oc: GEN. FILES
W.P 431-64

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

Attention: Mr. S. McCombie

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

DATE: May 24, 1966

OUR FILE REF.

IN REPLY TO

MAY 30 1966

SUBJECT:

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
The Proposed Underpass at the Ottawa
Queensway and County Road 40
Interchange - District #9 (Ottawa)
W.J. 66-F-16 -- W.P. 431-64

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

We believe that the factual data and recommendations contained therein, will suffice for your present design requirements.

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

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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
(Copies also sent to: P. Hervey (Transp. Plan. Toronto)
J. L. Foster (Transp. Plan. Kingston Reg.)

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PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
The Proposed Underpass at the Ottawa
Queensway and County Road 40
Interchange - District #9 (Ottawa)
W.J. 66-F-16 -- W.P. 905-64

1. INTRODUCTION:

The Foundation Section was equested to carry out a preliminary foundation investigation at the propcsed underpass structure where the Ottawa Queensway extension crosses County Road 40. This request was contained in a memo dated January 21, 1966, from the Bridge Location Section (Mr. G. Scott, Regional Bridge location Engineer). An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site. This report contains the results of our preliminary investigation, together with our recommendations.

2. SITE TOPOGRAPHY AND GEOLOGY:

The area surrounding the site is flat to undulating cultivated farmland.

Geologically, the site lies within the "Plains of Water-laid Sediments" in Carleton County. The materials forming the plains were deposited in Lake Champlain when the marine waters covered the underlying till. The bedrock is of Precambrian age. Generally, the soils at the site are grey-brown clays and silts containing a fairly high percentage of shells.

3. FIELD AND LABORATORY WORK:

Two sampled boreholes and four dynamic cone penetration tests were performed at the site. Two supplementary sampled boreholes, B.H.'s 3A and 4A, were carried out very close to B.H.'s 3 and 4, because it was found in the laboratory that the samples

cont'd. /2 .....

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

from B.H.'s 3 and 4 were disturbed, possibly due to freezing. For that reason, the laboratory test results for B.H.'s 3 and 4 were excluded from this report.

For the dynamic cone penetration test, a driving energy of 350 ft.-lbs. was used. Samples were recovered at the required depths using a 2" I.D. thin-wall sampler in cohesive soils, either by pushing the tube into the soil manually, or by using a piston sampler. In-situ vane tests were conducted immediately after the thin-wall sampling to determine the shear strength of the material. In non-cohesive soils, a 2-in. O.D. split-spoon sampler was employed. The dimensions of the split-spoon sampler and the energy used in driving it, conform to the requirements of the Standard Penetration Test. AXT rock core samples were obtained to prove bedrock.

The locations and elevations of all boreholes, together with the estimated soils profile, are shown on Dwg. No. 66-F-16A which accompanies this report.

4. LABORATORY TESTS:

Soil samples were visually examined and classified in the field before being transported to the laboratory where a further visual classification was performed.

Tests were performed for the determination of Atterberg limits, moisture content, grain-size distribution, bulk density and undrained shear strength. The test results are shown on the Borehole Record sheets which form part of this report.

5. SUBSOIL CONDITIONS:

5.1) General:

Subsoil at the site consists of a deep deposit of clay to clayey silt underlain by glacial till followed by bedrock.

cont'd. /3 .....

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

5.2) Clay to Clayey Silt:

This material may be described as a three-zone deposit - i.e., the crust, upper zone, and lower zone. For the deposit as a whole, the average $Cu/_p$ ratio was about 0.31.

Crust - The crust is relatively thin (about 6 to 8 ft. thick) and is predominantly a clay of high plasticity (CH) with thin layers of silty sand. The shear strength varied from 3000 to 1000 p.s.f. Liquid limits range from 56% to 67%, plastic limits from 22% to 27%, and moisture content from 33% to 65%.

Upper Zone - The upper zone is predominantly clayey silt (CL) with a slight organic content (0.3 to 1.2% by weight) and extends to a depth of about 50 to 55 ft. The consistency varies from soft to stiff with shear strengths increasing with depth from 350 to 1100 p.s.f. The liquid limits vary from 24% to 34%, plastic limits from 16% to 19%, and moisture contents from 16% to 19%.

Lower Zone - The lower zone extends from 55 ft. to 119 ft. in B.H. #3, and from 50 to 84.5 ft. in B.H. #4. The material is generally a silty clay (CI) of a stiff consistency with shear strengths increasing with depth from 1100 to about 2000 p.s.f. Liquid limits vary from 44% to 54%, plastic limits from 21% to 24% and moisture contents from 45% to 80%.

5.3) Glacial Till:

This deposit varied from 4 ft. thick in B.H. #3 to 21 ft. thick in B.H. #4 and was found to be a heterogeneous mixture of clay, silt, sand and gravel with a very dense relative density. 'N' values varied from 91 to in excess of 100 blows/ft.

5.4) Bedrock:

Bedrock was proven for a depth of 5 ft. and was found to be gneiss of Precambrian age. Some sections contained considerable brolite mica which would be susceptible to grinding during coring operations. Recovery was about 65% to 85%.

cont'd. /4 .....

6. GROUND WATER:

Ground water levels in the boreholes were observed during a period of 15 days. The water level in borehole #3 was approximately at elev. 302.7, and in borehole #4 was approximately at elev. 297.4.

7. DISCUSSION AND RECOMMENDATIONS:

A four-level complex interchange is proposed in the preliminary layout for the proposed extension of the Queensway where it crosses County Road 40 near Bell's Corner. At this stage the type and the length of the proposed structures are not available; however, the maximum fills could be in the order of 60 ft.

Structure Foundations - The presence of soft to firm silty clay to clayey silt some 8 ft. below the ground surface raises the problem of very low bearing capacity and large differential settlements. The new structures should, therefore, be supported on end-bearing piles driven to practical refusal into the glacial till stratum above the bedrock. Allowable loads will depend upon the section chosen and also on the amount of negative friction to be expected due to the compression of the clay deposit under the approach fills.

Approach Fills - The maximum height of the approach fills for the multi-level complex interchange may be in the order of 60 ft. above the ground surface. Based on an average shear strength of 500 p.s.f. between elev. 295 and elev. 280 for the underlying clay deposit, stability problems can be anticipated for fills in excess of 16 ft. in height using standard 2:1 slopes. In order to improve the overall stability, berms are required for fills in excess of 16 ft. in height for both longitudinal and transverse directions. A graph showing the relationship between the height of fill and the length of berm required, is appended to this report. The contemplated structures may have to be lengthened considerably in order to accommodate the required berm length in the longitudinal direction. However, as an alternative, multi-span structures may

cont'd. /5 .....

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

Approach Fills - (cont'd.) ...

be considered so that the fill heights will not be more than 16 ft.

Since this is only a preliminary investigation, it may be necessary to carry out additional borings in the field when final design details are available. Recommendations given in this report are, therefore, to be regarded as conditional only, and as such, are subject to revision at a later date when and if new information becomes available.

8. MISCELLANEOUS:

The field work, performed during the period February 16 to 24, 1966 and March 30 to April 1, 1966, together with the preparation of this report, was undertaken by Mr. P. L. Wang, Project Foundation Engineer. The investigation was carried out under the supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed this report.

Equipment was owned and operated by Johnston Drilling Co. Ltd. of Ottawa.

May 1966

APPENDIX I.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTIO

JOB 66-F-16 LOCATION Prop. Queensway & County Rd. 40 - Ottawa ORIGINATED BY P.L.W.

W.P. 431-64 BORING DATE Feb. 28, 1966 COMPILED BY P.L.W.

DATUM Geodetic BOREHOLE TYPE CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT %	BULK DENSITY P.C.F.	REMARK
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
305.8 0							Frozen			
						300				
						290				
						280				
						270				
						260				
						250				
						240				
						230				
						220				
						210				
						200				
						190				
						180				
170.0						170	100/10"			
135.8	End of Cone Test						REFUSAL			

FORM 08-MT-126 (FORMERLY 08-ML-126)
65-1831

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-16 LOCATION Prop. Queensway & County Rd. 40, Ottawa ORIGINATED BY P.L.W.
W.P. BORING DATE March 1, 1966 COMPILED BY P.L.W.
DATUM Geodetic BOREHOLE TYPE CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
303.4 / 0						300				
						290				
						280				
						270				
						260				
						250				
						240				
						230				
						220				
						210				
						200				
						190				
						180				
						170				
164.4 / 139.0	End of Cone Test					160	Refusal			

