

G.I.-30 SEPT. 1976

GEOCRES No. 30M5-171DIST. 4 REGION W.P. No. 46-88-02CONT. No. W. O. No. STR. SITE No. 10-139AHWY. No. Q.E.W.LOCATION C.N.R. Overhead at
Q.E.W. (E.B.L.)No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 46-88-02 DIST 4
HWY Q.E.W. STR SITE 10-139A

C.N.R. Overhead Bridge
(Q.E.W. East Bound Lanes)

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FOUNDATION INVESTIGATION REPORT

For

C.N.R. Overhead Bridge

(Q.E.W. East Bound Lanes)

W.P. 46-88-02; Site 10-139A

Q.E.W., District 4, Burlington

INTRODUCTION

This report contains the results of a site investigation carried out at the above mentioned site to provide information for the design and construction of the proposed CNR Overhead EBL on a new alignment of the Q.E.W.

The field work for this project was carried out between 1990 10 15 and 1990 10 22, and comprised of two sampled boreholes.

Boreholes were advanced to a maximum depth of 7.6 m below the existing ground level (El. 96.9 m) using a continuous flight-hollow stem auger and BW casing. Rock cores were obtained using BX size diamond bit.

SITE DESCRIPTION

The site under investigation is located about 1.0 km West of Guelph Line at the crossing of Q.E.W. and C.N.R. Overhead in the City of Burlington.

The topography of the site with the exception of the existing crossing (embankment fill) is generally flat. The site in question is modified to the present condition by the construction of the existing C.N.R. Overhead bridge.

The site is located in shale plains and in this area, the soil is formed directly on the wave-eroded surface of the red shale. Physiographically the area is located in the region known as the "Iroquois Plain".

SUBSURFACE CONDITIONS

The underlying subsoil at this site consists of shallow cover of stiff clayey silt underlain by shale bedrock of Queenston Formation. For

classification purposes, the soils encountered at this site can be divided into two different zones.

- a) Clayey Silt, trace of Sand and Gravel
- b) Shale Bedrock

The subsurface conditions encountered during the course of the investigation, together with field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. Two stratigraphical sections and a profile along centerline of E.B.L. are shown on Drawing No. 468802-A. This drawing also shows the locations and elevations of the borings. In addition, information gathered from the site investigation carried out for the existing bridge foundation is also included in this report. Description of the strata encountered are given below.

Clayey Silt, trace of Sand and Gravel

The borings at this site indicate presence of 0.4 m to 1.0 m of stiff clayey silt which was encountered immediately below the topsoil. This shallow soil cover extends to El. 103.3.

Bedrock

The rock cores were examined by Mr. D. A. Williams, Petrographer and his description is included in the Appendix of this report.

The project area is underlain by the shale bedrock of the Queenston Formation. The bedrock is interbedded with siltstone. The upper 2.0 m to 3.3 m of the bedrock is highly weathered and the elevation of the unweathered bedrock is expected to be in the depth range of El. 101.5 to 100.0.

Standard Penetration Tests were carried out in the highly weathered portion of the bedrock and the 'N' values were observed to vary from 50 blows/30 cm to over 100 blows/30 cm. The RQD values measured from BX size cores (15%

to 47%) indicate that the unweathered bedrock up to the depth of drilling may be classified as very poor to poor quality rock.

Groundwater Conditions

The groundwater level was not encountered in any of the boreholes during our investigation which was carried out between 1990 10 15 and 1990 10 22.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to remove the existing C.N.R. Overhead E.B.L bridge and to construct a new C.N.R. Overhead E.B.L. on a new alignment of the Q.E.W. The new bridge will be a $21.6 \pm$ m wide single span structure. Initially, the bridge will be constructed to accommodate three east-bound lanes and eventually, it will be widened to accommodate four lanes.

The existing bridge is a single span concrete structure. The clear span between the face of the abutment is about 16.0 m. The abutment walls as well as the side slopes appear in very good condition. However, a few noticeable cracks were observed on the toe walls.

