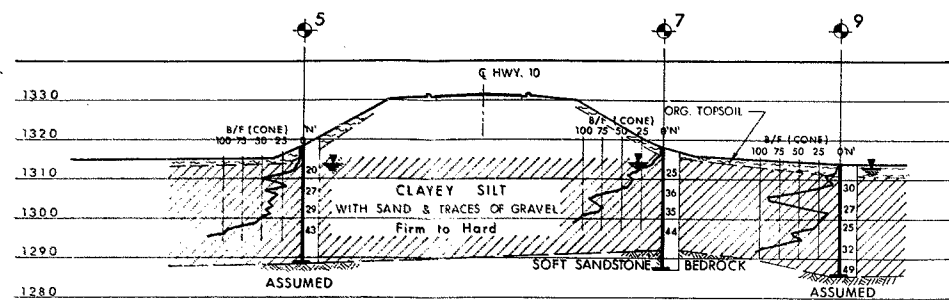
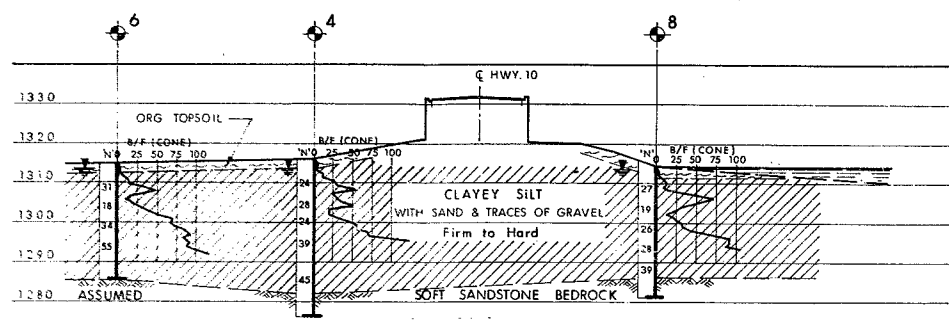


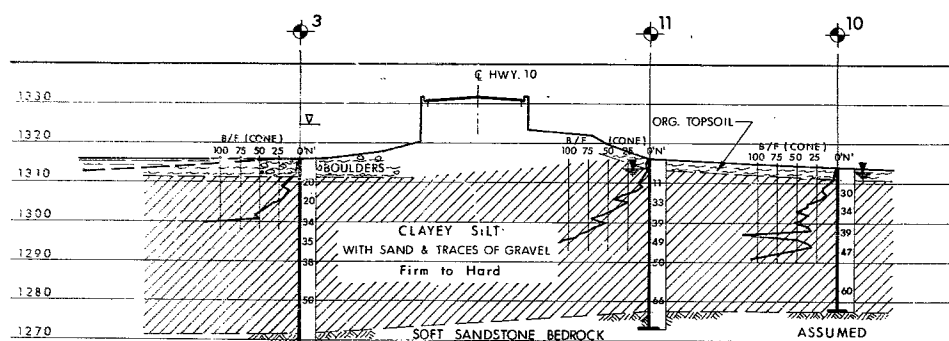
#65-F-121
W.P. #99-64
Hwy #10
Rocky
SAUGEEN R.
STRUCTURE



