

Gen. 23-63-120

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Division,
(Foundation Section)

March 12, 1962.

D.H.O. FOUNDATION INVESTIGATION
REPORT.
W.J. 62-F-6 -- W.P. 198-61.

Attention: Mr. S. McCombie.

Re: Proposed New Bridge - Hwy. #18 and
Wigle Creek, 1.9 Miles West of
Kingsville, Twp. of Gosfield-South,
County of Essex, District No. 1.

Attached, we are forwarding to you, our detailed
report on soil conditions existing at the above-mentioned
structure location.

We believe you will find the factual data and
recommendations contained therein, adequate for your future
design work. If clarification, or further information is
required, please do not hesitate to contact our Office.

AGS/MdeF

Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
A. Gater
G. U. Howell
J. Roy
T. J. Kovich
J. E. Gruspier
E. R. Saint
F. Norman
A. Watt
Foundations Office ✓
Gen. Files.

Afterman
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION

For

Proposed New Bridge - Hwy. #18 and Wigle Creek,
1.9 Miles West of Kingsville, Twp. of Gosfield-South
County of Essex, District No. 1

W.J. 62-F-6 ----- W.P. 198-61.

1. INTRODUCTION:

It is proposed to erect a new bridge, to carry Hwy. #18 over the Wigle River. The site of the proposed bridge is located in the Twp. of Gosfield-South. At this location, the chainage of Hwy. #18 is 359+63.

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

2. DESCRIPTION OF SITE:

The area in which the structure is located, is generally flat terrain. Physiographically, the site is located in the St. Clair Clay Plain.

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, two sampled boreholes, and four dynamic cone penetration tests, were carried out at this site. Split-spoon

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

samples were taken at various depth intervals. Because of the dense nature of the soil, it was not possible to obtain undisturbed samples. Samples recovered in the split-spoon sampler were used to determine the following physical properties:-

1. Natural Moisture Content.
2. Grain Size Distribution.

Results of these 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 the various soil types encountered during the investigation, is shown in Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile, shown on Dwg. No. 62-F-6A, is based upon this information.

4.2) Very Soft Organic Clay (OH):

This layer, approx. 5.5 ft. thick, was found at the surface in B.H. #1. In B.H. #2, which was drilled through the existing fill, this material was not encountered, and it may be assumed that it was removed during construction.

This layer is in a very soft state, with an average 'N' value of 1 blow/foot.

cont'd. /3 ...

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

4.3) Loose Silty Sand (SM):

This stratum, which extends to approx. El. 567.0 for a depth of about 6.0 ft., may be classified as loose, with an average 'N' value of 3 blows/foot.

The percentage of sand in this layer is 61%; silt forms 35%, and the res' of 4%, is clay.

4.4) Very Dense Silt with Sand (ML):

Following the stratum of loose silty sand, is a stratum of very dense silt with sand. The overall stratum is in a very dense state with an average 'N' value of 78 blows/foot. This layer extends down to bedrock, for a depth of about 30.0'.

The percentage of silt in this layer is about 72%, sand forms 20%, and the rest of 8%, is clay.

4.5) Bedrock:

The bedrock at the site (light grey limestone), was found at El. 536.5 in B.H. #1 and El. 539.5 in B.H. #2.

In both boreholes the top surface of the bedrock was found in a weathered condition to a depth of about 1'-6".

5. GROUND WATER CONDITIONS:

The ground water level at the time of the investigation, was found to be at approx. El. 574.0.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As can be seen from the previously described soil stratigraphy, the soil consists of very soft organic clay, underlain by loose silty sand, followed by very dense silt with sand which extends to the limestone bedrock.

The proposed structure may be supported on spread footings or on piled foundations.

If spread footings are used, the bottom of the footings should be placed at El. 565.0 because above that level the soil cannot provide adequate support. At El. 565.0 or below, a safe bearing pressure of 2.5 tons per sq. ft. may be employed.

Spread footings would require extensive excavations and consideration should be given to an alternative solution of piled foundations.

