

MEMORANDUM

cc: GEN. FILE  
 23-62-136  
 W.P. 224-63

To: Mr. B. R. Davis,  
 Bridge Engineer,  
 Bridge Division.  
Attention: Mr. S. McCombie

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

Date: July 7, 1966

Our File Ref.

In Reply to

JUL 28 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
 For  
 Proposed Underpass of Q.E.W. at  
 Offield Road (Revision), Township of  
 North Grimsby, District #4 (Hamilton)  
 W.J. 66-P-54 -- W.P. 224-63

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 do not hesitate to contact our Office.

AGS/MdeF  
 Attach.

cc: Messrs. B. R. Davis (2)  
 H. A. Tregaskes  
 D. W. Farren  
 G. K. Hunter (2)  
 H. Greenland  
 T. J. Kovich  
 W. S. Melinyshyn  
 A. Watt

Foundations Office  
 Gen. Files

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

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Underpass of Q.E.W. at  
Ofield Road (Revision), Township of  
North Grimsby, District #4 (Hamilton)  
W.J. 66-F-54    --    W.P. 224-63

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed underpass at the crossing of Q.E.W. and the relocated Ofield Road, was received from the Bridge Location Section (memorandum from Mr. W. Melinyshyn, dated May 9, 1966). Subsequently, an investigation consisting of six sampled boreholes and three dynamic cone penetration tests, was carried out by the Foundation Section.

Presented in this report are the results of this investigation, together with our recommendations for the foundation design of the proposed structure and approaches.

The site is a portion of the Niagara Fruit Belt, lying between the Niagara Escarpment and Lake Ontario, in the Township of North Grimsby. During the Pleistocene Period the site was inundated by Lake Iroquois, which carved the present relatively flat topography from the underlying glacial deposit. The glacial deposit extends to the bedrock (Queenston Shale).

2. SUBSOIL CONDITIONS:

A thin, 2-ft. to 5-ft. thick layer of very stiff to hard clayey silt overlies the entire site. The clayey silt is red-brown in colour and contains occasional traces of organics in the upper portion.

The clayey silt immediately overlies shale bedrock. The upper 1 ft. to    ft. of the shale was found to be extensively

cont'd. /2 ...

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

weathered. Below that, the bedrock was in sound condition. The sound bedrock was proved by drilling it for approximately 10 ft. in all boreholes.

Water level elevations observed in boreholes during the time of investigation, reveal the groundwater level to be at approximate elevation 273.

The exact locations and elevations of the boreholes as shown on the office log sheets as well as on Dwg. 66-F-54, were supplied by a Department of Highways' survey crew provided by Central Region Engineering Surveys Section.

3. DISCUSSION AND RECOMMENDATIONS:

It is proposed to reconstruct the existing Q.E.W. as a controlled access highway from Stoney Creek traffic circle to St. Catharines. In addition, two-lane service roads are proposed to be built on both sides of the Q.E.W. This reconstruction program necessitates the construction of several underpass structures.

At the crossing of Ofield Road revision and the Q.E.W., an underpass structure is proposed. Present proposals call for a six-span (38' - 77' - 83' - 83' - 77' - 38') structure with approach fills having a maximum height of about 24 ft. above existing ground level.

Subsoil at the site generally consists of 2 to 5 ft. of clayey silt followed by shale bedrock. The upper 1 to 4 ft. of shale bedrock has been subjected to extensive weathering.

It is recommended that the proposed structure be founded on sound shale bedrock with an allowable bearing pressure of 10 t.s.f. No major dewatering problems are anticipated during construction of footings.

cont'd. /3 ...

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

If perched abutments are contemplated, they may be constructed within the approach fills and supported on end-bearing piles driven to practical refusal to shale bedrock. Design loads to be used are dependent on the pile section selected. Care should be taken to ensure that no bouldery fill is placed at locations through which piles have to be driven.

No stability problems are anticipated with regard to approach fills, using standard 2:1 slopes.

4. MISCELLANEOUS:

The field work, performed during the period June 1 to June 6, 1966, together with the preparation of this report, was undertaken by Mr. L. Palmer, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also reviewed the report.

