

CC: GEN. FILES

DEPARTMENT OF HIGHWAYS ONTARIO

D.P. 319-64.

MEMORANDUM

Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: October 7, 1965

Our File Ref.

IN REPLY TO

NOV 2 1965

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed New Bridge on Hwy. #31 and
Hess (Branch) Creek - North Crossing,
County of Dundas, Twp. of Williamsburg,
Lot 30, Conc. 7, District #9 (Ottawa).

W.J. 65-P-92 -- W.P. 246-64 319-64

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

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

AGS/MdeF
Attach.

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

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
R. S. Pillar
L. E. Walker
J. E. Gruspier
A. Watt
Foundations Office
Gen. Files

FOUNDATION INVESTIGATION REPORT

For

Proposed New Bridge on Hwy. #31 and
Hess (Branch) Creek - North Crossing,
County of Dundas, Twp. of Williamsburg,
Lot 30, Conc. 7, District #9 (Ottawa)

W.J. 65-F-92 -- W.P. 246-64

1. INTRODUCTION:

A request to carry out a foundation investigation at the crossing of Hwy. #31 and Hess (Branch) Creek, North Crossing, was received from the Bridge Location Engineer, Mr. A. P. Watt, dated August 12, 1965.

It is proposed to erect a new bridge to carry Hwy. #31 over the Hess (Branch) Creek - North Crossing. The site of the proposed bridge is located in the County of Dundas, Twp. of Williamsburg, Lot 30, Conc. 7. At this location the chainage for Hwy. #31 is from 497+70 to 498+32.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Results and the discussion of field and laboratory investigations for future design work, are continued in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The site of the proposed bridge is located approximately 3.2 miles North of the Village of Williamsburg, County of Dundas, Twp. of Williamsburg, Lot 30, Conc. 7. The surrounding area is

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-

2. DESCRIPTION OF SITE: (cont'd.) ...

generally flat terrain. The width of Heso (Branch) Creek varied from 16'-0" to 19'-0" and the depth, during the time of investigation, was 0'-6" to 1'-0".

Physiographically, the site is located in the so-called "Glengary Till Plain".

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, four sampled boreholes and three penetration tests, were carried out at this site. All boreholes were taken down to bedrock and 5 feet of bedrock core was taken in B.H. #1 and B.H. #3. Split-spoon samples were taken at various depth intervals; samples recovered in the split-spoon were used to determine the following physical properties:

1. Natural Moisture Content
2. Grain Size Distribution
3. Atterberg Limits

Results of these laboratory tests are summarized in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in Appendix I of this

cont'd. /3 ...

4. SUBSOIL CONDITIONS: (cont'd.)

report and is also given in subsequent paragraphs. The estimated stratigraphical profile shown on Dwg. No. 65-F-92A, is based upon this information.

4.2) Clayey Sandy Silt with Clay Seams:

This layer which was found immediately below the 1.5 foot black organic topsoil extends for 22 to 24 ft. down to between elevation 225 and 220. Basically, it is a sandy silt with some clay. However, seams of highly plastic clay were found in that layer. The silty portion of the layer can be described as compact or stiff to very stiff, if considered as cohesive material, while the seams of clay of high plasticity are of firm consistency.

Atterberg limits and natural moisture contents are given on the attached log sheets. A Plasticity Chart is also included.

4.3) Silty Sand and Gravel - Dense to Very Dense:

Following the layer of clayey sandy silt is a stratum of silty sand and gravel, which extends down to bedrock. It may be classified as dense to very dense with an average 'N' value in excess of 80 blows/foot. Grain size distribution curves indicated that this stratum is composed of 42% gravel, 41% sand, and 17% silt.

4.4) Limestone Bedrock:

Sound limestone bedrock was encountered beneath the overburden. Five feet of bedrock core was taken in B.H. #1 and B.H. #3.

As can be seen on Dwg. No. 65-F-92A, the surface of the bedrock is nearly horizontal.

cont'd. 1/4 ...

