



## Memorandum

40P1-71  
GEOCRES No.

To: G.C.E. Burkhardt (3)  
Reg. Structural Planning Engineer  
Central Region  
3501 Dufferin St., Downsview

From: Soil Mechanics Section  
Geotechnical Office  
West Building, Downsview

Attention:

Date: July 17, 1975

Our File Ref.

In Reply to JUL 21 1975

Subject:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Pedestrian Crossing Over  
Realigned Eastward Creek  
From Alfred St. to Greenwich St.  
City of Brantford, B.S.A.R.  
District #4 (Hamilton)  
W.P. 40-74-01

Attached we are forwarding to you our detailed Foundation Investigation Report on the subsoil conditions existing at the above mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

*K.G. Selby*

K.G. SELBY  
Supervising Engineer

c.c. E.J. Orr  
B.R. Davis  
B.J. Giroux  
G.A. Wrong  
R.S. Pillar  
D. Gunter  
C.R. Robertson  
R. Hore  
M.M. Dillon Ltd.  
J. Anderson )  
R. Fitzgibbon ) memo only  
G. Sloan )  
Files  
Record Services

## TABLE OF CONTENTS

1. INTRODUCTION
2. SUBSOIL CONDITIONS
3. RECOMMENDATIONS
  - a) Culvert
  - b) Single Span Structure
4. OTHER CONSIDERATIONS
5. MISCELLANEOUS

# FOUNDATION INVESTIGATION REPORT

For

Proposed Pedestrian Crossing Over  
Realigned Eastward Creek  
From Alfred St. to Greenwich St.  
City of Brantford, B.S.A.R.  
District #4 (Hamilton)  
W.P. 40-74-01

---

## 1. INTRODUCTION

The construction of the B.S.A.R. will make it necessary to close the existing bridge between Alfred St. and Greenwich St. over the Eastward Creek.

To provide crossing between these streets for pedestrian traffic, an approx. 8 ft. wide sidewalk is proposed over the realigned Eastward Creek, some 420 ft. west of the existing structure.

## 2. SUBSOIL CONDITIONS

Subsurface investigation was carried out at the proposed pedestrian (sidewalk) structure site to assess the subsoil and groundwater conditions. From ground level (elev. 658.5) downward the following different soil types were encountered:

- 0.0' - 3.0' : Fill material; sand, industrial waste, organics etc., loose
- 3.0' - 10.5' : Clayey silt, traces of sand, firm
- 10.5' - 15.2' : Mixture of sand and organics, black coloured, very soft
- 15.2' - 21.3' : Sand and gravel, traces of silt, very loose to compact
- 21.3' - 49.0' : Irregular layers of clayey silt and silt, stiff to very stiff
- 49.0' - 52.0' : Glacial till, heterogeneous mixture of gravel, (rock pieces) sand, silt and clay, very dense
- 52.0' - : Refusal - Probable bedrock

The groundwater level was found to be at elev. 644.5 or 14 ft. below ground level.

### 3. RECOMMENDATIONS

Two types of structures are being considered at this crossing:

- a) culvert
- b) single span (50') structure

#### a) Culvert

A 12' X 10' box culvert is proposed at this location. According to Plan #7301-11-1 (prepared by M.M. Dillon Ltd.) the top of the culvert will be at elev. 660± and the invert is at elev. 649±.

Our recommendations for the construction of a culvert are as follows:

Excavate organic material in creek bed to its full vertical extent. Horizontally, the subexcavation should extend for a minimum distance of 5 ft. beyond the culvert sides, and replaced with suitable granular material.

A minimum 18" thick pad, consisting of Granular 'A' is required at the underside of the proposed box culvert.

Net safe bearing capacity of 1.25 t.s.f. is suggested for the box culvert.

Since the compaction of the Granular 'A' pad and formation of the culvert floor requires dry conditions, a dewatering scheme will be necessary. This dewatering scheme may consist either of interlocking sheet piling driven to an approximate distance of 3 ft. into the cohesive stratum (i.e. elev. 640±) or, an oversize excavation with perimeter ditches. These ditches should have a depth of 2 ft. below the bottom of the Granular 'A' pad.