The proposed bridge may be founded on 'H' piles driven down to bedrock. The design load will be dependent on the pile section and may be as high as 70 tons in the case of a 12 BP at 74. The bottom of the pile footings should be El. 568.0 for scour protection as recommended by the Hydrology Section.

A dewatering scheme will be necessary as excavations will be carried out below creek or ground water levels. The subsoil material at this location is such that 'boiling' is likely to occur under conditions of unbalanced hydrostatic heads. Therefore, it is essential that an efficient dewatering method be used if a spread footing type of foundation is considered. Failing this, the bearing capacity of the subsoil is

cont'd. /5 ...

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

likely to be considerably reduced. From our experience in the past with similar material, we believe that a wellpoint method of dewatering would probably be inefficient: therefore, we would recommend that the excavations be protected by interlocking sheet piling driven to a depth below the formation level, equal to the height of the prevailing water table above it. If this scheme is adopted, the sheeting may be left in place at the front and sides of the footings to provide protection against scour. This latter provision has been recommended by the Bridge Hydrology Section.

Footings for falsework may be placed on the surface of the inorganic layer. A safe load of 0.5 Tons/sq. ft. may be employed.

7. SUMMARY:

1. The stratification of the soil is quite uniform. The relative density of the material encountered varies from loose to very dense.

2. Spread or pile footings are recommended for the structure.

3. If spread footings are used, the bottom of the footings should be at El. 565.0. An allowable bearing pressure on the subsoil of 2.5 tons per sq. ft. may be employed.

cont'd. /6 ...

7. SUMMARY: (cont'd.) ...

4. If the alternate solution is selected, 'H' piles should be driven down to bedrock. A design load of 70 tons per pile, may be employed in the case of a 12 BP at 74. The bottom of the pile footings should be at El. 568.0.

5. Dewatering will be necessary as excavations will be carried out below creek or ground water levels. Suggested details of dewatering are given in the report.

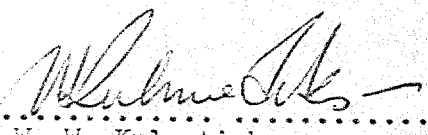
6. Footings for falsework may be placed on the surface of the inorganic layer. A safe load of 0.5 tons per sq. ft. may be used.

8. MISCELLANEOUS

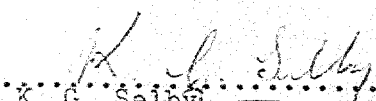
The field work was carried out during the period January 29, 1962 - February 2, 1962. Field equipment used was owned and operated by Canadian Longyear, Ltd., under the supervision of Mr. W. W. Kulmatickas of the D.H.O.

March 1962

REPORT PREPARED BY:


.....
W. W. Kulmatickas,
PROJECT FOUNDATION ENGINEER

REPORT APPROVED BY:


.....
K. G. Selby,
SR. PROJECT FOUNDATION ENGR.

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-6 LOCATION 359497 (36'-0" Rt.) ORIGINATED BY W.W.K.
W P 198-61 BORING DATE Jan. 29/62 COMPILED BY H.S.
DATUM 578.0 BOREHOLE TYPE Wash Boring. CHECKED BY W.W.K.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w _L		BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT			
							20 40 60 80 100			
							SHEAR STRENGTH P.S.F.			
							WATER CONTENT — w			
							w _p — w _L			
							WATER CONTENT %			
							25 50 75			
578.0	Groundlevel					580.0			Established in Casing.	
0.0	Very soft organic clay.		1	S.S. P						
572.5			2	S.S. P		570.0				
5.5	Loose silty sand.		3	S.S. 26						
568.0			4	S.S. 56		560.0				
10.0			5	S.S. 69		550.0				
	Very dense silt with fine sand.		6	S.S. 90		540.0				
			7	S.S. >100						
536.5			8	R.C.		530.0				
41.5	Limestone Bedrock									
531.5										
46.5	End of borehole.									

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION		RECORD OF BOREHOLE NO. 2		FOUNDATION SECTION	
JOB 62-F-6	LOCATION 359+25 (28.0' Lt.)	ORIGINATED BY W.W.K.			
W.P. 198-61	BORING DATE Jan. 31/1962.	COMPILED BY H.S.			
DATUM 584.0	BOREHOLE TYPE Wash Boring	CHECKED BY W.W.K.			