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found as follows:

In B.H. #1 at Elevation 236.2
In B.H. #2 at Elevation 236.0
In B.H. #3 at Elevation 236.5
In B.H. #4 at Elevation 236.1

It may be assumed that the ground water level will vary with the seasons of the year. No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As was described in the previous paragraphs, the subsoil basically consists of clayey sandy silt, followed by silty sand and gravel, which in turn, is underlain by sound limestone bedrock. The investigation has revealed that within the upper 20 feet of the deposit the properties are such that adequate support for spread footings could be obtained. It is recommended to place the footings approximately 6'-0" below creek bottom level at approximate El. 220.0. This, however, should be checked with the D.H.O. Hydrological Section, when their studies of possible scour are completed. A net allowable pressure of 2.5 t.s.f. may be assumed for design purposes.

Since the subsoil consists of relatively impervious material, and the water level is low, dewatering should not present any major problems. No stability problems are anticipated, with the approach fills.

cont'd. /5 ...

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

If scour is a problem, piles driven to refusal either in the sandy gravel layer or bedrock, are recommended as an alternative. The bearing capacity of the piles, concrete or steel, will depend on their structural properties.

7. SUMMARY:

1) The stratification of the soil, which consists of sandy clayey silt, followed by silty sand and gravel, underlain by sound limestone bedrock, is quite uniform. The density of the materials encountered varied from dense to very dense.

2) Because of the denseness of the upper layers, footings should be placed approximately 6'-0" below creek bottom level at El. 229.0. This, however, should be checked with the D.H.O. Hydrological Section when their study is completed. A net allowable pressure of 2.5 t.s.f. may be assumed for design purposes. As an alternative, end-bearing piles are recommended.

3) Dewatering of the excavations should not present major problems.

4) No stability problems are anticipated for the approach fills.

cont'd. /6 ...

8. MISCELLANEOUS:

The field work, performed during the period from August 21 to August 27, 1965, together with the preparation of this report, was undertaken by Mr. W. W. Klimatickas, Project Foundation Engineer. The investigation was carried out under the supervision of Mr. K. G. Selby, Senior Foundation Engineer, who also reviewed this report.

October 1965

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 65-8-92

LOCATION Rwy 31 & Bass Creek Line "D" Ch 49/70 27'-0" Rt.

ORIGINATED BY H.W.K.