FORM 08-MT-126 (FORMERLY 08-ML-126)
65-1831

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3 & 3A

FOUNDATION SECTION

JOB 66-F-16 LOCATION Prop. Queensway & County Road 40, Ottawa ORIGINATED BY P.L.W.
W.P. 431-64 BORING DATE Feb. 16 to 18, 1966 COMPILED BY P.L.W.
DATUM Geodetic BOREHOLE TYPE Wash-boring & Diamond Drill CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BULK DENSITY P.C.F.	REMARKS
304.6 / 0	Mottled, Topsoil, Clay with layers of Silty Sand Soft to Firm		1	TW	PM	300	105	▼ Elev. 302.7 Observed during Inv period.
296.6 / 8			2	TW	PM			
			3	TW	PM		102	
292.5 / 12.1	Grey		4	SS	PM	290		
			5	TP	PM			Org. 1.2%
			6	TP	PM		114	Org. .7%
	Dark Blue		7	TP	PM	280		.5%
	Clayey Silt to Silty							.6%
	Clay with Sand		8	TP	PM			
			9	TP	PM	270		.8%
	Seams, traces of						111	
			10	TP	PM			1.0%
	Organics					260		.8%
	Very Soft to Stiff		11	TP	PM			
			12	TP	PM		112	.6% .7%
249.5 / 55.						250		
	Grey Stiff		13	TP	PM		105	
						240		
			14	TP	PM		102	
						230		
			15	TP	PM		114	
						220		
			16	TP	PM		107	
						210		
			17	TP	PM		109	
						200		
			18	TP	PM			
						190		
185.6 / 119.0	Brown, Glacial till (Het. mixture of clay, silt, sand and gravel)		19	SS	100/2"			
181.3 / 123.3	Gneiss Bedrock		20	(AXT) R.C.	66% Recovery	180		
176.4 / 128.2	End of Borehole					170		

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. + - Field Vane X - Lab. Vane ● - Unconfined ○ - Triaxial — 500 1000 1500 2000 2500

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT % — 20 40 60

NOTE: Borehole 3 & 3A were carried out very close to each other. The results of B.H. #3 were not included because of the sample disturbance.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4 & 4A

FOUNDATION SECTION

JOB 66-F-16 LOCATION Prop. Queensway & County Road 40, Ottawa ORIGINATED BY P.L.W.

W.P. 431-64 BORING DATE Feb. 22 to 24, 1966 COMPILED BY P.L.W.

DATUM Geodetic BOREHOLE TYPE Wash boring, Diamond Drill CHECKED BY AR

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT
305.0					
0	Topsoil				
1.5	Brown Clay with Silty Sand layer, Soft to Stiff.		1	TW	PM
			2	TW	PM
			3	TW	PM
292.0			4	TW	PM
13.0	Grey		5	TP	PM
			6	TP	PM
281.0					
24	Dark blue Clayey Silt to Silty Clay with Sand seams, and traces of organics. Soft to Firm		7	TP	PM
			8	TP	PM
			9	TP	PM
			10	TP	PM
			11	TP	PM
255			12	TP	PM
50	Grey - Stiff		13	TP	PM
			14	TP	PM
			15	TP	PM
220.5					
84.5	Brown, Glacial till (Het. mixture of clay, silt, sand and gravel)		16	SS	91
			17	WS	
			18	SS	75/6"
199.7			19	WS	
105.3	Gneiss Bedrock		20	(AXT) R.C.	65% Recovery
194.7			21	(AXT) R.C.	85% Recovery
110.3	End of Bore Hole				

ELEV. SCALE: 300, 290, 280, 270, 260, 250, 240, 230, 220, 210, 200, 190, 180

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20, 40, 60, 80, 100

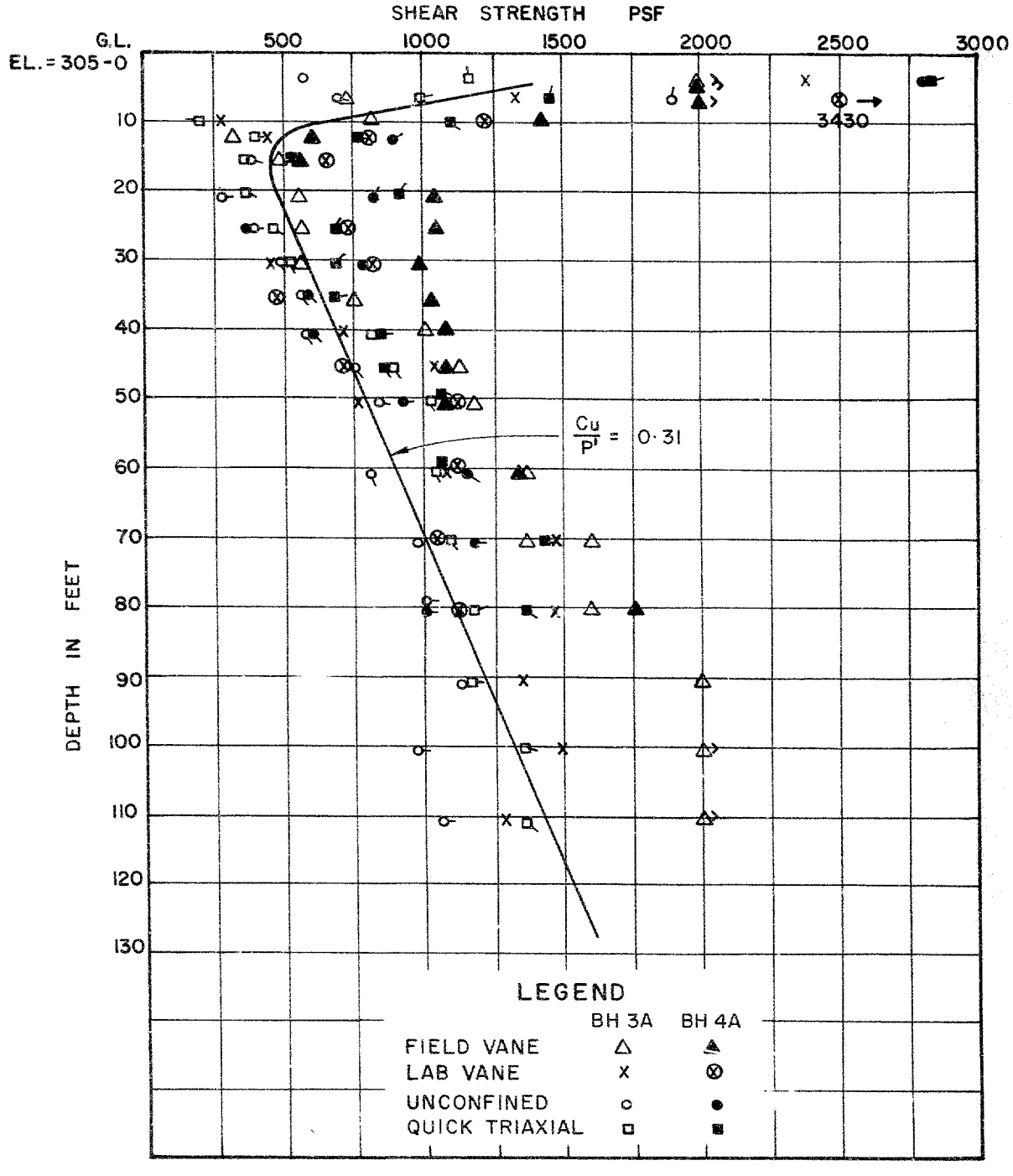
SHEAR STRENGTH P.S.F. — + - Field Vane, X - Lab. Vane, ● - Unconfined, ○ - Triaxial — 500, 1000, 1500, 2000, 2500

