

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 8, 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 - South Crossing,
County of Dundas, Twp. of Williamsburg,
Lot 30, Conc. 7, District #9 (Ottawa).
W.J. 65-F-91 -- W.P. 219-64

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.

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

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) Clay of Medium Plasticity - Stiff.
 - 4.3) Silty Sand and Gravel - Compact to Very Dense.
 - 4.4) Limestone Bedrock.
 5. GROUND WATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 7. SUMMARY.
 8. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT

For

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

M.J. 65-F-91 -- W.P. 219-64

1. INTRODUCTION:

A request to carry out a foundation investigation at the crossing of Hwy. #31 and Hess (Branch) Creek, South 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 - South 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 the realigned Hwy. #31 is from 459/80 to 460/62.

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, as well as conclusions and recommendations for future design work, are contained in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The site of the proposed bridge is located approximately 2.5 miles north of the Village of Williamsburg, County of Dundas, Twp. of Williamsburg, Lot 30, Conc. 7. The surrounding area is generally flat terrain. The width of Hess (Branch) Creek varied

cont'd. /2 ...

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

from 15'-0" to 18'-0" and the depth, during the time of investigation, was 0'-6" to 1'-0".

Physiographically, the site is located in the so-called "Glengarry 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 seven 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. #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

cont'd. /3 ...

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

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

this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile shown on Dwg. No. 65-F-91A, is based upon this information.

4.2) Clay of Medium Plasticity - Stiff:

This layer which extends to approximate El. 240.0 for a depth of about 8'-0" to 8'-6", was found immediately below the topsoil. It may be classified as stiff with an average 'N' value of 12 blows/foot. 'N' values varied from 10 blows/foot to 14 blows/foot.

Liquid limits for this material varied from 46% to 53%, while plastic limits ranged from 24.8% to 30.8%. The natural moisture contents are shown on the attached borelogs. The Plasticity Chart is given in Appendix I of this report. Grain size distribution curves indicated that this layer is composed of approximately 58% silt, 24% clay, and 18% sand.

4.3) Silty Sand and Gravel - Compact 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 compact to very dense with 'N' values between 24 to over 80 blows/foot. Grain size distribution curves indicated that this stratum is composed of 43% Gravel, 38% sand, and 19% silt.

4.4) Limestone Bedrock:

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

As can be seen on Dwg. No. 65-F-91A, the surface of the bedrock is nearly horizontal.

cont'd. /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 239.8

In B.H. #2 at Elevation 240.0

In B.H. #3 at Elevation 240.5

In B.H. #4 at Elevation 239.8

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 stiff clay of medium plasticity with some sand, 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. 237.0. 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 3 t.s.f. may be assumed for design purposes.

If the above recommended foundation elevation is finally accepted, dewatering of the excavation will be necessary. It appears to us that sheet piles driven to approximately elevation 234.0 would

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

be required to prevent the bottom of the excavation from boiling while the water is being pumped.

As an alternative to the spread footings, piles driven to bedrock should be considered. The allowable bearing capacity would depend on the structural characteristics of the pile used.

7. SUMMARY:

(1) The stratification of the soil, which consists of stiff clay of medium plasticity, followed by silty sand and gravel, underlain by sound limestone bedrock, is quite uniform. The density of the materials encountered, varied from compact to very dense.

(2) Because of the denseness of the upper layers, footings should be placed approximately 6'-0" below creek bottom level at Sl. 237.0. This, however, should be checked with the D.H.O. Hydrological Section when their study is completed. A net allowable pressure of 3 t.s.f. may be assumed for design purposes.

(3) Suggested dewatering of the excavations is explained in the report.

(4) As another foundation alternative, piles driven to bedrock, are suggested.

(5) No stability problems are anticipated for the approach fills.

cont'd. /6 ...

3. MISCELLANEOUS:

The field work, performed during the period from Aug. 17 to Aug. 20, 1965, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas, 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-F-91

LOCATION Hwy #31 & Hess Crk Line "D" Ch 459/80 23'-0" Lt.

ORIGINATED BY W.W.K.

W. P. 219-64

BORING DATE Aug 16 & 17, 1965.

