

OAKVILLE-HAMILTON SECTION  
ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WO 82-26025 DIST 4  
HWY GO-ALRT STR SITE  
Oakville Project - West Extension  
Appleby Creek Bridge

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### EXPLANATION OF TERMS USED IN REPORT

### RECORD OF BOREHOLES

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## LIST OF DRAWING AND FIGURES

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Figure 1	Plasticity Chart Silty Clay
Figure 2	Grain Size Distribution Silty Clay
Figure 3	Sliding Friction Tests Sound Bedrock (Queenston Shale)

## 1 - INTRODUCTION

At the request of the Ministry of Transportation and Communications of Ontario (MTC), and as authorized by Agreement No. WGG 001-26A dated January 30, 1984, a foundation investigation was undertaken by Acres Consulting Services Limited (Acres) for the construction of several bridges for the GO-ALRT West Section crossing of Appleby Creek. The investigation was to evaluate foundation conditions at the site in order to make design and construction recommendations regarding the foundation type, embankment stability and construction considerations.

The location, site plan and section of the proposed bridge are shown on MTC Plan P-018. The details of the site, scope of work and job procedures were discussed in a meeting with Mr. K.G. Selby of the MTC on February 8, 1984. During the progress of the work, liaison was maintained with Mr. Selby.

The drilling, soil sampling and rock core drilling were performed by Longyear Canada Inc. under the supervision and direction of Acres geotechnical engineer, Dr. P. Valliappan. Fieldwork commenced on February 13, 1984, and was completed February 17, 1984. The locations of the boreholes drilled during this program are shown on Drawing 1.

All soil and rock samples were returned to Acres' geotechnical laboratory in Niagara Falls for inspection, detailed logging and testing.

The results of the field and laboratory investigations are presented in this report, together with an interpretation of the data obtained and recommendations regarding the design and construction of the foundations and embankments for the proposed new bridges. Comments are also included regarding the proposed new CN spur bridge.

## 2 - EXPLORATORY WORK

Eight boreholes, located as shown on Drawing 1, were drilled during this investigation program. In performing the drilling and soil sampling operations, Longyear Canada Inc. used CME 55 and CME 75 drills mounted on muskeg tractors and equipped with hollow and solid stem augers. It became necessary to mobilize the latter drill when the CME 55 broke down while attempting to reach the last borehole (BH-288). The soil was sampled using 51-mm diameter thin walled Shelby tubes and a 51-mm outside diameter split barrel sampler operated in accordance with the Standard Penetration Test procedure. All boreholes, with the exception of BH-281, were NQ size with NW casing driven through the overburden and seated into rock. BH-281 was advanced by augering with 10-cm diameter solid stem augers. Bedrock core was recovered using a double tube diamond corebarrel utilizing the wireline technique. The rock cores were stored in standard wooden core boxes. Photographs of rock cores were taken and logging completed before removing pieces for testing.

Table 1 summarizes the pertinent physical locations and elevations for each of the boreholes. The hole number sequence was established by the MTC.

TABLE 1SUMMARY OF BOREHOLE PHYSICAL DATA

<u>Borehole Number</u>	<u>Ground Surface Elev (m)</u>	<u>Co-ordinates</u>		<u>Overburden/Bedrock Contact</u>		<u>Bottom of Borehole</u>	
		<u>Northing</u>	<u>Easting</u>	<u>Depth (m)</u>	<u>Elevation (m)</u>	<u>Depth (m)</u>	<u>Elevation (m)</u>
281	102.94	4,804,284.4	283,660.8	0.60	102.34	6.10	96.84
282	103.06	4,804,283.0	283,653.7	0.75	102.31	5.69	97.37
283	102.35	4,804,277.8	283,667.2	0.50	101.85	5.49	96.86
284	102.50	4,804,293.6	283,661.1	0.50	102.00	4.52	97.98
285	102.92	4,804,303.4	283,670.2	1.22	101.70	5.79	97.13
286	101.57	4,804,291.1	283,676.6	0.60	100.97	5.64	95.93
287	101.86	4,804,296.3	283,671.1	0.50	101.36	4.72	97.14
288	102.75	4,804,321.7	283,691.1	1.10	101.65	2.60	100.15

### 3 - SITE CONDITIONS

#### 3.1 - General

Appleby Creek flows southward and exists in two separate channels where it crosses Harvester Road. Immediately north of the CN embankment, the two channels come together then flow through a culvert in the CN fill as shown on Drawing 1. The proposed bridge structures are located immediately north of the CN tracks and are centered on the CN culvert.