LIQUID LIMIT — w_L; PLASTIC LIMIT — w_P; WATER CONTENT — w

WATER CONTENT % — 20, 40, 60

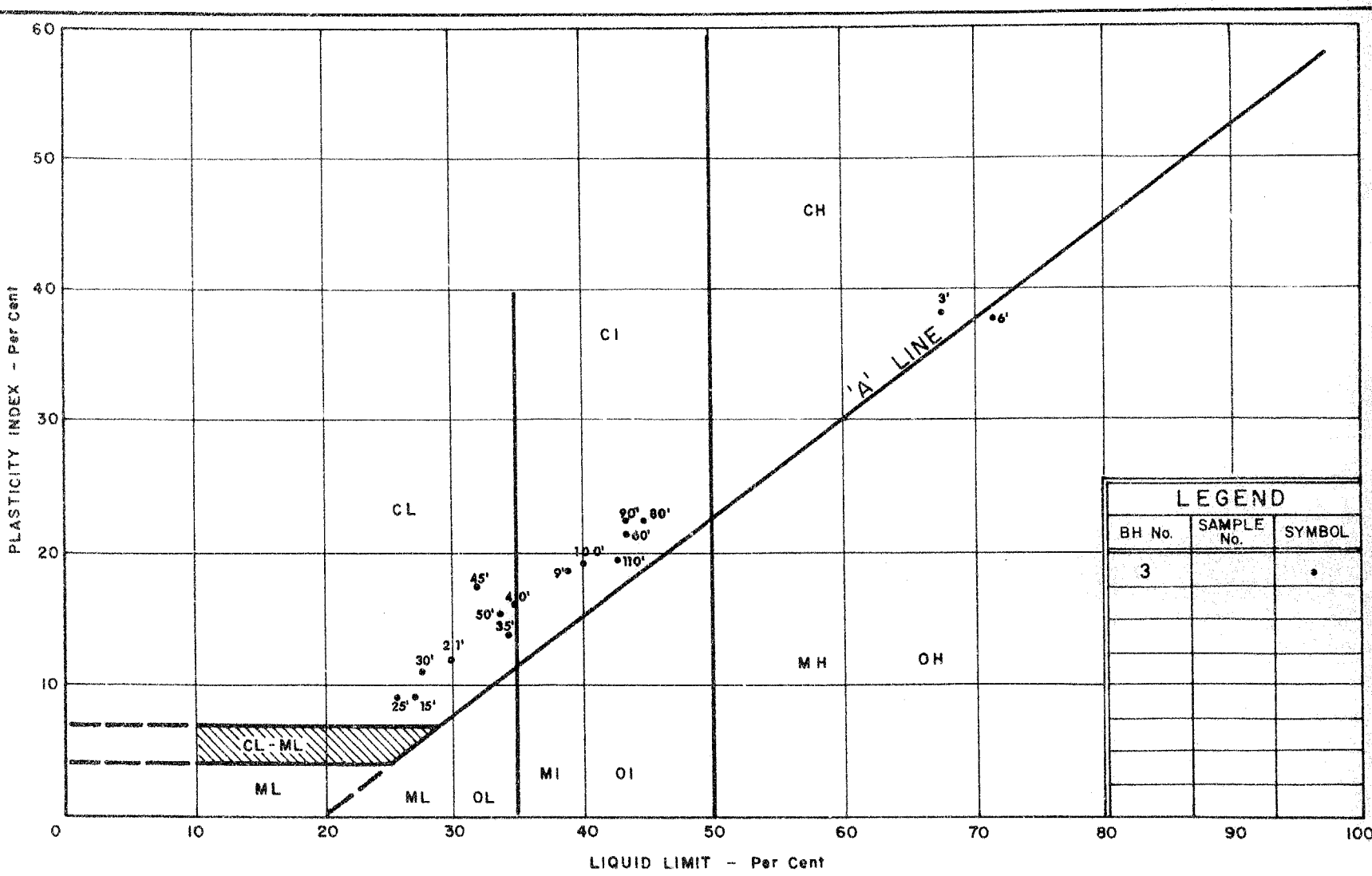
BULK DENSITY γ P.C.F.	REMARKS
110	
109	▼ Ele. 297.4
114	Observ. during the invest. period.
116	Org. .4%
	" .3%
	" .4%
	" .4%
116	Gr-0% Sa-9% Si-58% Cl-33% Org's.-.3%
	Org. .4%
107	Gr-1% Sa-1% Si-48% Cl-50%
106	
	Gr-3% Sa-9% Si-97% Cl-11%

NOTE: Borehole 4 & 4A were carried out very close to each other. The results of B.H. 3 were not included because of the sample disturbance.


SHEAR STRENGTH PSF
G.L.
EL. = 305-0
500
1000
1500
2000
2500
3000
3430
10
20
30
40
50
60
70
80
90
100
110
120
130
DEPTH IN FEET
Cu/P' = 0·31
LEGEND
BH 3A
BH 4A
FIELD VANE
LAB VANE
UNCONFINED
QUICK TRIAXIAL