The backfill to the culvert should be according to current MTC specifications.

#### b) Single Span Structure

As an alternative, a single span structure (span length: 50 ft.) utilizing a prestressed double tee for the superstructure is proposed for this crossing by the consultant. The reconstructed creek channel under the structure will have 10 ft. base width and 2:1 slopes.

In our opinion, the most suitable support for the abutments is the piles foundation. The piles may consist of end bearing piles driven to approx. elev. 606 where refusal to conventional borings was reached.

Consideration should be given to friction pile support. For #14 timber piles a safe design load (Q) of 0.50L is recommended. (L = embedded length of a pile in ft., and Q = safe design load in tons).

In any case, the pile caps should be protected with a minimum of 4 ft. of earth cover against frost action.

#### Open Channel

The existing creek channel will be reconstructed over a length of about 150 ft. This will require cuts up to 11 ft. The slopes should be constructed with 2:1 slopes. An approximate 12 inches thick Granular 'A' filter blanket should be placed on the cut slopes. Rip-rap should be provided as a means of protection against erosion.

#### 4. OTHER CONSIDERATIONS

a) According to the hydraulic study for this area the observed high water level in the creek is at about elev. 660±. The surrounding terrain is at elev. 658±. To contain overland flooding, diking to approximate elev. 660± will be required. The material for the dikes should consist of well compacted cohesive type material. The slopes of the dikes (constructed 2 horizontal to 1 vertical) should be protected against surface erosion by means of sodding.

b) An abandoned railway trestle is located approx. 50 ft. east of the proposed pedestrian crossing over Eastward Creek. The timber structure appears to be in good condition and may be used for the pedestrian crossing, instead of constructing a new culvert or bridge.

5. MISCELLANEOUS

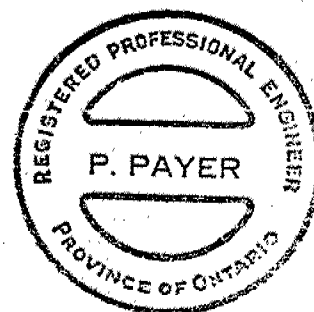
The field work was carried out on June 9, 1975, under the supervision of Mr. G.R. Bardell, Project Engineer.

The equipment used for the field work was owned and operated by Atcost Soil Drilling Inc.

This report was written by Mr. P. Payer, Senior Engineer and reviewed by Mr. K.G. Selby, Supervising Engineer.

*P. Payer*  
P. PAYER  
Senior Engineer

*K. G. Selby*  
K.G. SELBY  
Supervising Engineer



July 1975

## APPENDIX

RECORD OF BOREHOLE NO 248

W.P. 40-74-01 LOCATION Co-ords. 15,673,583 N; 797,968 E. ORIGINATED BY GB  
 DIST. 4 HWY. EBS.A.R. BORING DATE June 9, 1975 COMPILED BY GB  
 DATUM Geodetic BOREHOLE TYPE Cont. Flight Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			UNIT WEIGHT $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	$w_p$	$w$	$w_L$	
658.5	Ground Level														
0.0	Fill Material														
3.0	Clayey silt, traces of sand.		1	SS	5										
			2	SS	4										
648.0	Firm														
10.5	Mixture of sand and organic material.		3	SS	3										
643.3	Black														
15.2	Sand & gravel, traces of silt.		4	SS	2										
637.2	Very Loose to Compact		5	SS	13										
21.3	Irregular layers of clayey silt and silt		6	SS	13										
			7	TW	PH										
	Stiff to Very Stiff		8	SS	9										
			9	SS	16										
609.5															
49.0	Glacial Till		10	SS	193										
606.5															
52.0	Probable Bedrock End of Borehole														

OFFICE REPORT ON OIL EXPLORATION



ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

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

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" " ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTSOIL 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
$w_s$	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
$\log_e a$ 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
$\sigma$	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