Equipment used was owned and operated by Canadian Longyear Co. Ltd.

July 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-54

W. P. 224-63

DATUM Geodetic

LOCATION GEN & Ofield Rd., Sta. 27/80; 45' Rt.

BORING DATE June 1, 1966.

BOREHOLE TYPE Cone: Washboring BX: BXL

FOUNDATION SECTION

ORIGINATED BY L.P.

COMPILED BY W.T.E.

CHECKED BY                      M.D.

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-54

LOCATION Gen & Ofield Rd., Sta. 28/60, 37' Rt.

ORIGINATED BY L.P.

W. P. 224-63

BORING DATE June 2, 1966.

COMPILED BY W.T.E.

DATUM Geodetic

BOREHOLE TYPE Cone: Washboring BX; EKL

CHECKED BY                      M.D. *[Signature]*

SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT						LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W				BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	SHEAR STRENGTH P.S.F.				WP			W
275.4	Groundlevel																		
273.2	Clayey Silt		1	SS	52	270													
270.6	(Weathered)																		
4.8	Shale Bedrock (Sound)		2	RC (BAL)	-														
260.4			3	RC (BAL)	-	260													
15.0	End of Borehole.																		



SOIL PROFILE				SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W	WATER CONTENT %		
276.6	Groundlevel											
0.0												
273.2	Clayey Silt		1	SS	32							
271.5	(Weathered)											
5.1	Shale Bedrock (Sound)		2	RC (BAL)	-	270						
262.0			3	RC (BAL)	-							
14.6	End of borehole.					260						

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-54

LOCATION Cen. & Ofield Rd., Sta. 32+05, 42' Lt.

ORIGINATED BY L.P.

W. P. 224-63

BORING DATE June 3, 1966.

COMPILED BY W. T. B.

DATUM Geodetic

BOREHOLE TYPE Cone, Washboring BX; BXL

CHECKED BY N.D.

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

JOB 66-F-54

LOCATION QEW & Ofield Rd., Sta. 31+43, 47' Rt.

ORIGINATED BY L.P.

W. D. 224-63

BORING DATE June 3, 1966.

COMPILED BY W.T.E.

DATUM Geodetic

BOREHOLE TYPE Washboring BX, BXL

CHECKED BY \_\_\_\_\_ M.D.

[illegible]

# OFFICE REPORT ON SOIL EXPLORATION

MATERIALS &amp; TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

LOCATION Ofield Rd. & GEW, Sta. 31/01, 46' Lt.

ORIGINATED BY L.P.

BORING DATE June 6, 1966.

COMPILED BY W.T.E.

BOREHOLE TYPE Washboring BX: BXL

CHECKED BY            M.D.

[illegible]

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

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

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

### DESCRIPTION OF SOIL

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

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

### TYPE OF SAMPLE

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

### SOIL TESTS

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

z	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

The following information was given to Tom Reich  
by phone

HAEN DOWN 1 JUNE 7/66 11.45 A VR

H GREENLAND DIST ENGR

ATT W D HAM MAINTCE ENGR

RE NO. 1 WINGNA 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-15

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

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

M DEVAIA SENIOR FOUND ENGR FOR A G STERNAC PRINC FOUND ENGR

STATS AND TESTING DIV

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## MEMORANDUM

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

From: Bridge Division,  
Downsview, Ontario.

Date: May 9th, 1966.

Our File Ref.

In Reply To:

SUBJECT: W.P. #216-63, Site #36-207, Winona Road Underpass,  
W.P. #217-63, Site #36-208, Fifty Road Interchange,  
W.P. #218-63, Site #18-191, Oakes Road Underpass,  
W.P. #224-63, Site #18-196, Oxford Road Interchange.

Herewith one print each of the following bridge site plans for the above structures, E-4731-1, E-4732-1, E-4728-1, and E-4729-1. The probable location of footings have been marked in red. Please arrange for a foundation investigation of sufficient scope to enable us to proceed with the design.

Also enclosed are the preliminary structure site report sheets.

