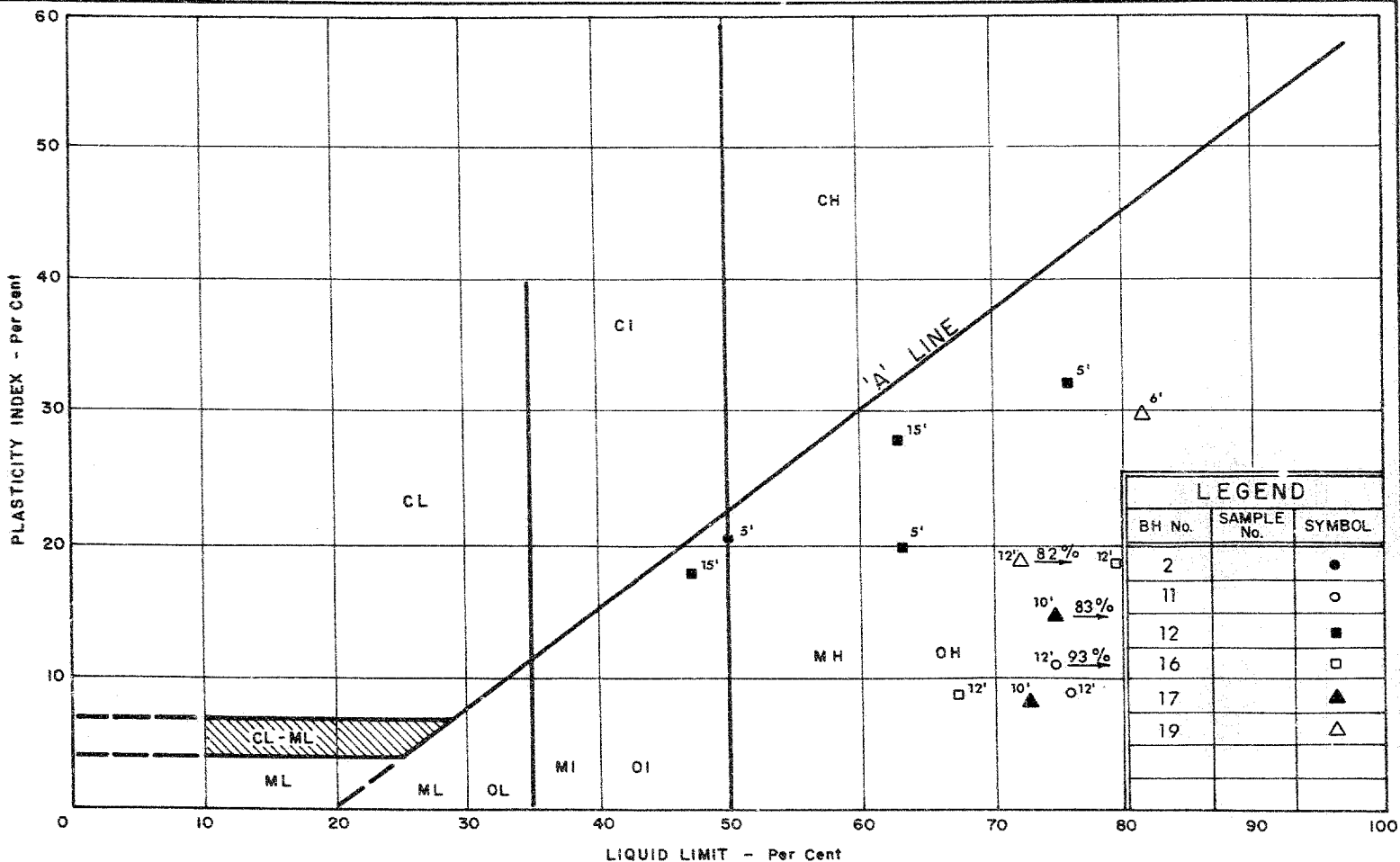
6. MISCELLANEOUS:

The field work, carried out in October and November, 1965, together with the preparation of this report, was undertaken by Mr. R. Magi and Mr. F. Wang, Project Foundation Engineers. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report. The equipment was owned and operated by Dominion Soil Investigation Ltd. of Toronto.

April 1966.



APPENDIX I



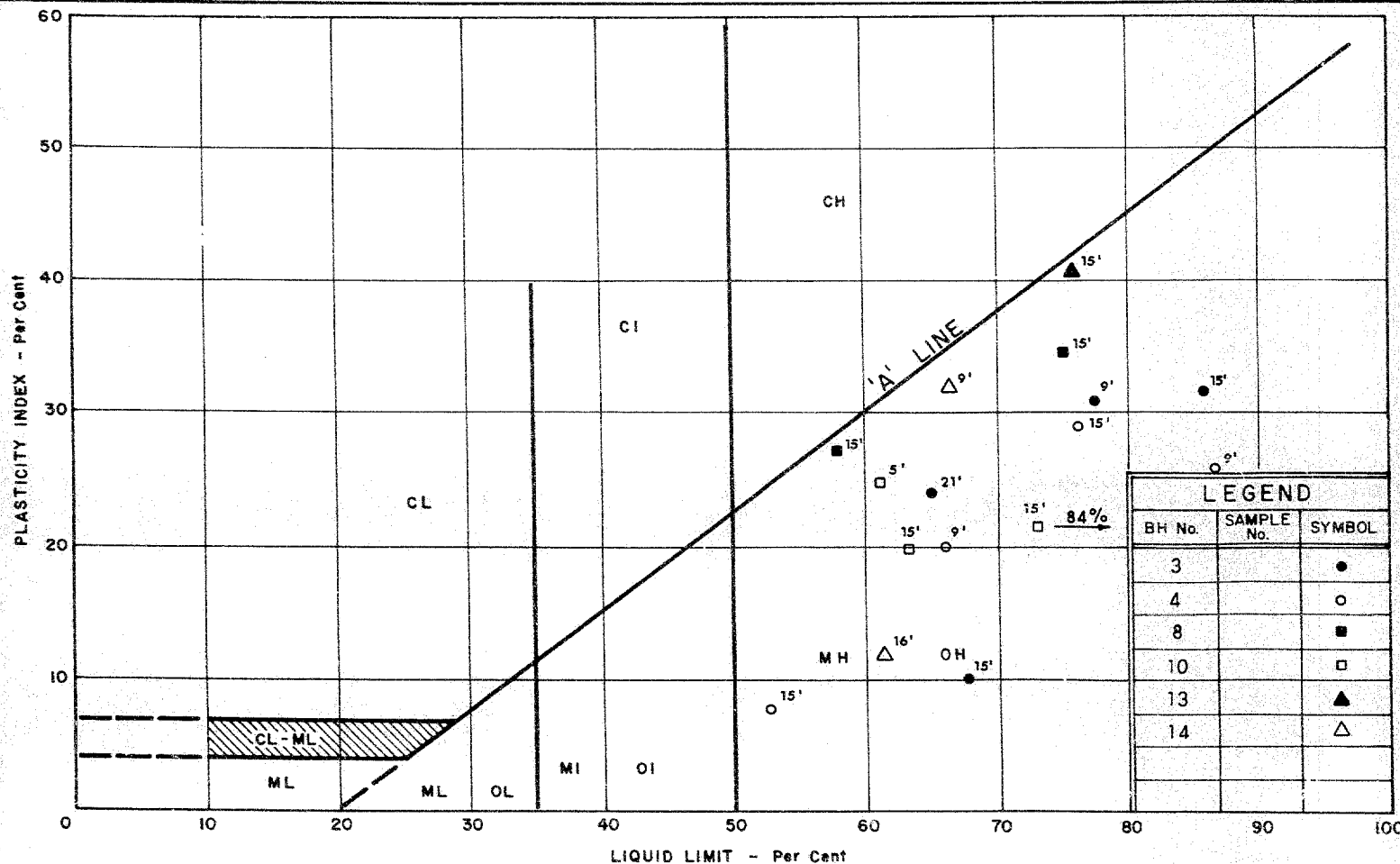
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