Shale bedrock is exposed in the walls and bed of the creek upstream of the railway embankment.

#### 3.2 - Soil Conditions

The overburden at the site is very thin being about 1 m or less on the west bank of Appleby Creek, and up to 1.5 m on the east bank. The thickness of overburden generally increases upstream from the existing CN culvert. The top 0.2 to 0.3 m of overburden contains fibrous organic roots. BH-288, drilled in the swamp area east of the bridge site, encountered a considerable amount of organic matter to a depth of 0.7 m consisting mainly of decayed surface grass.

The overburden consists of reddish-brown silty clay of low plasticity with some subangular to subrounded sand and gravel size shale particles. Some of the sand and gravel size particles are grayish weathered shale fragments and can be broken down further by hand. Atterberg consistency limit tests, carried out on a composite sample of overburden, indicated a liquid limit of 33 percent and a plastic limit of 20 percent as indicated in Figure 1. The silt and clay size fines (passing No. 200 sieve) content is about 80 percent as shown in Figure 2. The consistency of the overburden is generally soft to stiff. An unconfined

compressive strength test performed on a sample taken from BH-285 indicated an unconfined compressive strength of 80 kPa.

### 3.3 - Bedrock Conditions

The site bedrock consists of reddish-brown to pinkish compaction type shale grading locally to grayish, calcareous, silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, and thin to medium bedded with the bedding being essentially horizontal. The top 1.5 m of rock is relatively fractured and contains zones with highly weathered and weak partings up to 2 cm in thickness. The cores in this top zone are also fragmented and closely broken in places. In general, the top 1.5 m of bedrock can be considered as fractured. Average RQD in the fractured zone is about 47 percent and in the sound rock zone below is about 85 percent. Sliding friction tests carried out on two typical shale samples in the sound rock zone indicated a friction angle of 26 deg as shown in Figure 3. The uniaxial compressive strength of the unweathered shale was also checked on some typical samples. The strength values obtained, along with the respective RQD of the zone, are as follows.

Table 2

#### Uniaxial Strength of Shale Bedrock

<u>Borehole Number</u>	<u>Depth (m)</u>	<u>Uniaxial Compressive Strength (MPa)</u>	<u>RQD (%)</u>
BH-282	3.2	64.9	98
BH-283	3.8	70.5	100
BH-287	3.7	42.3	85



The average RQD of the sound bedrock encountered at BH-285 is comparatively lower than the average values obtained for the sound bedrock at other boreholes indicating that the rock conditions are variable across the site.

Samples of the sound rock were placed in water and found to disintegrate within a day.

### 3.4 - Groundwater

Piezometers were installed in BH-282 and BH-285 at a depth of about 4.3 m from the ground surface, within the sound rock, and sealed near the contact between the sound and fractured rock. Groundwater levels were recorded on the last day of the drilling program, February 17, 1984, and five weeks later on March 23, 1984. The observed levels are tabulated below.

<u>Date</u>	<u>Groundwater Elevations</u>	
	<u>BH 282</u> (m)	<u>BH-285</u> (m)
February 17, 1984	101.86	101.97
March 23, 1984	102.03	102.08

The groundwater levels at the site, based on the above observations appear to be controlled by the water level in the creek.

#### 4 - SUMMARY OF SITE CONDITIONS

The site overburden is generally thin with a thickness less than 1.25 m in the vicinity of the proposed structures. It consists of reddish-brown silty clay, of low plasticity with some sand and gravel size shale particles and organic matter. The consistency of the soil is generally soft to stiff. A single unconfined compression test performed on an undisturbed sample gave an undrained shear strength of 40 kPa.

The bedrock is a reddish-brown compaction type calcareous shale grading locally to a grayish calcareous silty shale of the Queenston Formation. Fragmented and very closely broken zones occur in the upper 1 to 1.5 m of rock. Some weak, highly weathered partings, up to 2 cm thick and parallel to the bedding planes, were also encountered in this zone.

The bedrock below elevation 100 m generally appears to be sound with an average RQD of approximately 85 percent.

The groundwater level, at low and medium creek flows, is at or within approximately 1 m of the ground surface.

## 5 - GEOTECHNICAL DESIGN AND CONSTRUCTION CONSIDERATIONS

### 5.1 - General

Considering the stratigraphic sequence as described above and as shown on Drawing 1, together with the types of structures proposed, it is recommended that the structures be supported on spread footings founded on the sound shale bedrock, at or below elevation 100 m. Placing the footings at this elevation is expected to provide a minimum frost cover of 1.2 m.