JOB NO. 66-F-16

FORM 08-MT-252
(REV. JUNE 1965)
65-1624

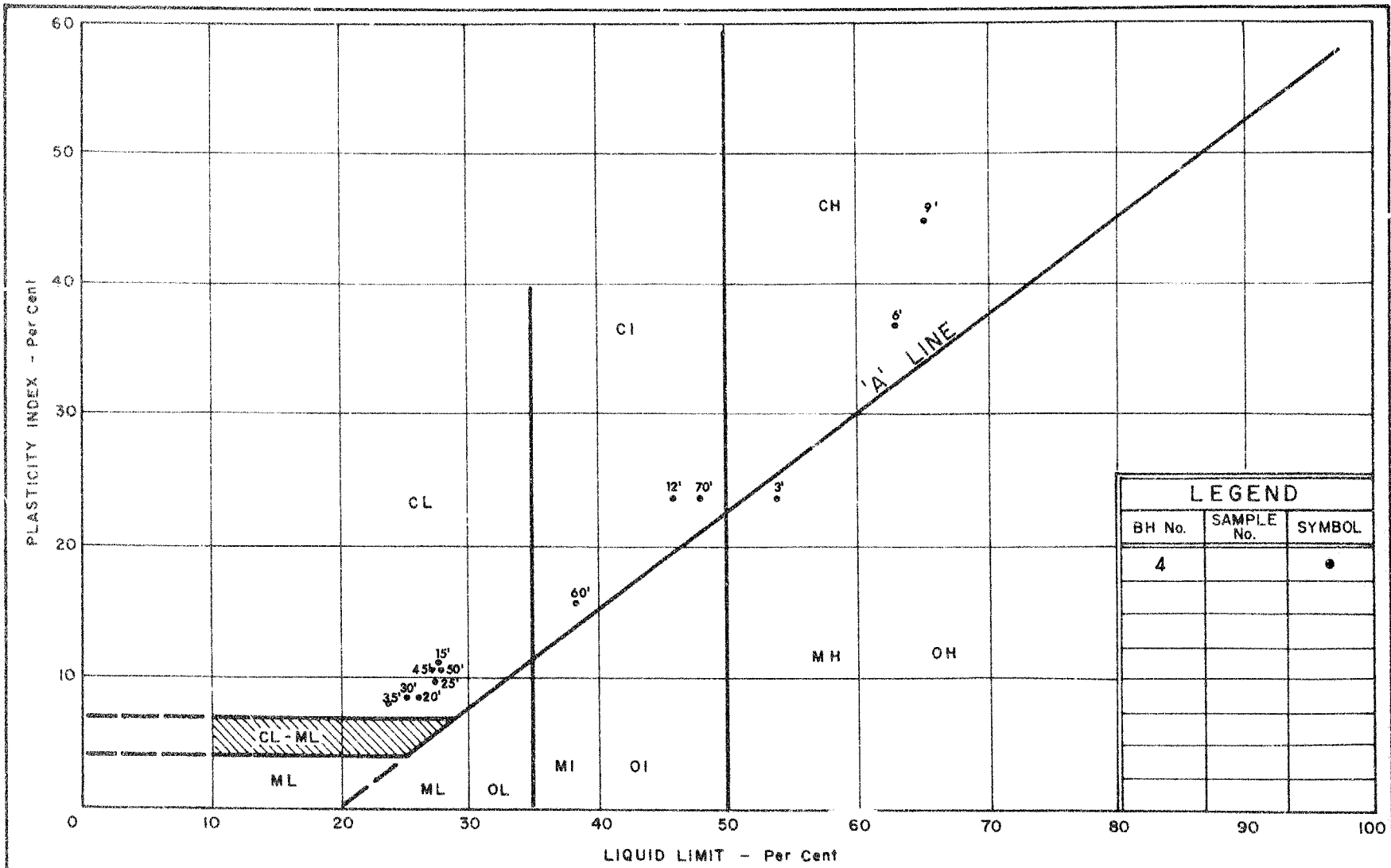


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 431-64
JOB No. 66-F-16

FORM 05-MT-252
(REV. JUNE 1965)
65-1624



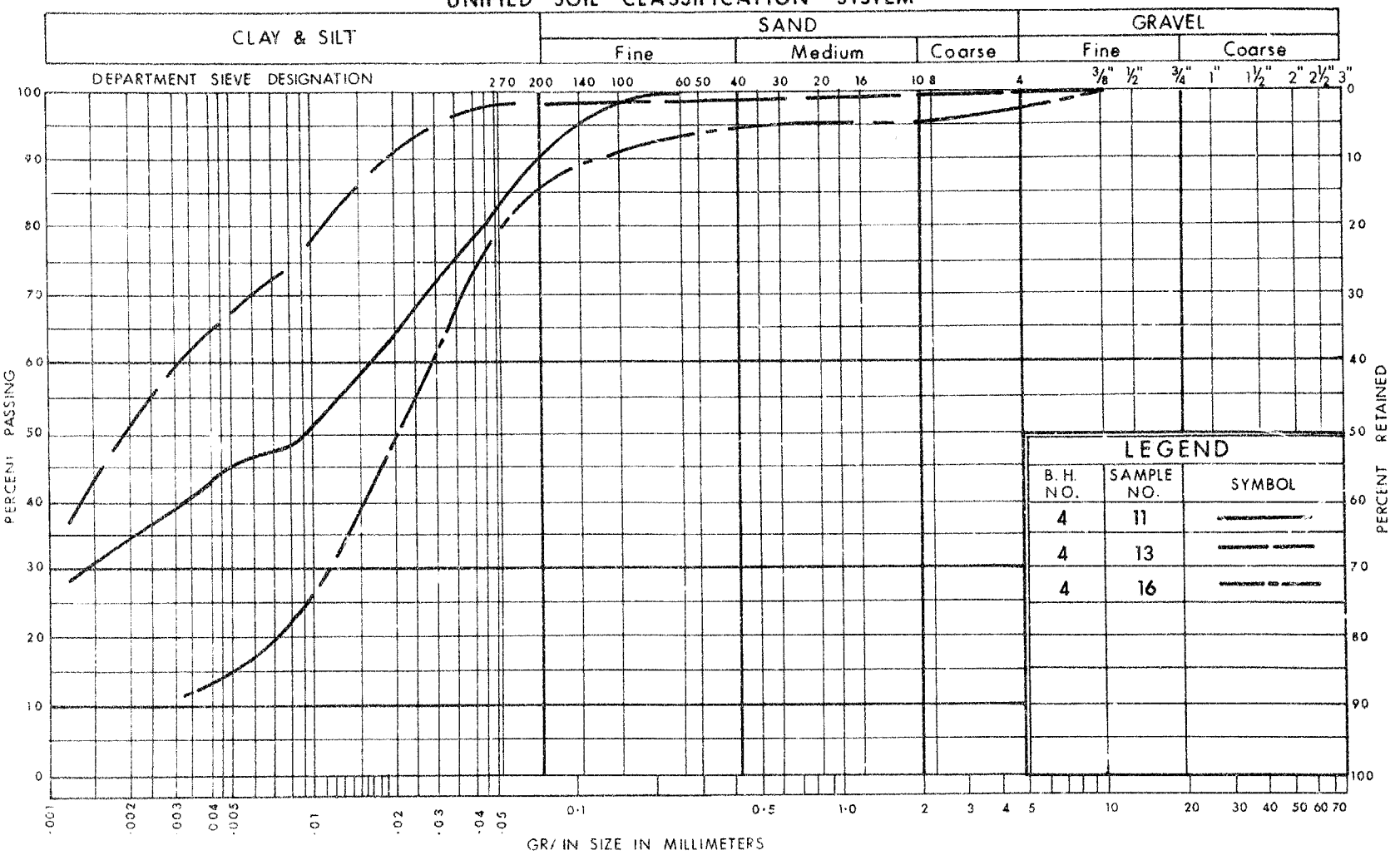
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

PLASTICITY CHART

W.P. No. 431 - 64
JOB No. 66 - F - 16

FORM OB MT - 17
REV. APR. 1963
65-414

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION
ONTARIO

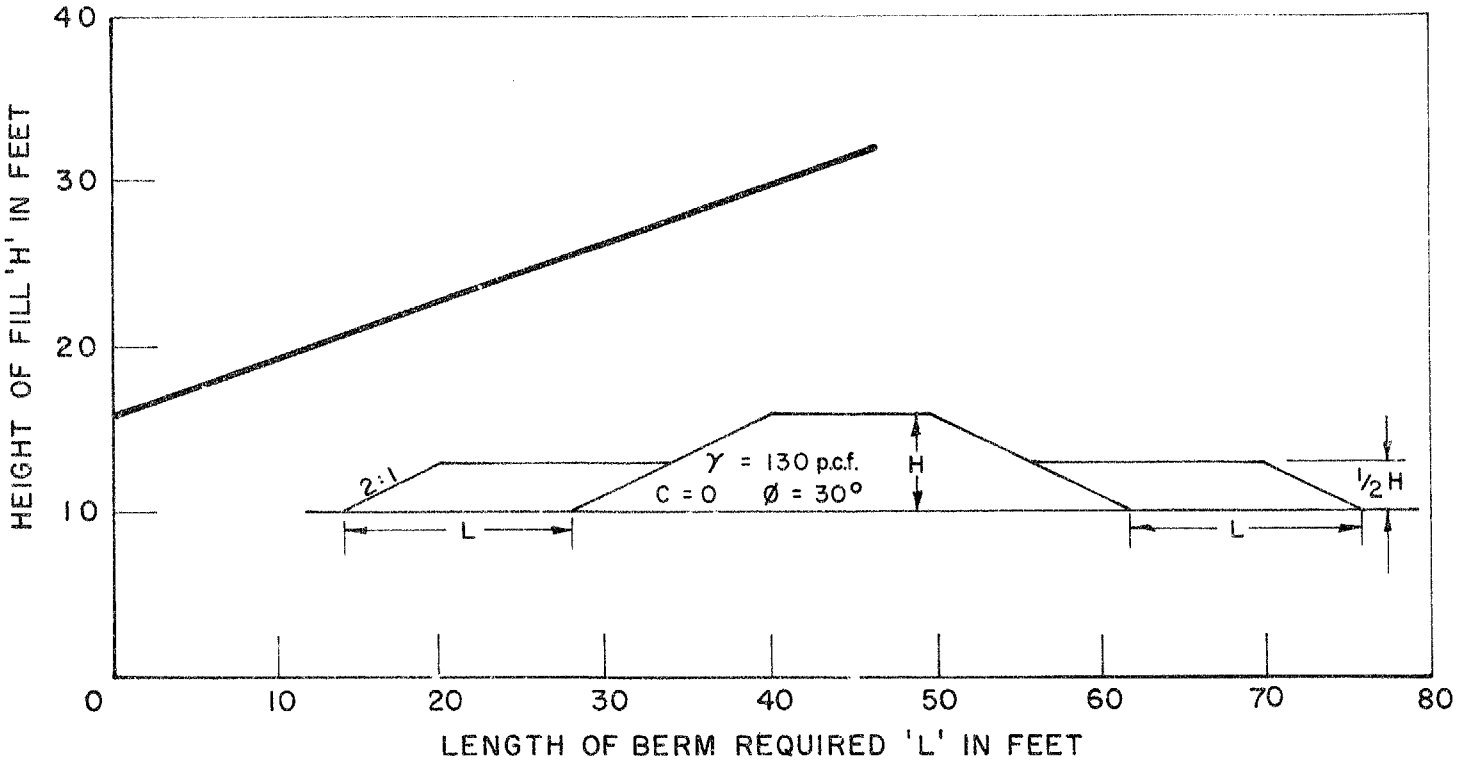
GRAIN SIZE DISTRIBUTION

CLAYEY SILT WITH TRACES OF SAND

W.P. No. 431-64

JOB No. 66 - F - 16

FOR FILLS BETWEEN 16' - 32'



NOTE : BERM SECTIONS FOR FILLS GREATER THAN 32' WILL BE AVAILABLE WHEN DESIGN DETAILS ARE FINAL

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 :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
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
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
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 (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

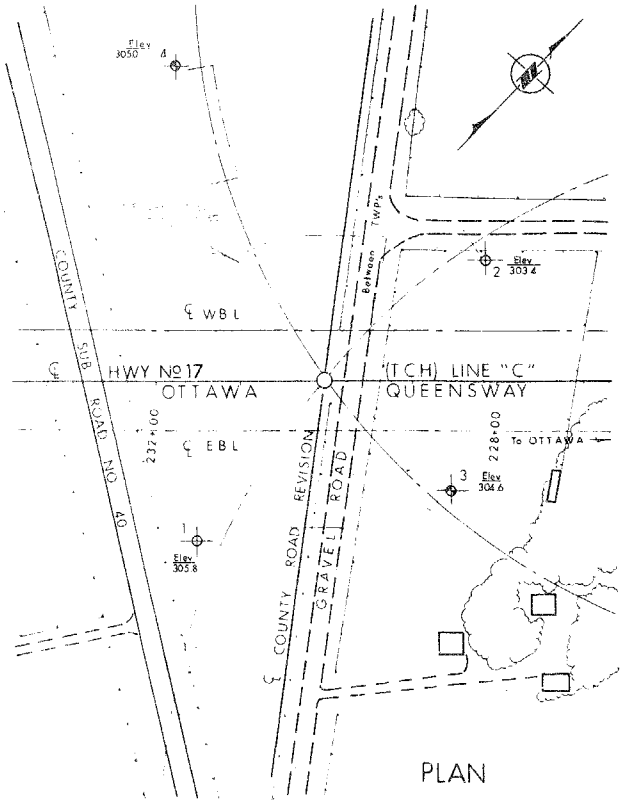
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

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

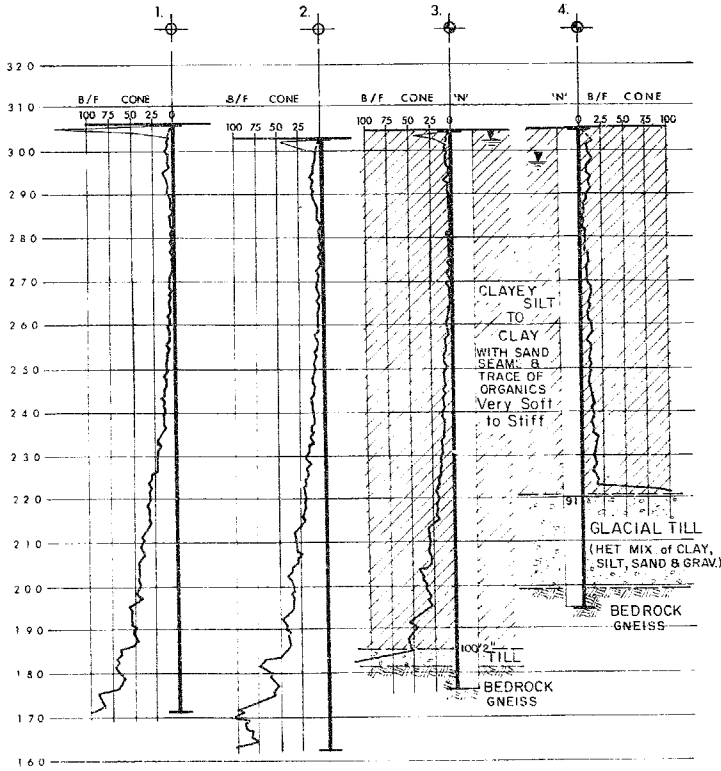
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