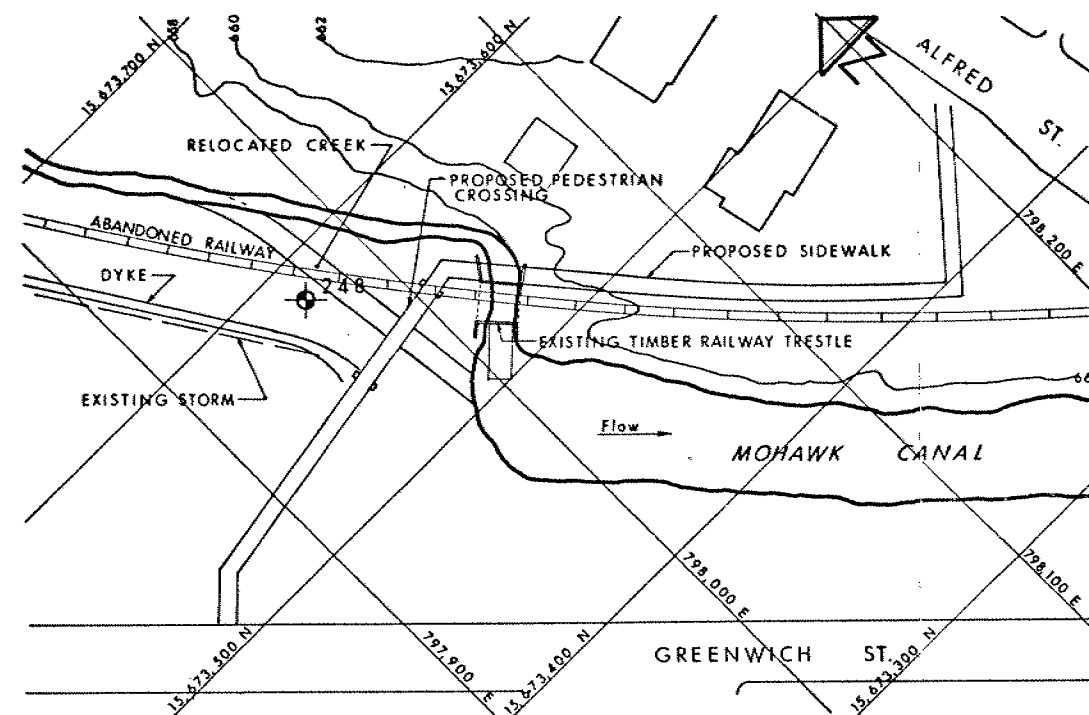
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

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

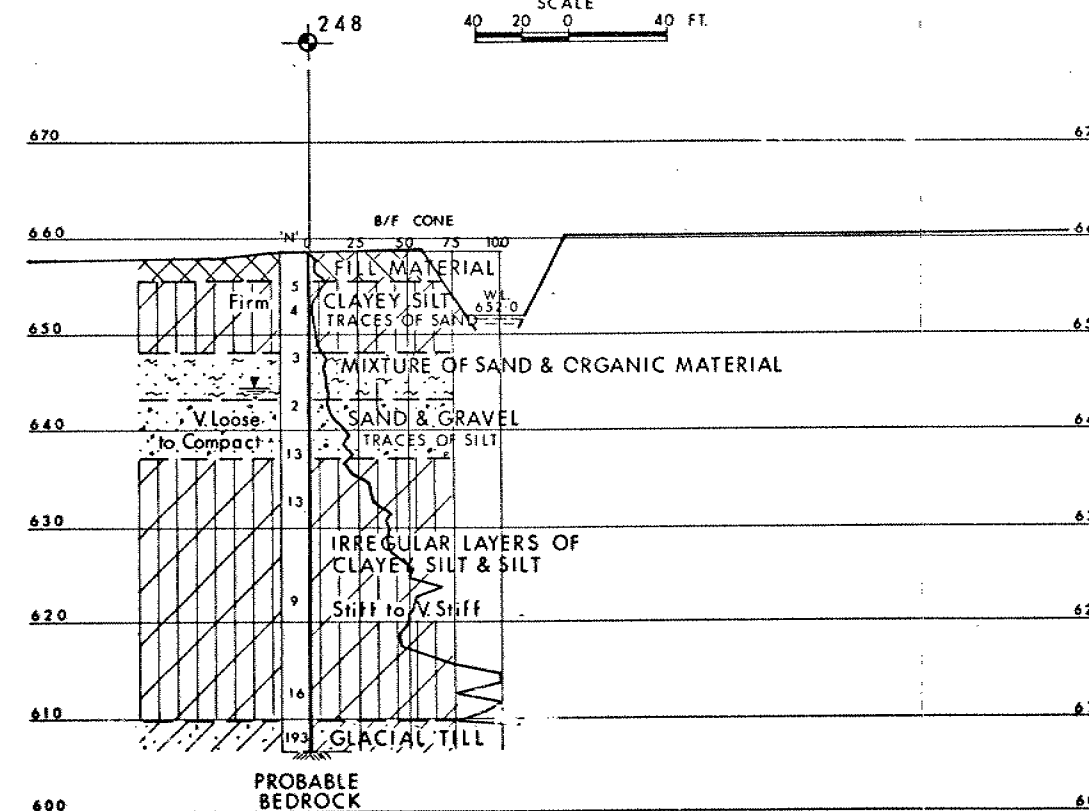
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