The shale conditions do vary somewhat throughout the area as noted previously in BH-285. Should weaker zones of rock be encountered locally at a footing site, such weaker rock should be removed and replaced by concrete.

Excavation of the shale should be possible using techniques such as ripping and ramming with a vibrating point thus avoiding the use of drilling and blasting methods.

The shale is subject to deterioration by swelling and slaking on exposure to air and water. It is therefore recommended that all rock surfaces be covered with a thin layer of concrete immediately on reaching the final grade. This concrete layer is also recommended for the creek bed between the footings and for a distance of at least 5 m upstream of the bridge and retaining wall foundations.

To construct the most southerly bridge, it will be necessary to excavate into the existing CN embankment. Suitable temporary support works, such as braced sheet-pile walls, will be required to prevent deformation of the embankment and trackworks.

Creek diversion works will be required during construction and also for the final arrangements. Dewatering is not expected to be a major problem due to the generally impervious nature of the overburden and weathered bedrock.

## 5.2 - GO-ALRT Bridge

For the GO-ALRT bridge foundation, a factored bearing capacity of 1,500 kPa at ultimate limit state is recommended for the spread footings on sound shale bedrock. Since the foundation is shallow and on unyielding bedrock, the bearing capacity at serviceability limit state, Type II, will not govern the design.

It is advisable to take the retaining wall foundation of the GO-ALRT bridge to the sound rock level at elevation 100 m.

For reasons of economy, the foundation of the retaining wall of the GO-ALRT bridge may be set at varying elevations above elevation 100 m, following the natural ground surface as shown on MTC Drawing P-018. For this case, however, the foundation should be within the fractured or weathered bedrock where a factored bearing capacity of 1,000 kPa at ultimate limit state is recommended, considering the fractured zone as hard ground. The capacity at serviceability limit state will not govern the design as the anticipated settlement under the design pressure is expected to be small.

Any overexcavation of the rock resulting from setting the retaining wall at different levels should be backfilled with 'Granular A' material or equivalent, and compacted in layers not exceeding 150 mm in thickness and to a density equal to not less than the maximum dry density attained in the ASTM Test Designation D 698. In the event that the zone of overexcavation is small, making compaction difficult to achieve, it is recommended that the area be backfilled with concrete.

The retaining walls should be designed to withstand the at-rest earth pressure since the foundation is considered to be nonyielding.

Backfill to structures should consist of free draining granular materials in accordance with MTC Special Provision 121, October 1983. All backfill materials shall be compacted and thoroughly drained by perforated pipes, weep holes or equivalent.

If 'Granular A' backfill material is to be used for the design then the following parameters may be assumed for the design:  $\gamma = 22 \text{ kN/m}^3$  and  $\phi = 35$  degrees.

If a free draining granular material other than 'Granular A' is used then the fill should be well graded and contain not more than 10 percent passing the No. 200 sieve. In the absence of the exact source of the fill and the tests to substantiate the design parameters, the equivalent fluid pressures in accordance with Section 6.6.1.2.2 of O.H.B.D.C. may be used for the design.

A sliding friction angle of 26 deg as determined by the tests on shale may be used to check the sliding stability of the foundations of the bridge and the retaining wall on sound shale. If consideration is given to founding the retaining wall on weathered shale, a reduced sliding friction angle of 20 deg may be assumed. These angles represent the ultimate resistance and must therefore be factored to provide an adequate factor of safety.

The foundations should be placed at a minimum depth of 1.2 m below finished ground elevation to obtain adequate protection against frost action.

### 5.3 - CN Spur Bridge

For the CN spur bridge, the foundations for the bridge should be taken down to the level of sound rock which is also at elevation 100 m. The fractured or weathered rock at the top will provide adequate bearing capacity for the foundation of the retaining wall.

A safe bearing capacity of 1,500 kPa for the sound shale and 1,000 kPa for the fractured or weathered shale can be considered appropriate.

As outlined in Section 5.2 for the GO-ALRT bridge, the retaining walls should be designed to withstand at-rest earth pressure and the backfill should consist of free draining granular materials in accordance with MTC Special Provision 121, October 1983. All backfill materials shall be compacted as specified in Section 5.2 and thoroughly drained by perforated pipes.

If 'Granular A' backfill material or equivalent is to be used in the design, the following parameters may be assumed:

$\gamma = 22 \text{ kN/m}^3$  and  $\phi = 35$  degrees.