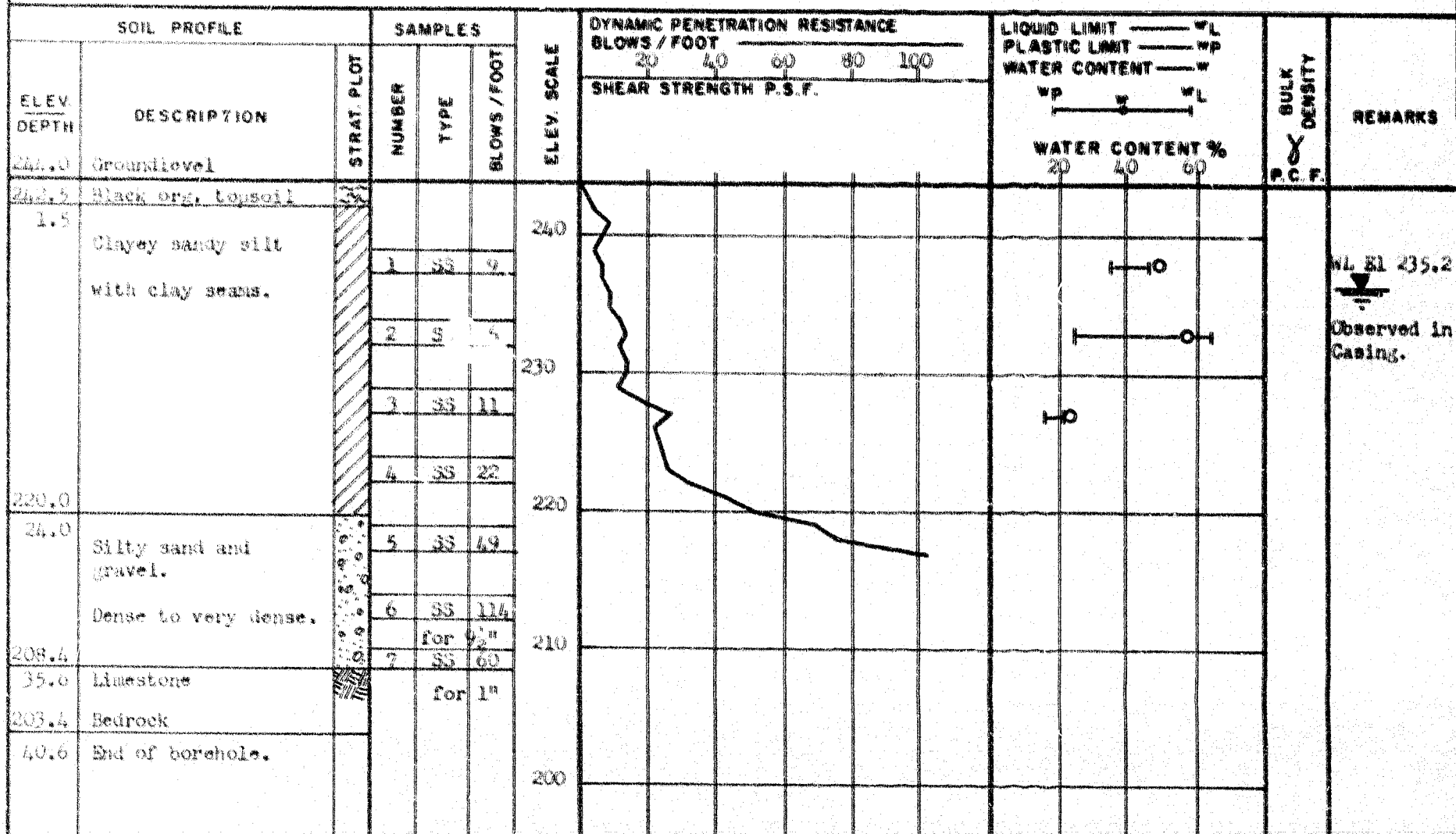
W.P. 245-61 517-64

BORING DATE Aug 12 & 20, 1965.

COMPILED BY H.W.K.

DATUM 244.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A.G.S. *dl*


DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-7-72LOCATION Rwy 31 & Moss Creek Line "D" On 487/72 37'-0" W.ORIGINATED BY W.W.K.W.P. 246-04BORING DATE Aug 20, 1965.COMPILED BY W.W.K.DATUM 243.5BOREHOLE TYPE Hammering BX Casing.CHECKED BY A.G.S.

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		20	40	60	80	100	wp	w		
243.5	Groundlevel														
242.0	Black org. topsoil														
1.0	Clayey sandy silt with clay seams.		1	SS	13	240									
			2	SS	19	230									
220.0						220									
23.5	Silty sand and gravel. Dense to very dense.		3	SS	31	210									
208.7			4	SS	18	200									
35.5	Assumed Bedrock End of borehole.				for 5"										

W. Bl 236.0

Observed
in Casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 05-P-92

LOCATION Hwy 31 to Hess Creek Line "D" Ch 428+57 31'-0" Lt.

ORIGINATED BY W.H.A.