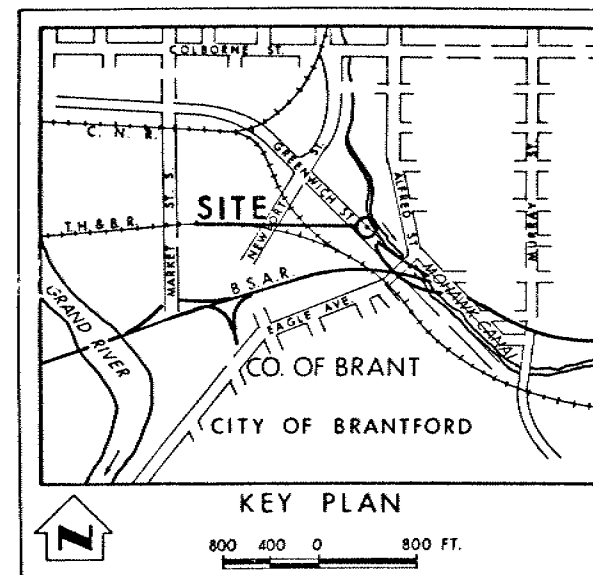


PLAN

SCALE  
40 20 0 40 FT.



SCALE  
HOR. 40 20 0 40 FT.  
VERT. 1 0.5 0 1



KEY PLAN

800 400 0 800 FT.

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Resistance Test  
B/F CONE - Blows/Ft. Cone Test (350 ft. lbs. energy/blow)
- ⊕ Bore Hole & Cone Test
- ⊕ Water Levels established at time of field investigation, 9 JUNE 1975

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
248	658.5	15,673,583	797,968

NOTE: FOR CONTRACT DOCUMENTS  
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the HAMILTON District Office.