If a free draining granular material other than 'Granular A' is used the fill should be well graded and contain not more than 10 percent passing No. 200 sieve. The design parameters have to be checked by appropriate tests.

The sliding friction angle and frost penetration depths are the same as the values recommended for the GO-ALRT bridge.

#### 5.4 - Embankments

It is recommended that all overburden under the approach embankments be stripped because of its relatively low strength and organic content.

A side slope of 2H:1V in competent fill material should provide an adequate factor of safety against a failure through the foundation material.

The portion of the creek running parallel to the existing CN bridge, along the toe of the embankment, must be diverted farther upstream and the swamp on the northeast side of the bridge should be drained before the commencement of overburden excavation.

The overburden at the location of the swamp east of the bridge is of the order of 1.5 m in thickness and should be stripped and wasted because of its high organic content.

The weathered rock coming from the excavations may be used as the embankment material. It should break down relatively easily and form a suitable fill. As the shale is susceptible to swelling and slaking on exposure to air and water, it is recommended that it be used inside the embankment with a minimum cover of 1.5 m.

## 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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

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

### PHYSICAL PROPERTIES OF SOIL

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



RECORD OF BOREHOLES



## METRIC

W O 82 - 26025 LOCATION Appleby Creek - Co-ords: E 283,660.8 ORIGINATED BY PV  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger COMPILED BY PV  
DATUM GEODETIC DATE 1984 02 13 CHECKED BY JLB

[illegible]

+3, x5: Numbers refer to Sensitivity

15 20  
10

OFFICE 'REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No 282

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: N 4804.283.0 E 283.653.7  
DIST 4 HWY GO-ALST BOREHOLE TYPE Solid Stem Auger and NQ Rock Core  
DATUM GEODETIC DATE 1984 02 13 and 14  
ORIGINATED BY PV  
COMPILED BY PV  
CHECKED BY JAB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
103.06	Ground Level															GR SA SI CL
0.00	Silty clay, traces of organics and some shale particles. Firm to stiff.		1	SS	18											3 15 (82)
102.31	Reddish brown.															
0.75	Bedrock (Queenston Shale)		2	RC NQ	100% REC		102 EL. 102.03 1984 03 23									RQD = 64%
			3	RC NQ	100% REC											RQD = 55%
	Weathered sound:		4	RC NQ	100% REC										25.30	RQD = 98%
			5	RC NQ	100% REC											RQD = 92%
97.37																
5.69	End of Borehole															

# RECORD OF BOREHOLE No 283

METRIC

W O 82-26025 LOCATION Appleby Creek - Co.ords: E 283,667.2 N 4804,277.8  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NO Rock Core  
DATUM GEODETIC DATE 1984 02 14  
ORIGINATED BY PV  
COMPILED BY PV  
CHECKED BY JMB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
102.35	Ground Level																
0.00	Silty clay, traces of organics and some shale particles. Firm to stiff. Reddish brown					*	102										3 JS (82)
101.85				SS	99	200 mm											
0.50	Bedrock (Queenston Shale)		2	RC NQ	100% REC												RQD = 56%
			3	RC NQ	100% REC												RQD = 37%
	Weathered sound		4	RC NQ	100% REC		100										RQD = 100%
			5	RC NQ	100% REC		98									25.59	RQD = 94%
96.86																	
5.49	End of Borehole																
	*Note Water level not observed																



# RECORD OF BOREHOLE No 284

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: E 283,661.1 N 4804,293.6 ORIGINATED BY PV  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NQ Rock Core COMPILED BY PV  
DATUM GEODETIC DATE 1984 02 14 CHECKED BY JAB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
102.50	Ground Level																
0.00	Silty clay, traces of Organics and some shale particles. Firm to stiff.																
102.00	Reddish brown		1	SS	64	*	102										3 15 (82)
0.50	Bedrock (Queenston Shale)		2	RC NQ	86% REC												RQD = 17%
			3	RC NQ	100% REC		100										RQD = 57%
			4	RC NQ	100% REC												RQD = 100%
97.98																	
4.52	End of Borehole																
	*Note Water level not observed																