SOIL PROFILE			SAMPLES			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	ELEV. SCALE	BLOWS / FOOT 20 40 60 80 100			SHEAR STRENGTH P.S.F.				WATER CONTENT % 15 30 45	
584.0	Groundlevel					585.0									
0.0	Fill		1	S.S.	12	575.0									
573.0			2	S.S.	3										
11.0	Loose silty sand.		3	S.S.	5										
567.0			4	S.S.	60										
17.0	Very dense silt with fine sand.		5	S.S.	138										
			6	S.S.	56										
539.5	Limestone Bedrock		7	R.C.											
44.5															
529.5	End of borehole.														
44.5															

▽ w.l. 574.0
Established
in Casing.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT — WL			BULK DENSITY P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	20	40	60	80	100			PLASTIC LIMIT — WP	WATER CONTENT — W
						SHEAR STRENGTH P.S.F.								WATER CONTENT %	
579.6 0.0	Groundlevel					580.0									
						570.0									
						560.0									

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

LOCATION 560.10 (21.0' Left)

ORIGINATED BY W.W.K.

BORING DATE Feb. 2, 1962.

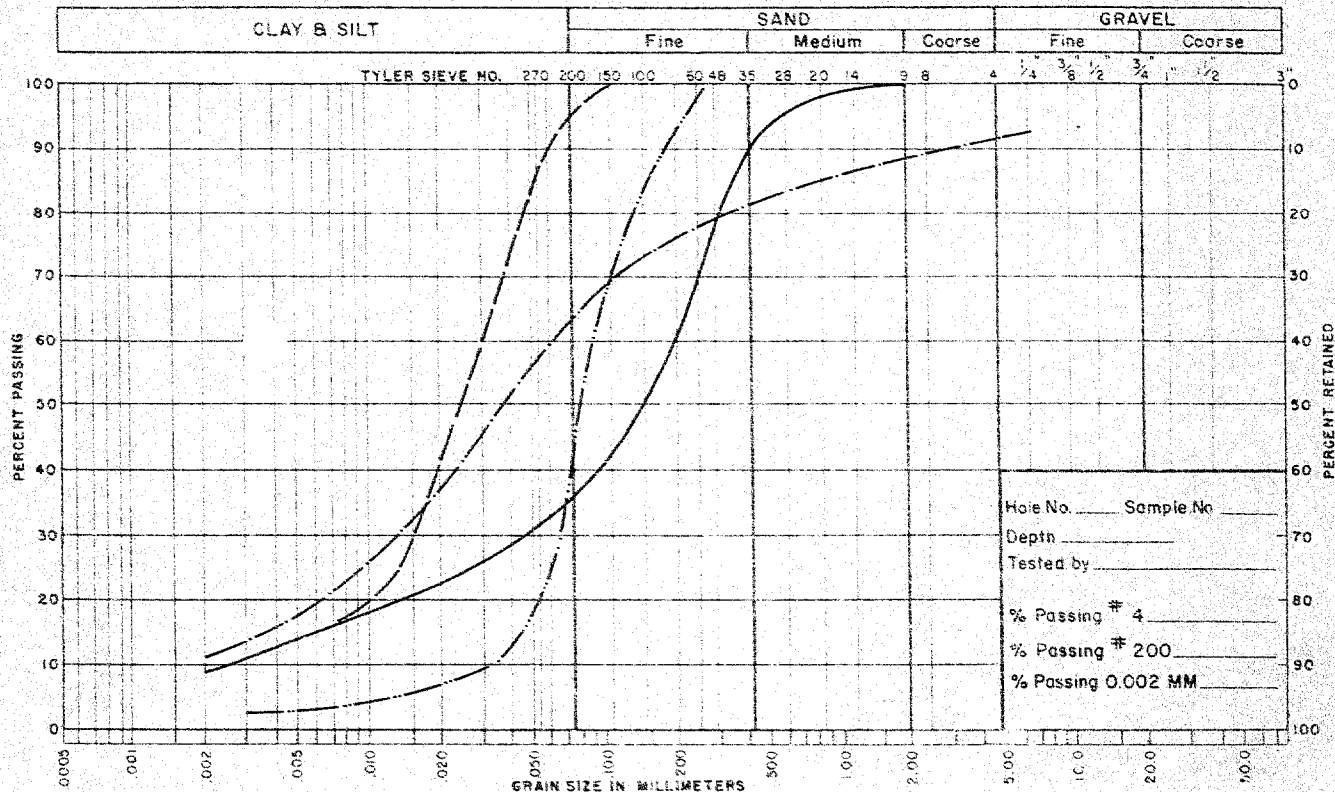
COMPILED BY H.S.