NOTE

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



REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

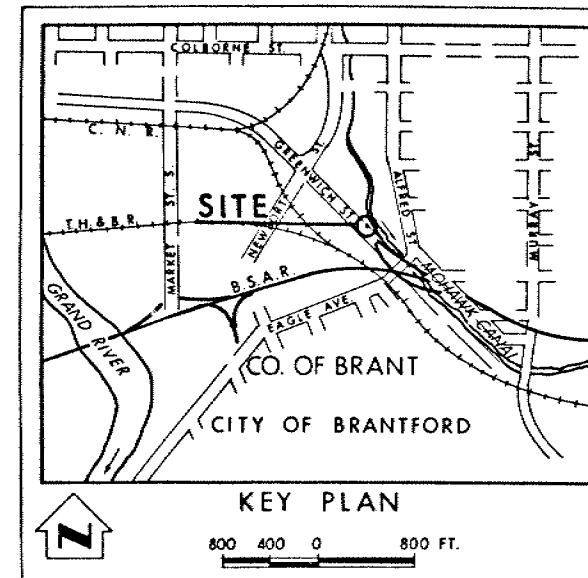
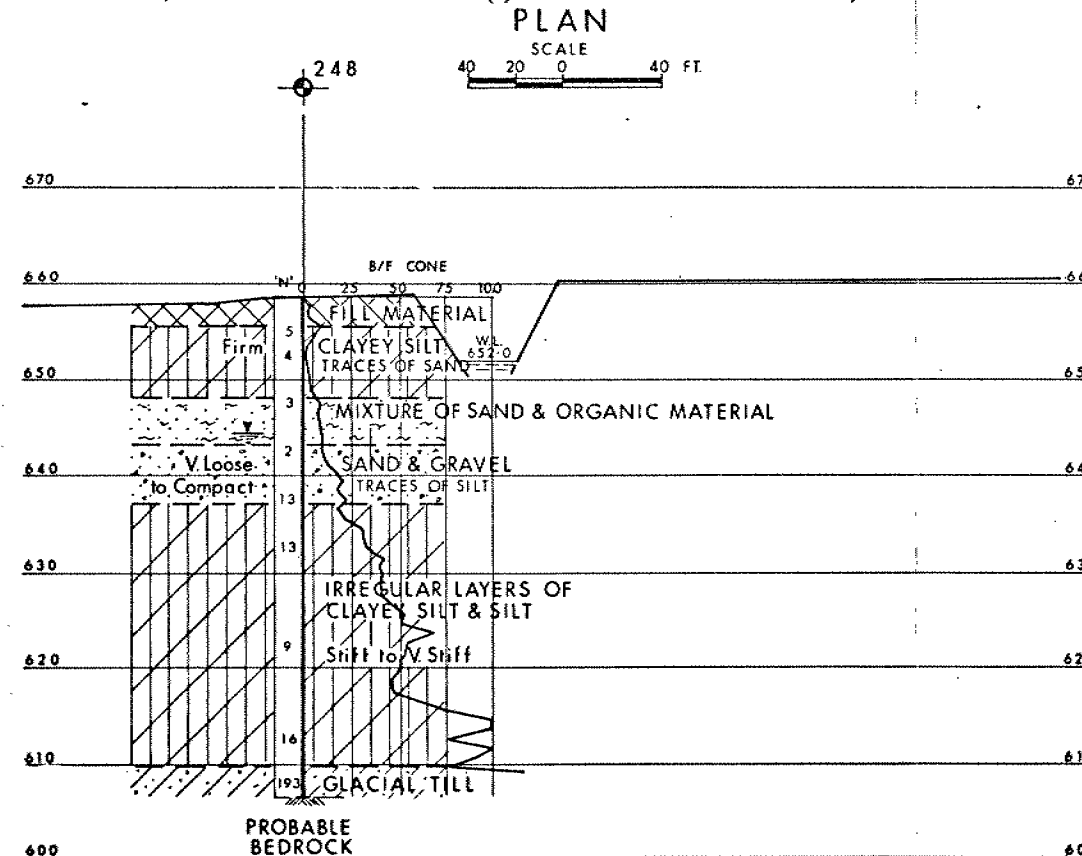
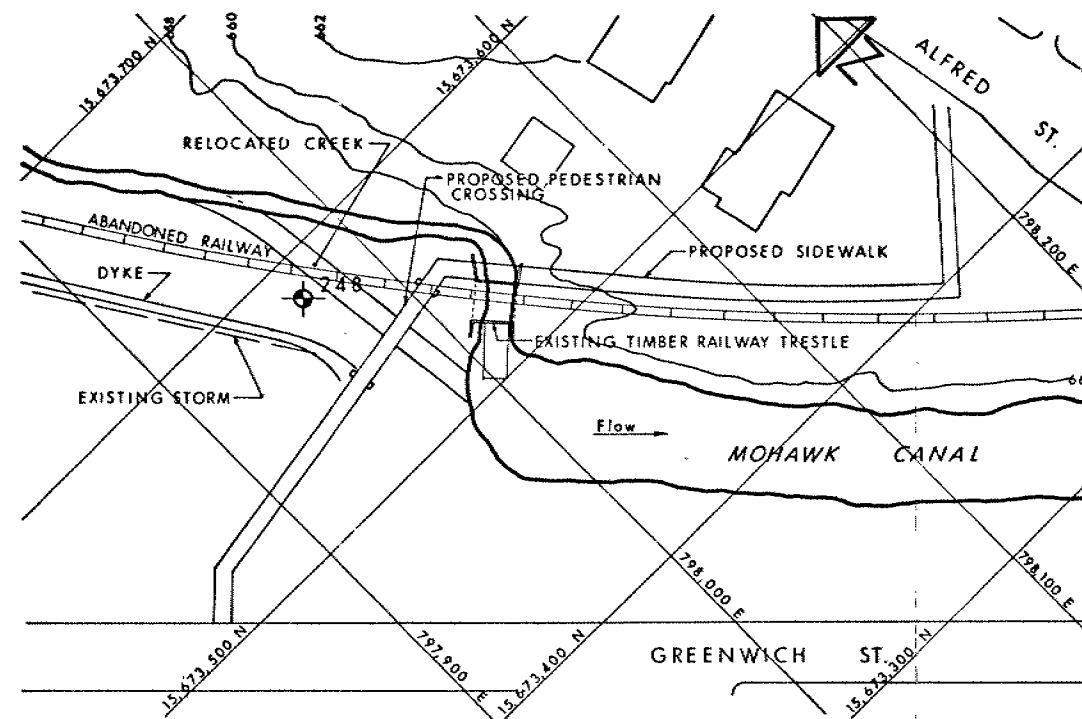
### ALFRED ST. TO GREENWICH ST. PEDESTRIAN CROSSING

