#65-F-246

W.P. # 67-65

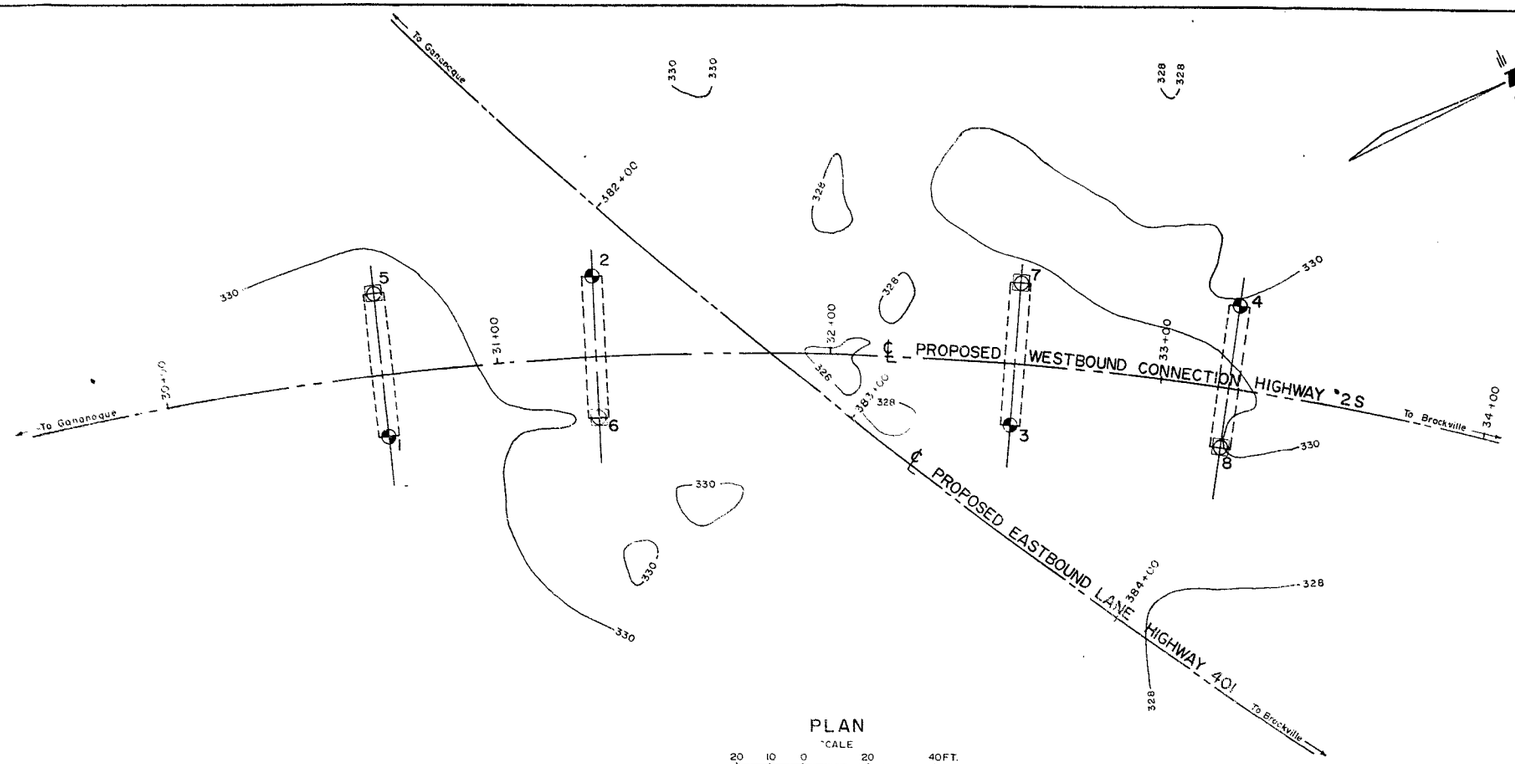
Hwy. #401 &

Hwy. #2 S

WESTBOUND

CONNECTION

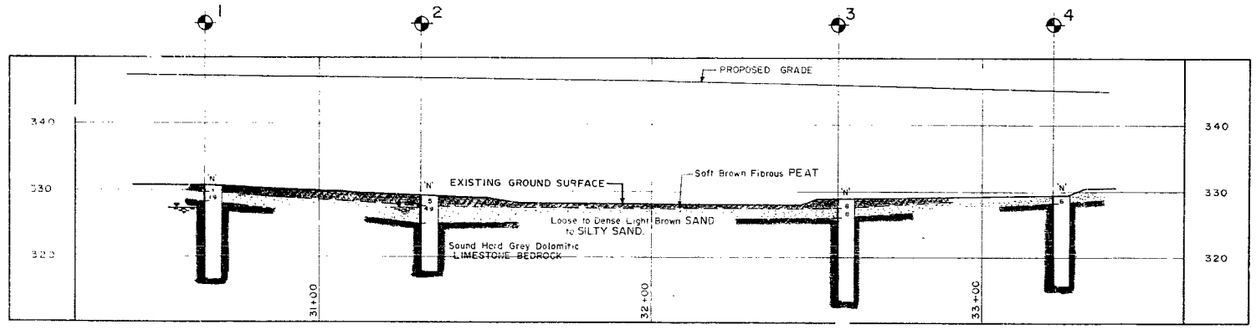
UNDERPASS



PLAN

SCALE

20 10 0 20 40 FT.