BOREHOLE TYPE Dynamic Cone Penetration Test.

CHECKED BY W.H.K.

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM



NOTES	BOREHOLE - 2, SAMPLE - 2	10' - 11.5'
	BOREHOLE - 2, SAMPLE - 5	30' - 31.5'
	BOREHOLE - 1, SAMPLE - 3	10' - 11.5'
	BOREHOLE - 1, SAMPLE - 6	30' - 31.5'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION
GRAIN SIZE DISTRIBUTION

Job No. 62-F-6

W.P. No. 198-61

Location _____

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
	P.M.		SAMPLE ADVANCED MANUALLY
	P.H.		SAMPLE ADVANCED HYDRAULICALLY

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

IN TERMS OF
EFFECTIVE STRESS
 $\tau_f = c' + \sigma' \tan \phi'$

IN TERMS OF
TOTAL STRESS
 $\tau_f = c_u + \sigma \tan \phi$

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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

#62-F-6

W.P. # 198-61

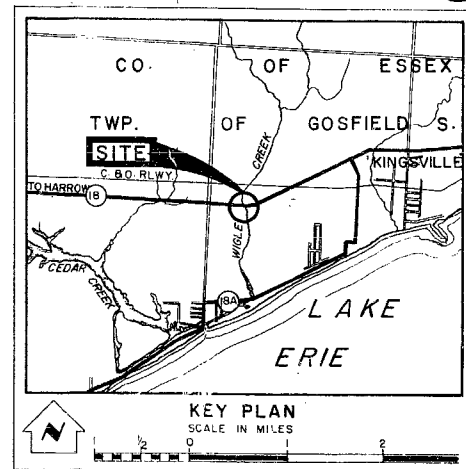
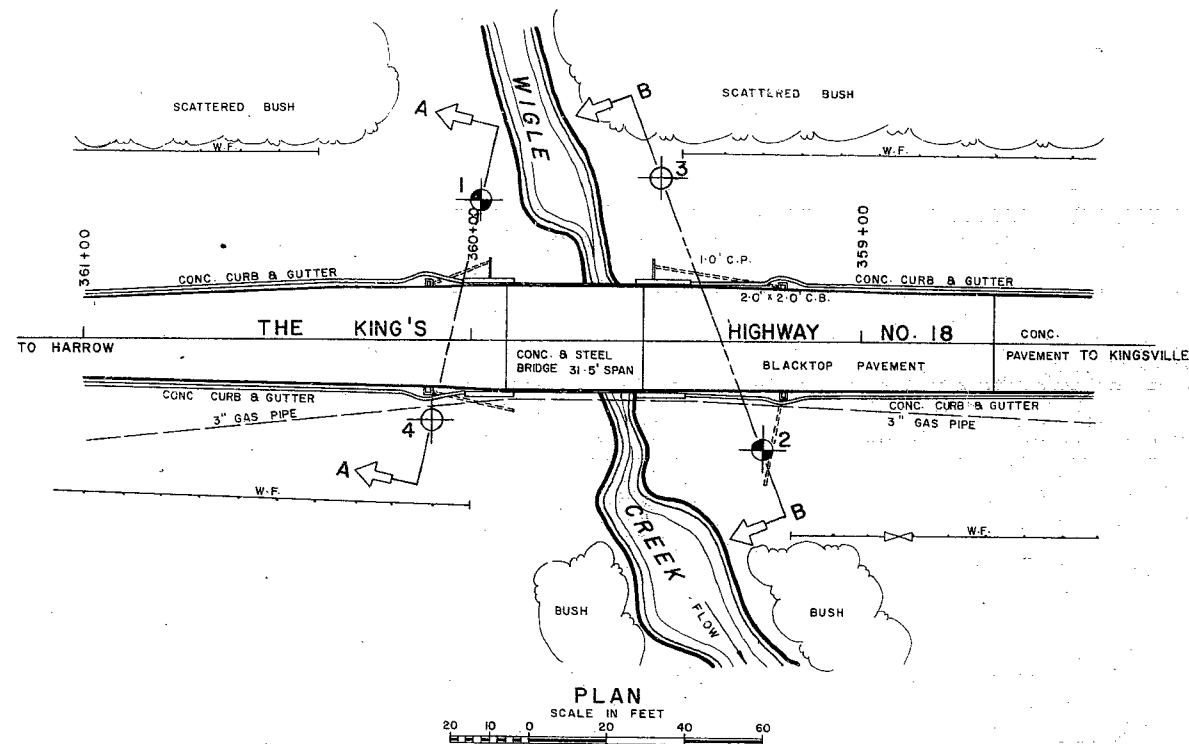
Hwy. # 18