HIGHWAY NO. B.S.A.R. DIST NO. 4  
CO. BRANT CITY OF BRANTFORD  
TWP.   LOT   CON.  

### BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P. P.	CHECKED <input checked="" type="checkbox"/>	WP NO. <u>40-74-01</u>	DRAWING NO. <u>407401-A</u>
DRAWN O. L. J.	CHECKED <input checked="" type="checkbox"/>	WO NO. <u> </u>	BRIDGE DRAWING NO. <u> </u>
DATE <u>16 JULY 1975</u>	SITE NO. <u>1-R.W.</u>		
APPROVED <u> </u>	CONT NO. <u> </u>		

REF: DILLON 7301-11-1



LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Resistance Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, 9 JUNE 1975		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
248	658.5	15,673,583	797,968

NOTE: FOR CONTRACT DOCUMENTS  
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the HAMILTON District Office.

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



40P1-71  
GEOCRES No.

REF: DILLON 7301-11-1

REVISIONS	DATE	BY	DESCRIPTION

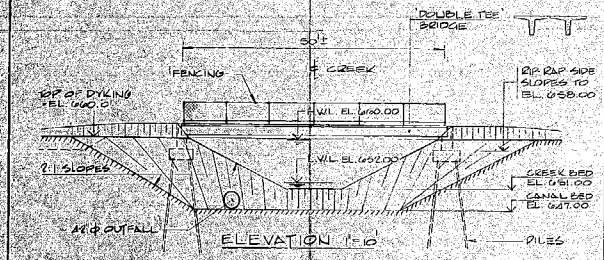
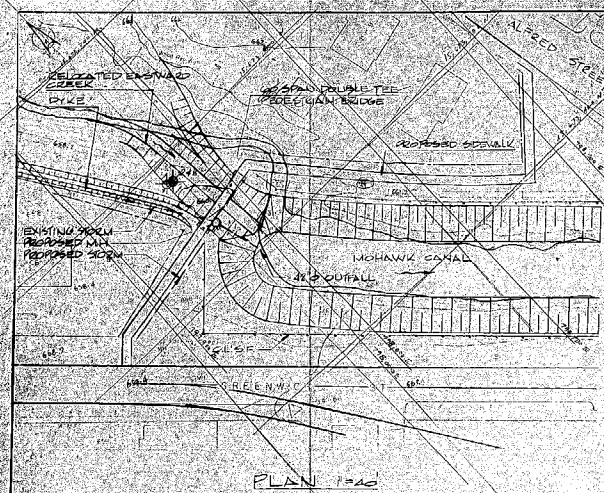
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE—SOIL MECHANICS SECTION

**ALFRED ST. TO GREENWICH ST.  
PEDESTRIAN CROSSING**

HIGHWAY NO. B.S.A.R. DIST. NO. 4  
CO. BRANT CITY OF BRANTFORD  
TWP.   LOT.   CON.  