PLASTICITY CHART  
ORGANIC SILT - CLAY

W.P. No.

**JOB No.**

65 - F - 115

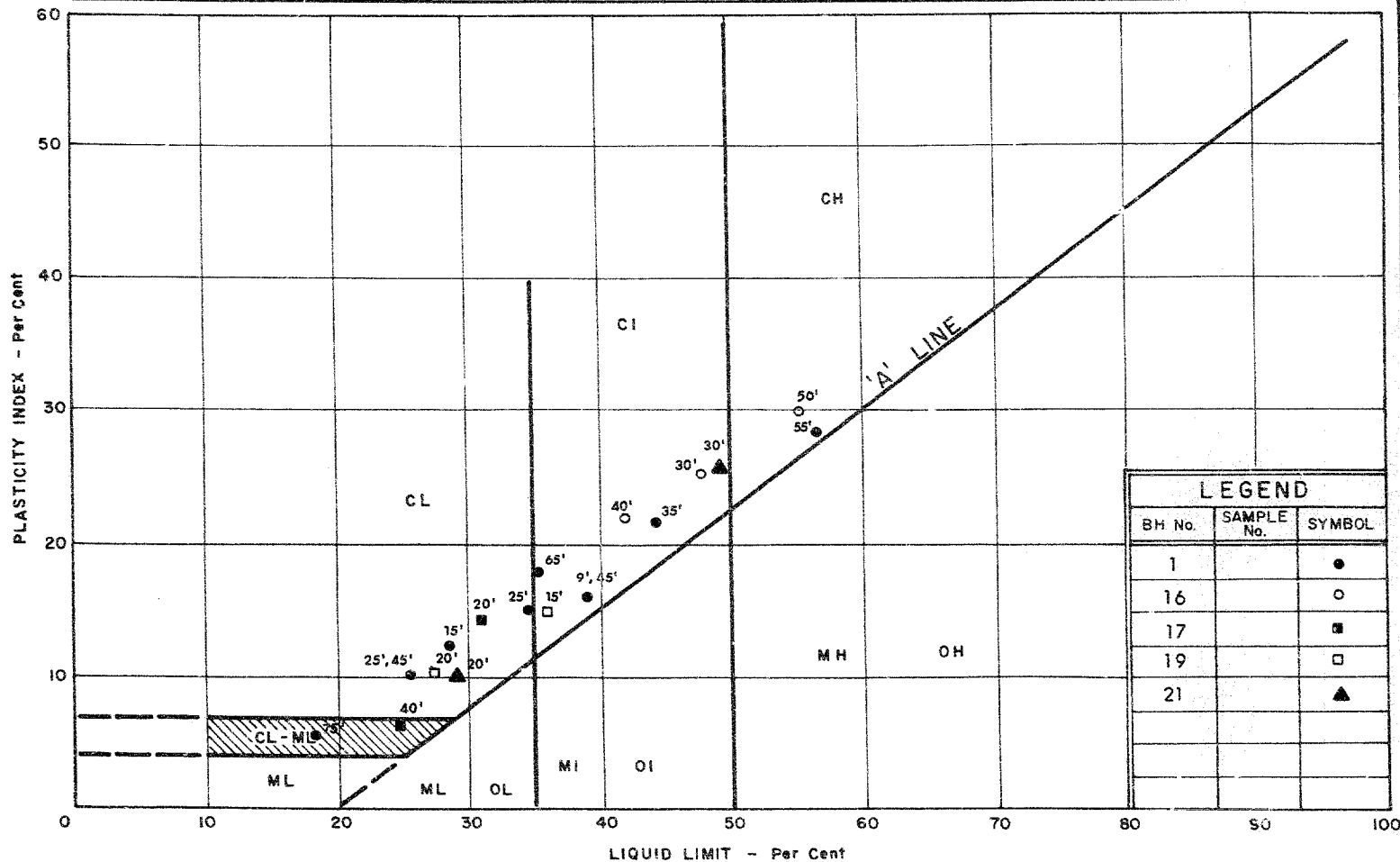


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART ORGANIC SILT-CLAY

W.P. No.