CROSSING

WIGLE CR.

1.9 MILES W. OF

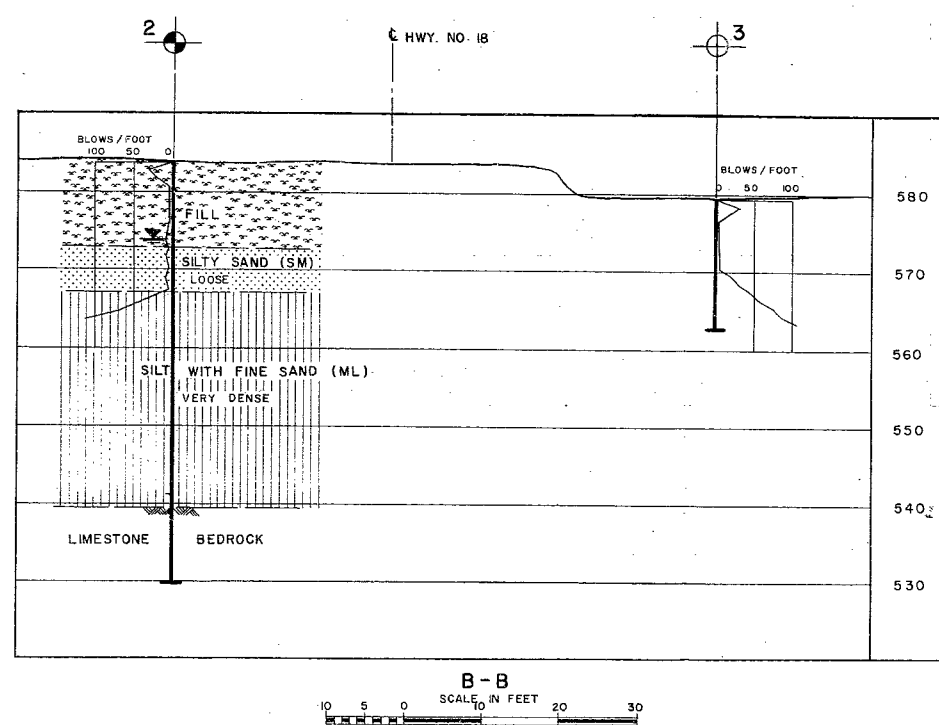
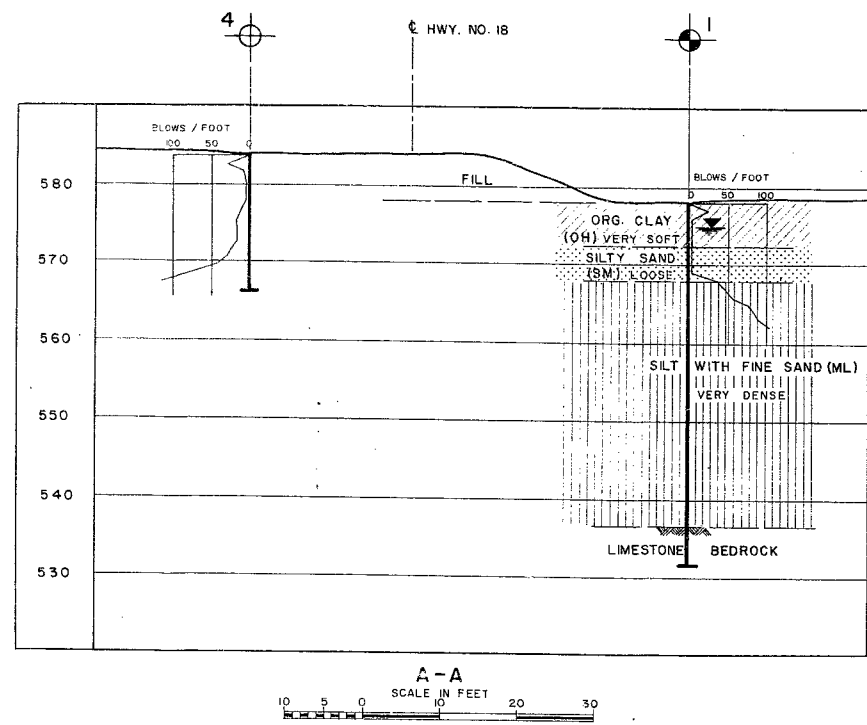
KINGSVILLE