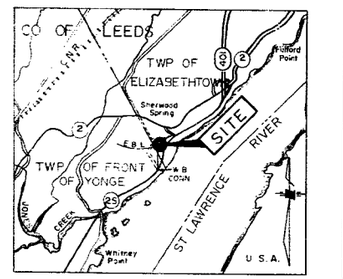


SCHEMATIC SECTION ALONG CENTRELINE OF PROPOSED WESTBOUND CONNECTION HIGHWAY 2S

SCALE

20 10 0 20 40 FT.

4374SDE
4929SDN 18 31B12



KEY PLAN

SCALE IN MILES

1 0.5 0 1 2 3

LEGEND

- Bore Hole
- Cone Penetration Hole & Test Pit
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation (Within Bedrock)

NO.	ELEVATION	STATION	OFFSET
1	331.4	30+65	18.5'RT.
2	328.5	31+32	24.5'LT.
3	328.4	32+56	18.5'RT.
4	330.2	33+21	24.5'LT.
5	330.3	30+65	24.5'LT.
6	328.7	31+30	18.5'RT.
7	329.1	32+56	24.5'LT.
8	329.5	33+21	18.5'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.

PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

H.Q. GOLDER & ASSOCIATES LIMITED

DEPARTMENT OF HIGHWAYS – ONTARIO

MATERIALS & TESTING DIVISION - FOUNDATION SECTION

PROPOSED WESTBOUND CONNECTION UNDERPASS HIGHWAY 401 AND HIGHWAY 2S

KING'S HIGHWAY NOS. 401 & 2S DIST. NO. 8

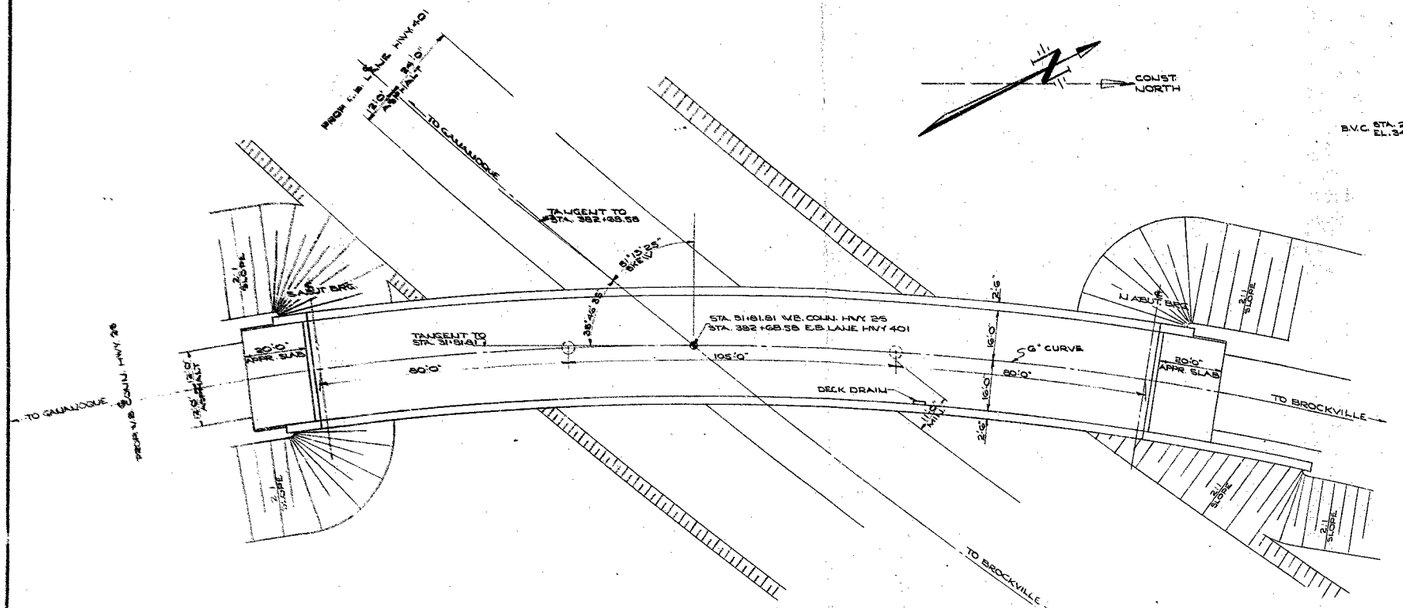
CO. LEEDS

TWP. ELIZABETHTOWN LOT 38 & 37 CON. 1

BORING PLAN & SOIL STRATIGRAPHY

SUBM'D	CHECKED	W.P. NO. 67 – 65	DRAWING NO. 1
DRAWN J.A.	CHECKED	JOB NO. 65058	
DATE JUNE 16, 1965	SITE NO		BRIDGE DRAWING NO.
APPROVED	CONT NO		

REF NO E-4604-1



PLAN

SCALE - 1" = 20'-0"

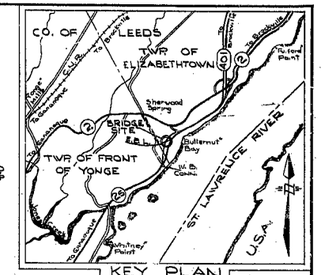
B.M. ELEV. 329.79
GEODETIC DATUM
I.I.S. W. IN W. ROOT OF 0-8" ELM
290'-0" RT OF STA. 380+50 "G"

PROFILE of W.B. CONN. HWY. 25

N.T.S.

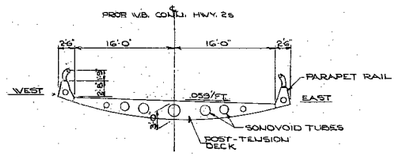
PROFILE of E.B. LANE HWY. 401

N.T.S.