JOB No. 65-F-115

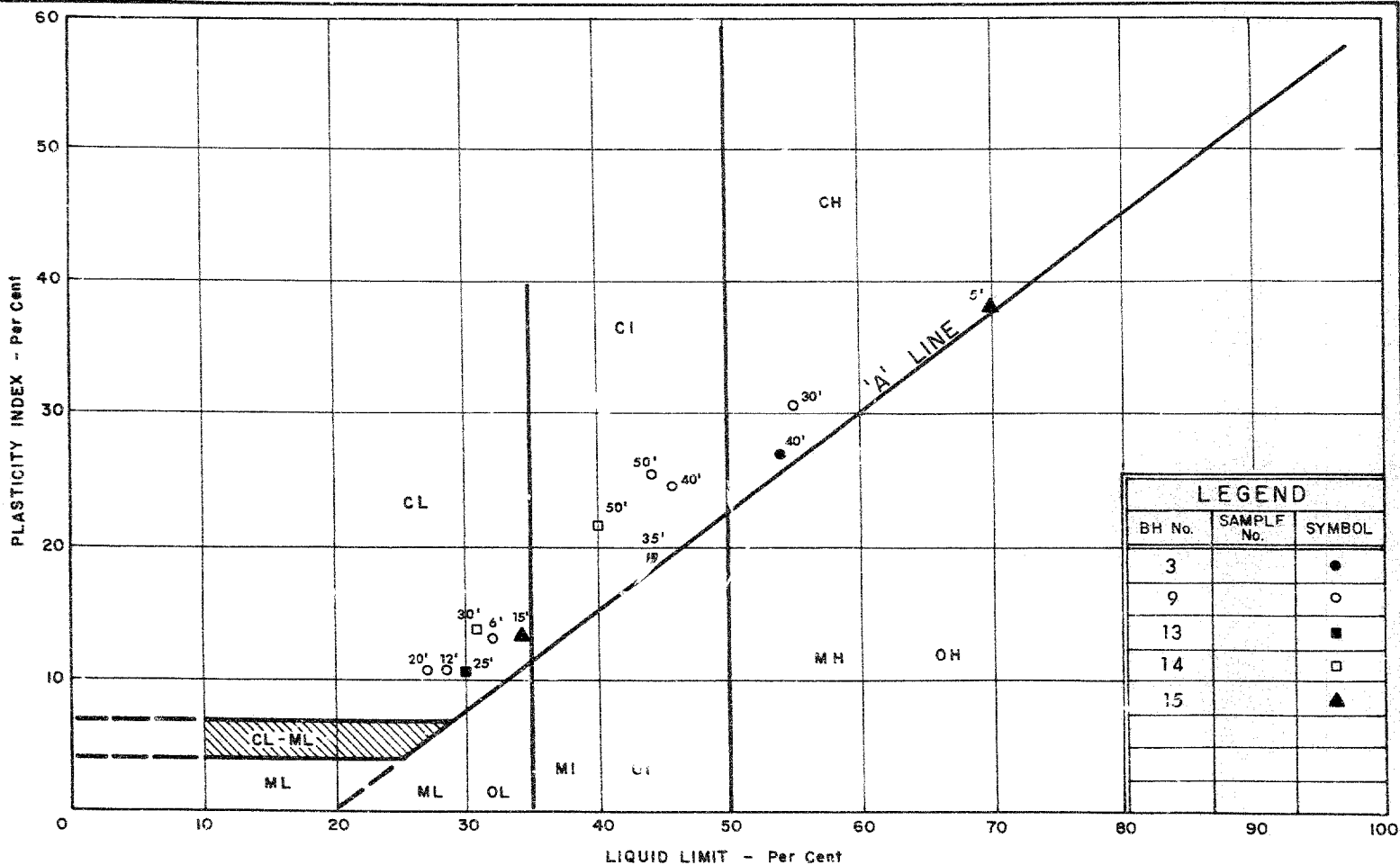


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT TO CLAY

W.P. No.

JOB No. 65-F-115

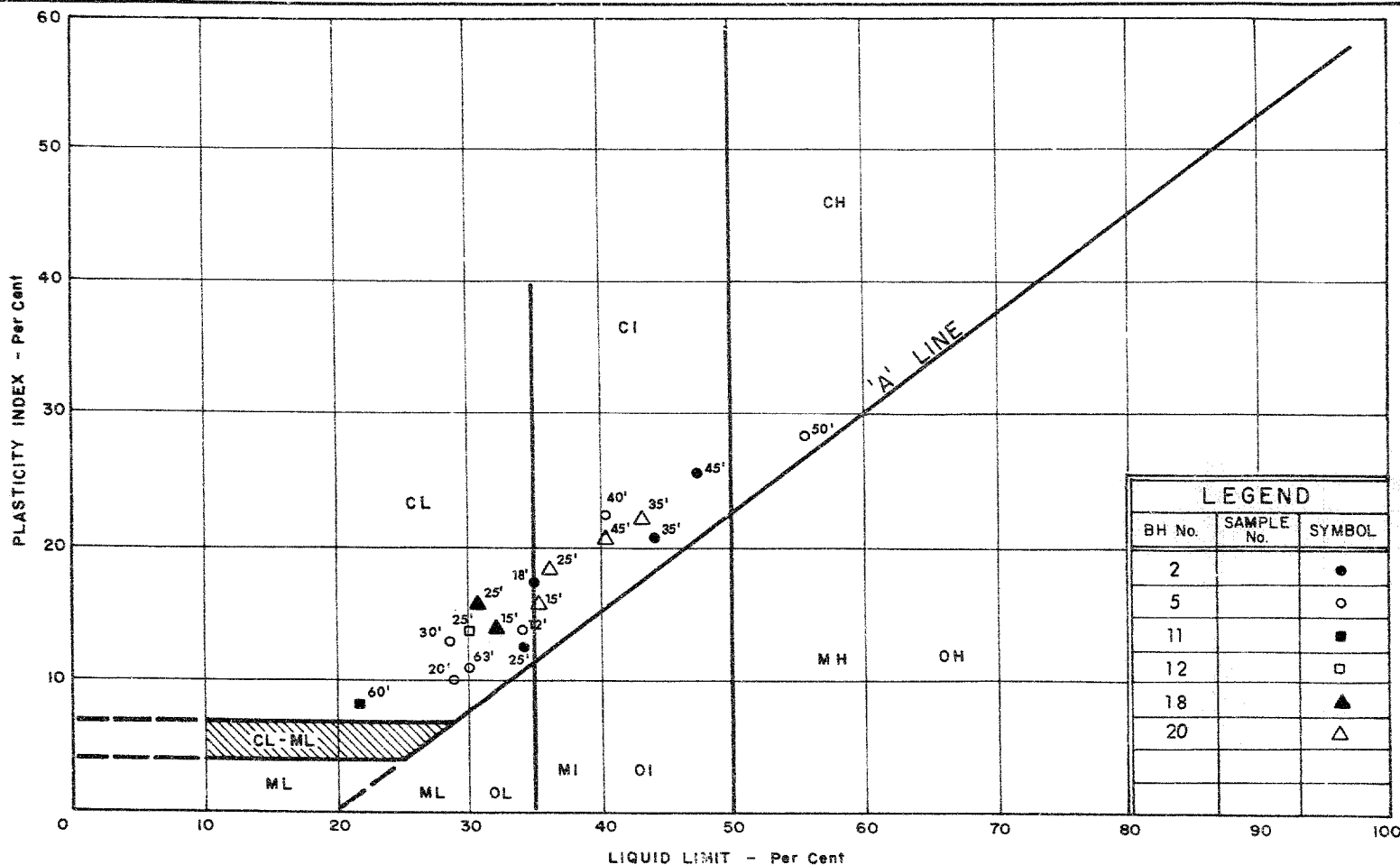


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT TO CLAY

WP No.