PLAN

SCALE IN FEET

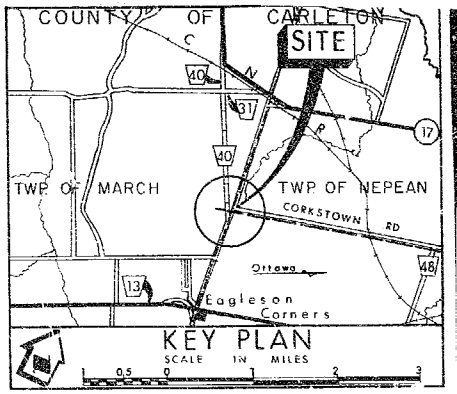
100 50 0 100 200 300



BORE HOLE DETAILS

SCALE IN FEET

20 10 0 20 40 60



LEGEND

- BORE AND CONE PENETRATION HOLE
- CONE PENETRATION HOLE
- WATER LEVELS (Feb. 1966)

NO.	ELEV	STA	OFFSET
1	305.8	231 + 52	185' LT
2	303.4	228 + 14	140 RT
3	304.6	228 + 55	125 LT
4	305.0	231 + 76	365 RT

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS and TESTING DIVISION

PRELIMINARY INVESTIGATION

COUNTY RD. № 40 & OTTAWA QUEENSWAY

WP. 431-64 DIST. 9 JOB NO. 66-F-16

DATE 20 MAY 1966 APPROVED

DRAWING NO 66—F—16 A

The following information was given to Tom Kovich by phone.

HAVE DOWN 1 JUNE 7/56 11.45 A VR

H GREENLAND DIST ENGR

ATT W D HAM MAINTCE ENGR

RE NO. 1 WINONA ROAD UNDER PASS WP 216-63, WJ66-S-49

NO. 2 FIFTY-ROAD INTERCHANGE WP217-63, WJ66-F-55

NO. 3 OAKES ROAD UNDER PASS WP218-63 WJ-66-F-16

NO. 4 OFIELD ROAD INTERCHANGE WP224-63, WJ66-F-54

THE FIELD WORK FOR THE ASOVE MENTIONED FOUNDATION PROJECTS IS IN PROGRESS THIS IS FOR YOUR INFORMATION .

M DEVATA SENIOR FOUND ENGR FOR A G SIERMAC PRINC FOUND ENGR

MATLS AND TESTING DIV

TELETYPE

7 11:57

The following information was given to Tom Kovich
by phone -

B

HANN DOWN 1 JUNE 7/66 11.45 A VR

H GREENLAND DIST ENGR

TI W D HAM MAINTCE ENGR

RE NO. 1 WINONA ROAD UNDER PASS WP 216-63, WJ66-S-49

NO. 2 FIFTY-ROAD INTERCHANGE WP217-63, WJ66-F-55

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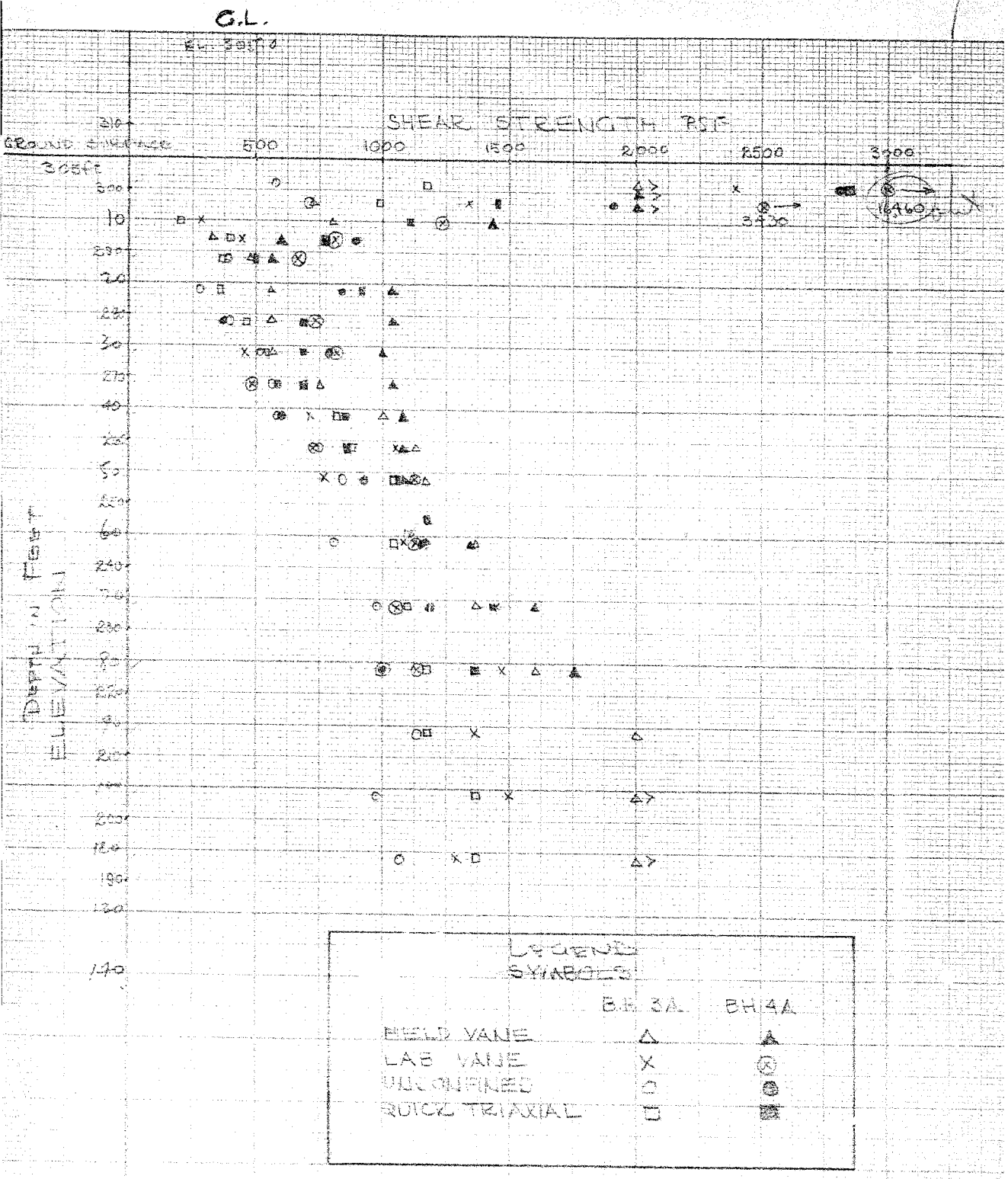
M DEVAIA SENIOR FOUND ENGR FOR A G STERMAC PRINC FOU NGR

TELETYPE

C.L.


SHEAR STRENGTH PSF
500
1000
1500
2000
2500
3000
3430
1660
GROUND SURFACE
DEPTH IN FEET
ELEVATION IN FEET
LEGEND
SYMBOLS
BH 3A
BH 4A
FIELD VANE
LAB VANE
UNCONFINED
QUICK TRIAXIAL

3430

1966 JUN 7 AM 11:57

The following information was given to Tom Kovich by phone - 11:42

TELETYPE

B

HAMN DOWN 1 JUNE 7/66 11.45 A VR

H GREENLAND DIST ENGR

ATT W D HAM MAINTCE ENGR

RE NO. 1 WINONA ROAD UNDER PASS WP 216-63, WJ66-S-49

NO. 2 FIFTY-ROAD INTERCHANGE WP217-63, WJ66-F-55

NO. 3 OAKES ROAD UNDER PASS WP218-63 WJ-66-F-16

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M DEMATA SENIOR FOUND ENGR FOR A G STERMAC PRINC FOUND ENGR

MATLS AND TESTING DIV

66-F-16

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac
Principal Foundation Engineer
Materials and Testing Office
Downsview

From: Materials and Testing Office
Kingston

Attention:

Date: March 4, 1969

Our File Ref.