COMPILED BY W.W.K.

DATUM 248.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— WL		REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT			PLASTIC LIMIT ——— wp	WATER CONTENT ——— w	
							20 40 60 80 100			
							SHEAR STRENGTH P.S.F.	wp w WL		
								WATER CONTENT % 15 30 45		
248.0	Groundlevel									
246.5	Black org. topsoil									
1.5	Clay of medium plasticity.									
240.0	Stiff.		1	SS	10	240				
8.0	Silty sand and gravel. Compact to very dense.		2	SS	24					
			3	SS	85	230				
227.8			4	SS	80					
20.2	Assumed Bedrock End of borehole.				for 4"	220				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-F-91

LOCATION Hwy 31 & Hess Crk Line "D" Ch 460/45.6'-0" Rt.

ORIGINATED BY W.W.K.

W.P. 219-64

BORING DATE Aug 17, 1965.

COMPILED BY W.W.K.

DATUM 248.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A.G.S.

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 % 15 30 45	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
248.0	Groundlevel									
246.5	Black org. topsoil									
1.5	Clay of medium plasticity, stiff.		1	SS	11					
240.0	Silty sand and gravel Compact to very dense.		2	SS	21					
			3	SS	80					
				for 3"						
227.6			4	SS	80					
				for 5"						
20.4	Assumed Bedrock End of borehole.									

For 10"

WL El 240.0

Observed in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 65-F-91

LOCATION Hwy 31 & Hess Crk Line "D" Ch 460/15 23'-0" Rt.

ORIGINATED BY W.W.K.

W.P. 219-64

BORING DATE Aug 18, 1965.

COMPILED BY W.W.K.

DATUM 250.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %				
							20	40	60	80	100	15 30 45				
							SHEAR STRENGTH P.S.F.					wp ——— w ——— WL				
250.0	Groundlevel															
248.5	Black org. topsoil															
1.5	Clay of medium plasticity. Stiff		1	SS	14											
241.5																
8.5	Silty sand and gravel. Compact to very dense.		2	SS	20	240										
			3	SS	146											
				for 11"												
229.0			4	SS	80	230										
21.0	Limestone Bedrock			for 2"												
222.5																
27.6	End of borehole.					220										

For 8"

WL El 240.5

Observed
in Casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 65-P-91

LOCATION Hwy 31 & Hess Crk Line "D" Ch 460+62 23'-0" Rt.

ORIGINATED BY W.W.K.

W.P. 219-64

BORING DATE Aug 19, 1965.

COMPILED BY W.W.K.

DATUM 248.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY A.G.S.

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			
248.0	Groundlevel									
246.5	Black org. topsoil									
1.5	Clay of medium plasticity. Stiff.		1	SS	14					
240.0	Silty sand and gravel. Compact to very dense.		2	SS	30					
8.0			3	SS	51					
227.9	Assumed Bedrock									
20.1	End of borehole.									

For 8"

WL El 239.8

Observed in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-91

W. P. 219-64

DATUM 250.0

LOCATION Hwy 31 & Hess Crk Line "D" Ch 459/67 on E

BORING DATE Aug 17, 1965.

BOREHOLE TYPE Penetration Only

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

ORIGINATED BY W.W.K.

COMPILED BY W.W.K.

CHECKED BY A.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WP	WL		
250.0	Groundlevel											
0.0	Penetration only.											
237.2						240						
12.8	End of Penetration					230						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.6

FOUNDATION SECTION

JOB 65-F-91

LOCATION Hwy 31 & Hess Crk Line "D" Ch 460-475 on C

ORIGINATED BY W.W.K.

W. P. 219-64

BORING DATE AUG 17, 1965

COMPILED BY W.W.K.

DATUM 247.0

BOREHOLE TYPE Penetration Only

CHECKED BY A.G.S.

[illegible]

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 65-F-91

LOCATION Hwy 31 & Hess Crk Line "D" Ch 460/97 98'-0" Rt.

ORIGINATED BY W.W.K.

W. P. 219-64

BORING DATE Aug 19, 1965.