It appears from the structural drawings that the abutments of the existing bridge as well as the toe walls are supported on spread footings placed at about El. 101.5. The footings of the abutment walls are about 2.6 m wide, whereas the footings of the toe walls vary from 3.7 m to 4.3 m.

Structure Foundations

The south end of the new foundation is expected to overlap or interfere with the footing of the existing bridge, and also, the material around the existing footing may have been disturbed during the construction of the bridge.

Considering the subsoil condition, and in order to match the founding level of the existing footings, it is recommended that the footing be placed at El. 101.5 and designed using the following bearing capacities.

Factored Bearing Capacity at U.L.S. = 750 kPa
Bearing Capacity at S.L.S. Type II = 500 kPa

If any loose material or soft areas observed within the base width of the footing should be removed and replaced with mass concrete.

Alternatively, the structure may be supported on caissons founded at El. 100 for west abutment and at El. 99 for east abutment. The following bearing capacity values are recommended for the design of the caissons.

	<u>Pile Diameter in Metre</u>	
	0.76	0.9
Factored Capacity at U.L.S.	1300 kN	1800 kN

Bearing Capacity at S.L.S. Type II will not govern, because the loads required to produce detrimental settlement of the structure will be much larger than the recommended values for factored bearing capacity at U.L.S.

If shallow foundation is proposed to be used for the new structure, the north side of the east-bound lane will require support during construction. Rakers may be used to support the existing approach fill and it may be designed assuming the following parameters.

Angle of Internal Friction $\phi = 30^\circ$
Unit Weight (kN/m^3) $\gamma = 21$

Alternatively, the excavation may be supported by soldier piles and timber lagging. Considering the site conditions, the soldier piles may be lowered in large diameter pre-augered holes and filled with concrete.

However, the excavation problems could be either avoided or minimized by supporting the new bridge on caissons and taking the caissons to the underside of the deck level. In order to match the existing abutment walls, a panel wall may be constructed to cover the caissons. A liner may be used in the area where the caisson is constructed through fill.

Earth pressure for the design of the abutments should be computed as per Section 6.1.2.2 of the O.H.B.D.C., and an unyielding foundation condition may be assumed for the computations. The Granular 'A' or 'B' backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular fill.

	Granular 'A'	Granular 'B'
Angle of Internal Friction	$\phi = 35^\circ$	$\phi = 30^\circ$
Unit Weight (kN/m^3)	$\gamma = 22.8$	$\gamma = 21.2$

An unfactored coefficient of friction value of $\tan 22^\circ$ may be assumed for the estimate of sliding resistance, if the structures are placed on shallow foundations.

Approach Embankment

Considering the competent subsoil conditions encountered at this site, no stability problems are anticipated for the approach embankments constructed with 2 horizontal to 1 vertical side slopes. The benching for the approach fill shall be carried out in accordance with OPSD 208.01.

Other Considerations

The footings should have a minimum of 1.2 m earth cover to protect against the frost penetration.

Considering the nature of the bedrock encountered at this site, the base of the excavation at the founding level should be covered with 150 mm thick lean concrete pad within 4 hours of exposure to avoid any deterioration.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer. The equipment used was owned and operated by Master Soil Investigation Ltd. This report was prepared by M. Vasavithasan and reviewed by P. Payer, Senior Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



M. Vasavithasan

M. Vasavithasan, P.Eng.
Foundation Engineer

M. Devata

M. Devata, P.Eng.
Chief Foundation Engineer

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 46 - 88 - 02 LOCATION CO - ORDS. N 4 800 462.7; E 279 337.7 ORIGINATED BY M.V.
 DIST 4 HWY QEW BOREHOLE TYPE SOLID STEM AUGER & BW CASING COMPILED BY M.V.
 DATUM GEODETIC DATE 90 10 15 CHECKED BY P.P.








SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
104.5	Ground Surface																
0.0	Topsoil CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff					DRY *	104										
103.6			1	SS	10												
0.9			2	SS	50	/Bcm	103										
			3	SS	65	/Bcm	102										
			4	SS	75	/Bcm	101										
	Highly Weathered		5	RC BX	REC 53%		100										RQD 15%
	QUEENSTON SHALE BEDROCK Unweathered		6	RC BX	REC 83%		99										RQD 47%
98.2																	
6.3	End of Borehole																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 46 - 88 - 02 LOCATION CO - QRS. N 4 800 447.8; E 279 317.5 ORIGINATED BY M.V.
 DIST 4 HWY QEW BOREHOLE TYPE SOLID STEM AUGER & BW CASING COMPILED BY M.V.
 DATUM GEODETIC DATE 90 10 22 CHECKED BY P.P.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
104.5	Ground Surface							20 40 60 80 100							
0.0	CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff		1	SS	9	DRY + /15cm	104								
103.5			2	SS	50		103								
1.0	Highly Weathered		3	SS	93		102								
			4	RC BX	REC 87%		101								
	QUEENSTON SHALE BEDROCK Unweathered		5	RC BX	REC 88%		100								
			6	RC BX	REC 82%		99								
96.9						98									
7.6	End of Borehole						97								

RECORD OF BOREHOLE No 101

1 OF 1

METRIC

W.P. 46 - 88 - 02 LOCATION CO - ORDS. N 4 800 436.0; E 279 313.8 ORIGINATED BY
DIST 4 HWY QEW BOREHOLE TYPE BW CASING COMPILED BY A T
DATUM GEODETIC DATE 55 11 04 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT UNIT			UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) 10 20 30 W _P W W _L				
104.0	Ground Surface																
0.0	CLAYEY SILT, Trace of Sand, Trace of Gravel					*											
103.5																	
0.5																	
			1	TW	PH												
			2	RC BX	REC												
			3	RC BX	REC 40%												
			4	RC BX	REC 80%												
	QUEENSTON SHALE BEDROCK		5	RC BX	REC 50%												
			6	RC BX	REC 40%												
96.7																	
7.3	End of Borehole • Note: Water Level Not Observed																

RECORD OF BOREHOLE No 102

1 OF 1

METRIC

W.P. 46 - 88 - 02 LOCATION CO - QRS. N 4 800 411.8; E 279 313.5 ORIGINATED BY
DIST 4 HWY QEW BOREHOLE TYPE BW CASING COMPILED BY A T
DATUM GEODETIC DATE 55 11 07 CHECKED BY P P

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC UNIT	NATURAL MOISTURE CONTENT	LIQUID UNIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
104.0	Ground Surface															
103.8	CLAYEY SILT, Tr. Sand & Gravel															
0.4	QUEENSTON SHALE BEDROCK		1	TW	PH										19.6	
102.5						103										
1.5	End of Borehole															
	• Note: Water Level Not Observed															

RECORD OF BOREHOLE No 103

1 OF 1

METRIC

W.P. 45 - 88 - 02 LOCATION CO - ORDS. N 4 800 444.0; E 279 334.0 ORIGINATED BY
DIST 4 HWY QEW BOREHOLE TYPE BW CASING COMPILED BY A T
DATUM GEODETIC DATE 55 11 07 CHECKED BY P P

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID UNIT MOISTURE UNIT CONTENT CONTENT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _p	W		
104.3	Ground Surface															
0.0	CLAYEY SILT, Trace of Sand, Trace of Gravel															
103.5			1	TW	PH											
0.8	QUEENSTON SHALE BEDROCK															
102.8																
1.5	End of Borehole * Note: Water Level Not Observed															

RECORD OF BOREHOLE No 104

1 OF 1

METRIC

W.P. 46 - 88 - 02 LOCATION CO - ORDS. N 4 800 414.8; E 279 330.2 ORIGINATED BY
DIST 4 HWY QEW BOREHOLE TYPE BW CASING COMPILED BY A T
DATUM GEODETIC DATE 55 11 08 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
103.8	Ground Surface																
0.0	CLAYEY SILT, Trace of Sand.					*											
103.3	Trace of Gravel																
0.5	QUEENSTON SHALE BEDROCK		1	TW	PH												
97.1			3	RC BX	REC 80%												
6.7	End of Borehole																
	* Note: Water Level Not Observed																