In reply to

Subject:

Re: W.P. 432-64, Interchange at
Cty. Rd. 9 and Queensway Extension
District 9, Ottawa

The attached correspondence is self-explanatory. The information plotted on the enclosed profiles is a summary of all the information obtained by us to date, together with a summary of the foundation investigation carried out by your office for W.P. 431-64 (W.J. 66-F-16).

It is requested that the alternate proposals be reviewed, particularly with regard to any possible problems at the crossing of the watercourse (Sta. 5± Twp. March), and at the structure site itself, where cut sections and approach fills will be in close proximity.

We would appreciate the return of the plan and profiles after you have obtained all the necessary information from them.

J. A. Cruickshank

for: J. E. Gruspier
Regional Materials Engineer

JAC:mgm
Encl.

cc: J. L. Forster
G. Scott
G. A. Wrong

Mr. J. A. Forster
Regional Functional Planning Engr.
Functional Planning Office, Kingston

Materials and Testing Office
Kingston

March 4, 1969

Re: W.P. 432-64, Interchange
at Cty. Rd. 9 and Queensway

The following are our preliminary comments on your gradeline proposals regarding the excavation treatments, use of cut materials for fill purposes, and expected performance of the road in cut sections.

The upper 4 to 6 ft. of soil is predominantly stiff clay of high plasticity with layers of fine sand. Most of the excavation material from cuts within the upper 4 to 6 ft. could be utilized, at least outside 1:1 slopes of high fills, or in berm construction. The material directly below the upper 4 to 6 ft. is a soft clayey silt. It is felt that this material will be difficult to handle and cannot be utilized for any fill purposes. Approximately 3' of granular base and sub-base material would be required for cuts greater than 4' to 6' depth. Sub-drainage will likely be difficult to control satisfactorily for the cut sections indicated, particularly in cuts below 4 to 6 ft.

In view of the above, good pavement performance cannot be guaranteed in the cut sections, and therefore, all other conditions being equal, it would be preferable to provide an overpass at this interchange. (Queensway on fill) -

Overpass scheme calls for greater depth of excavation

Underpass - (Queensway in nominal cut (4+5' rev.) should be in competent surficial deposits

However, it is to be noted that provision of an overpass will result in fill heights of up to 26' on the Queensway extension, which will again likely result in poor pavement performance due to differential settlement, and the possibility of increased cost if the stability of these fills is critical. In addition to this, the County Road will be in cut, resulting in problems with wet cut and subgrade materials as previously noted. Granular requirements for the County Road in

Continued /2

this cut would likely be similar to those indicated for the Queensway Extension.

The final choice of scheme will presumably have to be based on (1) cost, and (2) the relative seriousness of pavement deficiencies because of either poor construction and subgrade conditions in cut, or excessive settlements in high fills.

Since foundation conditions under the high fills will have a direct bearing on both the cost of the job and the pavement performance, we are forwarding your proposals to the Foundation Section in Downsview for further appraisal and comment.

J. A. Cruickshank

J. A. Cruickshank

for: J. E. Gruspier
Regional Materials Engineer

JAC:mgm

cc: A. G. Stermac
G. Scott
C. A. Wrong

MEMORANDUM

To: Mr. J.E. Gruspier,
Regional Materials Engineer,
Kingston, Ontario.

From: Functional Planning Section,
Kingston, Ontario.

Attention: Mr. H. Meyer

Date: February 17, 1969.

Our File Ref.

In reply to

Subject: W.P. 432-64, Assumed Carleton Cty. Rd. 9, Hwy. 7 & 15 to Hwy. 17, District 9 - Ottawa

We enclose profiles of proposed Highway 417 and the interchange legs at County Road 9. As already discussed with you, these indicate two possible grades, one for an underpass condition and one for an overpass. We would be grateful for your comments on these grades as soon as possible.

B. Khojajian,
Project Planning Engineer.

PB/BK/mjh
Encl.

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

file please M.D Dec 11/71

TO: Mr. A. G. Stermac,
Principal Foundation Engineer,
Downsview, Ontario.

FROM: Bridge Section,
Kingston, Ontario.

ATTENTION: Mr. M. Devata

DATE: December 7, 1971.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 431-64-00, Site 3-260,
Former County Road 9 Interchange Underpass,
Highway 417, District 9 - Ottawa

66-F-16

As discussed in your office we are now sending you herewith two copies of Bridge Site Plan E-5221-1 for the above structure.

We have shown the proposed profile grade of former County Road 9 but understand that it is still subject to change.

for T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl
Encls.
c.c. -
C. S. Grebski (with encl.)
R. Forrest

cc: Foundations Files (Rm. 110)

Mr. J. E. Gruspier,
Regional Materials Engineer,
Eastern Region,
KINGSTON, Ont.

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

March 17, 1969

Interchange at County Rd. #9 and Queensway Extension
W.J. 66-F-16 -- W.P. 431-64 -- Dist. #9 (Ottawa)

Further to your memo of March 4, 1969, we have reviewed the subsoil conditions presented in our Preliminary Foundation Report W.J. 66-F-16. The subsoil consists mainly of 8 to 13 ft. of stiff clay with sand layers underlain by very soft to stiff clayey silt to silty clay between 70 and 110 ft. in thickness. The cohesive strata are underlain by a thin, competent glacial till stratum followed by bedrock.

The present proposal calls for either an underpass or overpass structure at the crossing of County Rd. #9 and the Queensway Extension. If an overpass structure is contemplated, the profile grade will be such that embankments up to 26 ft. will be required at the crossing of Watts Creek and the Queensway, located some 500 ft. west of the structure crossing. The embankment heights, however, will only be 15 ft. at the creek crossing if an underpass structure is considered. In view of this, it would be desirable to adopt an underpass structure so that the consolidation settlements and problems associated with regard to stability of embankments, could be minimized at the water course. However, if the water course is crossed by a structure, either of the schemes proposed at the crossing of County Rd. #9 and the Queensway, would be satisfactory from a foundation point of view.

With regard to the alternate schemes for the structure at the crossing of County Rd. #9 and the Queensway, the consolidation settlements due to the embankment loading, will affect the County Road in the case of an underpass structure, whereas, in the case of an overpass, the settlements will affect the major highway.

For preliminary design purposes, the berm requirements for various heights of fill, given in our Foundation Report W.J. 66-F-16, may be used. In order to assess the various problems, a detailed foundation investigation will be required.

If you require any further comments pertaining to this project, please contact our Office.

MD/MdeP
cc: Messrs. J. L. Forster
G. Scott
Foundations Files
Gen. Files

M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Sternac,
PRINCIPAL FOUNDATION ENGR.

cc: Foundation Office (Pm. 110)

Mr. H. Aron,
Regional Services Manager,
Regional Office - Kingston.

Foundation Section,
Materials & Testing Division,
Rm. 107, Lab. Bldg.

February 14, 1966

66-F-16

Preliminary Foundation Investigations
for Ottawa Queensway Extension.

W.P. 431-64	--	W.J. 66-F-16
W.P. 108-64	--	W.J. 66-F-17
W.P. 430-64	--	W.J. 66-F-18
W.P. 423-64	--	W.J. 66-F-19

Please arrange the necessary permission from the property owners, in order to carry out the preliminary investigations for the above mentioned Work Projects.

M. Devata

MD/MdeF

M. Devata,
SENIOR FOUNDATION ENGINEER
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office ✓
Gen. Files

MEMORANDUM

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

From: Bridge Division, Downsview, Ontario.

Date: January 21, 1966.

Our File Ref.

In reply to 66-F-16

Subject: Ottawa Queensway Extension, District 9.

At a recent regional meeting attended by the various planning, design, construction, materials and bridge location engineers, it was clearly established that a preliminary soil investigation for the Ottawa Queensway Extension West of Ottawa was necessary.

Present indications are that in this area bedrock may be found at depth probably greater than 90 feet, whilst in some cases, notably at the quarry shown on the topographical map some 1500' westwards from the proposed C.N.R. Crossing (W.P. 108-65), rock is visible at the roadway elevation.

Attached please find a print of Mr. Forster's letter dated January 17th. 1966 together with portion prints (plans and profiles) showing tentatively proposed locations of the following structures:

W.P. 423-64 U'pass at twp. road 0.4 miles W. of Jct. Hwy. 15 - Ottawa

W.P. 430-64 Moody Drive Interchange 1.8 miles W. of Jct. Hwy. 15 - Ottawa

W.P. 108-65 C.N.R. O'head 2.7 miles W. of Jct. Hwy. 15 - Ottawa

W.P. 431-64 County Road 40 Interchange U'pass 4.7 miles W. of Jct. Hwy. 15 - Ottawa

Please arrange to make a preliminary investigation at each of these sites (2 holes will probably be required to confirm the results) and report as to the possible embankment stability problem on this area.

..... 2

RE: Ottawa Queensway Extension,
District 9

A report (our file BA 932) is available for the existing structure at the Richmond Road Site (W.P. 909-64). There is a proposal to widen the existing structure and we propose shortly to request a complete foundation soils investigation for that project.