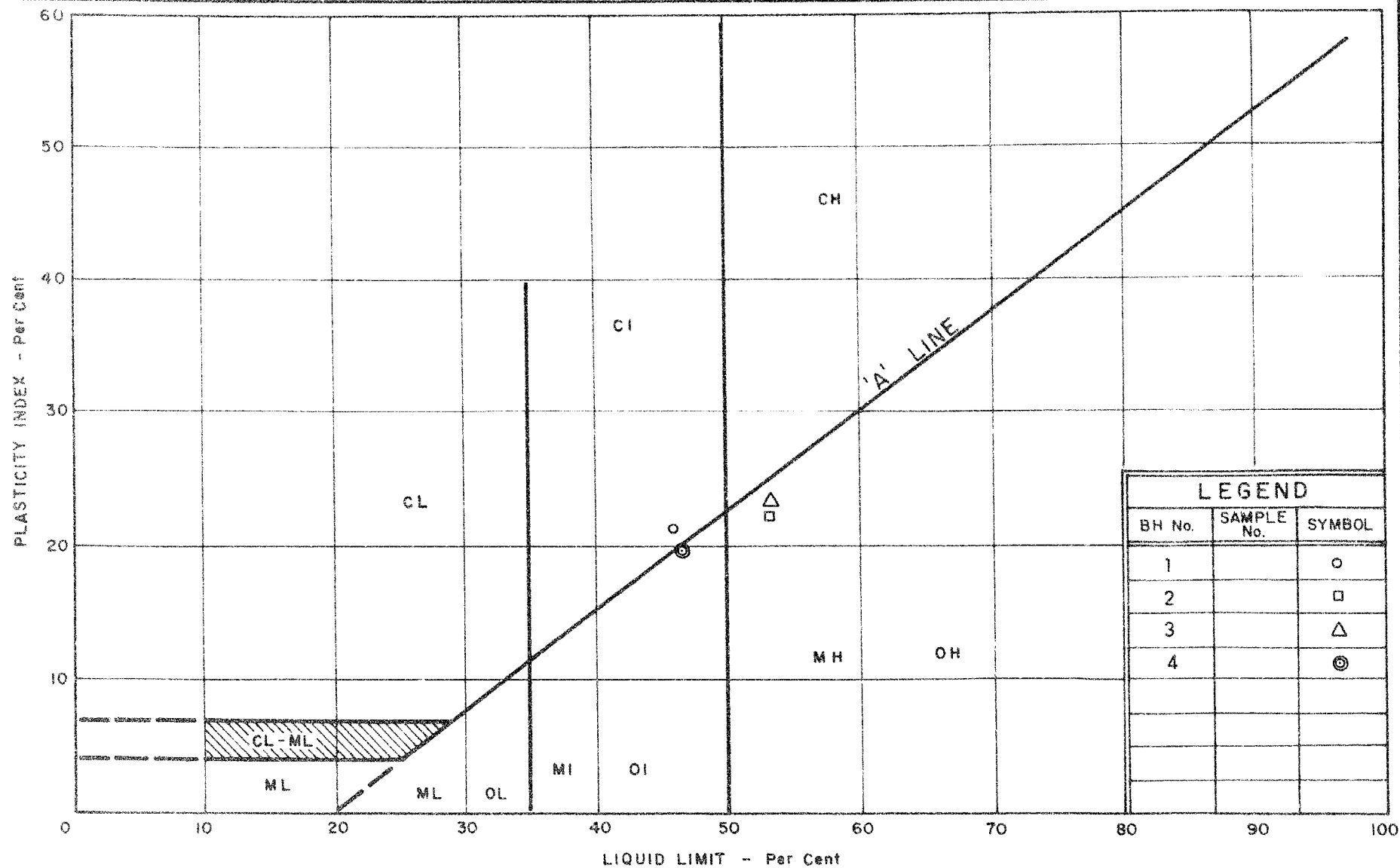
COMPILED BY W.W.K.

DATUM 248.0

BOREHOLE TYPE Penetration Only

CHECKED BY A.G.S.