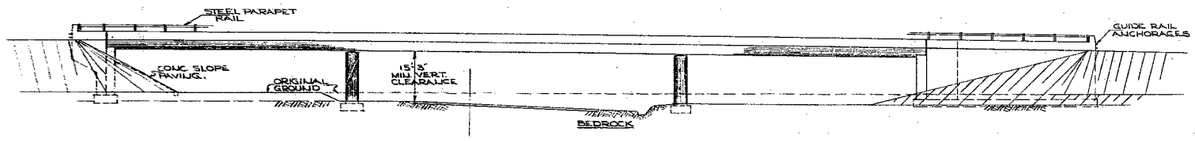
KEY PLAN

SCALE - 1 INCH = 1 MI.



DECK SECTION

SCALE - 1"=10'-0"



ELEVATION

SCALE - 1" = 20'-0"

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

WESTBOUND CONNECTION U-PASS

(1.3 MILES WEST OF HWY. 2 AND EXISTING HWY 401 AT CRYSTAL BEACH)

KING'S HIGHWAY No. 401 — DIST. No. 8

CO. LEEDS

TWP. ELIZABETHTOWN — LOT 38 & 37 — CON. I

PRELIMINARY

APPROVED _____ BRIDGE ENGINEER

DESIGN	W.L.L.	CHECK	
DRAWING	D.H.B.	CHECK	
DATE	JULY/65	LOADING	H20-S16

SITE No.	16-178	W.P. No.	67-65
CONTRACT Nos.			
DRAWING No.	D-5773-P		

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

W.P. 67-65

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED WESTBOUND CONNECTION UNDERPASS

HIGHWAY 401 AND HIGHWAY 2S

TOWNSHIP OF ELIZABETHTOWN, COUNTY OF LEEDS

Distribution:

10 copies - Department of Highways, Ontario, Toronto, Ontario.

2 copies - H. Q. Golder & Associates Ltd., Toronto, Ontario.

June, 1965

65058

TABLE OF CONTENTS

ABSTRACT

The results of an investigation to determine the subsurface conditions at the site of the proposed structure to carry the westbound connection of Highway 2S over the eastbound lane of the proposed Highway 401 in the Township of Elizabethtown, Ontario are reported and recommendations are made for the foundation design of the proposed structure and approach embankments.

It was found that the overburden at the site is less than about 4 feet thick and consists of a thin surficial deposit of soft fibrous peat underlain by compact to dense sand. Underlying the relatively thin overburden is fairly sound hard grey dolomitic limestone bedrock. The groundwater level across the site is generally at or near ground surface.

The piers for the proposed structure may be founded on spread footings placed on the surface of or in the bedrock using an allowable bearing pressure of up to 10 tons/sq.ft. The abutment footings may also be placed on the bedrock or alternatively within the roadway approach embankments. For properly compacted fill a bearing pressure of up to 2 tons/sq.ft. may be used as discussed in the report. Settlement of the bridge structure using these loadings should be negligible.

There should be no overall stability problem with the proposed roadway embankments provided the thin organic surface deposits overlying the sand stratum are removed.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Department of Highways, Ontario, to carry out a subsurface investigation for a proposed structure to carry the westbound connection of Highway 2S over the eastbound lane of the proposed Highway 401 at Crystal Beach in the County of Leeds, Ontario. The purpose of this investigation was to determine the subsurface conditions at the site and to provide information for the design of a proposed bridge structure and associated roadway approach embankments.

PROCEDURE

The field work for this investigation was carried out between June 4 and June 9, 1965. During this period 4 boreholes with adjacent dynamic penetration tests (numbered 1 to 4, inclusive), ranging in depth from about 10 to 15 feet, and 4 additional dynamic penetration tests (numbered 5 to 8, inclusive), were put down using a skid-mounted machine drillrig supplied and operated by the F.E. Johnston Drilling Co. Ltd. A test pit was dug manually on June 18, 1965 at the location of dynamic penetration tests 5 to 8, inclusive, to confirm the relatively shallow depth to bedrock surface as inferred from the penetration test results. The field work was supervised throughout by a member of our engineering staff.

The locations of the borings put down during the investigation are shown on Figure 1 located in a pocket following the Records of Boreholes. A detailed log for each boring, dynamic penetration test and and test pit is given on the Records of Boreholes following the text of this report. A section of the inferred soil stratigraphy along the centerline of the westbound connection of Highway 2S is given on Figure 1.

The samples obtained during the investigation were brought to our laboratory for detailed examination and testing. The results of the laboratory testing are shown on the Records of Boreholes and on Figure 2.

The elevations used in this report are referred to Geodetic Datum. The elevations and borehole locations were supplied to us by the Department of Highways, Ontario.

SITE AND GEOLOGY

The site of the proposed structure carrying the westbound connection of Highway 2S over the eastbound lane of Highway 401 is located some 1.3 miles west of the existing Highway 2 and Highway 401 interchange and about 200 to 300 yards west of the existing Highway 401 in the Township of Elizabethtown in the County of Leeds, Ontario.

The site is presently unoccupied, is swampy in nature, and is covered by thick underbrush and trees. The ground surface across the site undulates between about elevation 331 and 327. Small bedrock outcrops occur at several locations in the general vicinity of the site.

Based on previous site investigations carried out in the general area and available geological information, it is known that the proposed site is located in the physiographic region known as "Leeds Knobs and Flats" which consists primarily of scattered rock outcrops between which lie water laid deposits of clays, sands and gravels. The bedrock in the area consists generally of Palaeozoic calcareous sandstones, fossiliferous limestones and dolomites of the Potsdam series.