For W.P. 431-64 the profile shows two levels of road crossing however the portion plan shows an interchange involving 4 levels of roads crossing. For preliminary investigation purposes tentative height differences at the 4 levels crossing could be taker as 20' + 20' + 20' = 60' maximum. The possibility of depressing the Queensway elevation should also be considered.

This preliminary information is required at an early date to permit further planning of this roadway and we would be pleased to have your report as soon as possible.

GS/pr

G. Scott,
Regional Bridge Location Engineer.

cc. S. McCombie
A. Watt
R. Forrest

P.S. Attached also are two prints showing the location of the projects on a scale 1:50,000.

MEMORANDUM

To: Mr. A. Watt,
Bridge Location Engineer,
Bridge Division,
Downsview.

From: Functional Planning Section,
Kingston.

Date: January 17, 1966

Our File Ref.

In reply to

Subject: WP 431-64
W.P. 429-64, Ottawa Queensway Extension,
District 9 - Ottawa

Further to our meeting of Friday, January 14, 1966, we require the following information from the Foundation Section: -

At Acres Sideroad:

1. Is the embankment stable at the tentative gradeline shown on the enclosed profile?

2. Would it be better to put Acres sideroad under the Queensway in open cut due to the subsoil conditions?

Moodie Drive:

Same questions as at Acres Sideroad

C.N.R. Embankment:

1. Will the embankment shown at the C.N.R. require berms? If so, can these berms be contained within the right-of-way on our proposed scheme?

2. What will be the effect of this embankment on the existing right-of-way embankment?

County Road No. 40:

1. As discussed at the meeting there are many ways of designing this interchange. To achieve the most economical design we must know what the critical height of embankment is, that is, at what height of embankment must we start to build berms?

continued on page 2...

2. Would it be better to put Cty. Rd. 40 in open cut due to the subsoil conditions or is there no advantage to this from a foundation point of view?

This information is urgently required in order that we may meet our scheduled date for this project.

J. L. Forster,
Regional Functional Planning Engineer

MJM/cam
Encl.

#66-F-16

W.P. # 431-64

OTTAWA

QUEENSWAY :

CTY. RD. #40

PLAN B-64-5

TWP. NEPEAN
CON. I OTTAWA FRONT
LOT 1

RD. ALLCE

FOR PROFILE OF RELOCATED CORKSTOWN RD. - SEE PLL-C5

RE-LOCATED CORKSTOWN RD.

FOR DETAIL OF INTERSECTION SEE PLAN

LINE 'B' — PROF. C-52-27

TO OTTAWA

PLAN B-52-24
PROF. C-52-24

B-52-2

CON. 2 OTTAWA FRONT
LOT 1
NATIONAL CAPITAL COMMISSION

W. TERON

HANNING

R SCARFE

LOT
CON

PROP. QUEENSWAY EXT. (HWY. 417)

COLONEL BY DR.

PROF. C-64-3

F. CARLUTHERS

AVENUE

H.O.T. 225+110.94 LINE 'D'

H.O.T. 228+17.58 LINE 'D'

H.O.T. 231+01.30 LINE 'D'

H.O.T. 237+69.70 LINE 'D'

H.O.T. 44+29.10 SUB RD. LINE 'D'
H.O.T. 231+42.04 LINE 'D'