RECORD OF BOREHOLE No 204

1 OF 1

METRIC

W.P. 45 - 88 - 02 LOCATION CO - ORDS. N 4 800 455.0; E 279 322.5 ORIGINATED BY
DIST 4 HWY QEW BOREHOLE TYPE BW CASING COMPILED BY A T
DATUM GEODETIC DATE 55 11 04 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID UNIT MOISTURE UNIT CONTENT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	10 20 30	10 20 30					
104.1	Ground Surface																
0.0	CLAYEY SILT, Trace of Sand.					*											
103.6	Trace of Gravel																
0.5	QUEENSTON SHALE BEDROCK																
102.7			1	TW	PH		103										
1.4	End of Borehole																
	* Note: Water Level Not Observed																

ROCK CORE DESCRIPTION **WP 46-88-02**

Page 1 of 1

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	1	3.28-4.78	53	15	3.28-6.30	SHALE, dark reddish brown, interbedded with greyish green SILTSTONE (28%); very fine grained; weak to very weak; unweathered to slightly weathered (moderately weathered, 3.28-4.27 m); very close to moderately close spaced fractures (flat, planar to undulating, smooth).
	2	4.78-6.30	83	42		
2	1	3.05-4.57	87	18	3.05-7.57	SHALE, dark reddish brown, interbedded with greyish green SILTSTONE (21%); very fine grained; weak to very weak; unweathered to slightly weathered (moderately weathered, 4.42-4.57 m); very close to close spaced fractures (flat, planar, smooth).
	2	4.57-6.10	88	27		
	3	6.10-7.57	82	46		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION:

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

EXPLANATION OF TERMS USED IN REPORT

N VALUE THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N}

DYNAMIC CONE PENETRATION TEST CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	KN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	KN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ'	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	KN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	KN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	KN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE	j	KN/m^2	SEEPAGE FORCE
γ'	KN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