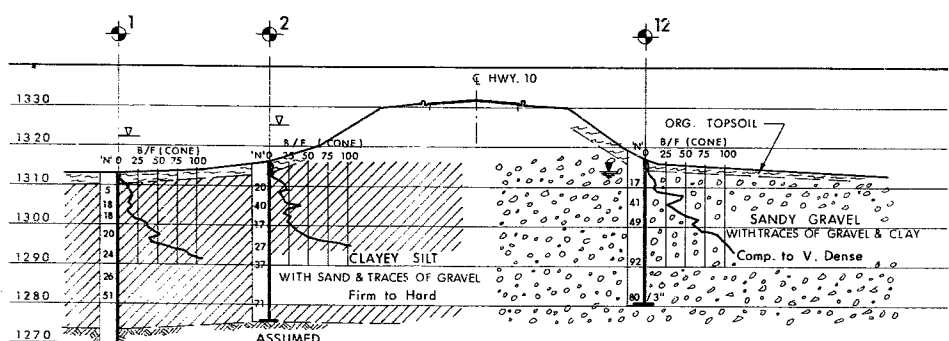
A-A



B-B



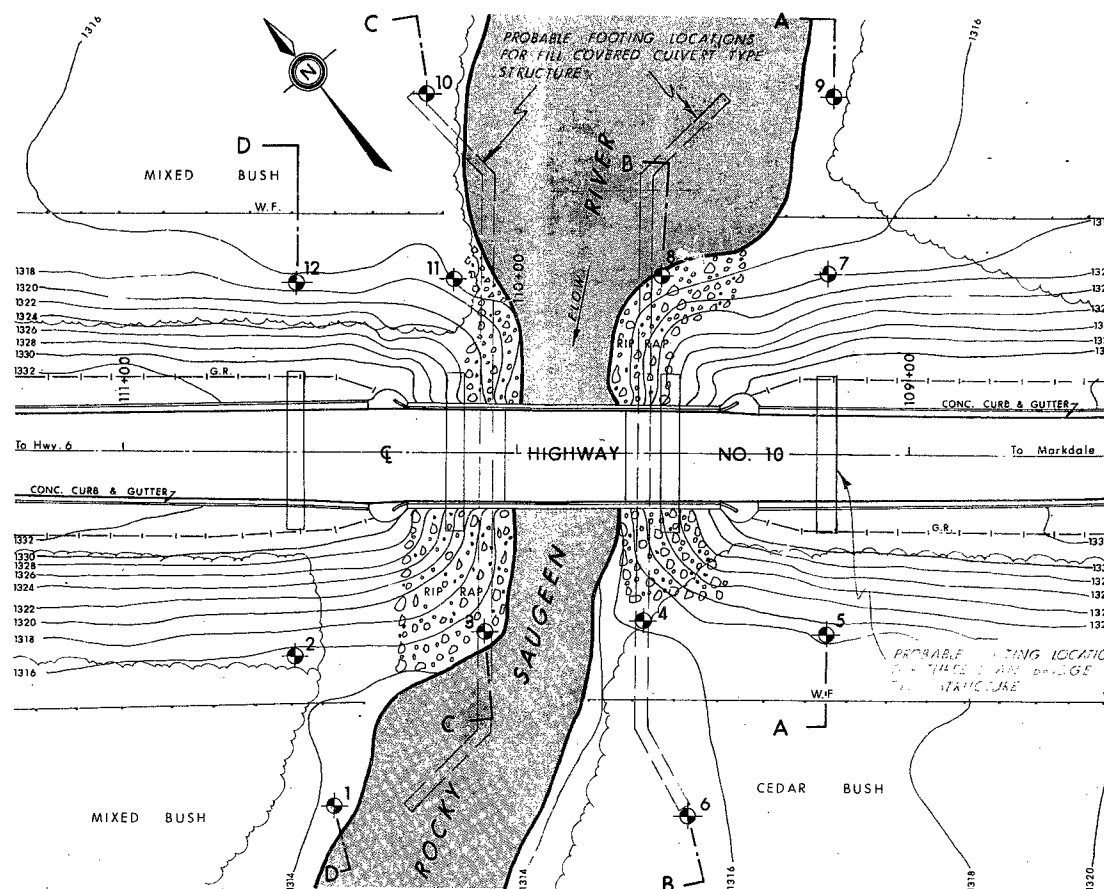
C-C



D-D

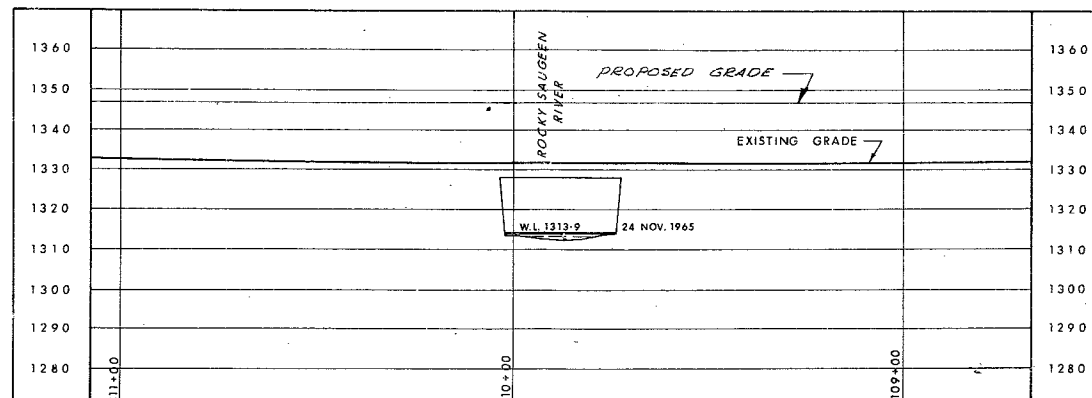
SECTIONS

20 10 0 SCALE 20 40 FT.



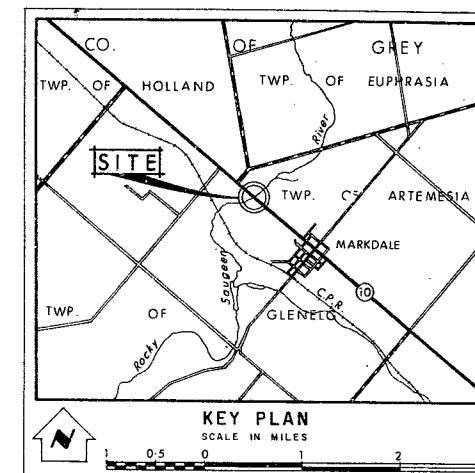
PLAN

20 10 0 SCALE 20 40 FT.