# RECORD OF BOREHOLE No 285

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: E 283,670.2  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NQ Rock Core  
DATUM GEODETIC DATE 1984 02 15  
ORIGINATED BY PV  
COMPILED BY PV  
CHECKED BY JAB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
102.92	Ground Level																
0.00	Silty clay, traces of Organics and some shale particles. Firm to stiff.		1	SS	7												3 15 (82)
	Reddish brown		2	TW	PH		102 El. 102.08 1984 03 23									21.08	
101.70																	
1.22	Bedrock (Queenston Shale)		3	RC NQ	100% REC												RQD = 52%
	Weathered sound		4	RC NQ	100% REC		100										RQD = 52%
			5	RC NQ	100% REC		98										RQD = 77%
97.13																	
5.79	End of Borehole																

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



Ministry of  
Transportation and  
Communications  
Ontario

# RECORD OF BOREHOLE No 286

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: E 283,676.6 N 4804,291.1  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NQ Rock Core ORIGINATED BY PV  
DATUM GEODETIC DATE 1984 02 15 COMPILED BY PV  
CHECKED BY JAB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
101.57	Ground Level																
0.00	Silty clay, trace of Organics and some shale particles. Firm to stiff.																
100.97	Reddish brown		1	SS	61	*											3 15 (82)
0.60	Bedrock (Queenston Shale)		2	RC NQ	100% REC												RQD = 61%
	Weathered sound		3	RC NQ	100% REC		100										RQD = 92%
			4	RC NQ	100% REC		98										RQD = 70%
			5	RC NQ	100% REC												RQD = 100%
95.93							96										
5.64	End of Borehole.																
	*Note Water level not observed																

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No 287

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: N 4804,296.3 E 283,671.1  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NO Rock Core  
DATUM GEODETIC DATE 1984 02 15  
ORIGINATED BY PV  
COMPILED BY PV  
CHECKED BY MB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
101.86	Ground Level																
0.00	Silty clay, traces of Organics and some shale particles. Firm to stiff.																
101.36	Reddish brown		1	SS	50	*											3 15 (82)
0.50	Bedrock (Queenston Shale)		2	RC 100% NQ REC													RQD = 36%
	Weathered sound		3	RC 100% NQ REC			100										RQD = 88%
			4	RC 100% NQ REC												25.52	RQD = 85%
97.14																	
4.72	End of Borehole.																
	*Note Water level not observed																

\*3, \*5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10





# RECORD OF BOREHOLE No 288

METRIC

W O 82-26025 LOCATION Appleby Creek - Co-ords: E 283,691.1 ORIGINATED BY PV  
DIST 4 HWY GO-ALRT BOREHOLE TYPE Solid Stem Auger and NQ Rock Core COMPILED BY PV  
DATUM GEODETIC DATE 1984 02 17 CHECKED BY JAB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
102.75	Ground Level																GR SA SI CL
0.00	Silty clay, some decayed roots and Organics, traces of shale particles. Soft to firm.		1	SS	3	*	102										
	Reddish brown		2	TW	PH												
101.65	Bedrock (Queenston Shale)  Mainly weathered.		3	RC NQ	100% REC												RQD = 37%
1.10																	
100.15																	
2.60	End of Borehole.  *Note Water level not observed																

DRILLING REPORTS



# Drilling Report

JOB P7078.00

HOLE BH-281

SHEET 1 OF 1

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

CONTRACTOR Longyear Canada Inc.      STARTED 1145h      1984 02 13  
FINISHED 1330h      1984 02 13

METHOD OF SOIL CME 55 with solid stem augers CASING DIAM -

DRILLING: ROCK Double tube wireline      CORE DIAM -  
diamond drilling

LOCATION: LATITUDE N 4804,284.4

DEPARTURE E 283,660.8

BEARING -

INITIAL DIP 90°

OTHER DIPS -

ELEVATIONS: DATUM GEODETIC

DRILL PLATFORM

GROUND SURFACE 102.94

ROCK SURFACE 102.34

BOTTOM OF HOLE 96.84

WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE			PENE-		
			*TYPE	NO.	SIZE	DEPTH	RET'D	TRATION TEST
0.00	Silty clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy, to floury texture, moist, low plasticity, traces of fibrous organics in the top 0.3 m. Some sand and gravel size particles are greyish weathered fragments and can be broken down by hand.	AQ	1	38	0.30 to 0.76	400	5 10 30
0.60	Bedrock	Reddish brown to pinkish compaction type calcareous silty shale grading locally to calcareous silty shale.	AQ	2	38	1.52 to 1.62	90	65/100
			AQ	3	38	3.04 to 3.12	60	62/80
6.10		End of Borehole. NOTE: Bedrock augered at a consistent steady pressure with SPT's taken at 1.52 m and 3.04 m.						