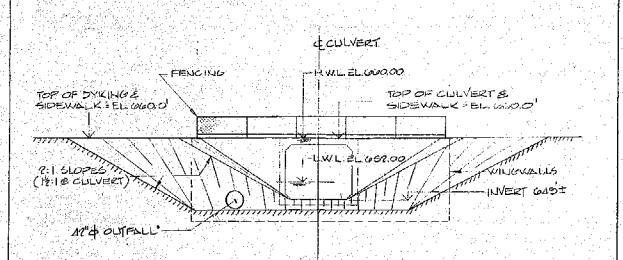
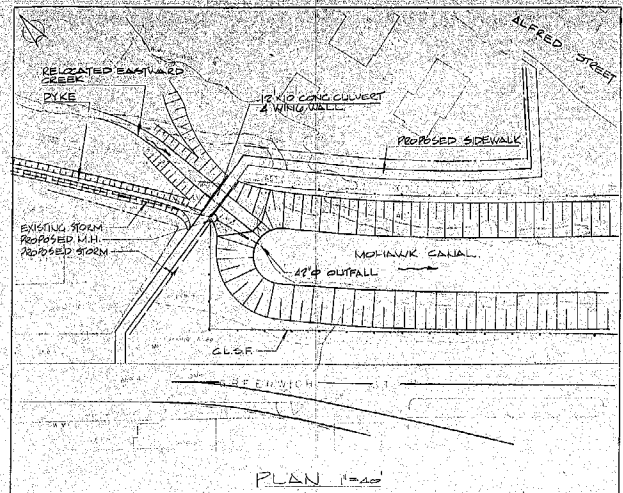
**BORE HOLE LOCATIONS & SOIL STRATA**

SUBMD P. P.	CHECKED <input checked="" type="checkbox"/>	WP NO. 40-74-01	DRAWING NO.
DRAWN O. L. J.	CHECKED <input checked="" type="checkbox"/>	WO NO.	<b>407401-A</b>
DATE 16 JULY 1975	SITE NO. 1-R.W.	BRIDGE DRAWING NO.	
APPROVED	CONT NO.		



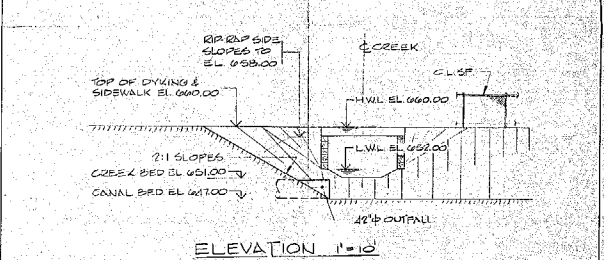
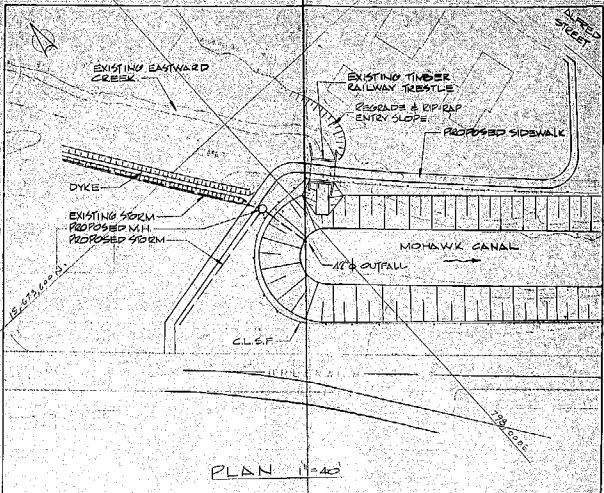
ALFRED TO GREENWICH PEDESTRIAN ROUTE  
BRIDGE CROSSING

DSA 2  
7301-11-1 (A)



ALFRED TO GREENWICH PEDESTRIAN ROUTE  
CULVERT CROSSING

DSA 2  
7301-11-1 (B)



ALFRED TO GREENWICH PEDESTRIAN ROUTE  
TRESTLE CROSSING

DSA 2  
7301-11-1 (C)

B. S. A. R. Alfred Street To Greenwich Street Pedestrian Route

Alternative Methods Of Crossing Eastward Creek