JFW/cew  
Attach.

cc. R. Forrest  
A. Crowley

*W. S. Melnyshyn*  
W. S. Melnyshyn,  
Regional Bridge Location Engineer.

COMPLETED DATE JULY 27 1966



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Mr. C. S. Grebski,  
Bridge Design Engineer,  
Bridge Division,  
Admin. Bldg.

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

April 10, 1967

Offield Road Underpass --  
16.3 Miles west of St. Catharines West Limits,  
A.P. 224-63, Site 13-1966, W.J. 66-P-54,  
Q.E.W., District #4.

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The revised Preliminary Bridge Plan D-6029-P1,  
submitted by Mr. F. Gormek of your Section on April 7,  
1967, has been reviewed. We have no comments pertaining  
to the structure foundations.

D/MieP

cc: Messrs. S. McComble  
A. S. Melnychyn

Foundations Files ✓  
Gen. Files

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

Department of Highways Ontario

Copy for the information of

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

Mr. W. Melinyskyn,  
Regional Bridge Location Engineer,  
Central Region,  
Administration Building

Bridge Division,  
Downsview, Ontario

March 22, 1967

Offield Road Underpass  
16.3 Miles West of St. Catharines W. Limits  
W.P. 224-63, Site 18-196  
Q.E.W., District No. 4

Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-6029-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$405,000.  
This cost includes tender, materials, engineering and sundry  
construction.

Any comments or revisions you may have should be submitted  
within three weeks.

CSG:rd

C.S. Grebaki,  
Bridge Design Engineer

Attach.