SUBSURFACE CONDITIONS

The detailed stratigraphy encountered in each boring is given on the Records of Boreholes. The stratigraphy along the centerline of Highway 2S has been interpolated from this data and is presented on Figure 1. Following is a summary account of the inferred subsurface conditions at the site.

The site, at the boring locations, is generally covered by up to about 2 feet of dark brown fibrous peat or organic sandy material. Based on a single laboratory determination the organic content

of this surficial material is about 66 percent and the in situ water content about 200 percent. Standard and dynamic penetration tests carried out in the peat gave consistent values of 1 blow/ft. indicating that the organic deposit is very soft to soft.

Underlying the surficial organic deposit the borings encountered up to about 3 feet of light brown silty sand to sand with some silt and a trace to some gravel and cobbles throughout. Grading curves for typical samples of the sand are shown on Figure 2. Five laboratory determinations indicate that the sand has an average in situ water content of about 25 percent.

Standard and dynamic penetration tests carried out in the sand stratum gave penetration resistance values ranging from about 5 to 50 blows/ft. with an average of about 16 blows/ft., indicating that the stratum is loose to dense but is generally compact.

Underlying the sand stratum, generally at a depth of about 3 feet, the dynamic penetration tests met practical refusal and the borings encountered bedrock. The bedrock was cored in AXT size for about 8 to 12 feet in all boreholes. Bedrock was found to be a fairly sound hard grey dolomitic limestone which has occasionally been weathered light brown in the upper 2 to 4 feet, as in borehole 4. Some near horizontal fractures were observed

throughout the bedrock. The bedrock also contains occasional open seams or joints, as in borehole 4, where complete water loss was observed during drilling.

Following completion of boreholes 1, 2 and 4 a piezometer was installed in the bedrock for groundwater level observation. Readings were taken in these installations and in the open borehole (number 3) following completion of the work. The installation details together with the latest readings obtained on June 18, 1965 are shown on the Records of Boreholes and on Figure 1.

Observations made in open boreholes during the boring operations (June 4 to 9, 1965) showed that the groundwater level within the overburden was at about ground surface. The swampy nature of the site confirmed this high water level condition. On June 18, 1965 when the test pits were put down at the location of dynamic penetration tests 5 to 8, inclusive, it was found that the overburden was essentially dry with the groundwater level at about or below bedrock surface.

Readings taken in the piezometer installations placed in the bedrock indicate that, with the exception of borehole 4, the groundwater level in the bedrock is within about one foot of ground surface. In borehole 4 the piezometer was found to be dry to a 13 foot depth 14 days after installation. The dry nature of

this boring is probably due to the presence of open seams or fractures within the bedrock. It was observed during drilling operations in borehole 4 that there was a complete water loss in a few zones within the bedrock. In the remainder of the borings good water return was obtained during bedrock core drilling.

DISCUSSION

General

It is understood that the proposed underpass is to be a 3 span structure with a 125 foot long central span and 65 foot long end spans. It is further understood that the proposed grade of the westbound connection of Highway 2S is to be at about elevation 347 and the proposed grade of the eastbound lane of Highway 401 is to be slightly below the existing ground surface which is at about elevation 330. The height of the roadway approach embankments for Highway 2S will be some 18 feet above existing ground surface. Spill-through type abutments are to be used for the bridge structure.

Roadway Approach Embankments

The approach embankments to both bridge abutments will be some 18 feet in height above existing ground surface and will have side and end slopes not steeper than 2 horizontal to 1 vertical. To prevent erosion scour and gullying of the slopes, provision

should be made for sodding or seeding and mulching as soon as possible following completion of the embankments.

There should be no overall stability problem with the proposed approach embankments if constructed of suitable material properly compacted in place, provided all of the soft organic surface deposits overlying the thin sand deposit are removed beneath the full width of the embankments. Care should, however, be taken to prevent loosening of the sand overlying the bedrock due to water and construction operations.

As the groundwater level at the site could be at or very close to ground surface, some control of groundwater may be necessary during removal of the surficial organic material to ensure that the in situ density of the sand deposit is maintained. It is suggested that this control consist of ditches leading to an area of lower elevation to draw the water table down to the lower portion of the sand stratum prior to general stripping across the site.

As spill through abutments are to be used for the structure it may be economical to found the abutments on spread footings placed in the roadway approach fill. If this is done the embankments in the abutment zones should be constructed of well graded granular material placed in 9 to 12 inch lifts and

compacted to at least 100 percent standard Proctor dry density. Outside the abutment zones the embankments need not be constructed of granular material.

If the embankments are constructed as discussed above, settlement of the approach fills should be negligible.

Bridge Structure

Due to the extremely shallow depth of the overburden at the site, the north and south piers may be founded on spread footings placed on the surface of or in the bedrock using an allowable bearing pressure of up to 10 tons/sq.ft. For this bearing pressure settlement of the piers will be negligible. If the footings are placed on bedrock surface dowels should be installed into the rock to prevent possible footing movement, particularly if a sufficient earth cover is not provided for frost protection purposes.

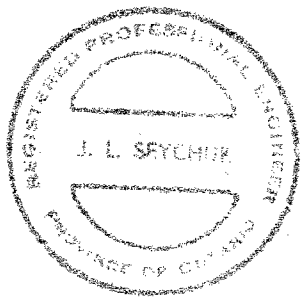
The bridge abutments may be founded directly on the bedrock using an allowable bearing pressure of 10 tons/sq.ft., as discussed for the piers. This would however limit the use of large construction equipment for placing and compacting the approach fill on both sides of the abutment. It may therefore be more economical to found the abutments on spread footings placed directly in the roadway approach fills, as previously discussed.