PROFILE

20 10 0 SCALE 20 40 FT.



LEGEND

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

NO.	ELEVATION	STATION	OFFSET
1	1313.0	110+46	9.0' LT.
2	1316.0	110+56	52' LT.
3	1316.0	110+08	46' LT.
4	1313.0	109+67	43' LT.
5	1318.0	109+21	46' LT.
6	1315.0	109+56	92' LT.
7	1318.0	109+21	46' RT.
8	1314.0	109+63	45' RT.
9	1314.0	109+21	90' RT.
10	1314.0	110+23	91' RT.
11	1316.0	110+16	44' RT.
12	1317.0	110+56	45' RT.

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

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

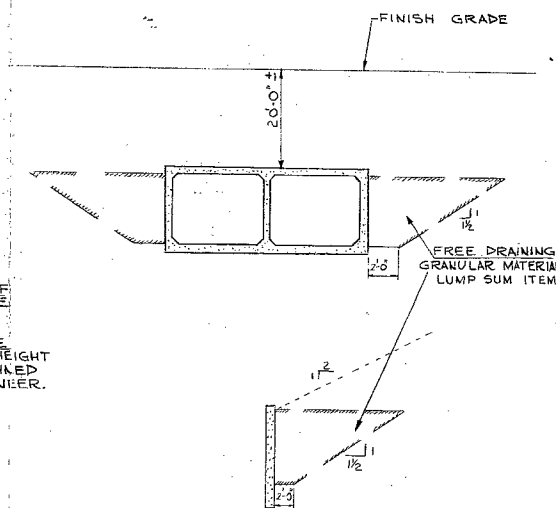
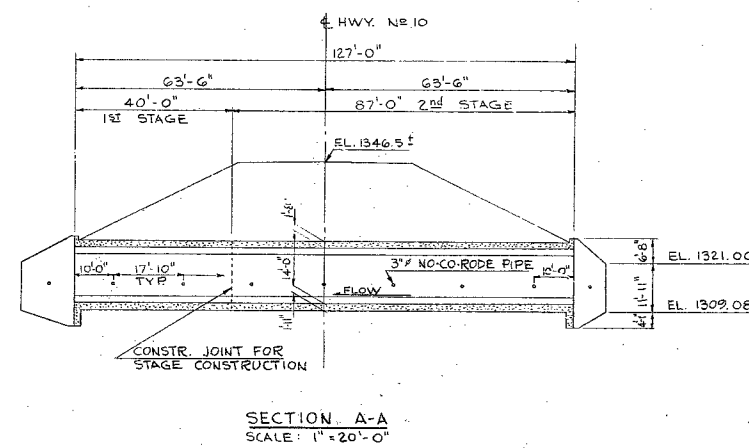
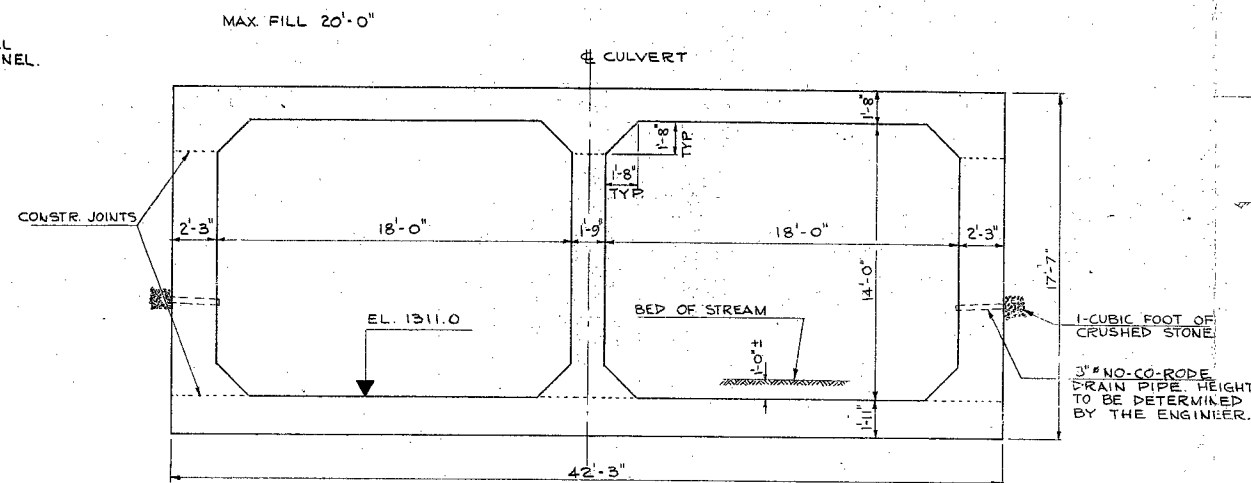
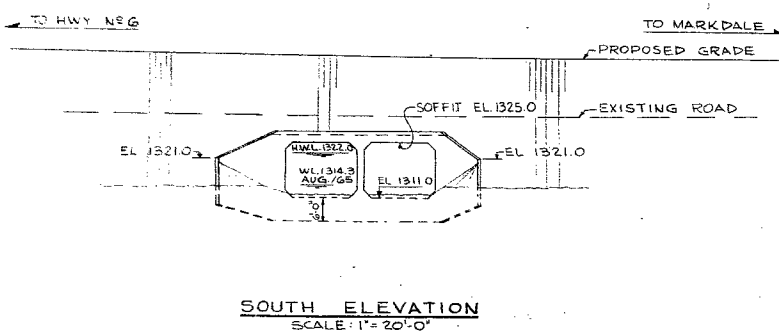
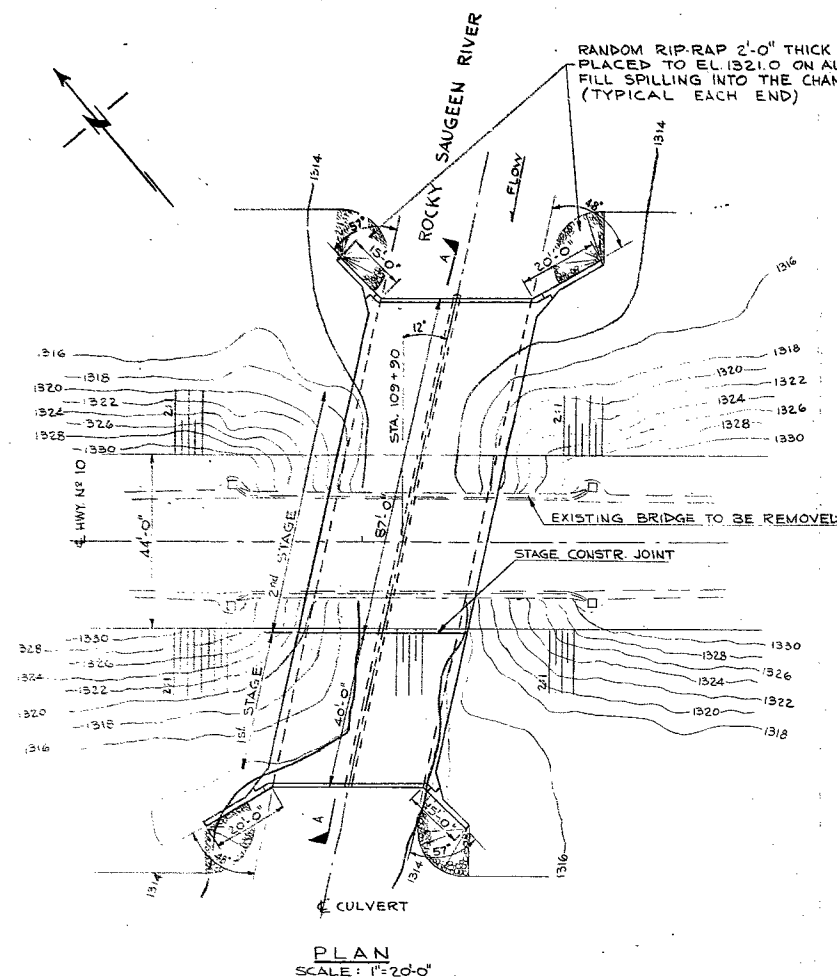
ROCKY SAUGEEN RIVER