c.c. S. McCombie  
A. Stermac  
R. Forrest  
E. Cross

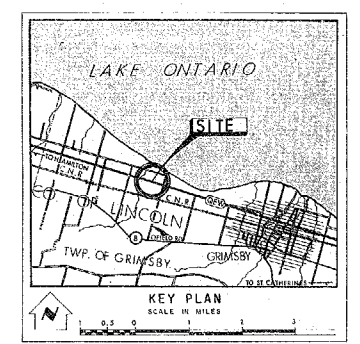
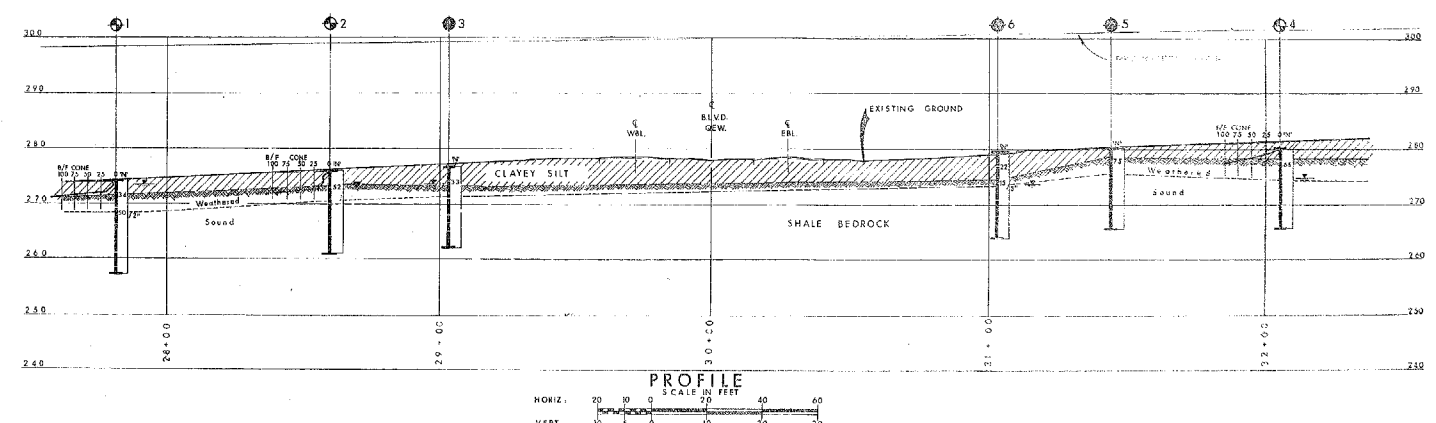
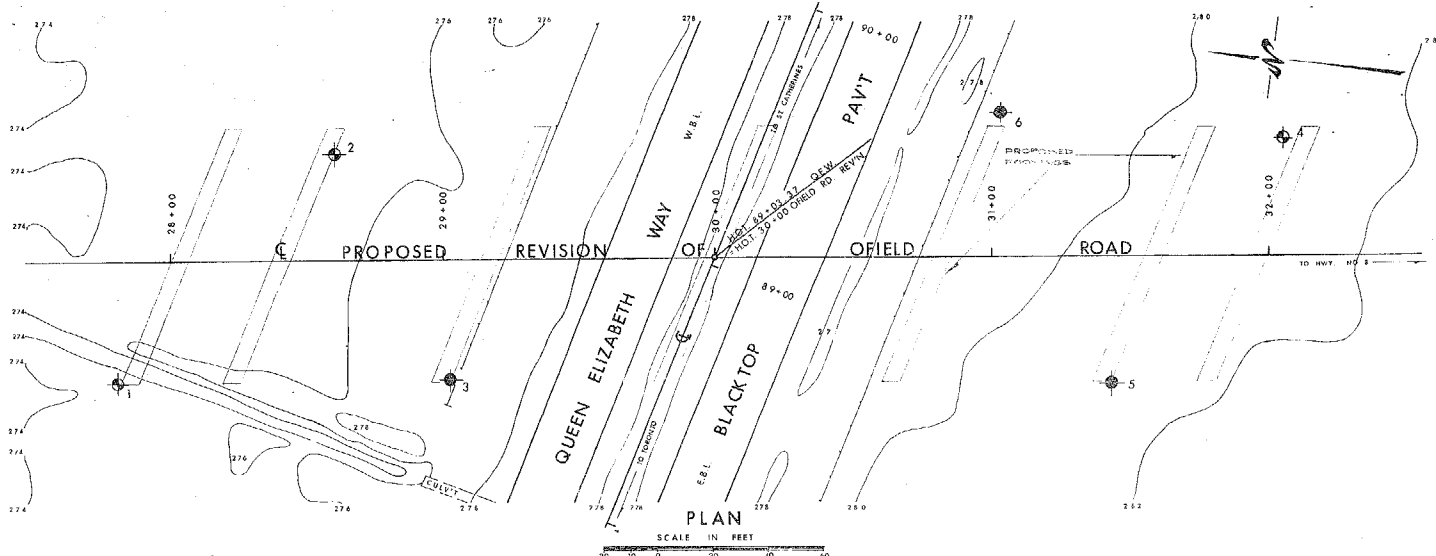
#66-F-54





W.P. #224-63

Q.E.W.,

UNDERPASS

AT OFIELD RD.



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation. JUNE, 1966.		

NO.	ELEVATION	STATION	OFFSET
1	274.8	27+6.0	45W
2	275.4	26+9.0	37" L
3	276.0	29+9.02	44" W
4	280.4	32+05	43" L
5	280.9	31+42	52" W
6	279.5	31+01	40" L

**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					
<h1>OFFICIAL ROAD REVISION</h1>					
KING'S HIGHWAY NO. _____		Q. E. W. _____		DIST. NO. <u>4</u>	
C/O. LINCOLN _____					
TWP. NORTH GRIMSBY _____		LOT. <u>17</u>		CON. <u>B.C. 61</u>	
<h2>BORE HOLE LOCATIONS &amp; SOIL STRATA</h2>					
SUBNO.	L.P.	CHECKED <u>g.v.v.</u>	W.P. NO. <u>224 - 63</u>	M & T DRAWING NO.	
DRAWN	J.N.	CHECKED <u>g.v.v.</u>	229 NO. <u>6 &amp; F - 84</u>	<b>66-F-54A</b>	
DATE	<u>20 JULY, 1966</u>		SITE NO.	BRIDGE DRAWING NO.	
APPROVED	<u>[Signature]</u>		PORT. NO.		
<small>(ORIGINAL FILED WITH ENG. SERV.)</small>					