If this is done and the approach fills are constructed of well compacted material, an allowable bearing pressure of up to 2 tons/sq.ft. may be used in design of the abutment footings. Settlement of the footings within the approach fill should be negligible.

For abutments founded in the approach fills a minimum of 4 feet of earth cover should be provided for frost protection purposes.

J. B. Davis

J. L. Seychuk, P.Eng.



JBD:JLS:HJB
65058
June, 1965

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/ft.*
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, *lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer[1]
Q undrained triaxial[2]
R consolidated undrained triaxial[2]
S drained triaxial
U unconfined compression
V field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.
[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$

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

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	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

III. SOIL PROPERTIES

(a) *Unit weight*

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_s	specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) *Consistency*

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_S	shrinkage limit
I_L	liquidity index $= (w - w_P)/I_P$
I_C	consistency index $= (w_L - w)/I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

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

(d) *Consolidation (one-dimensional)*

m_v	coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
C_c	compression index $= -\Delta e/\Delta \log_{10} \sigma'$
c_v	coefficient of consolidation
T_v	time factor $= c_v t/d^2$ (d, drainage path)
U	degree of consolidation

(e) *Shear strength*

τ_f	shear strength	
c'	effective cohesion intercept	in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	effective angle of shearing resistance, or friction	
c_u	apparent cohesion*	in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$
ϕ_u	apparent angle of shearing resistance, or friction	
μ	coefficient of friction	
S_t	sensitivity	

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

PROJECT No. 65058

RECORD OF BOREHOLES 1 & 2

LOCATION See Figure 1 BORING DATE JUNE 7 - 8, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER Bx & Ax CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

BOREHOLE 1

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.
331.4	GROUND LEVEL			
0.0	SOFT BROWN FIBROUS **PEAT**	1	2" D.O.	1
329.7		2	"	19
1.7	COMPACT LIGHT BROWN **SAND**, TRACE SILT AND GRAVEL			
328.4		3	AXT RC	—
3.0	SOUND HARD GREY DOLOMITIC LIMESTONE **BEDROCK**, WITH SOME NEAR HORIZONTAL FRACTURES (WEATHERED BROWN ABOVE ABOUT EL 324)	4	"	—
		5	"	—
316.5				
14.9	END OF HOLE			

PERCENT CORE RECOVERY: 100, 100, 100

END OF PEN. TEST @ EL. 329.4 PRACTICAL REFUSAL, RODS AND HAMMER BOUNCING.

ORGANIC CONTENT 6.6%

MH

GROUND LEVEL
SURFACE SEAL
BENTONITE SEAL
PLASTIC TUBING
SAND FILL
PIEZOMETER

W.L. IN PIEZOMETER AT EL. 327.4 ON JUNE 18, 1965

BOREHOLE 2

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.
328.5	GROUND LEVEL			
327.6	SOFT BROWN FIBROUS **PEAT**	1	2" D.O.	5
0.9	COMPACT TO DENSE LIGHT BROWN **SAND** TRACE TO SOME SILT AND GRAVEL	2	"	49
325.0		3	AXT RC	—
3.5	SOUND HARD GREY DOLOMITIC LIMESTONE **BEDROCK**, SOME NEAR HORIZONTAL FRACTURES	4	"	—
317.9				
10.6	END OF HOLE			

PERCENT CORE RECOVERY: 100, 98

END OF PEN. TEST @ EL. 225.5 PRACTICAL REFUSAL, 50 BLOWS FOR NO ADVANCE

MH
MH

GROUND LEVEL
SURFACE SEAL
BENTONITE SEAL
PLASTIC TUBING
SAND FILL
PERFORATED PIPE

W.L. IN PIEZOMETER AT EL. 327.5 ON JUNE 18, 1965

ELEVATION SCALE: 335, 330, 325, 320, 315, 230, 225, 215

DYNAMIC PENETRATION RESISTANCE BLOWS/FT. 20 40 60 80 100

SHEAR STRENGTH C_u, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT W_P W W_L 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

ε1 ε3 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5'-0'

GOLDER & ASSOCIATES

DRAWN J.A.
CHECKED A.S.

PROJECT No. 65058

RECORD OF BOREHOLES 3 & 4

LOCATION See Figure 1 BORING DATE JUNE 4-7, 1965 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER BX & AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.
328.4	GROUND LEVEL				
327.4 / 1.0	SOFT BROWN FIBROUS **PEAT**		1	2" D.O.	6
325.9 / 2.5	COMPACT LIGHT BROWN **SAND** TRACE TO SOME SILT		2	"	6
			3	AXT RC	1
	SOUND HARD GREY DOLOMITIC LIMESTONE **BEDROCK** WITH SOME NEAR HORIZONTAL FRACTURES		4	"	1
			5	"	1
313.4 / 15.0	END OF HOLE				

ELEVATION SCALE: 330, 325, 320, 315

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

SHEAR STRENGTH C_u, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT — W_P, W, W_L — 10, 20, 30, 40