W.P. 200-95

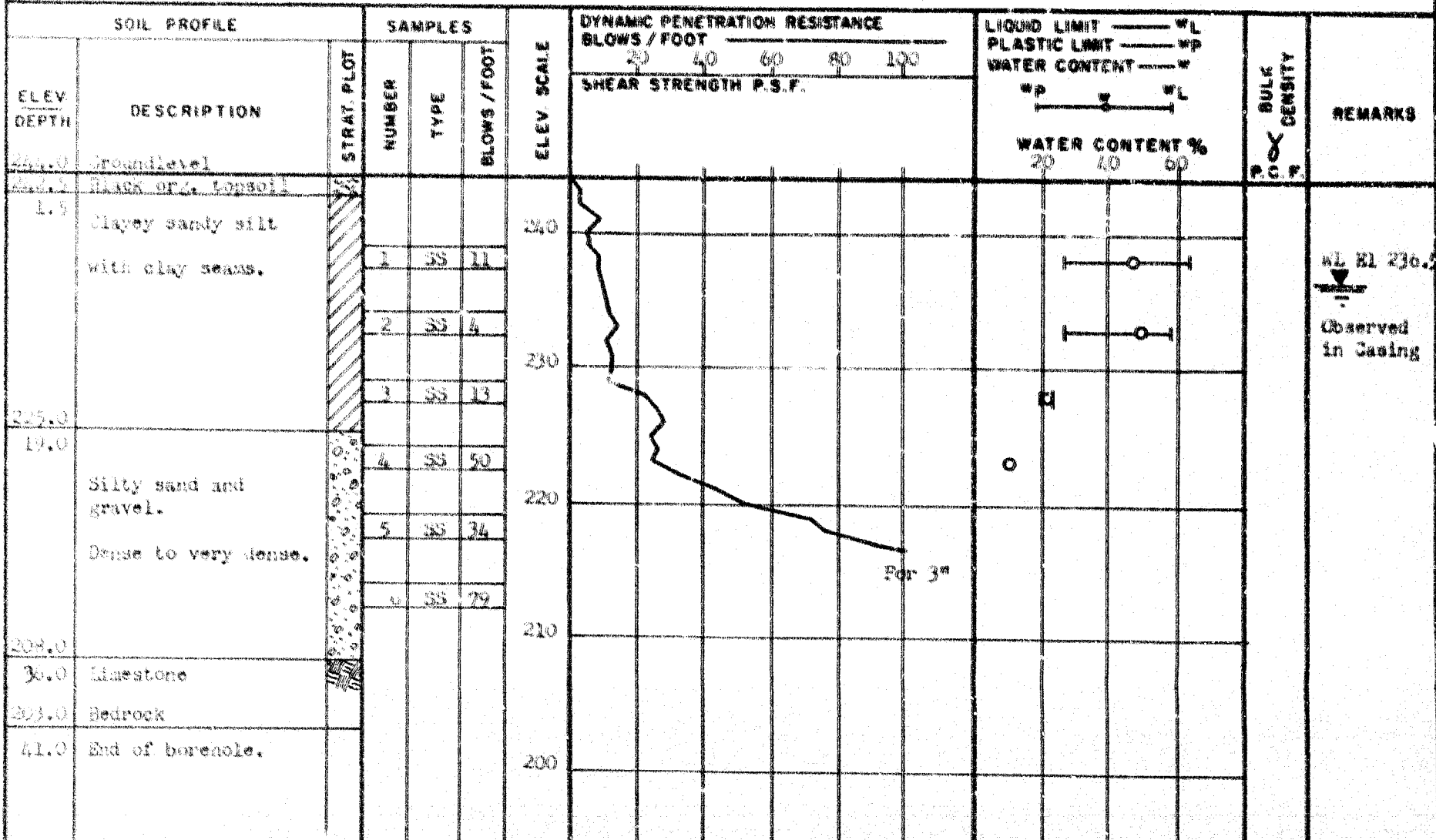
BORING DATE Aug 21, 1965.

COMPILED BY W.H.A.

DATUM 244.0

BOREHOLE TYPE Washboring HX Casing.

CHECKED BY A.G.S. *AGS*



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 65-2-72 LOCATION Lot 31 & Hess Creek Line "D" Ch 498-32 25'-0" RL. ORIGINATED BY W.W.K.
W.P. 240-34 BORING DATE Aug 21, 1968. COMPILED BY W.W.K.
CATUM 243.0 BOREHOLE TYPE Gaslifting BX Casing. CHECKED BY A.G.S. *AS*

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 — WL WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
243.0	Ground level									
241.5	Black org. topsoil									
1.5	Clayey sandy silt with clay seams.		1	SS	10	240				WL BL 230.1 Observed in Casing.
			2	SS	16	230				
222.0										
21.0	Silty sand and gravel. Dense to very dense.		3	SS	52	220				
208.2						210				
31.8	Assumed Bedrock End of borehole.					200				