KING'S HIGHWAY NO. 10 DIST. NO. 5
CO. GREY
TWP. ARTEMESIA & GLENELG LOT 94 CON. LINE & 15W

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D W.K. CHECKED K.C.S. W.P. NO. 99-64 M.B.T. DRAWING NO.
DRAWN S.O. CHECKED W.P. JOB NO. 65-F-121 65-F-121A
DATE 26 JAN. 1966 SITE NO. BRIDGE DRAWING NO.
APPROVED [Signature] PRINCIPAL FOUNDATION ENGINEER

REF. NO. E-4356-1



DETAILS OF MINIMUM GRANULAR BACKFILL REQUIREMENT
SCALE: 1/4"=1'-0"

NOTE: SECTION 1 TO CULVERT WALLS AND RET. WALLS LATERAL LIMITS- END TO END OF CULVERT, AND OF RETAINING WALLS TO INTERSECTION WITH CULVERT BACKFILL.

NOTES:
CLASS OF CONCRETE
3000 PSI.
CLEAR COVER ON REINFORCING STEEL
3" UNLESS SHOWN OTHERWISE.

G.B.M. No 278 EL 1367.833
SMALL CONCRETE BOX CULVERT UNDER C.P.R., 1 MILE SOUTH-EAST OF STATION AND AT SECOND POLE NORTH-WEST OF MILE P ST 43 FROM ORANGEVILLE, 750 FEET NORTH-WEST OF A ROAD-CROSSING BOLT SET HORIZONTALLY AT CENTRE OF NORTH-EAST FACE.
PUB. No 19 MARKDALE
65-F-121
O. K. W. K. M. - APR-18-66

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
ROCKY SAUGEEN RIVER TWIN 18'x14' RIGID FRAME BOX CULVERT KING'S HIGHWAY No. 10 0.75 MI. NORTH OF MARKDALE DIST. No. 5 CO. GREY STA. 109+90 TWP. ARTEMESIA & GLENELG LOT 21 CON. 1 NE 15W 15R			
PRELIMINARY			
APPROVED	SITE No. 8-166	W.P. No. 99-64	
DESIGN D.S.M.	CHECK W.T.H.	CONTRACT No.	
DRAWING G.F.M.S.	CHECK E.O.W.	DRAWING No.	D-5891-P
DATE MARCH/66	LOADING H20-51G		

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

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

Attention: Mr. S. McCombie

Date: January 28, 1966

Our File Ref.

In Reply To

FEB 1 1966

Subject:

FOUNDATION INVESTIGATION REPORT
For
Hwy. #10 and Rocky Saugeen River
Structure, Co. of Grey, Twp's. of
Artemesia and Glenelg, Lot 94,
Conc's 1 N.E. and 1 S.W. T.S.R.
District #5 (Owen Sound)
W.J. 65-F-121 -- W.P. 99-64

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 additional information be required, please feel free to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
A. Gater
H. F. Gilbert
J. Roy
A. Watt

Foundations Office
Gen. Files ✓

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

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 2. DESCRIPTION OF SITE.
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 - 4.3) Clayey Silt with Sand and traces of Gravel - Firm to Hard.
 - 4.4) Soft Sandstone Bedrock.
 5. GROUND WATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 7. SUMMARY.
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FOUNDATION INVESTIGATION REPORT
For
Hwy. #10 and Rocky Saugeen River
Structure, Co. of Grey, Twp's. of
Artemesia and Glenelg, Lot 94,
Conc's 1 N.E. and 1 S.W. T.S.R.
District #5 (Owen Sound)
W.J. 65-F-121 -- W.P. 99-64

1. INTRODUCTION:

A request to carry out a foundation investigation at Hwy. #10 and the Rocky Saugeen River, was received from the Bridge Location Section, in a memo dated October 19, 1965.

It is proposed to erect a new structure to carry Hwy. #10 over the Rocky Saugeen River. The site of the proposed structure is located approximately 0.75 miles North-West of the Town of Markdale, County of Grey, Twp's. of Artemesia and Glenelg, Lot 94, Conc's. 1 N.E. and 1 S.W. T.S.R. At this location the chainage of Hwy. #10 is from 109+21 to 110+57.

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 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 site of the proposed structure is located in the County of Grey, Townships of Artemesia and Glenelg, Lot 94, Concessions 1 N.E. and 1 S.W. T.S.R., approximately 0.75 miles North-West of the Town of Markdale. The surrounding area forms a natural ravine at the bottom of which flows the Rocky Saugeen River (approximately 30'-0" wide and 2 - 3 feet deep). Both banks of the river are swampy.

cont'd. /2

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

The existing concrete bridge, which was built in 1923 on 7'-6" wide spread footings at approximately El. 1,309.0 (bottom of footing), is badly damaged by traffic. Some spalling of beams and abutments may also be seen. No visible settlements of the existing structure could be observed.

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, twelve sampled boreholes and twelve penetration tests were carried out at this site. 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 Contents.
2. Grain Size Distributions.
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 report, and is also given in subsequent paragraphs. The estimated stratigraphical profile shown on Dwg. No. 65-F-121A is based upon this information.

cont'd/3

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

4.2) Black Organic Topsoil:

A 2- to 5-foot thick layer of organic topsoil was found at the site. It consists mostly of decayed wood, grass and tree leaves. This layer should be completely removed prior to construction of new structure footings.

4.3) Clayey Silt with Sand and traces of Gravel - Firm to Hard:

This stratum, which extends to the bedrock, was found immediately below the topsoil.

The average percentage of silt in this stratum is 54%, sand 23%, clay 18%, and the rest of 5%, is gravel. Moisture content determination for this stratum averaged about 12%, ranging from 6% to 31%, while liquid limits varied from 14% to 21%, and plastic limits from 12% to 14%. The overall stratum was found to be in a firm to hard condition, with an average 'N' value of 34 blows/foot. The 'N' values varied from 5 blows/foot to 92 blows/foot.

4.4) Soft Sandstone Bedrock:

Soft sandstone bedrock was encountered beneath the stratum of clayey silt with sand and traces of gravel. Five feet of bedrock core taken in B.H.'s #1, 3, 4, 7, 8, and 11, shows soft sandstone bedrock. Recovery of bedrock core varied from 25% to 40%.