## SAMPLING METHOD

\*A - split tube      E - auger  
B - thin wall tube      F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert      R - cloth bag  
O - tube      S - plastic bag  
P - water content tin      Y - core box  
Q - glass jar      Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03



# Drilling Report

JOB P7078.00

HOLE BH-282

SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario

PROJECT GO-ALRT Program - West Section

SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

CONTRACTOR Longyear Canada Inc.

STARTED 1340h 1984 02 13

FINISHED 1030h 1984 02 14

METHOD OF SOIL CME 55 with solid stem  
DRILLING: augers

CASING DIAM NW (0.00 - 0.90 m)

ROCK Double tube wireline diamond  
drilling

CORE DIAM NQ (0.75 - 5.69 m)

LOCATION: LATITUDE N 4804,283.0  
DEPARTURE E 283,653.7  
BEARING  
INITIAL DIP 90°  
OTHER DIPS -

ELEVATIONS: DATUM GEODETIC

DRILL PLATFORM

GROUND SURFACE 103.06

ROCK SURFACE 102.31

BOTTOM OF HOLE 97.37

WATER LEVEL 101.86 (1984 02 17)

102.03 (1984 03 23)

PENE-

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE			TRATION		
			*TYPE	NO.	SIZE	DEPTH	RET'D	TEST
0.00	Silty clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, saturated, low plasticity, traces of fibrous organics in the top 0.4 m. Some sand and gravel size particles are greyish weathered fragments and can be broken down by hand.	AQ	1	38	0.30 to 0.76	450	2 3 15
0.75	Bedrock	For description see following page.						
5.69		End of Borehole.						

## SAMPLING METHOD

\*A - split tube E - auger  
B - thin wall tube F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert R - cloth bag  
O - tube S - plastic bag  
P - water content tin Y - core box  
Q - glass jar Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03



# Drilling Report

JOB P7078.00  
HOLE BH-282  
SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description, see previous page		
0.75	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD ranging from fair to excellent, thin to medium bedded with beddings mainly subhorizontal.	0.75 to 1.68  1.68 to 3.20	100 (64)  100 (55)
		1.27 - 2.74 - Weak highly weathered parting up to 2 cm in thickness parallel to bedding in places.	3.20 to 4.72	100 (98)
		2.03 - 2.10 - Breakage of core along some slick to tight joints inclined at 70° to core axis.	4.72 to 5.69	100 (92)
		5.36 - Weak highly weathered parting up to 1 cm in thickness parallel to bedding.		
5.69		End of Borehole		

## NOTES:

- 1 - Standpipe piezometer installed at a depth of 4.3 m.
- 2 - High blow count in the last 0.15 m of the SPT test is due to slight penetration into bedrock.
- 3 - Uniaxial compressive strength of a sample from a depth of 3.2 m = 64.9 Mpa.
- 4 - SPT sample saturated possibly due to heavy rain during drilling.



# Drilling Report

JOB P7078.00  
HOLE BH-283  
SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton  
CONTRACTOR Longyear Canada Ltd. STARTED 1040h 1984 02 14  
FINISHED 1330h 1984 02 14  
METHOD OF SOIL CME-55 with solid stem augers CASING DIAM NW (0.00 - 0.90 m)  
DRILLING: ROCK Double tube wireline diamond CORE DIAM NQ (0.61 - 5.49 m)  
LOCATION: LATITUDE drilling N 4804,277.8 ELEVATIONS: DATUM GEODETIC  
DEPARTURE E 283.667.2 DRILL PLATFORM  
BEARING - GROUND SURFACE 102.35  
INITIAL DIP 90° ROCK SURFACE 101.85  
OTHER DIPS - BOTTOM OF HOLE 96.86  
WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE				PENE- TRATION
			*TYPE	NO.	SIZE	DEPTH RET'D	
0.00	Silty Clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, moist low plasticity, traces of fibrous organics.	AQ	1	38	0.30 to 0.65	16 64 35/50
0.50	Bedrock	For description see following page.					
5.49		End of Borehole.					