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation		
NO.	ELEVATION	STATION	OFFSET
1	578.0	359+97	36' RT.
2	584.0	359+25	28' LT.
3	579.6	359+51	42' RT.
4	584.0	360+10	21' LT.

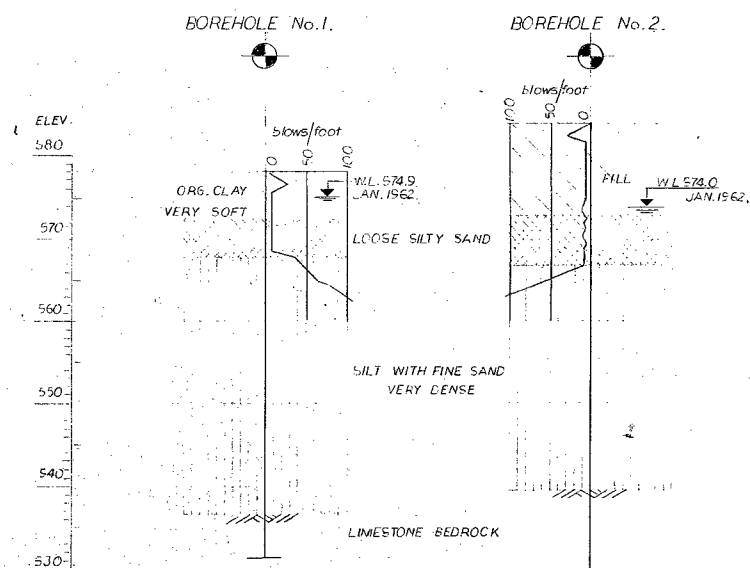
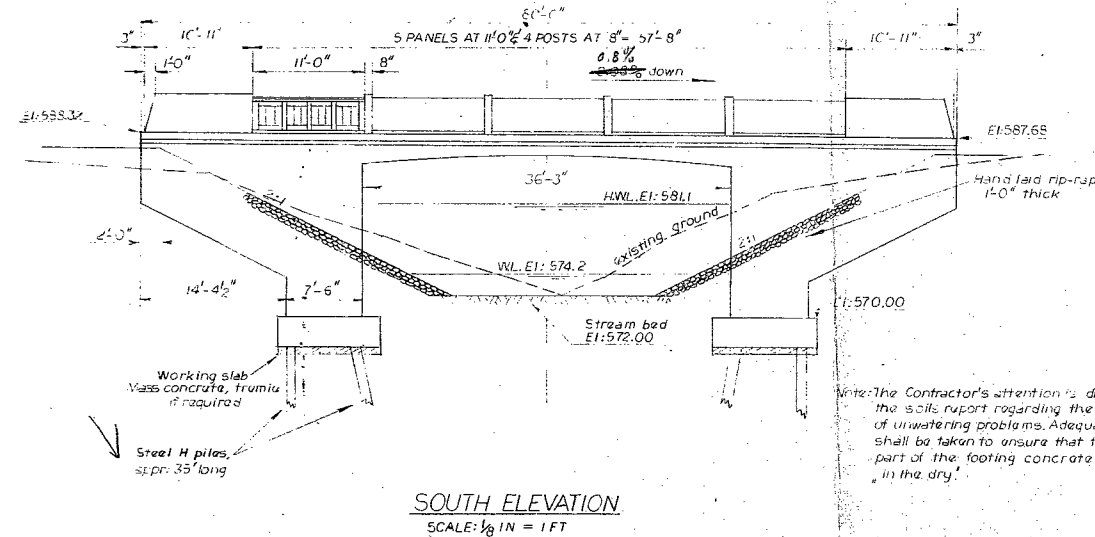
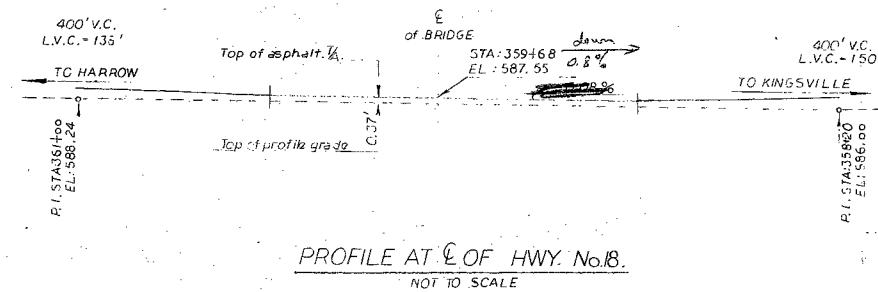
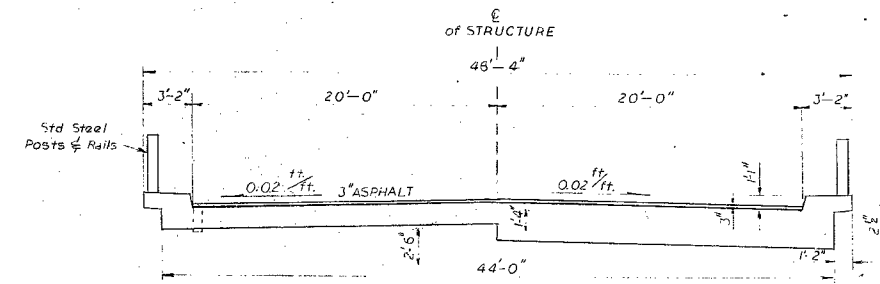
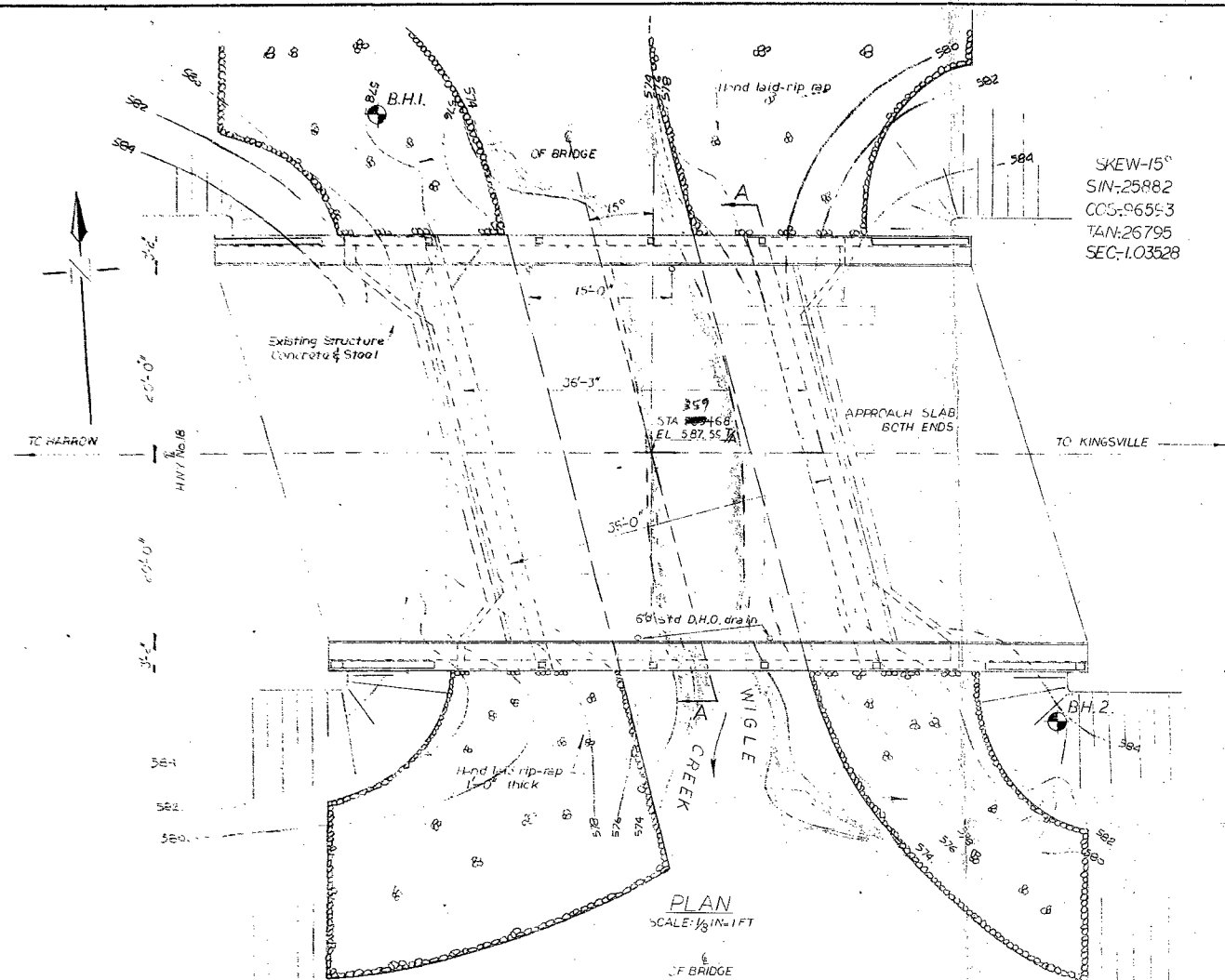