JOB No. 65 - F-115



LEGEND		
BH No.	SAMPLE No.	SYMBOL
2		●
5		○
11		■
12		□
18		▲
20		△

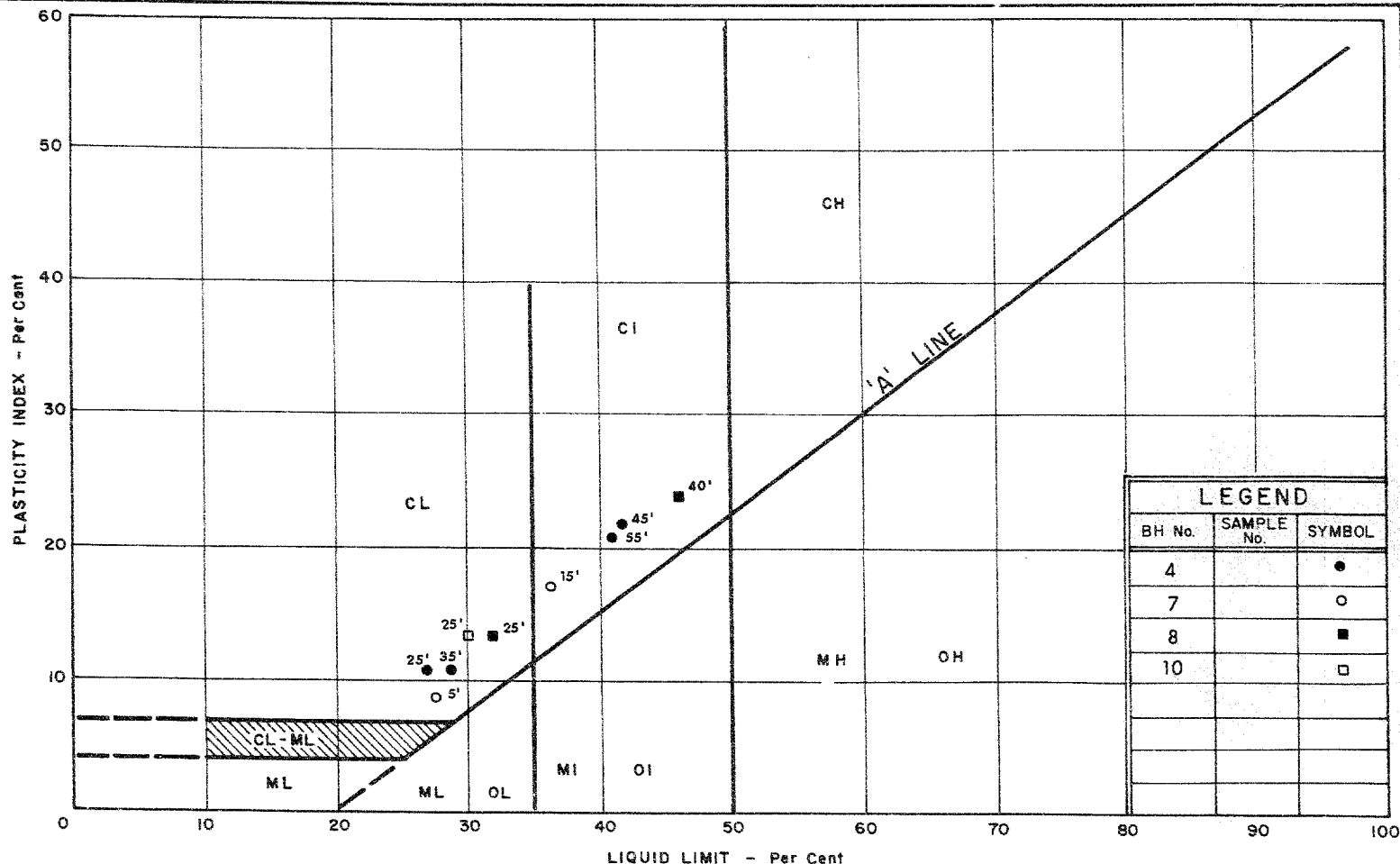


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT TO CLAY

W.P. No.

JOB No. 65 - F - 115



LEGEND		
BH No.	SAMPLE No.	SYMBOL
4		●
7		○
8		■
10		□



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

# PLASTICITY CHART CLAYEY SILT TO SILTY CLAY

W.P. No.

JOB No. 65-F-115

## 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

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

FOUNDATION SECTION

JOB 65-F-115 LOCATION 3181 Rt., Sta. 1453 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 14, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Washboring. CHECKED BY HR

SOIL PROFILE			SAMPLES			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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane 500    1000    1500    2000    2500					WATER CONTENT % 20    40    60					
572.8	Groundlevel															
0	Clayey silt to clay with some silt and sand layers.  Firm to very stiff.		1	SS	28	570										
			2	SS	24											
			3	TW	P										128	
			4	TW	P	560										
			5	TW	P										132	
			6	TW	P											
			7	TW	P	550									126	
			8	TW	P											
			9	TW	P	540									130	
			10	TW	P											
			11	TW	P	530									120	
			12	TW	P											
			13	TW	P	520									116	
			14	TW	P											
			15	TW	P	510									123	
			16	TW	P											
			17	TW	P	500									146	
495.5	Silty sand with gravel.		18	RC	-	490									Sa 36% Si 52%	
			19	RC	-											CI 12%
485.8	Dolomitic shale bedrock.		20	RC	-	480									Δ 494	
87																AXT core Barrel Rec. 36%
478.8	End of borehole.															
94.0																

FOUNDATION SECTION

CHECKED BY AK

SOIL PROFILE			SAMPLES			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    ■ Tor Vane ● Unconf. Comp.    □ Lab Vane 500 1000 1500 2000 2500						WATER CONTENT % 20 40 60				
566.0	Groundlevel															
0	Fill(sand, stones, debris)		1	SS	17										W.L. Elev 562.0	
561.0	Compact.		2	TW	P										4.8% Org's	
5	Organic silt-clay.		3	TW	P											
			4	TW	P											
			5	TW	P											
			6	TW	P											
547.0	Soft to firm		7	TW	P										124	
19.0	Clayey silt to silty clay.		8	TW	P										124	
			9	TW	P											
			10	TW	P										102	
			11	SS	P											
			12	TW	P										117	
			13	TW	P											
512.0	Firm to stiff.		14	SS	70/2"											
54	Silty sand with gravel.		15	SS	100/5"											
	Very dense		16	SS	50/2"											
			17	SS	92/6"											
498.4			18	SS	150/1"											
67.6	Presumably Bedrock															
	End of borehole.															