PERCENT CORE RECOVERY: 100, 100, 100

3

END OF PEN. TEST @ EL. 327.4 PRACTICAL REFUSAL ROD AND HAMMER BOUNCING

ADDITIONAL LAB. TESTING: MH

PIEZOMETER OR STANDPIPE INSTALLATION

WATER LEVEL IN OPEN BOREHOLE AT GROUND SURFACE EL. 328.4 ON JUNE 9 1965

OPEN BOREHOLE DRY TO EL. 325.9 ON JUNE 18, 1965

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.
330.2	GROUND LEVEL				
329.6 / 0.6	SOFT BROWN FIBROUS **PEAT**		1	2" D.O.	5
328.3 / 1.9	LOOSE LIGHT BROWN **SAND**, TRACE GRAVEL TO SILTY SAND		2	"	6
			3	AXT RC	—
	SOUND HARD GREY DOLOMITIC LIMESTONE **BEDROCK** WITH SOME NEAR HORIZONTAL FRACTURES, OCCASIONAL OPEN SEAMS OR JOINTS BELOW ABOUT EL. 326 (WEATHERED BROWN ABOVE EL. 326.5)		4	"	—
			5	"	—
			6	"	—
315.7 / 14.5	END OF HOLE				

ELEVATION SCALE: 330, 325, 320, 315

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

SHEAR STRENGTH C_u, LB./SQ.FT.

COEFFICIENT OF PERMEABILITY k, CM./SEC.

WATER CONTENT, PERCENT — W_P, W, W_L — 10, 20, 30, 40

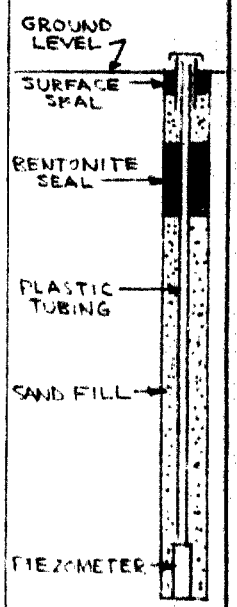
PERCENT CORE RECOVERY: 100, 98, 100, 100

4

END OF PEN. TEST @ EL. 328.5 8 BLOWS FOR LAST 8 INCHES PRACTICAL REFUSAL, RODS AND HAMMER BOUNCING

ADDITIONAL LAB. TESTING: MH

PIEZOMETER OR STANDPIPE INSTALLATION



PIEZOMETER DRY TO EL. 317 ON JUNE 18, 1965

15 / 10 5 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A.

CHECKED

PROJECT No. 65058

RECORD OF ~~BOREHOLE~~ PEN. TESTS & TEST PITS 5, 6, 7 & 8

LOCATION See Figure 1 BORING DATE JUNE 5 - 8 & JUNE 18, 1965 DATUM GEODETIC

BOREHOLE TYPE PENETRATION TESTS AND TEST PITS BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE ELEVN./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FT.	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FT. / SHEAR STRENGTH C_u, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
330.3	GROUND LEVEL					335	5			
329.8	SOFT BROWN FIBROUS PEAT						COMPACT BROWN SILTY SAND, TRACE TO SOME GRAVEL AND COBBLES			TEST PIT DRY TO EL. 329.0 ON JUNE 18, 1965
329.0						330				
1.3	END OF PEN. TEST AND TEST PIT FLAT GREY BEDROCK SURFACE						8 BLOWS FOR LAST 4 INCHES PRACTICAL REFUSAL, 50 BLOWS FOR NO ADVANCE			
						325				
							6			
328.7	GROUND LEVEL					330	BLACK SILTY SAND WITH ORGANIC MATTER			WATER LEVEL IN TEST PIT AT EL. 327.6 JUNE 18, 1965
328.2							COMPACT TO DENSE LIGHT BROWN SAND WITH SOME SILT, GRAVEL AND COBBLES			
327.2							20 BLOWS FOR LAST 3 INCHES PRACTICAL REFUSAL, 50 BLOWS FOR NO ADVANCE			
1.5	END OF PEN. TEST AND TEST PIT FLAT WEATHERED BROWN BEDROCK SURFACE					325				
							7			
329.1	GROUND LEVEL					330	COMPACT BROWN SILT SOME SAND AND GRAVEL, TRACE CLAY			TEST PIT DRY TO EL. 327.1 ON JUNE 18, 1965
328.1	SOFT BLACK FIBROUS PEAT						5 BLOWS FOR LAST 9 INCHES PRACTICAL REFUSAL, 50 BLOWS FOR NO ADVANCE			
327.1						325				
2.0	END OF PEN. TEST AND TEST PIT FLAT GREY BEDROCK SURFACE						8			
329.5	GROUND LEVEL					330	LOOSE BROWN SILTY SAND WITH ORGANIC MATTER			TEST PIT DRY TO EL. 327.8 ON JUNE 18, 1965
328.8							DENSE GREY SILTY SAND AND GRAVEL			
327.8							16 BLOWS FOR LAST 10 INCHES PRACTICAL REFUSAL, 25 BLOWS FOR NO ADVANCE			
1.7	END OF PEN. TEST AND TEST PIT FLAT GREY BEDROCK SURFACE					325				