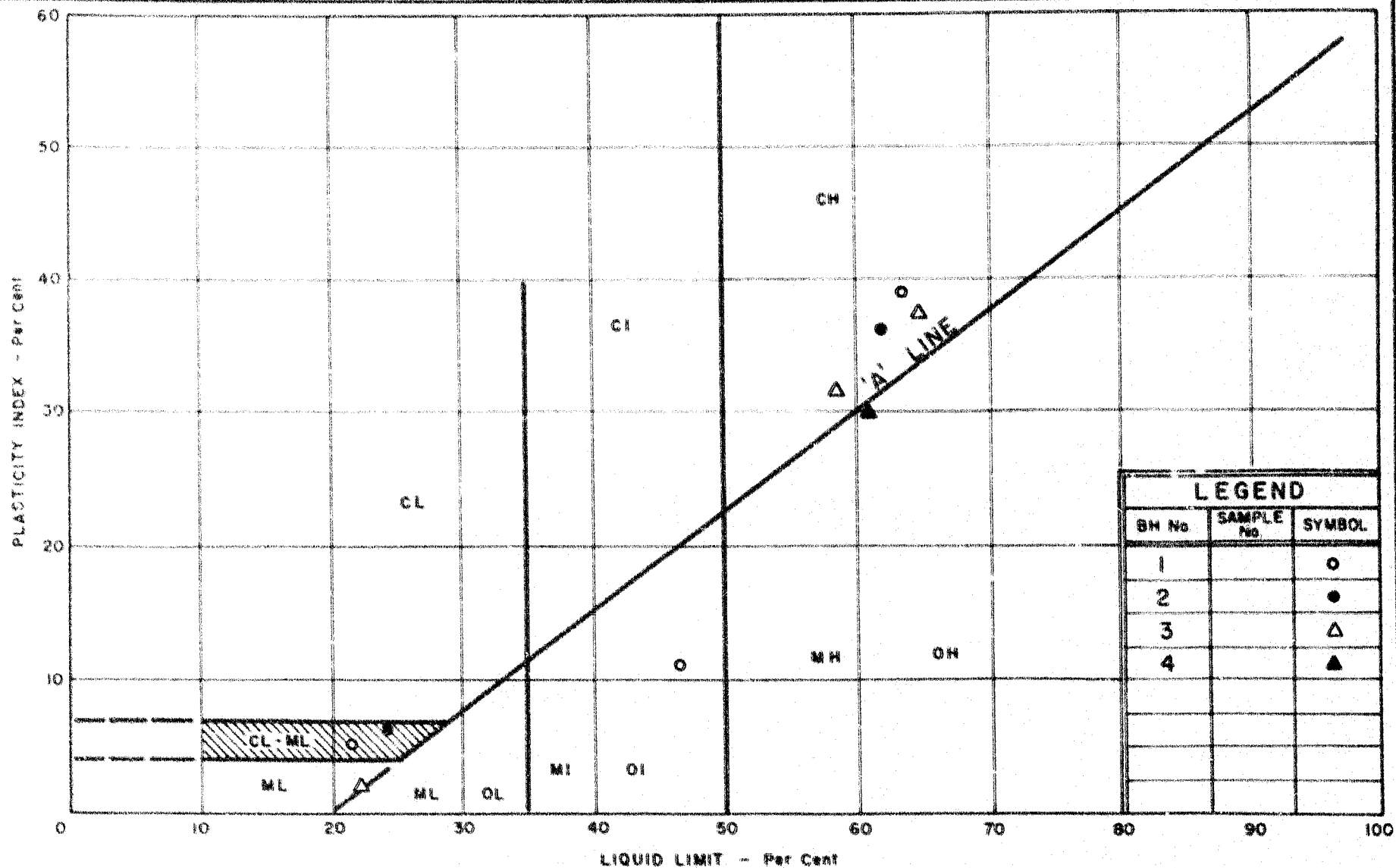
DATUM 24/11/2011

FOUNDATION SECTION

BOREHOLE TYPE Penetration Only.

CHECKED BY A.G.S.

[illegible]



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

WP No. 319-64

JOB No. 65-F-92

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
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

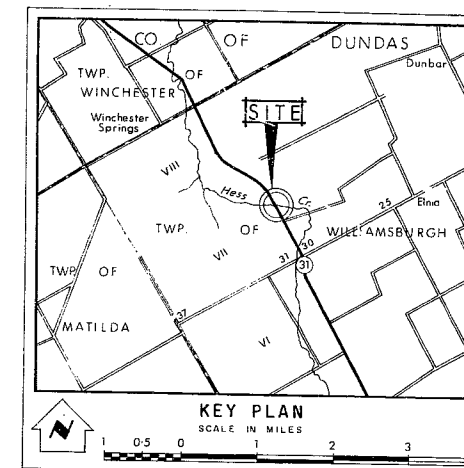
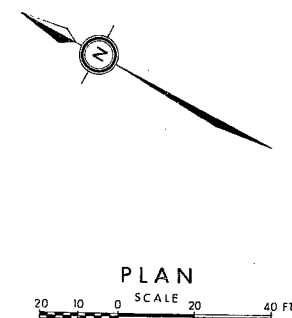
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Hwy. #31