0  
5  
10

Percent strain at failure

FOUNDATION SECTION

CHECKED BY AK

SOIL PROFILE		STRAT. PLOT	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		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane		WATER CONTENT % 20    40    60			
565.8	Groundlevel											
0	Fill(silty sand with debris, lumps of clayey silt)		1	SS	10							WL Elev. 562.0
558.8	Compact.		2	SS	10							
7	Organic silt-clay.		3	TW	P							86 120% Org's
			4	TW	P							
			5	TW	P							
	Very soft to firm.		6	TW	P							
542.8			7	TW	P							12.7% Org's
23			8	TW	P							
	Silty clay to clay.		9	TW	P							
			10	TW	P							
			11	TW	P							111
			12	TW	P							
513.3	Soft to stiff.		13	TW	P							
52.5			14	SS	90/6"							
	Sandy silt.		15	SS	100/3"							Gr1%Sa34% Si52%Cl 13%
			16	SS	100/5"							
	Very dense.		17	SS	100/4"							
490.5			18	SS	100/4"							
75.3	End of borehole.				4"							

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115 LOCATION 220' Lt., Sta. 7+93 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 19, 1965 COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Penndrill 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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					WP	W	WL		
564.9	Groundlevel						500	1000	1500	2000	2500	20	40	60		
0	Organic silt-clay.		1	SS	5	560										WL Elev. 562.0
			2	SS	12											
			3	TW	P		+					Oven Air	W 124%		81	17.0% Org's
			4	TW	P		+						W 96%			
	Very soft to stiff.		5	TW	P	550	+					Oven Air			84	11.0% Org's
543.9			6	TW	P											
21			7	TW	P	540			+							130
			8	TW	P				+							
			9	TW	P	530			+							130
	Clayey silt to silty clay.		10	TW	P				+							
			11	TW	P	520			+							122
			12	TW	P				+							
			13	TW	P	510			+							116
			14	TW	P				+							
	Firm to stiff.		15	TW	P	500			+							
			16	TW	P				+							
494.4			17	SS	194	490										Gr 8% Sa 55% Si 37%
70.5	Silty sand with gravel.		18	SS	102											
485.6	Very dense.															AXT Core Barrel Rec. 40%
79.3	Dolomitic shale bedrock.		19	RC	-											
480.6																
84.3	End of borehole.															

15 0 5 Percent strain at failure.  
10

FOUNDATION SECTION

JOB 65-P-115 LOCATION 1821 Rt., Sta.-0452 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 20, 1965. COMPILED BY R.M.  
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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane 500    1000    1500    2000    2500		WATER CONTENT % 20    40    60		
568.5	Groundlevel										
0	Clayey silt to clay with some sand and silt layers.		1	SS	45	560					
			2	SS	18						
			3	TW	P						
			4	TW	P						
			5	TW	P						
			6	TW	P		550				
			7	TW	P						
			8	TW	P		540				
			9	TW	P						
			10	TW	P		530				
			11	TW	P						
			12	TW	P		520				
			13	TW	P						
			14	TW	P		510				
	Firm to very stiff.				500						
497.3											
71.5	Silty sand with gravel.		15	SS	41						
	Dense										
488.7					490						
79.8	Presumably bedrock										
	End of borehole.										

0  
5  
10

Percent strain at failure.

Elev 494

DEPARTMENT OF HIGHWAYS - ONTARIO		<b>RECORD OF BOREHOLE NO. 6</b>		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB <u>65-F-115</u>	LOCATION <u>220' Lt. Sta. 9+30</u>	ORIGINATED BY <u>R.M.</u>			
W.P. <u>N11</u>	BORING DATE <u>Oct. 21, 1965.</u>	COMPILED BY <u>R.M.</u>			
DATUM <u>Geodetic</u>	BOREHOLE TYPE <u>Penn-drill</u>	CHECKED BY <u>HL</u>			

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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					WATER CONTENT % 20    40    60				
566.0	Groundlevel	X														
0	Fill															
562.5																
35																
	Organic silt-clay.		1	TW	P	560										121
	Stiff.		2	TW	P											
550.0			3	TW	P	550										124
16			4	TW	P											
	Clayey silt.					540										
						530										
						520										
						510										
						500										
						490										
482.0						480										
84	Silty sand with gravel.															
479.0																
87	End of borehole.															

0  
15-5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 65-F-115 LOCATION 220' Lt. Sta. 10410 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 25, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY HL

SOIL PROFILE		STRAT. PLOT	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		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane    ■ Tor Vane • Unconf. Comp.    □ Lab Vane 500   1000   1500   2000   2500					WP	W	WL		
567.0	Groundlevel															
0	Clayey silt to silty clay.		1	Tw	P	560	•								128	WL Elev. 562.0
			2	Tw	P											
	Soft to stiff.		3	Tw	P	550	• ■								120	
545.5			4	Tw	P											
21.5	End of borehole.															

0  
15+5    Percent strain at failure.  
10



DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115

LOCATION 220' Lt. Sta. 4/80

ORIGINATED BY R.M.

W.P. Nil

BORING DATE Oct. 25, 1965.

COMPILED BY R.M.

DATUM Geodetic

BOREHOLE TYPE Washboring.

CHECKED BY *HL*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>p</sub> 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    ■ Tor Vane ● Unconf. Comp.    Lab Vane 500 1000 1500 2000 2500					w <sub>p</sub> w    w <sub>L</sub> 20 40 60				
561.8	Waterlevel															
0	Water					560										
550.3						550										
11.5	Organic silt-clay.		1	TW	P		+							97	5.1% Org's	
541.8	Very soft		2	TW	P	540	+									
20			3	TW	P		+	■						123		
	Clayey silt to silty clay.		4	TW	P			+								
			4A	SS	24	530										
			5	SS	14				+							
			6	TW	P	520	+	■						115		
	Soft to stiff.		7	TW	P				+							
513.8									+							
48	Sandy silt with gravel. V. dense		8	SS	80/6"	510									Gr 11% Sal 9% Si 54% Cl 16%	
508.8																
53	End of borehole.															