ε_{15} ε_{10} ε_{5} Percent axial strain at failure

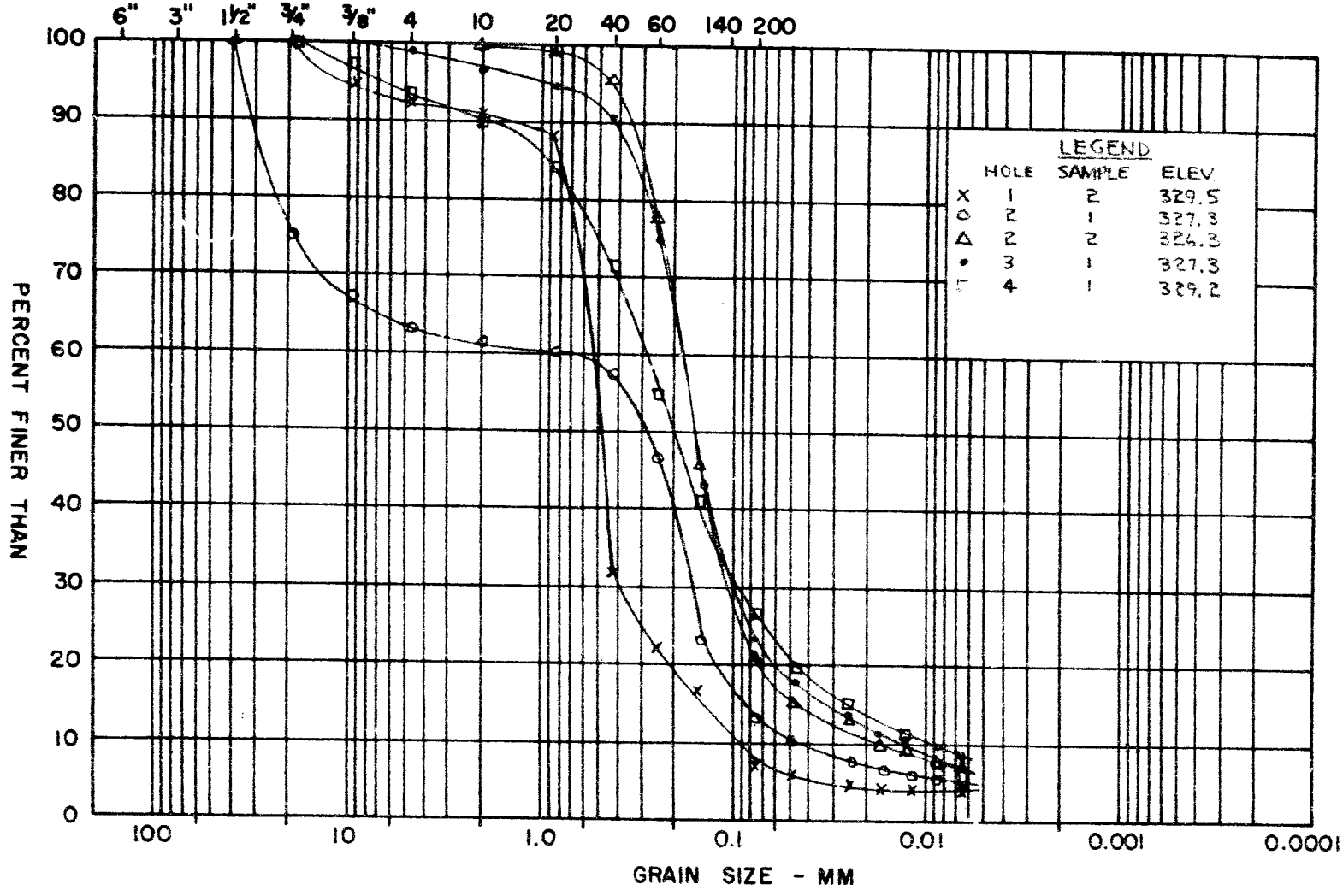
VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN J.A.
CHECKED

PROJECT No. 65058

M.I.T. GRAIN SIZE SCALE



GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION

SAND STRATUM

FIGURE 2

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

Attn: Mr. A. P. Watt,
Reg. Bridge Location Engr.

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

August 16, 1965

W.P. 67-65 Site #16-178,
Westbound Connection Underpass,
1.3 Miles West of Hwy. #2 and
existing Hwy. #401 at Crystal Beach,
Highway #401, District #8 (Kingston)

We have reviewed the Bridge Dwg. D-5773-P, showing the general arrangements of the above-mentioned job, and submit the following comments:

1) All soft organic material at the approach fill locations should be sub-excavated and back-filled with suitable earth material prior to placing the approach fills. This work should be carried out as per current D.H.O. Standards DD 406.

M. Devata

MD/MceF

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

cc: Foundations Office
Gen. Files

cc: Foundations Office (Rm. 110)

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

Attn: Mr. A. P. Watt,
Reg. Bridge Location Engr.

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

August 16, 1965

W.P. 67-65 Site #16-178,
Westbound Connection Underpass,
1.3 Miles West of Hwy. #2 and
existing Hwy. #401 at Crystal Beach,
Highway #401, District #8 (Kingston)

We have reviewed the Bridge Dwg. D-5773-F, showing the general arrangements of the above-mentioned job, and submit the following comments:

1) All soft organic material at the approach fill locations should be sub-excavated and back-filled with suitable earth material prior to placing the approach fills. This work should be carried out as per current D.H.O. Standards DD 406.

M. Devata

MD/MeF

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

cc: Foundations Office
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

From: Bridge Division,
Downsview, Ontario.

Date: August 10, 1965.

Our File Ref.

In reply to

Subject: W.P. 67-65 Site #16-178
Westbound Connection Underpass
1.3 Miles West of Hwy. #2 and
existing Hwy. #401 at Crystal Beach
Highway #401 District #8.

Enclosed please find one copy of the preliminary plan D-5773-P for the above structure.

Would you kindly review the bridge foundations proposed and inform us if they are satifactory.

Apwatt

APW/im

A. P. Watt,
Regional Bridge Location Engineer.

Comments:

All soft organic material at the approach fill locations should be completely removed and backfilled with suitable granular material prior to placing the approach fill. This work should be carried out as per current D.H.O. Standards SS 206.