## SAMPLING METHOD

\*A - split tube E - auger  
B - thin wall tube F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert R - cloth bag  
O - tube S - plastic bag  
P - water content tin Y - core box  
Q - glass jar Z - discarded

INSPECTOR P. Valliappan

LOGGED BY P. Valliappan

APPROVED

DATE 1984 03



# Drilling Report

JOB P7078.00  
HOLE BH-283  
SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description see previous page.		
0.50	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD ranging from poor to excellent, thin to medium bedded with beddings mainly subhorizontal.	0.65 to 1.52  1.52 to 3.05	100 (56)  100 (37)
		0.61 - 0.81 - Fragmented zone.	3.05	100
		1.52 - 1.60 - Fragmented zone.	to	(100)
		1.75 - Weak highly weathered parting up to 2 cm in thickness parallel to bedding.	4.57	
		2.13 - Weak highly weathered parting up to 1 cm in thickness parallel to bedding.	4.57 to 5.49	100 (94)
		2.60 - Rough tight joint inclined at 40° to core axis.		
		4.14 - 4.57 - Some smooth to slick tight joints inclined at 70° to core axis.		
5.49		End of Borehole.		

## NOTES:

- 1 - High blow counts in the SPT test is due to penetration into bedrock from about 0.5 m.
- 2 - Sliding friction angle obtained for a sample from a depth of 2.6 m = 26°.
- 3 - Uniaxial compressive strength of a sample from a depth of 3.8 m = 70.5 Mpa.



# Drilling Report

JOB P7078.00  
HOLE BH-284  
SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton  
CONTRACTOR Longyear Canada Inc.

STARTED 1400h 1984 02 14  
FINISHED 1600h 1984 02 14

METHOD OF DRILLING: SOIL CCM 55 with solid stem augersCASING DIAM NW (0.00 - 0.90 m)  
ROCK Double tube wireline diamondCORE DIAM NQ (0.76 - 4.52 m)  
drilling

LOCATION: LATITUDE N 4804,293.6  
DEPARTURE E 283,661.1  
BEARING -  
INITIAL DIP 90°  
OTHER DIPS -

ELEVATIONS: DATUM GEODETIC  
DRILL PLATFORM  
GROUND SURFACE 102.50  
ROCK SURFACE 102.00  
BOTTOM OF HOLE 97.98  
WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE				PENE- TRATION TEST
			*TYPE	NO.	SIZE	DEPTH	
0.00	Silty clay	Reddish brown silty clay with some angular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, moist, low plasticity, traces of fibrous organics. Some sand and gravel size particles are greyish weathered fragments and can be broken down by hand.	AQ	1	38	0.30 to 0.76	18 24 40
0.50	Bedrock	For description see following page.					
4.52		End of Borehole.					

## SAMPLING METHOD

\*A - split tube E - auger  
B - thin wall tube F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert R - cloth bag  
O - tube S - plastic bag  
P - water content tin Y - core box  
Q - glass jar Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03





# Drilling Report

JOB P7078.00

HOLE BH-284

SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, OntarioPROJECT GO-ALRT Program - West SectionSITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description see previous page.		
0.50	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD increasing with depth from very poor to excellent, thin to medium bedded with limonite coatings on some bedding planes.	0.76 to 1.52 1.52 to 3.05	86 (17)  100 (57)
		0.76 - 1.05 - Core fragmented to closely broken.	3.05 to 4.52	100 (100)
		1.62 - Weak highly weathered parting up to 2 cm in thickness parallel to bedding.		
		1.62 - 2.13 - Closely broken zone.		
		2.20 - 2.30 - Weak highly weathered parting up to 2 cm in thickness parallel to bedding.		
		2.74 - 4.52 - Some smooth to slick tight joints inclined at 50° - 70° to core axis.		
4.52		End of Borehole.		

## NOTE:

- High blow counts in the SPT test is due to penetration into bedrock from about 0.5 m.



# Drilling Report

JOB P7078.00  
HOLE BH-285  
SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario

PROJECT GO-ALRT Program - West Section

SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

CONTRACTOR Longyear Canada Inc.

STARTED 0830h 1984 02 15

FINISHED 1230h 1984 02 15

METHOD OF SOIL CME 55 with solid stem augers CASING DIAM NW (0.00 - 1.37 m)  
DRILLING: ROCK Double tube wireline diamond CORE DIAM NQ (1.22 - 5.79 m)

LOCATION: LATITUDE drilling  
DEPARTURE N 4804,303.4  
BEARING E 283,670.2  
INITIAL DIP 90°  
OTHER DIPS -

ELEVATIONS: DATUM GEODETIC  
DRILL PLATFORM  
GROUND SURFACE 102.92  
ROCK SURFACE 101.70  
BOTTOM OF HOLE 97.13  
WATER LEVEL 101.97 (1984 02 17)  
102.08 (1984 03 23)

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE					PENE- TRATION TEST
			*TYPE	NO.	SIZE	DEPTH	RET'D	
0.00	Silty clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, moist, low plasticity, traces of fibrous organics in the top 0.4 m.	AQ	1	38	0.30 to 0.76	380	2 3 4
1.22	Bedrock	For description see following page.	BO	2	50	0.76 to 1.22	355	
5.79		End of Borehole.						