0  
15.5 Percent strain at failure.  
10

0  
15.5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 65-F-115 LOCATION 78.5' Sta. 0/28 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 25, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY dk

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	□ Lab Vane	● Unconf. Comp.	■ Tor Vane	WP	W	WL				
564.2	Groundlevel					500	1000	1500	2000	2500	20	40	60		▽		
0	Clayey silt to clay with some silt and sand layers.		1	SS	1L	560										Gr1%Sa2% Si66%Cl 31%  Sa4%Si61% Cl 35%	
			2	TW	P					+							123
			3	TW	P												
			4	TW	P												
			5	TW	P	550											128
			6	TW	P												
			7	TW	P												
			8	TW	P												
			9	TW	P												
			10	TW	P												
			11	TW	P												
			12	TW	P												
			13	TW	P	510											
505.2	Firm to hard.														Elev. 503 ▽		
59	Silty sand with gravel.		14	SS	38												
	Dense to very dense.		15	SS	72/6"												
			16	RC	-										BX Casing Drilled		
491.7 72.5	Presumably bedrock  End of borehole.																

0

15 + 5 Percent strain at failure.

10

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 65-F-115

LOCATION 110' Lt. Sta. 6405

ORIGINATED BY R.M.

W.P. Nil

BORING DATE Oct. 25, 1965.

COMPILED BY R.M.

DATUM Geodetic

BOREHOLE TYPE Penndrill

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. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane    ■ Tor Vane ● Unconf. Comp.    □ Lab Vane 500 1000 1500 2000 2500					WATER CONTENT % 20 40 60				
565.0	Groundlevel															
0	Fill	⊗													WL Elev. 562.0	
562.5															4.5% Org's	
2.5	Organic silt-clay.	~	1	TW	P	560										
			2	TW	P											
			3	TW	P	550									83 15.0% Org's	
	Soft to stiff.	~	4	TW	P											
544.5			5	TW	P	540									128	
20.5			6	TW	P											
	Clayey silt.	~				530										
						520										
	Firm to stiff.	~				510										
502.3						500										
63	Silty sand with gravel.	••														
500.0																
65	End of borehole.															

15 + 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115

LOCATION 180' Rt. Sta. 3490

ORIGINATED BY R.M.

W.P. Nil

BORING DATE Oct. 26, 1965.

COMPILED BY R.M.

DATUM Geodetic

BOREHOLE TYPE Penndrill

CHECKED BY *HL*

SOIL PROFILE			SAMPLES			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	ELEV. SCALE	SHEAR STRENGTH P.S.F. + Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane 500 1000 1500 2000 2500					WATER CONTENT % 20 40 60			
566.8	Groundlevel														
0	Fill (clayey silt with sand)														WL Elev. 562
561.8			1	TW	P										
5	Organic silt-clay.		2	TW	P										
			3	TW	P										
	Very soft to stiff.		4	TW	P										
541.3			5	TW	P										
21.5															
	Clayey silt to silty clay.		6	TW	P										
			7	TW	P										
	Firm to stiff.		8	TW	P										
505.3			9	TW	P										
61.5	Silty sand with gravel.														
500.9	Very dense		10	SS	100/5"										
65.9	End of borehole.														

0  
15  
10  
Percent strain at failure.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 65-F-115 LOCATION 180' Rt. Sta. 475 ORIGINATED BY R.M.  
W.P. N11 BORING DATE Oct. 26, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY dk

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    ■ Tor Vane ● Unconf. Comp.    □ Lab Vane					wp	w	WL		
						500	1000	1500	2000	2500	20    40    60					
567.7	Groundlevel															
0	Fill															
562.2			1	TW	P	560									WL Elev. 562	
5.5	Organic silt-clay.		2	TW	P											
	Soft to firm.		3	TW	P	550									94	
			4	TW	P											
546.2																
21.5	Clayey silt		5	TW	P	540									126	
	Stiff		6	TW	P											
534.7																
33	End of borehole.															

0

15

10

5

Percent strain at failure.

0  
15 — 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

## MATERIALS &amp; TESTING DIVISION

JOB 65-F-115 LOCATION E. Sta. 2492 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 27, 1965. COMPILED BY R.M.  
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				
							+ Field Vane    ■ Tor Vane ● Unconf. Comp.    □ Lab Vane					WATER CONTENT % 20    40    60				
561.8	Waterlevel						500	1000	1500	2000	2500					
0	Water					560										
550.3						550										
11.5	Organic silt-clay		1	TW	P									104		
543.3	Firm															
18.5			2	TW	P	540										
	Clayey silt to silty clay.		3	TW	P									129		
			4	TW	P	530										
	Firm to stiff.		5	TW	P									116		
			6	TW	P	520										
			7	TW	P											
512.8																
49			8	SS	7/4"	510										
	Silty sand with gravel.		9	SS	100/4"											
			10	SS	100/4"	500										
	Very dense.		11	SS	85/6"											
			12	RC	-	490									AXT Core Barrel	
489.5																
72.5	Dolomitic shale bedrock.		13	RC	-										AXT Core Barrel Rec. 60%	
485.3																
76.5	End of borehole.															

0

15

10

Percent strain at failure.

0  
15 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115 LOCATION E. Sta. 6400 ORIGINATED BY R.M.W.P. Nil BORING DATE Oct. 27, 1965. COMPILED BY R.M.DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY AK