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	PLASTIC LIMIT ——— W _P		
							20 40 60 80 100	WATER CONTENT ——— W		
							SHEAR STRENGTH P.S.F.	W _P ——— W ——— W _L		
								WATER CONTENT %		
								15 30 45		
248.0	Groundlevel									
0.0	Penetration Only									
235.2										
12.8	End of Penetration.						For 9"			



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

W.P. No. 219-64

JOB No. 65-F-91

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_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
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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario.

Date: March 29th, 1966.

OUR FILE REF.


IN REPLY TO

SUBJECT: W. P. #219-64 and #319-64, - 65-6-91
Bridge Site #31-97 and #31-98, - 65-6-92
Hess Creek Structures,
Highway #31, District #9.

Enclosed herewith please find prints of Preliminary Plan #D5839-1 and D5863-P1 of the above structures.

Would appreciate receiving your written comments at an early date.

JAF/cw
Encl.


J.A. Fisher,
for G. Scott,
Regional Bridge Location Engineer.

Mr. S. McCombie,
Bridge Planning Engineer.

Chemical Section,
Materials & Testing Division.

Attention: Mr. G. Scott, Regional
Bridge Location Engineer

April 13, 1966.

Highway 31 & Hess Creek, V.P. 219-64 & V.P. 319-64
Preliminary Plans #D5839-1 & D5863-P1

We have reviewed the above-mentioned preliminary plans with regard to the foundation design. We note that the designer has complied with the recommendations contained in the foundation reports.

KGS/c

cc. General Files,
Foundation Files. ✓


K.G. Selby,
Senior Foundation Engineer.

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

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

April 5, 1967

Re: Refusal to Pile Driving

There are many sites where the properties of the subsoil are such that spread footings cannot be used and piles must be resorted to. Whenever a competent stratum is within reasonable distance from the ground surface, it is recommended that piles be driven to this stratum, thus deriving their support capacity from end bearing.

This competent stratum may be any kind of sound rock or some other very dense material.

The most straightforward proposition is when some soft material overlies bedrock. The pile driving characteristics are very different, and there is no doubt when bedrock is reached and the pile driving should be stopped.

However, often bedrock is overlain by a layer of dense till of various thickness. This till layer sometimes contains pebbles and boulders, the preponderance of which may not have been well established during the subsoil investigation because of the inherent disadvantages of the methods used (small diameter of borings).

In such cases, the pile driving recommendation calls for piles driven to bedrock. This recommendation tacitly assumes that it will be possible to penetrate the dense till stratum and reach bedrock. In many instances, this is possible, although the till layer is very dense and contains boulders. However, there have been cases where the penetration through the till stratum was not possible and piles were stopped some distance above bedrock. The piles were driven to what is generally called "practical refusal". The use of the Hiley formula in such a case, serves as a reliable check of the bearing capacity of the pile.

It was recently drawn to our attention, that on Contract No. 65-275 (Hwy. #31 and South Crossing of Hess Creek - W.P. 219-64) where piles were required to be driven to bedrock, the contractor was unable to accomplish this. The piles reached "practical refusal" within the dense layer overlying bedrock.

cont'd. /2 ...

Mr. B. R. Davis,
Bridge Engineer,
Bridge Div., Admin. Bldg.

- 2 -

April 5, 1967

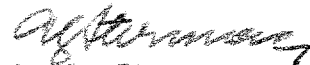
However, before it was agreed in the field that further advancement of the piles was practically impossible, some of the piles were so badly damaged that they had to be cut off once - or even twice - before further driving was resumed.

It would appear from the above, that the field personnel took the recommendation too literally and tried to comply with it, irrespective of the rather obvious indications that the objective could not be reached.

We would, therefore, recommend that whenever there is even the slightest possibility that the piles may not reach bedrock, although driven with the required energy, a note be inserted which would explain that if "practical refusal" is met, further driving of the piles can be discontinued. "Practical refusal" has to be checked by the Hiley formula.

It is believed that in this way, damaging of the piles and thus delaying of the pile driving operation, can be avoided.