P.I. 78+27.69

P.I. 54+39.99

P.I. 57+49.69

P.I. 57+94.76

P.I. 53+10.80

P.I. 54+60.80

CURVE DATA
Δ - 21° 52' 30"
Δx - 15° 07' 30"
D - 4° 30' LT.
R - 1273.24
Lc - 336.11
Es - 24.31

SPIRAL DATA
θs - 3° 22' 30"
Ls - 150.00
Ts - 321.19

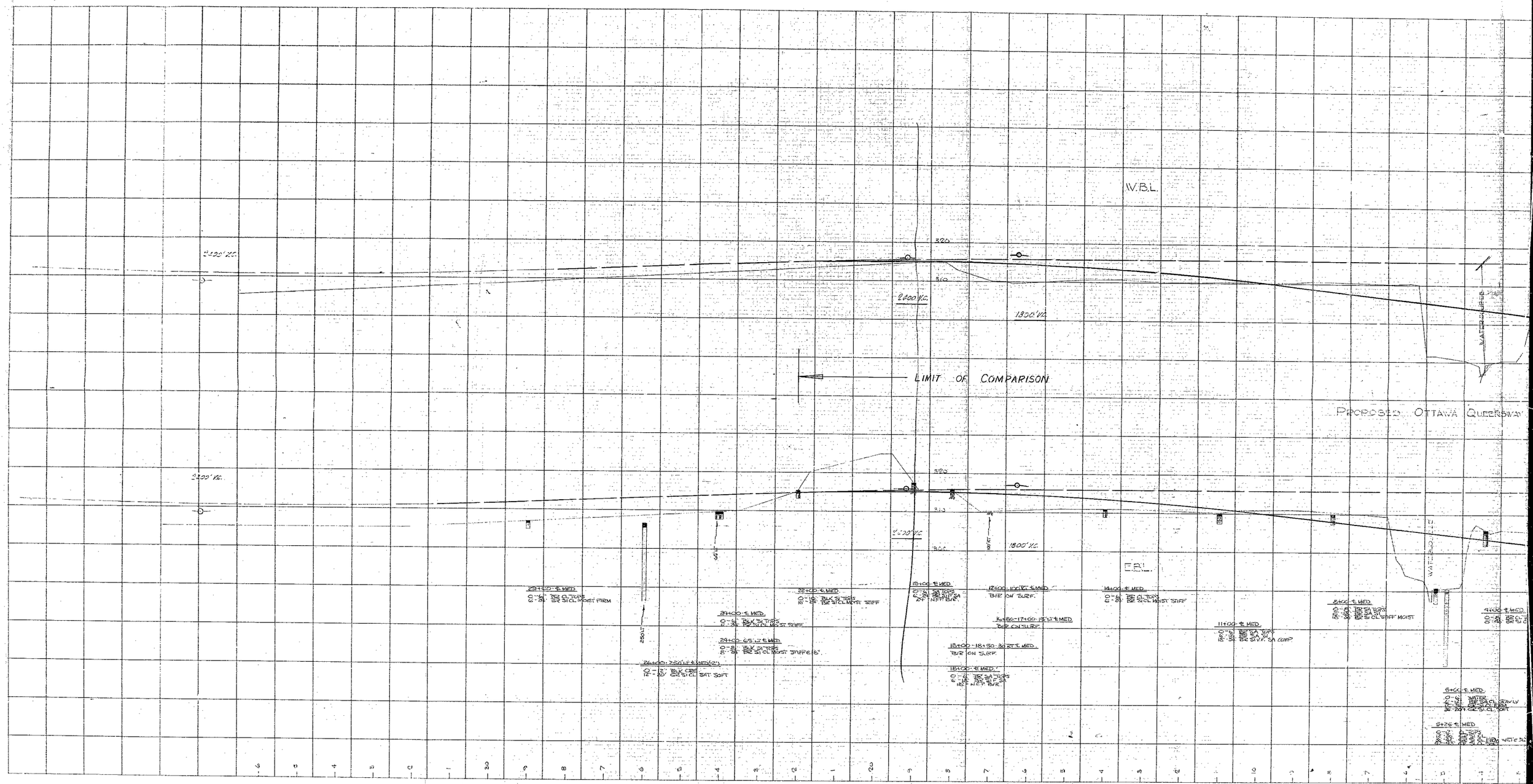
REFLECTOR DISTANCE TO BE PAINTED IN A 15' RADIUS AROUND BELL POLE

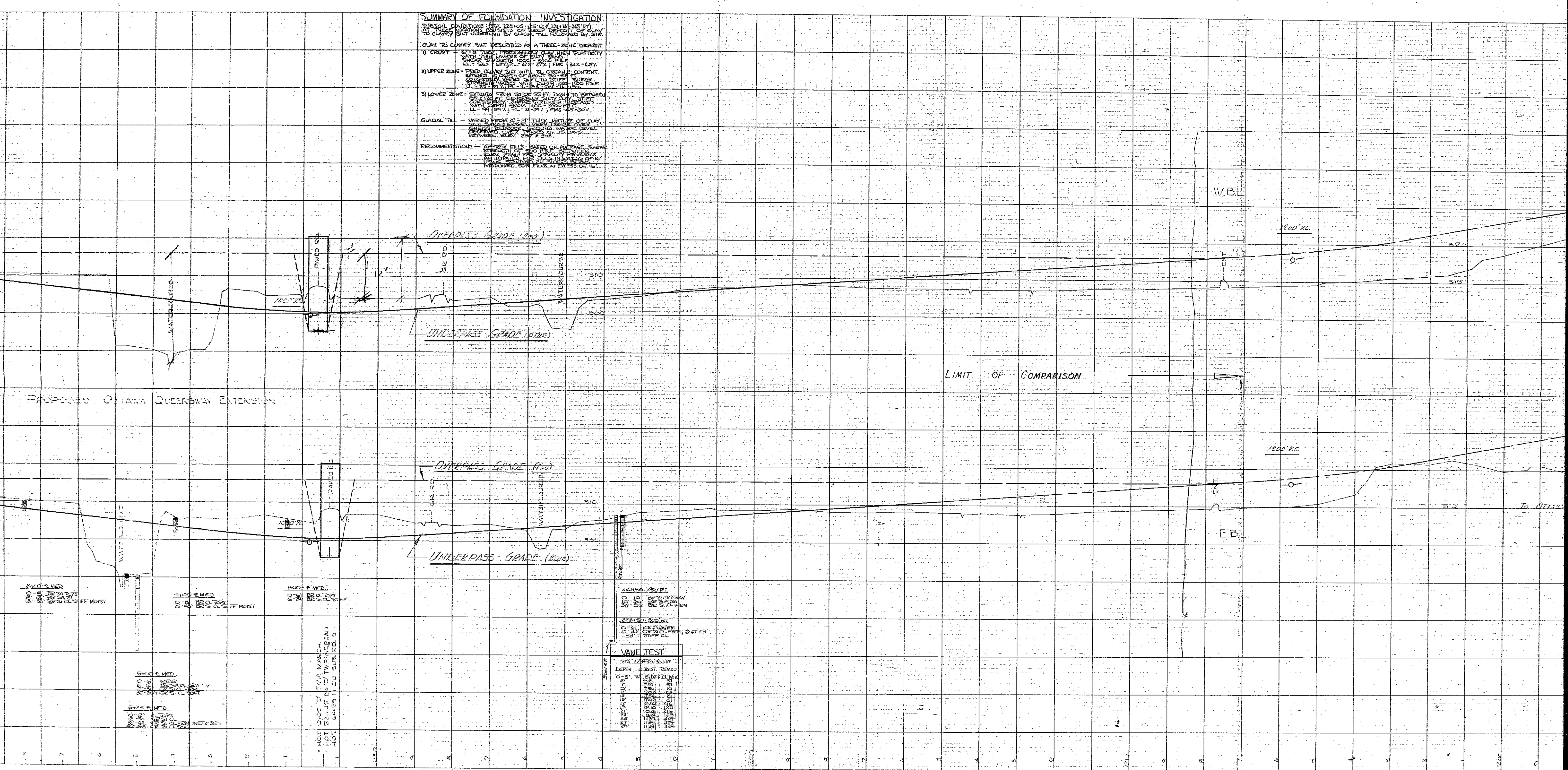
A

B

C

D





"PERFECT" CROSS SECTION 10 x 10 = ONE INCH EUGENE DIETZGEN CO.

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W.P. 432-64
PROPOSED OTTAWA QUEENSWAY E...
E.B.L. & W.B.L.

SUMMARY OF FOUNDATION INVESTIGATION

SUBSOIL CONDITIONS: STA 223+05 - 125' LT. & 331'± RT. (BH 5)
AT THESE LOCATIONS, CONSISTS OF VERY SOFT TO SOFT GREY CLAY TO CLAYEY SILT UNDERLAIN BY GLACIAL TILL FOLLOWED BY BEDROCK.

CLAY TO CLAYEY SILT DESCRIBED AS A THREE-ZONE DEPOSIT

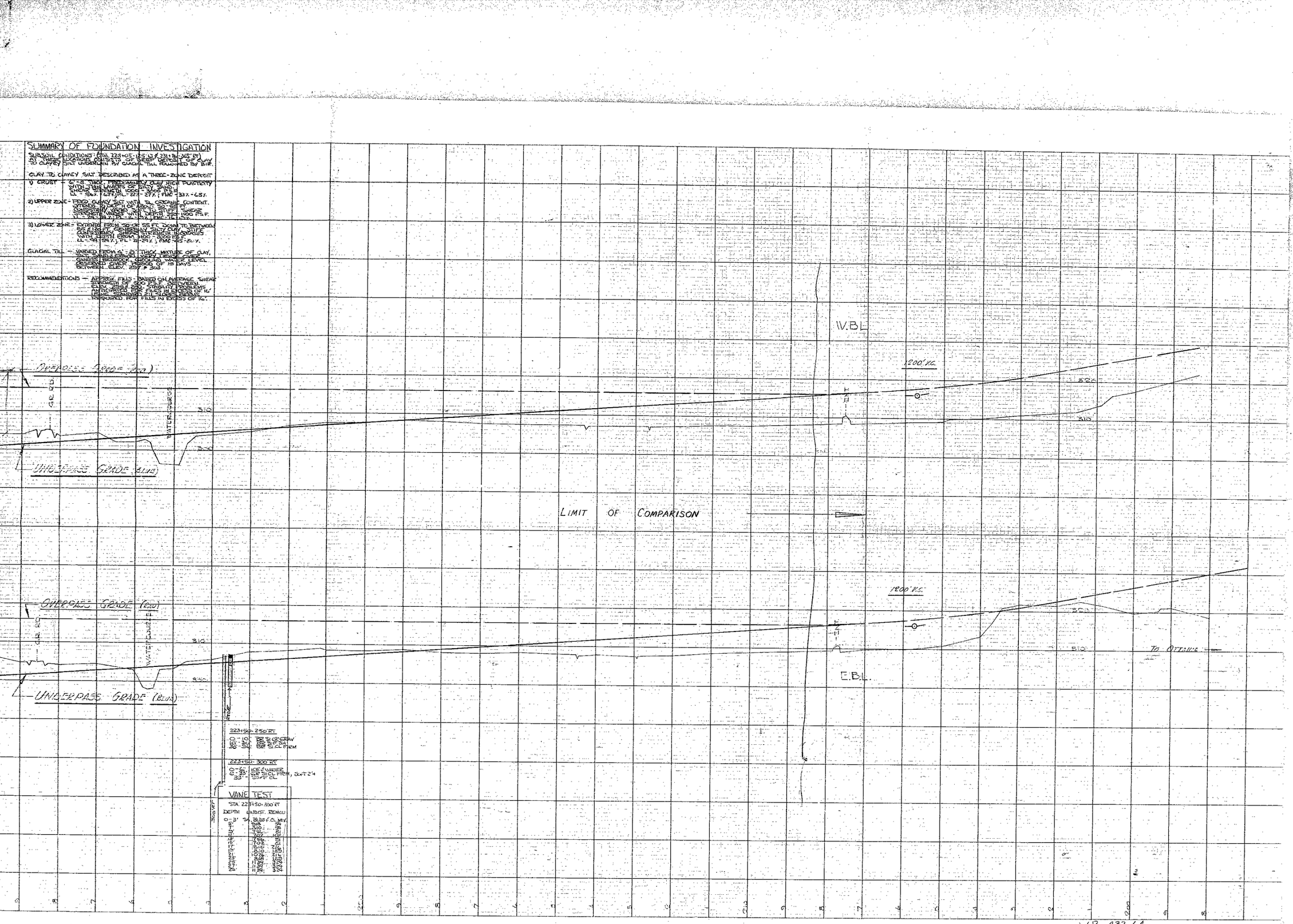
1) CRUST - 6'± THICK, PREDOMINANTLY CLAY, HIGH PLASTICITY
WITH THIN LAYERS OF SILTY SAND
MOISTURE CONTENT - 30% TO 40%
γ = 97 - 107 pcf; FINES - 33% - 65%.

2) UPPER ZONE - FIRM CLAYEY SILT WITH 5% ORGANIC CONTENT.
STRENGTH INCREASES WITH DEPTH - 1 TSF TO 2 TSF
CONSISTENCY VARIES FROM SOFT TO FIRM
MOISTURE CONTENT - 30% TO 40%
γ = 94 - 98 pcf; FINES - 90% - 95%.

3) LOWER ZONE - EXTENDS FROM 18'± TO 55'± FT. DEEP AND IS BETWEEN SILTY CLAY TO CLAYEY SILT
CONSISTENCY VARIES FROM FIRM TO VERY STIFF
STRENGTH INCREASES WITH DEPTH - 2 TSF TO 3 TSF
MOISTURE CONTENT - 20% TO 30%
LL = 34 - 39; PL = 21 - 24; FINES - 90% - 95%.

GLACIAL TILL - VARIED FROM 9'± TO 18'± THICK, MIXTURE OF CLAY, SILT, SAND & GRAVEL WITH VERY LITTLE COHESION
UNDERLAIN BY BEDROCK
GROUNDWATER LEVEL OBSERVED DURING DRILLING OF 19 DAYS BETWEEN ELEV. 309 & 323

RECOMMENDATIONS - APPROX. FILLS - BASED ON AVERAGE SHEAR STRENGTH OF 1 TSF
FILL SLOPES - 3 HORIZ. TO 1 VERT.
EARTH FILLS - NO STABILITY PROBLEMS ANTICIPATED FOR FILLS UP TO 16' HIGH
ROCK FILLS - SHOULD BE CONSIDERED FOR FILLS IN EXCESS OF 16'.



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W.P. 432-64

PROPOSED OTTAWA QUEENSWAY ETENSION

E.B.L. ; W.B.L.