SOIL PROFILE			SAMPLES			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	ELEV. SCALE	SHEAR STRENGTH P.S.F. + Field Vane □ Lab Vane • Unconf. Comp. ■ Tor Vane					WATER CONTENT % WP — W — WL 20 40 60			
567.2	Groundlevel														
0	Fill (clayey silt, sand and rubble)	XXXX	1	SS	9										WL Elev. 562
559.7			2	TW	P										111 3.4% Org's
7.5	Organic silt-clay.	~~~~~	3	TW	P										
		~~~~~	4	TW	P										88 11.2% Org's
	Very soft to stiff.	~~~~~	5	TW	P										
547.2															
20															
			6	TW	P										
	Clayey silt to silty clay.		7	TW	P										
			8	TW	P										122
			9	TW	P										
			10	TW	P										
	Soft to stiff		11	SS	100/6"										
494.7	Silty sand with gravel.	....													
492.7															
74.5	End of borehole.														

0  
15 + 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 15

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-115 LOCATION G. Sta. 7420 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Oct. 28, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Penndrill 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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					WATER CONTENT % 20    40    60				
568.0	Groundlevel															
0	Fill															
564.5																
3.5	Clayey silt to clay.		1	TW	P	560									109	
			2	TW	P											
			3	TW	P	550										
	Firm to f. stiff		4	TW	P										130	
545.8																
23	End of borehole.															

0

10

Percent strain at failure

0  
15-5 Percent strain at failure  
10



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION  
JOB 65-F-115  
W.P. Nil  
DATUM Geodetic

# RECORD OF BOREHOLE NO. 16

FOUNDATION SECTION

LOCATION 290' Rt. Sta. 3470 ORIGINATED BY R.M.  
BORING DATE Oct. 28, 1965. COMPILED BY R.M.  
BOREHOLE TYPE Pennndrill CHECKED BY AK

SOIL PROFILE			STRAT. PLOT	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	NUMBER		TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %					
						+ Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane 500    1000    1500    2000    2500					wp	w	wL			
567.3	Groundlevel															
0	Fill (clayey silt with sand & rubble)															
562.3		1	TW	P										112	WL Elev. 562	
5	Organic silt-clay.	2	TW	P	560										2.7% Org's	
		3	TW	P										81	13.5% Org's	
	Soft to firm	4	TW	P	550											
546.8		5	TW	P										111	Si43%Cl 57%	
20.5		6	TW	P	540											
	Clayey silt to clay.	7	TW	P										116		
		8	TW	P	530											
		9	TW	P										119		
	Soft to stiff.	10	TW	P	520											
		11	TW	P										114		
		12	TW	P	510											
508.3																
59	Sandy silt with gravel.	13	SS	80/6"												
		14	SS	90/6"	500										Gr18%Sa31% Si41%Cl 10%	
	Very dense	15	SS	125/6"												
491.5		16	SS	100/5"												
75.8	Presumably bedrock															
	End of borehole.															

0

15

10

Percent strain at failure.

0  
15 + 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS (TARIO)  
MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 17

FOUNDATION SECTION

JOB 65-F-115 LOCATION 380' Rt. Sta. 3435 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Nov. 1, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Washboring. CHECKED BY SL

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. EPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							+ Field Vane    □ Lab Vane ● Unconf. Comp    ■ Tor Vane					wp	w	wL		
567.4	Groundlevel						500	1000	1500	2000	2500	20	40	60		
0	Fill (clayey silt with sand & gravel)															WL Elev 562
561.9			1	TW	P	560										
5.5	Organic silt-clay.		2	TW	P											15.3% Org's
			3	TW	P											
549.4	Firm to stiff.					550										
18			4	TW	P											126
			5	TW	P	540										
	Clayey silt.															
			6	TW	P	530										125
			7	TW	P	520										
						510										
	Firm to stiff.															
						500										
						490										
485.4	Presumably bedrock.															
82	End of borehole.															

0  
15  
10

Percent strain at failure

15 0 5  
10 Percent strain at failure

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 18

FOUNDATION SECTION

JOB 65-F-115 LOCATION 180' Rt. Sta. 5470 ORIGINATED BY R.M.  
W.P. Nil BORING DATE Nov. 1, 1965. COMPILED BY R.M.  
DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY dl

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    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					WP	W	WL		
							500	1000	1500	2000	2500	20	40	60		
568.2	Groundlevel															
0	Clayey silt     Firm to v. stiff.		1	TW	P	560										105     132     124
			2	TW	P											