ACS/WdeF



A. G. Sternac

PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. C. S. Grebski
B. Richardson
Foundations Files
Gen. Files

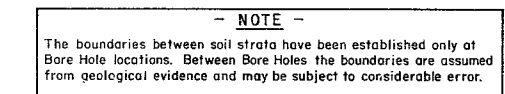
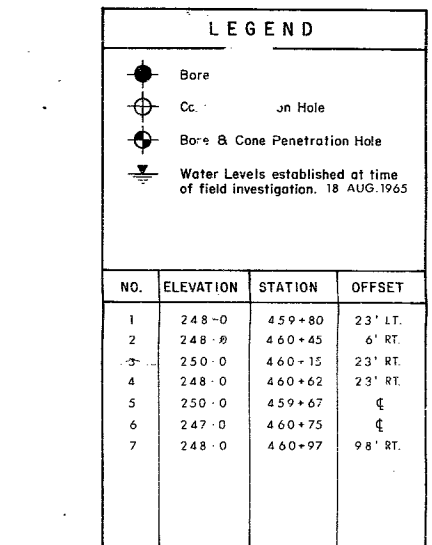
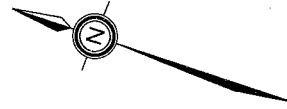
#65-F-91

W.P.# 219-64

W.P.# 319-64

HWY #31

HESS CREEK

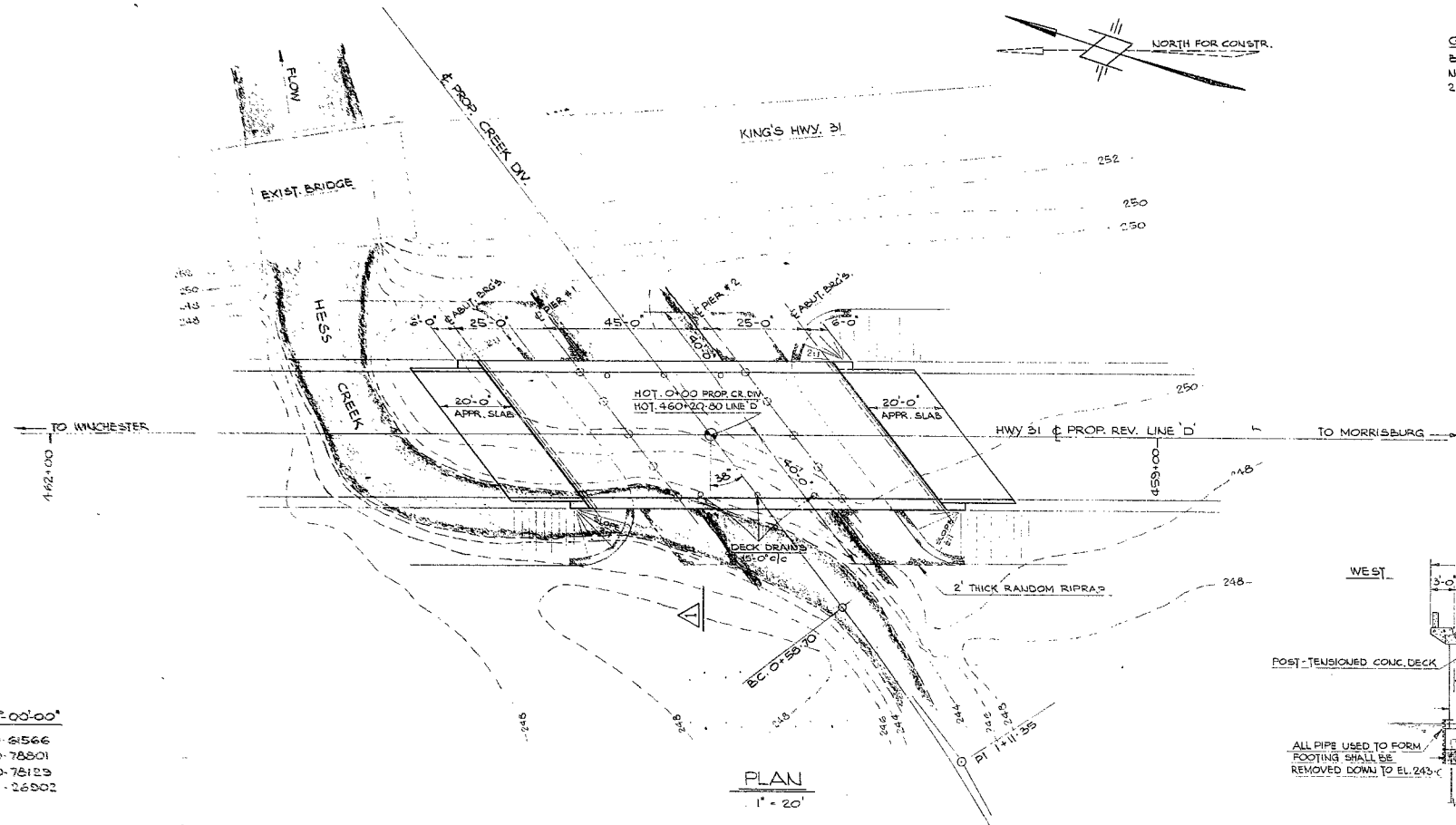


REVISIONS			
	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS – ONTARIO MATERIALS & TESTING DIVISION – FOUNDATION SECTION			
<h2 style="margin: 0;">HESS CREEK – SOUTH CROSSING</h2>			
KING'S HIGHWAY NO.	<u>31</u> LINE 'D' REV'N.	DIST. NO. <u>9</u>	
CO. <u>DUNDAS</u>			