The investigation has revealed that the surface of the bedrock is uneven and may vary slightly some distance away from the borehole.

5. GROUND WATER CONDITIONS:

Low pressure artesian water was encountered in B.H.'s #1, 2, and 3 (water rose 9 feet above ground level in BX casing in 18 minutes). In all other boreholes the ground water level was found at approximate El. 1,314.0, which was slightly higher than the prevailing creek level.

cont'd. /4

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to erect a new structure to carry Hwy. #10 over the Rocky Saugeen River. As described in the preceding paragraphs, the subsoil consists of soft organic topsoil underlain by firm to hard, clayey silt with sand and traces of gravel, followed by soft sandstone bedrock. The existing bridge is supported by spread footings at approximate elevation 1,309.0 (bottom of footings).

It is recommended that the new structure be supported also, on spread footings founded at El. 1,308.0. A safe load of up to 2.0 t.s.f. may be assumed for design purposes. If higher loads are desired, H-piles driven to bedrock, should be used. The design load on the pile should be the allowable maximum for the section used. Due to the unevenness of the bedrock, the pile penetration may be variable. If perched abutments are used, the existing fill (which consists mostly of broken rock) at the required locations, should be excavated and replaced by granular fill to facilitate the driving of piles.

Since excavations below the ground water level will have to be carried out, it will be necessary to provide a dewatering scheme which will prevent 'boiling' of the excavation bases. In order to dewater the excavations satisfactorily, it is recommended that a scheme which incorporates steel sheet piling, be used, and that the sheeting be left in place permanently. Sheeting should be driven to a depth below the excavation bottom equal to the height of the prevailing ground water level above it. A deeper penetration may be necessary for scour protection. The expected scour, if any, should be checked with the D.H.O. Hydrological Section when their study is completed.

No stability problems for the widening of the approaches are anticipated, provided standard 2:1 slopes are constructed.

cont'd. /5

7. SUMMARY:

A foundation investigation at the site of a proposed new structure at Hwy. #10 and the Rocky Saugeen River is reported.

Subsoil at the site consists of soft organic topsoil, underlain by a stratum of firm to hard, clayey silt, followed by soft sandstone bedrock.

Procedures for construction and dewatering, outlined in the body of this report, should be followed.

The danger of scour, if any, should be checked with the D.H.O. Hydrological Section, when their study is completed.

No stability problems are anticipated for the approach widening.

8. MISCELLANEOUS:

The field work for this project was carried out during the period November 9 - 24, 1965, under the supervision of Mr. W. W. Kulmatickas, Project Foundation Engineer.

Equipment used was owned and operated by Dominion Soil Investigation Co. Ltd.

The report was prepared by Mr. W. W. Kulmatickas, and reviewed by Mr. K. G. Selby, Senior Foundation Engineer.

January 1966.

APPENDIX I

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H.	SAMPLE ADVANCED HYDRAULICALLY	
	P.M.	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

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

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

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

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
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

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-121

LOCATION Rocky Saugeen River & Hwy #10 Ch 110/46 90'-0" Lt.

ORIGINATED BY W.W.K.

W. P. 99-64

BORING DATE Nov. 9 & 10, 1965.

COMPILED BY W.W.K.

DATUM 1313.0

BOREHOLE TYPE Washboring BX Casing.

CHECKED BY K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

LOCATION Rocky Saugeen River & Hwy. 10 Ch 110/56 52'-0" Lt.

FOUNDATION SECTION

W. P. 99-64

BORING DATE Nov. 10 & 11, 1965.

ORIGINATED BY W.W.K.

DATUM 1316.0

BOREHOLE TYPE Washboring - BX Casing.

COMPILED BY W.W.K.

CHECKED BY _____ K.G.S.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _p WATER CONTENT ——— w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	10	20	30			
1316.0	Groundlevel													
1313.0	Black organic topsoil												Artesian Water to 9'-0" above groundlevel.	
3.0	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	20	1310							Gr 0% Sa 14% Si 63% Cl 23%	
			2	SS	40									
			3	SS	17	1300								
			4	SS	27									
			5	SS	37	1290								
			6	SS	71	1280							Gr 0% Sa 14% Si 76% Cl 10%	
1275.3	Assumed Bedrock End of borehole.													
40.7														
						1270								

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 65-F-121

LOCATION Rock y Saugeen & Hwy 10 Ch 110-08 46'-0" Lt.

ORIGINATED BY W.W.K.

W. P. 99-64

BORING DATE Nov. 12 & 15, 1965.

COMPILED BY W.W.K.

DATUM 1316.0

BOREHOLE TYPE Washboring - BX Casing.

CHECKED BY K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

LOCATION Rocky Saugeen River & Hwy 10 Ch 109/67 43'-0" Lt.

FOUNDATION SECTION

W.P. 99-64

BORING DATE Nov. 15, 1965.

ORIGINATED BY W.W.K.