			3	TW	P	550										
			4	TW	P											
			5	TW	P	540										
			6	TW	P											
535.2	End of borehole.															
33																

0

15

10

5

Percent strain at failure.

0  
15 + 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 19

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115

LOCATION 380' Rt. Sta. 4/25

ORIGINATED BY R.M.

W.P. Nil

BORING DATE Nov. 2, 1965.

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 P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					wp	w	wL		
567.6	Groundlevel						500	1000	1500	2000	2500					
0	Fill (clayey silt with sand)															
562.1			1	TW	P	560										
5.5	Organic silt-clay.		2	TW	P											
555.1	Soft		3	TW	P	550										
12.5	Clayey silt.		4	TW	P											
544.6	Soft to stiff.															
23	End of borehole.															

0  
15 + 5 Percent strain at failure.  
10

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 20

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-F-115 LOCATION 180' Rt. Sta. 1430

ORIGINATED BY R.M.

W.P. Nil BORING DATE Nov. 2, 1965.

COMPILED BY R.M.

DATUM Geodetic BOREHOLE TYPE Washboring

CHECKED BY *dk*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — #L PLASTIC LIMIT — #P WATER CONTENT — %			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F. + Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane					wp	w	wL		
						500	1000	1500	2000	2500		20	40	60		
561.8	Waterlevel															
0	Water															
550.3																
11.5	Organic silt-clay.															
546.8			1	TW	P											
15																
	Silty clay.		2	TW	P											
			3	TW	P											
			4	TW	P											
			5	TW	P											
	Firm to stiff.		6	TW	P											
			7	TW	P											
514.8																
47	Sandy silt with gravel.		8	SS	77/8"											
			9	SS	84/8"											
	Very dense.		10	SS	100/6"											
			11	SS	70/4"											
491.8																
70	Dolomitic shale bedrock.		12	RC	-											
484.8																
77	End of borehole.															

Gr10%Sa22%  
Si157%Cl 11%

AXT Core  
Barrel  
Rec. 60%

0  
5  
10

Percent strain at failure.

DEPARTMENT OF HIGHWAYS - ONTARIO

FOUNDATION SECTION

ORIGINATED BY R.M.

COMPILED BY R.M.

CHECKED BY AK

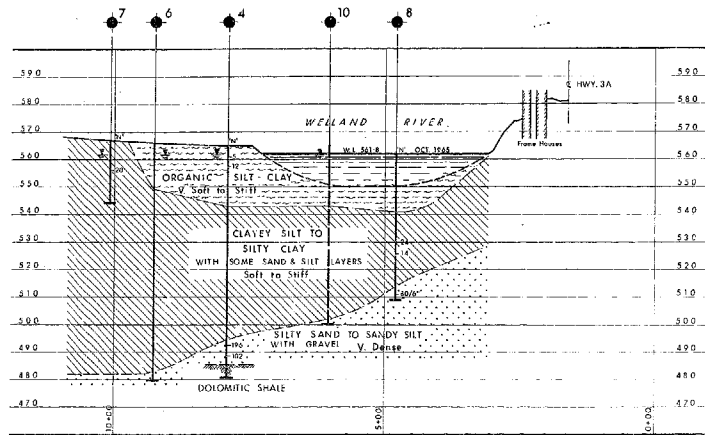
SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane    □ Lab Vane ● Unconf. Comp.    ■ Tor Vane 500    1000    1500    2000    2500						WATER CONTENT % WP      W      WL 20      40      60				
561.8	Waterlevel															
0						560										
	Water															
549.8						550										
12																
546.8	Organic silt-clay.		1	TW	P											
15																
	Clayey silt to silty clay.		2	TW	P	540		+								128
			3	TW	P											
			4	TW	P	530										
			5	TW	P											
	Firm to stiff.		6	TW	P	520										
517.8																
44			7	SS	125/9"											
	Sandy silt		8	SS	135/10"	510										
			9	SS	212											
	Very dense.		10	WS	-	500										
			11	SS	100/5"											
492.6																
69.2	Dolomitic shale bedrock		12	RC	-	490										AXT Core Barrel Rec. 95%
486.3																
75	End of borehole.															

0

15-5

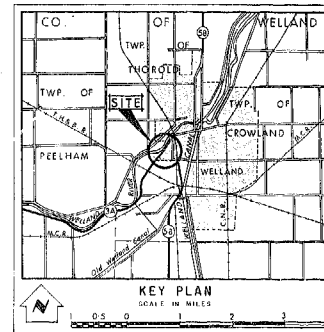
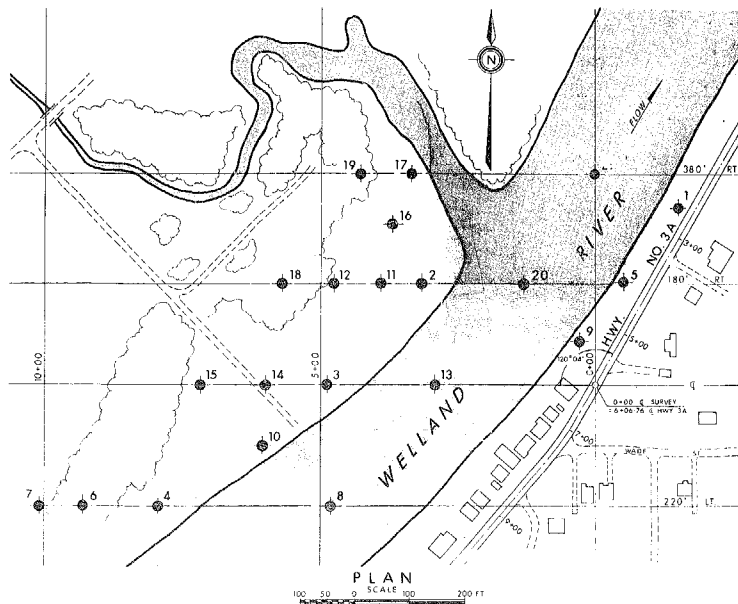
10

Percent strain at failure.



LINE 220' LT.

VERT. 20 10 0 SCALE 20 40 FT.  
HORIZ. 100 50 0 SCALE 100 200 FT.



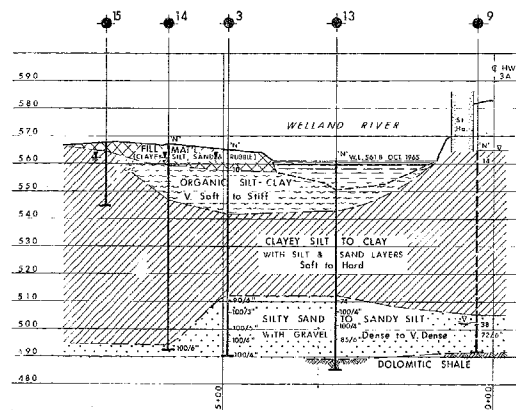
# LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, Oct., Nov. 1965
- Artesian Water

NO.	ELEVATION	STATION	OFFSET
1	572.8	1+55	318' RT
2	566.0	3+15	180' RT
3	565.8	4+90	6' C
4	564.9	7+93	220' LT
5	568.5	0+52	182' RT
6	567.0	0+30	220' LT
7	567.0	10+10	220' LT
8	567.1	4+40	220' LT
9	564.2	0+28	78' RT
10	565.3	6+05	110' LT
11	566.8	3+00	180' RT
12	567.7	4+25	180' RT
13	561.8	2+97	C
14	567.2	6+00	C
15	568.0	7+20	C
16	567.3	3+70	290' RT
17	567.4	3+35	380' RT
18	568.2	5+70	180' RT
19	567.6	4+35	380' RT
20	561.8	1+30	180' RT
21	561.8	6+00	380' RT

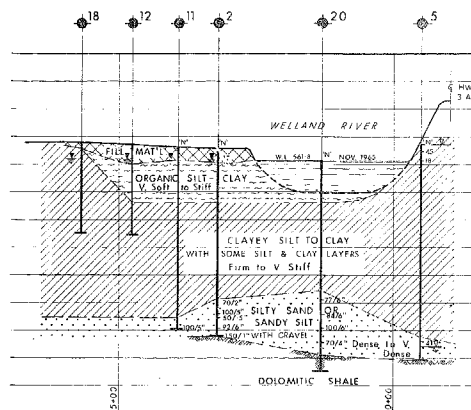
## NOTE

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.

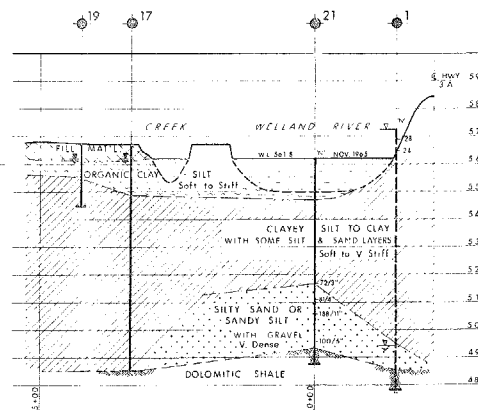


LINE 180' RT.

VERT. 20 10 0 SCALE 20 40 FT.  
HORIZ. 100 50 0 SCALE 100 200 FT.



LINE 380' RT.



NO.	DATE	DESCRIPTION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION - FOUNDATION SECTION

PRELIMINARY INVESTIGATION

## WELLAND RIVER CROSSING

KING'S HIGHWAY NO. DIST NO. 4  
CO. WELLAND CITY OF WELLAND  
TWP. CROWLAND LOT CON.

## BORE HOLE LOCATIONS & SOIL STRATA

SUBMITTAL NO. CHECKED BY DATE 26 JAN. 1966  
DRAWN BY S.O. CHECKED BY DATE 26 JAN. 1966  
APPROVED BY DATE 26 JAN. 1966  
W.P. DRAWING NO. 65-F-115 A  
PROJECT DRAWING NO.