TWP. <u>WILLIAMSBURGH</u>	LOT <u>30</u>	CON. <u>VII</u>	
<h3 style="margin: 0;">BORE HOLE LOCATIONS & SOIL STRATA</h3>			
SUB'D. W. K.	CHECKED <u>RLS</u>	W.P. NO. <u>219 - 64</u>	M.B.T. DRAWING NO.
DRAWN S. O.	CHECKED <u>RLB</u>	JOB NO. <u>65-F-91</u>	65-F-91A
DATE <u>12 OCT. 1965</u>	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <u>A. J. H. [Signature]</u>	CONT. NO.		

REF. NO. E-4609-

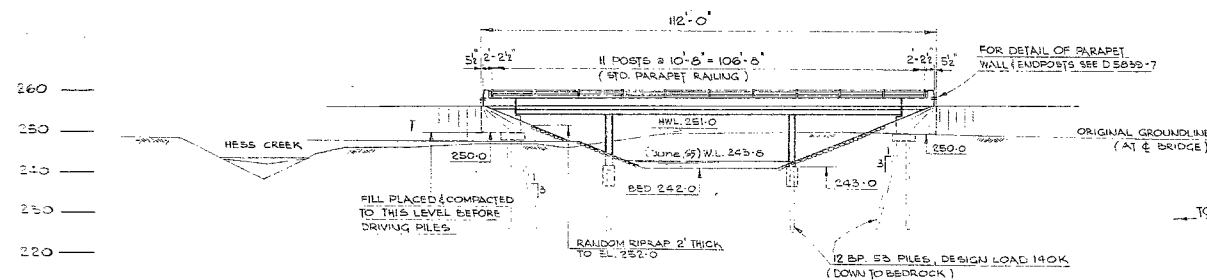
[illegible]



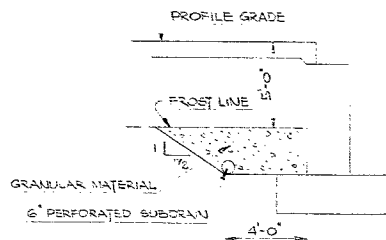
FUNCTION OF 38° 00' 00"

SIN. = 0.61566
COS. = 0.78801
TAN. = 0.78123
SEC. = 1.26502

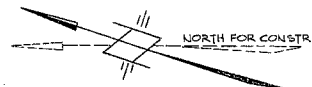
PLAN
1" = 20'