Dr. Dwyer
Aug 12/65.

cc: Foundations Office (Rm. 110)

Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. . . McCombie

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

June 24, 1965

FOUNDATION INVESTIGATION REPORT BY:
H. G. Golder and Associates, Limited,
Proposed Westbound Connection Underpass,
Highway 401 and Highway 25, Township of
Elizabethtown, County of Leeds, Dist. 18.
W.P. 67-65

Attached, please find the above-mentioned report submitted by the Consultant, H. G. Golder & Associates, Ltd. We have reviewed the report and found the factual data both adequate and well presented. The conclusions and recommendations are straightforward and do not require any comments. However, should there be any queries in connection with this report, please feel free to contact our office.

KYL/MdeP
Attach.
cc: Messrs. A. M. Toye (2)
H. . Tregaskas
D. W. Farren
J. Ford
. . Cash
J. E. Gruspier
. Watt

Foundations Office
Gen. Files

K. Y. Lo,
SUPERVISING FOUNDATION ENGINEER

cc: Foundations Office (Mr. Hu)

Hwy. 401 & Keele St.
Downsview, Ontario.

May 31, 1965

Materials and Testing Division

M. G. Golder and Associates, Ltd.,
2444 Bloor Street West,
Toronto, Ontario.

Attention: Mr. J. Mozuchuk

Re: W.P. 67-65, Westbound Connection Underpass,
1.3 Miles West of Hwy. 2 and Existing Hwy. 401
at Crystal Beach, Hwy. 401, District 8 (Kingston).

Dear Sir:

Please consider this your authority to carry out a foundation investigation at the above site. Two copies of the preliminary plan were given to your representative on May 28, 1965, in which the probable locations of the footings are shown. Bedrock may be near the surface in the majority of the holes.

The site is accessible from Hwy. 25 (Old King's Highway 401). The exact location can be obtained from Mr. L. G. Boucher, Regional Superintendent of Engineering Surveys, 1035-A, Princess Street, Kingston, Ontario.

Should you, during the course of the investigation, become aware of conditions that indicate that by moving the alignment slightly, more favourable conditions from the foundation point of view can be realized, you are requested to advise us of this immediately. This will enable other parties concerned with this job to analyze and study the problem and your crew, while still at the site, could be instructed to carry out additional investigations.

Ten (10) copies of the completed foundation report, with one additional copy of each subsoil profile, should be submitted to the Foundation Section as soon as possible. Previous requirements as to preliminary borehole information and laboratory testing progress, should be followed.

cont'd. /2 ...

Because the drawings accompanying the foundation reports, showing the location of borings, the inferred subsoil conditions, etc., are to become contract drawings, you are requested to prepare them in accordance with the M.H.O. standards. To enable you to do this, we are supplying you with sample drawings with all the necessary explanations, together with linen sheets for your drawings. You are also requested to provide us with Cronaflex copies of the drawings.

Charges for the work performed will be in accordance with your Schedule of Rates, dated September 10, 1964, and invoice to be addressed to the attention of the undersigned.

We are attaching Purchase Order # 34738, covering the purchase of any new material required for this work, in order that you may use this as a basis for exemption from the Federal Tax for such purchases. The Exemption Certificate is printed thereon.

Yours very truly,

A. Rutka,
MATERIALS & TESTING ENGINEER

KYL/MJeP
Attach.

cc: Messrs. A. McCombie
J. Ford
E. A. Cash
J. E. Gruspier
R. D. Smith (2)
H. Konings
Foundations Office (2)
Gen. Files (2)

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

June 23, 1965

Department of Highways, Ontario,
Materials & Testing Division,
Hwy. 401 & Keele Street,
Downsview, Ontario.

K. Lo.

Attention: Mr. A. Rutka, P.Eng.

RE: W.P. 67-65,
SUBSURFACE INVESTIGATION,
PROPOSED UNDERPASS,
HWY. 401 & HWY. 2S,
COUNTY OF LEEDS,

Dear Sirs:

We have forwarded to you today, by messenger, ten copies of our report covering the above work. A Cronaflex copy of Figure 1 which is the site and boring plan was included with this shipment.

We trust that our report contains the information that you require. If we can be of any further service to you, please call us.

Yours truly,

H. Q. GOLDER & ASSOCIATES LTD.

J. L. Seychuk, P.Eng.

JLS:HJB
65058

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. K. Y. Lo,
Supervising Foundation Engineer,
Room 107, Lab. Bldg.

From: Bridge Division,
Downsview, Ontario.

Date: May 26, 1965.

Our File Ref.

In reply to

Subject: W.P. 67-65, Westbound Connection Underpass, 1.3 miles west of Hwy. 2 and existing Hwy. 401 at Crystal Beach, Hwy. 401, District 8.

Would you kindly arrange to have a foundation investigation conducted at the above location. I have enclosed two copies of the site plan E 4604-1 with the probable footing locations marked in red. Would you also check the approach stability. Bedrock may be near the surface in a majority of the holes.

The site is accessible from Hwy. 25 (Old Kings Highway 401). The exact location can be obtained from Mr. A. G. Boucher, Regional Superintendent of Engineering Surveys, 1085 A Princess Street, Kingston, Ontario.

The location of the nearest accommodation is Long Beach Motel, Brockville, Ontario.

As there is drilling equipment in the area at W.P. 178-61 Jones Creek West Branch and W.P. 179-61 Jones Creek East Branch there maybe an advantage in utilizing the same equipment for the above work project.

Apwatt

APW/ag
c.c. N. D. Smith
R. Fitzgibbon

A. P. Watt,
Regional Bridge Location Engineer.

29/5/65