CONT No
WP No 46-88-02

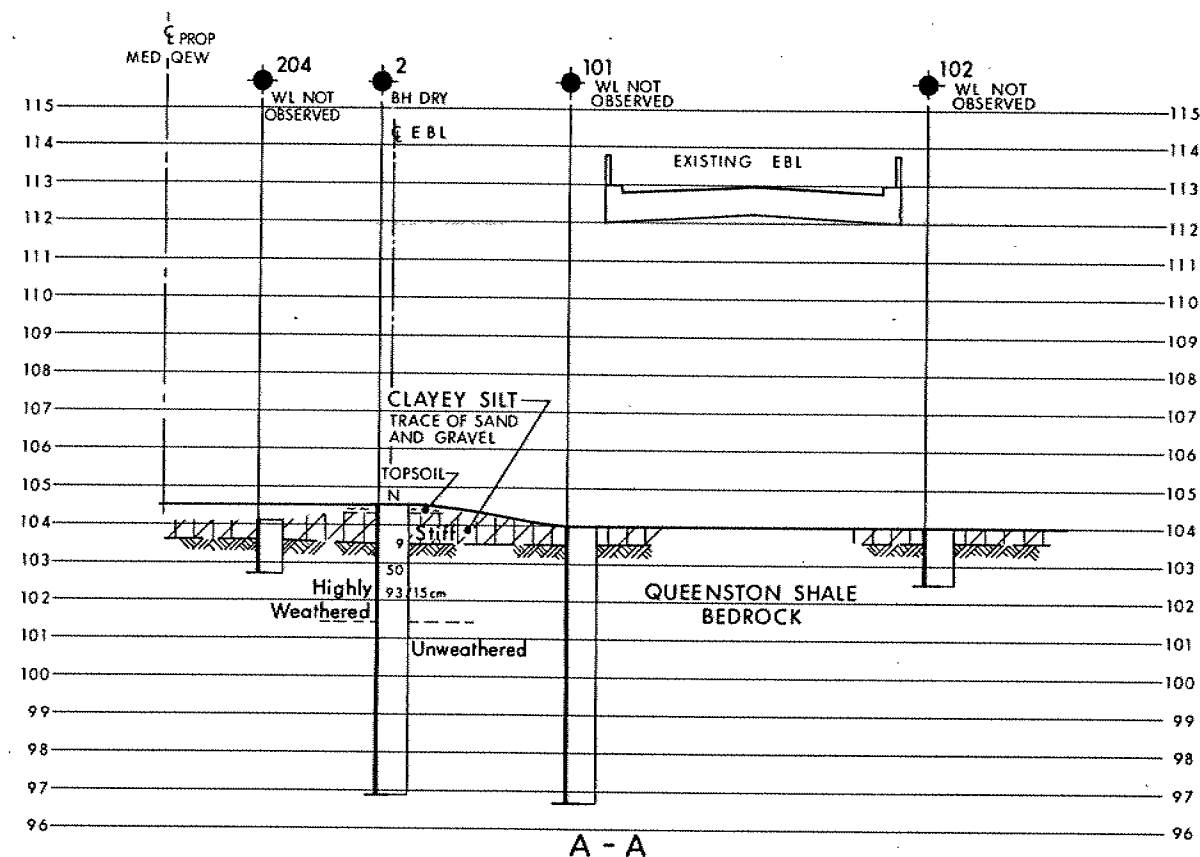


CNR OVERHEAD
(QEW EAST BOUND LANES)
BORE HOLE LOCATIONS & SOIL STRATA

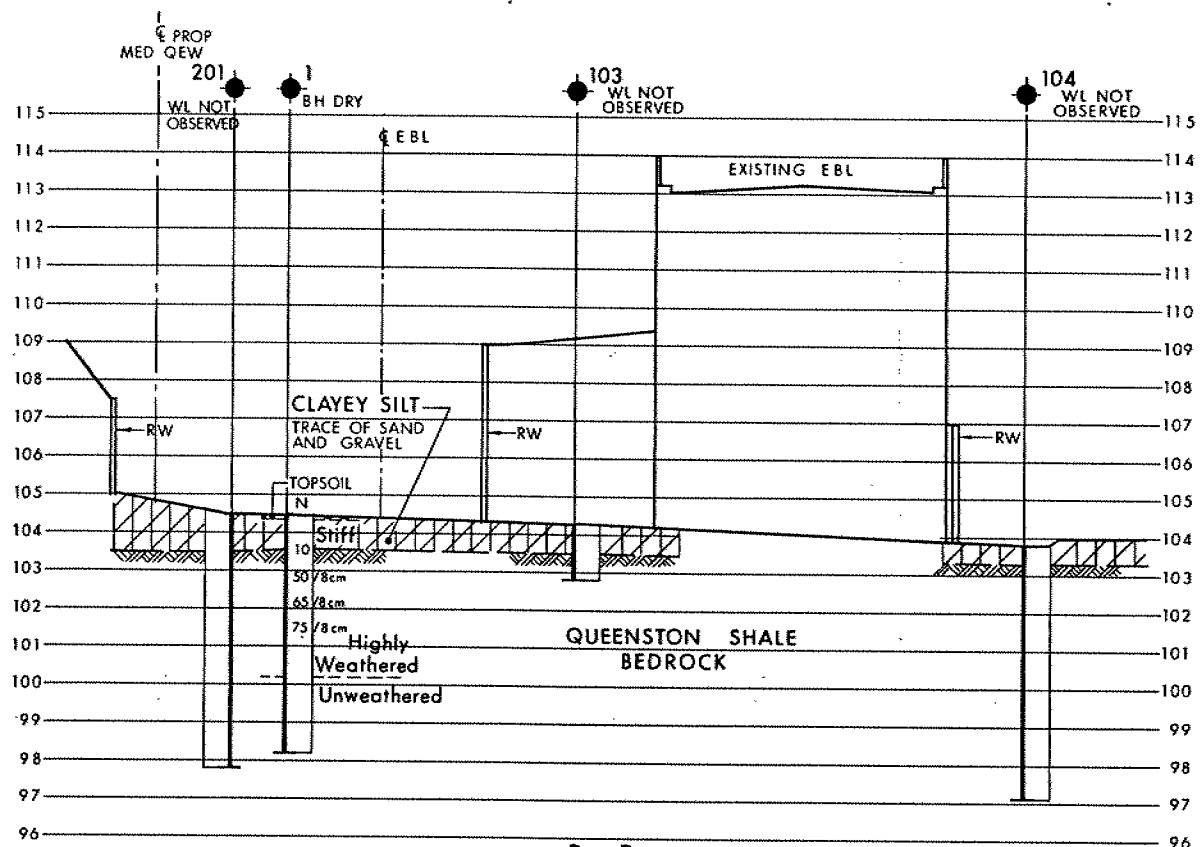
SHEET

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

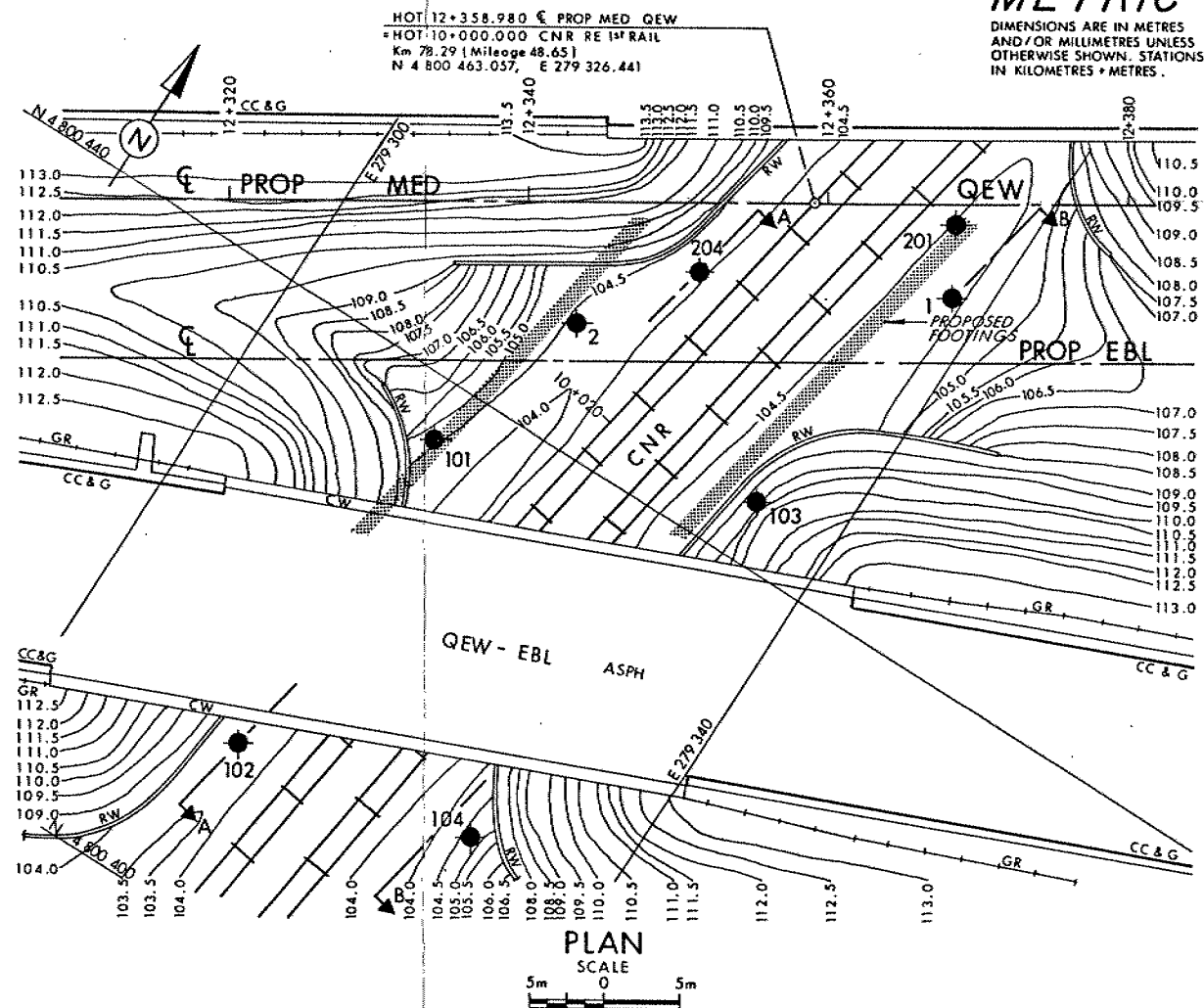


A - A



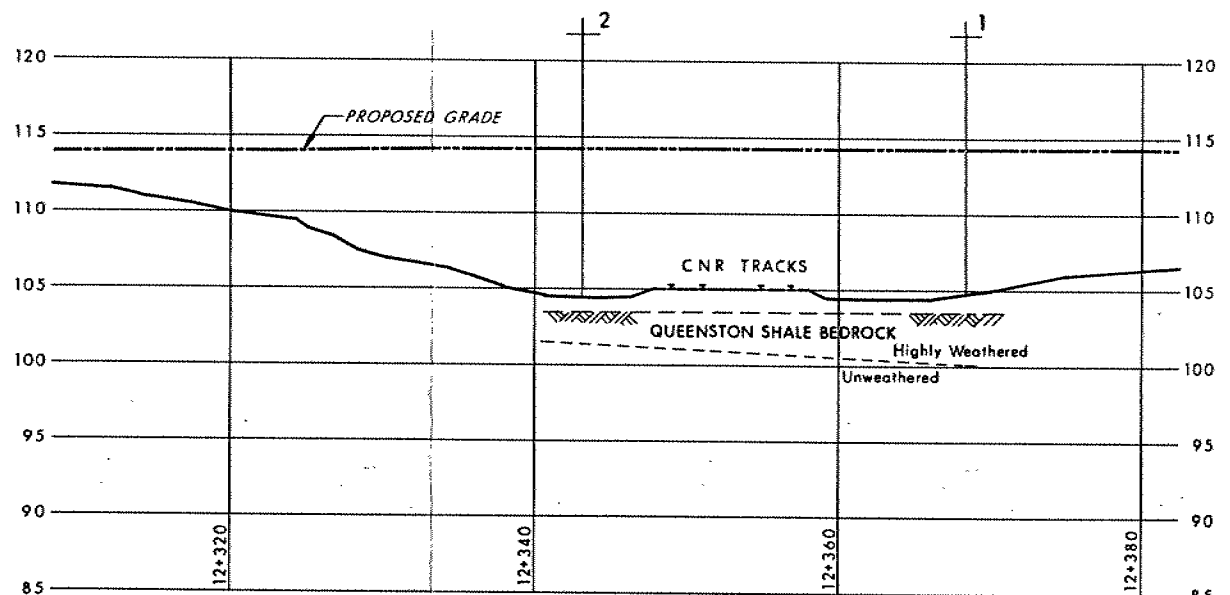
B - B
SECTIONS

SCALE
5m 0 5m HOR
2m 0 2m VERT



PLAN

SCALE
5m 0 5m



PROFILE PROPOSED QEW (EBL)

SCALE
5m 0 5m



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1990 10

No	ELEVATION	CO ORDINATES NORTH	EAST
1	104.5	4 800 462.7	279 337.7
2	104.5	4 800 447.8	279 317.5
101	104.0	4 800 436.0	279 313.8
102	104.0	4 800 411.8	279 313.5
103	104.3	4 800 444.0	279 334.0
104	103.8	4 800 414.8	279 330.2
201	104.5	4 800 466.9	279 335.2
204	104.1	4 800 455.0	279 322.5

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
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Geocres No 30M5-171

HWY No QEW (EBL)	DIST 4
SUBMD M.V. CHECKED BY	DATE 1991 01 23
DRAWN R.S. CHECKED BY	APPROVED