HESS CREEK


NORTH CROSSING




LEGEND




Bore Hole



Cone Penetration Hole



Bore & Cone Penetration Hole

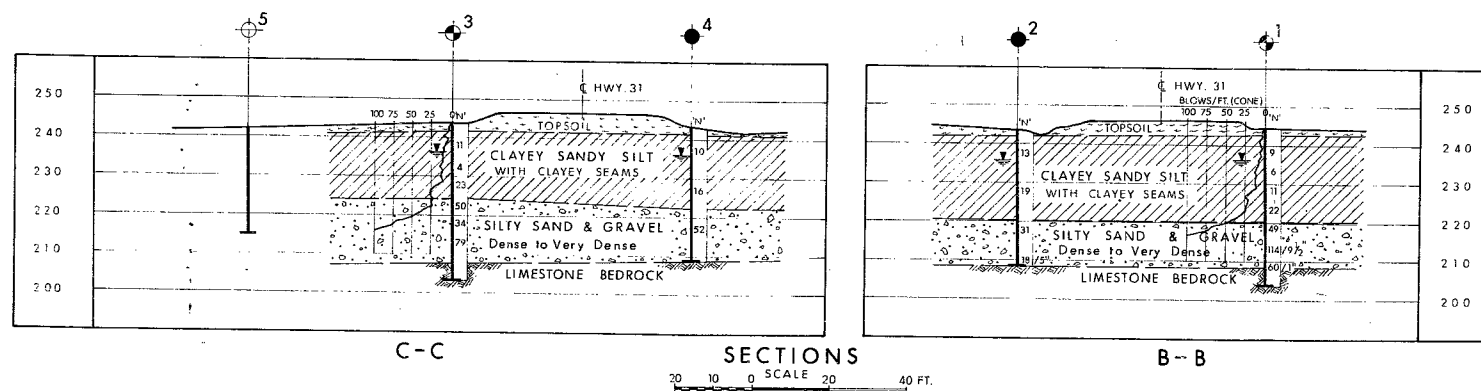
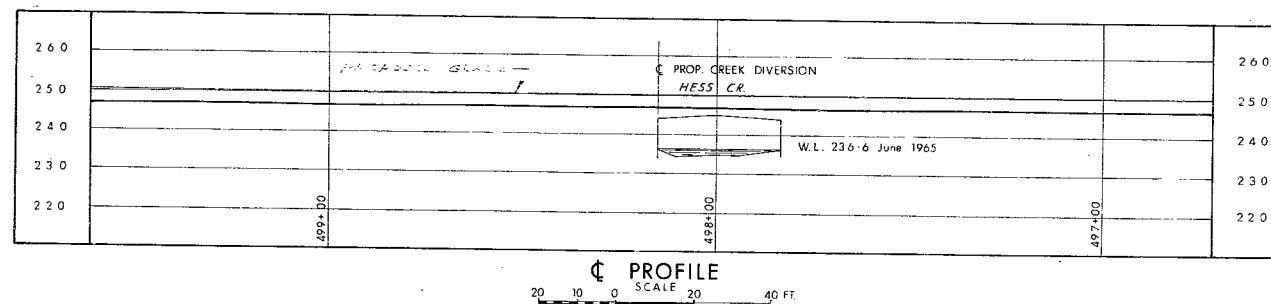


Water Levels established at time of field investigation. 21 AUG. 1965

NO.	ELEVATION	STATION	OFFSET
1	244.0	497+70	27' RT.
2	243.5	497+72	37' LT.
3	244.0	498+57	31' LT.
4	243.0	498+32	25' RT.
5	242.0	498+72	82' LT.

- 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			
HESS CREEK - NORTH CROSSING			
KING'S HIGHWAY NO. 31		LINE 'D' REV'N.	
CO. DUNDAS		DIST. NO. 9	
TWP. WILLIAMSBURGH		LOT	
BORE HOLE LOCATION		OIL STRATA	
SUBM'D W. K.		1ST DRAWING NO.	
CHECKED <i>W.K.</i>		75- F- 92 A	
DRAWN S. O.		JOB NO. 65 - F - 92	
DATE 18 OCT. 1965		BRIDGE DRAWING NO.	
SIGNED <i>W.K.</i>		18 OCT. 1965	
APPROVED <i>W.K.</i>		CONT. NO.	