DATUM 1316.0

BOREHOLE TYPE Washboring - BX Casing.

COMPILED BY W.W.K.

CHECKED BY K.G.S.

[illegible]

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

LOCATION Rocky Saugeen River & Hwy 10 Ch 109/21 46'-0" Lt.

ORIGINATED BY W.W.K.

BORING DATE Nov. 15 & 16, 1965.

COMPILED BY W.W.K.

BOREHOLE TYPE Washboring - BX Casing.

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT ——— wp	WATER CONTENT ——— w			
1318.0	Groundlevel											
1315.5	Black organic topsoil											
2.5	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	20							
			2	SS	27							
			3	SS	29							
			4	SS	43							
1288.5	Assumed Bedrock End of borehole.											

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

W.P. 92-64

DATUM 1315.0

LOCATION Rocky Saugeen River & Hwy 10 Ch 109/56 92'-0" Lt.

BORING DATE Nov. 15 & 17, 1965.

BOREHOLE TYPE Washboring - BX Casing.

FOUNDATION SECTION

ORIGINATED BY W.W.K.

COMPILED BY W.W.K.

CHECKED BY _____ K.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 % 10 20 30	BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
1315.0	Groundlevel									
1312.7	Black organic topsoil									
2.3	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	31	1310				Observed in Casing. Gr 0% Sa 29% Si 61% Cl 10%
			2	SS	18					
			3	SS	34	1300				
			4	SS	55					
1285.5	Assumed Bedrock. End of borehole.					1290				
29.5						1280				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

W.P. 99-64

DATUM 1318.0

RECORD OF BOREHOLE NO. 7

LOCATION Rocky Saugeen River & Hwy 10 Ch 109/21 46'-0" Rt.

BORING DATE Nov. 16 & 17, 1965.

BOREHOLE TYPE Washboring - BX Casing.

FOUNDATION SECTION

ORIGINATED BY W.W.K.

COMPILED BY W.W.K.

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL		BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — WP	WATER CONTENT — W		
							20 40 60 80 100		WP — W — WL	WATER CONTENT % 10 20 30		
1318.0	Groundlevel											
1316.0	Black organic topsoil											
2.0	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	25	1310						Observed in Casing.
			2	SS	36							
			3	SS	35	1300						
			4	SS	44							
1292.0												
26.0	Soft sandstone					1290						
1287.0	Bedrock											
31.0	End of borehole.					1280						

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

W. P. 99-64

DATUM 1314.0

LOCATION Rocky Saugeen River & Hwy 10 Ch 109/63 45'-0" Rt.

BORING DATE Nov. 18 & 19, 1965.

BOREHOLE TYPE Washboring - BX Casing.

FOUNDATION SECTION

ORIGINATED BY W.W.K.

COMPILED BY W.W.K.

CHECKED BY K.G.S.

[illegible]

FOUNDATION SECTION

CHECKED BY K.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 WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
1314.0	Groundlevel									
1311.0	Black organic topsoil									
3.0	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	30	1310				Observed in Casing.
			2	SS	27					
			3	SS	25	1300				Gr 4% Sa 9% Si 68% Cl 19%
			4	SS	32					
			5	SS	49	1290				Gr 0% Sa 26% Si 68% Cl 6%
1285.5	Assumed Bedrock End of borehole.					1280				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 65-F-121

LOCATION Rocky Saugeen River & Hwy 10 Ch 110/23 91'-0" Rt.

FOUNDATION SECTION

W.P. 99-64

BORING DATE Nov. 23, 1965.

ORIGINATED BY W.W.K.

DATUM 1314.0

BOREHOLE TYPE Washboring - BX Casing.

COMPILED BY W.W.K.

CHECKED BY K.G.S.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 65-F-121

LOCATION Rocky Saugeen River & Hwy 10 Ch 110/16 44'-0" Rt.

ORIGINATED BY W.W.K.

W.P. 99-64

BORING DATE Nov. 23, 1965.

COMPILED BY W.W.K.

DATUM 1316.0

BOREHOLE TYPE Washboring - BX Casing.

CHECKED BY K.G.S.