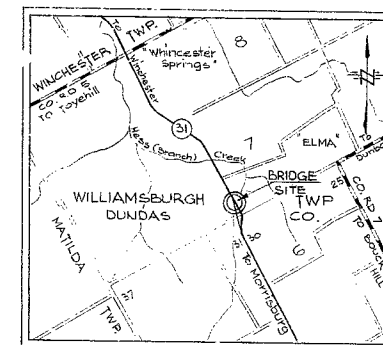
ELEVATION
1" = 20'



DETAILS OF MIN. GRANULAR BACKFILL REQUIREMENT
LATERAL LIMITS - INSIDE FACE TO INSIDE FACE OF W-WALLS
SECTION 1 TO ABUTMENT



GEODETIC DATUM
B.M. 250.78
N.W. IN S.W. ROOT OF 2'S OAK
219.0 RT. OF 456.00



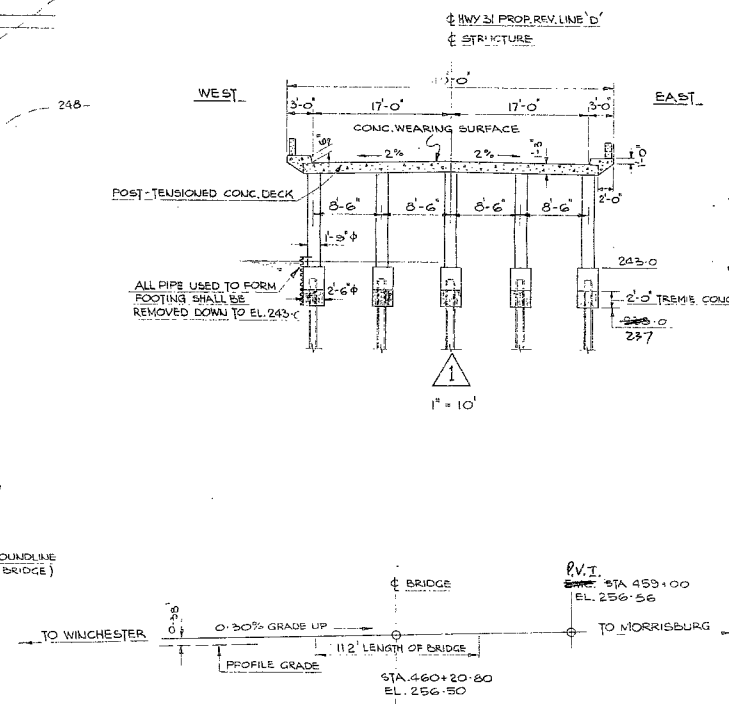
KEY PLAN
1 IN. = 1 MI.

GENERAL NOTES

CLASS OF CONCRETE: DECK, CURBS, PARAPET & PIER
COLUMNS 5000 P.S.I. REMAINDER 3000 P.S.I.
COVER: FOOTINGS, ABUTMENTS, WINGWALLS & PIERS 3"
DECK: TOP 2" BOT. 1 1/2" CURBS 2", POSTS 1 1/2"
CONSTRUCTION NOTE: THE CONTRACTOR IS RESPONSIBLE
FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE
SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8"

DRAWING LIST

- D 5839-1 GENERAL PLAN
-2 BORE HOLE LOCATIONS & SOIL STRATA
-3 FOOTINGS & PIERS, DIM. & REINF.
-4 ABUTM. WINGWALLS-APPR. SLAB DIM. & REINF.
-5 DECK DIM. & REINF.
-6 STANDARD PARAPET RAIL
-7 STANDARD DETAILS



PROFILE OF PROP. REV. LINE 'D'
N.T.S.
(ELEV'S TO FINISHED PAVEMENT)

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

HESS CREEK BRIDGE (SOUTH CROSSING)

2.5 MI. NORTH OF WILLIAMSBURG N. LIMITS

KING'S HIGHWAY No. 31 DIST. No. 9
CO. OF DUNDAS
TWP. OF WILLIAMSBURG LOT 30 CON. 7

GENERAL PLAN

APPROVED	BRIDGE ENGINEER	SITE No. 31-97	W.P. No. 219-54
DESIGN	CHECK	CONTRACT	No.
DRAWING	CHECK	DRAWING	No.
DATE	LOADING	H20-S16	D 5839-1