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION		
WIGLE CREEK AND HIGHWAY NO. 18		
ORIGINATED W. KULMATICAS	DISTRICT NO. 1	DATE FEB. 22, 1962
DRAWN F. CLARK	W.P. NO. 198-61	JOB NO. 62-F-6
CHECKED <i>[Signature]</i>	CONTRACT NO.	DRAWING NO.
APPROVED <i>[Signature]</i>		62-F-6A



REF. NO. E-4012-1

BA1381

[illegible][illegible]

DEPARTMENT OF HIGHWAYS ONTARIO				
BRIDGE DIVISION				
WIGLE CREEK BRIDGE				
1.2 MILES WEST OF HWY. No. 18A.				
KING'S HIGHWAY No. 18			DIST. No. 1	
CO. ESSEX				
TWP. GOSFIELD SOUTH		LOT 13/13	CON. WESTERN DIV. FRONT-GONC.	
PRELIMINARY PLAN				
APPROVED _____		SITE No. 6-183	W.P. No. 198-61	
BRIDGE ENGINEER				
DESIGN	N. Z.	CHECK	CONTRACT	
DRAWING	N. Z.	CHECK	Nos.	
		J. L. K.		
DATE	JUNE 1962	LOADING	DRAWING	D-5071-P1
		H-20 S-16	No.	