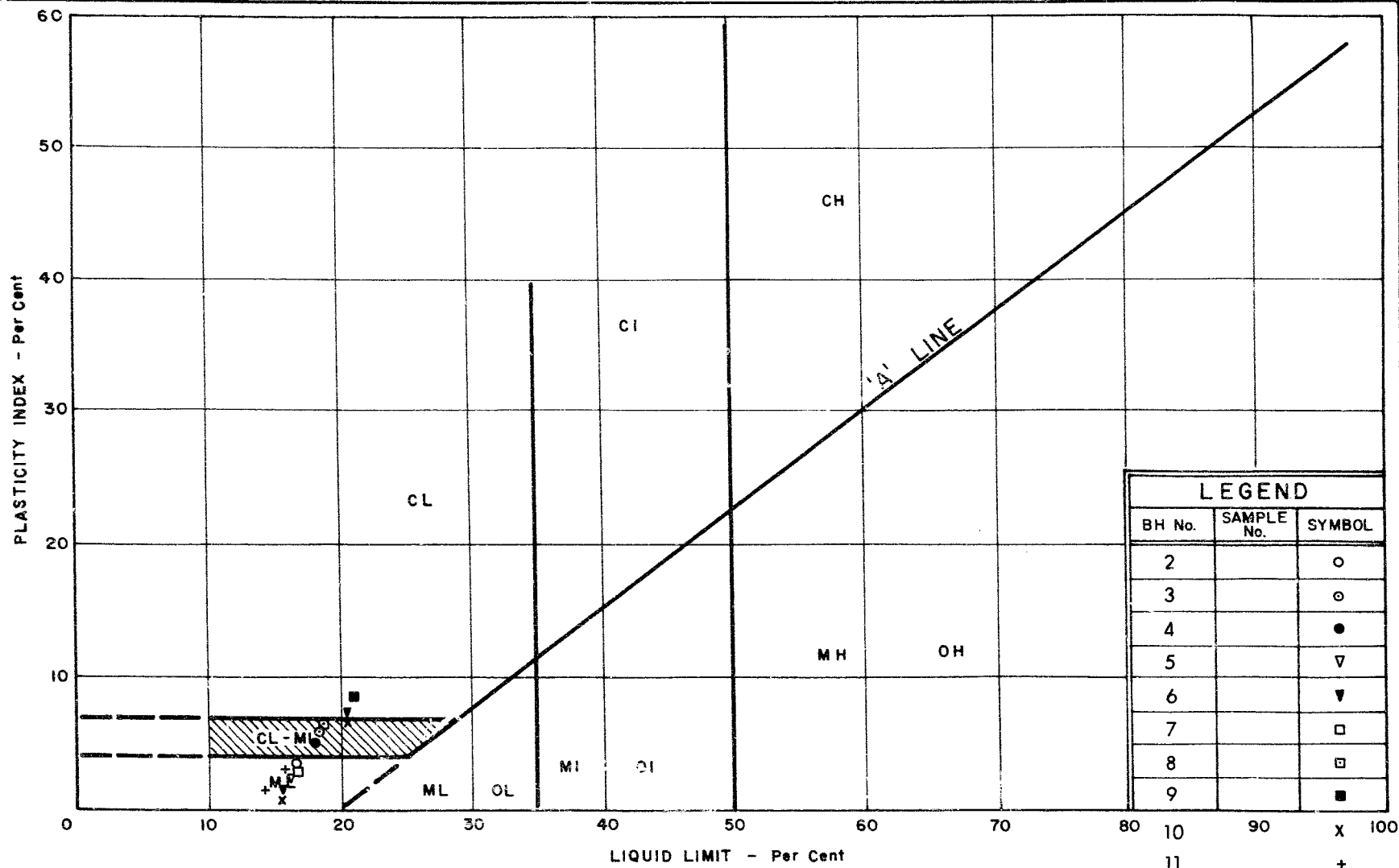
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	W	WL		
1316.0	Groundlevel															
1313.5	Black organic topsoil															
2.5	Clayey silt with sand and traces of gravel. Firm to hard.		1	SS	11	1310										
			2	SS	33											
			3	SS	39	1300										
			4	SS	49											
			5	SS	50	1290										
			6	SS	66	1280										
1277.3	Soft sandstone.															
1273.0	Bedrock															
43.0	End of borehole.					1270										

Gr 0%
Sa 5%
Si 73%
Cl 22%

Observed in Casing.

1313.5

P.C.F. WL Elev.



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

ONTARIO

PLASTICITY CHART

W.P. No. 99-64

JOB No. 65-F-121

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N': - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

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

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ 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_o	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. G. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

DATE: April 18, 1966.

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 99-64, Bridge Site #8-166,
Rocky Saugeen River,
Twin 18' x 14' Rigid Frame Box Culvert,
6.75 miles north of Markdale,
Hwy. 10, District 5.

Enclosed please find one copy of the preliminary
plan D 5891-P for the above structure.

Would you kindly review the structure foundations
proposed and inform me if they are satisfactory.



APW/ag

A. P. Watt,
Regional Bridge Location Engineer.

Encl.

cc: Foundations Office (Rm. 110)

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

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

Attention: Mr. A. P. Watt,
Regional Bridge
Location Engr.

April 21, 1966

Twin 18' x 14' Culvert at Hwy. #10 and
Rocky Saugeen River, Dist. #5 (Owen Sound).
W.P. 99-64, Site #8-166, W.J. 65-P-121

We have reviewed Preliminary Plan #D-5891-P for
the above mentioned proposed structure. The designer
appears to have complied with the recommendations contained
in the foundation report.

K. G. Selby

KGS/MdeP

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:

A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Foundations Office
Gen. Files