## SAMPLING METHOD

\*A - split tube E - auger  
B - thin wall tube F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert R - cloth bag  
O - tube S - plastic bag  
P - water content tin Y - core box  
Q - glass jar Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03



# Drilling Report

JOB P7078.00

HOLE BH-285

SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, Ontario

PROJECT GO-ALRT Program - West Section

SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description see previous page.		
1.22	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD ranging from fair to good, thin to medium bedded with beddings mainly subhorizontal.	1.22 to 2.74  2.74 to 4.27	100 (52)  100 (52)
		1.22 - 1.40 - Fragmented zone.	4.27 to	100 (77)
		1.63 - 1.93 - Weak highly weathered parting up to 3 cm in thickness parallel to bedding in places.	5.79	
		1.93 - 2.04 - Fragmented zone.		
		2.04 - 2.60 - Very close to closely broken zone.		
		3.00 - 4.00 - Some smooth to slick tight joints inclined at 60° - 70° to core axis.		
		4.90 - 5.02 - Weak highly weathered parting up to 1 cm in thickness parallel to bedding.		
		5.40 - 5.49 - Fragmented zone.		
5.79		End of Borehole.		

## NOTE:

- Standpipe piezometer installed at a depth  
of 4.4 m.



# Drilling Report

JOB P7078.00  
HOLE BH-286  
SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton  
CONTRACTOR Longyear Canada Inc.

STARTED 1300h 1984 02 15  
FINISHED 1500h 1984 02 15

METHOD OF DRILLING: SOIL CME 55 with solid stem Augers  
ROCK Double tube wireline diamond drilling  
CASING DIAM NW (0.00 - 0.90 m)  
CORE DIAM NQ (0.76 - 5.64 m)  
LOCATION: LATITUDE N 4804,291.1  
DEPARTURE E 283,676.6  
BEARING -  
INITIAL DIP 90°  
OTHER DIPS -  
ELEVATIONS: DATUM GEODETIC  
DRILL PLATFORM  
GROUND SURFACE 101.57  
ROCK SURFACE 100.97  
BOTTOM OF HOLE 95.93  
WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE					PENE- TRATION
			*TYPE	NO.	SIZE	DEPTH	RET'D	
0.00	Silty clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, saturated, low plasticity, traces of fibrous organics and grass roots.	AQ	1	38	0.30 to 0.76	200	1 5 56
0.60		For description see following page.						
5.64		End of Borehole.						

## SAMPLING METHOD

\*A - split tube  
B - thin wall tube  
C - piston sampler  
D - core barrel  
E - auger  
F - wash

## SHIPPING CONTAINER

N - insert  
O - tube  
P - water content tin  
Q - glass jar  
R - cloth bag  
S - plastic bag  
Y - core box  
Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03



# Drilling Report

JOB P7078.00

HOLE BH-286

SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, OntarioPROJECT GO-ALRT Program - West SectionSITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description see previous page.		
0.60	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD ranging from fair to excellent, thin to medium bedded with beddings mainly subhorizontal.	0.76 to 1.68 1.68 to 3.20	100 (61) 100 (92)
		1.14 - Weak highly weathered parting up to 1 cm in thickness parallel to bedding	3.20 to 4.72	100 (70)
		1.58 - Rough tight joint inclined at 45° to core axis.	4.72 to	100 (100)
		2.70 - 4.70 - Some smooth to slick tight joints inclined at 70° to core axis.	5.64	
5.64		End of Borehole.		

## NOTES:

- 1 - High blow count in the last 0.15 m of the SPT test is due to penetration into bedrock.
- 2 - Sliding friction angle obtained for a sample from a depth of 2.5 m = 26°.
- 3 - SPT sample saturated possibly due to the proximity of the borehole to the creek and the creek was running full during drilling.



# Drilling Report

JOB P7078.00

HOLE BH-287

SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton  
CONTRACTOR Longyear Canada Inc.      STARTED 1515h 1984 02 15  
FINISHED 1730h 1984 02 15  
METHOD OF SOIL CME 55 with solid stem augers CASING DIAM NW (0.00 - 0.90 m)  
DRILLING: ROCK Double tube wireline CORE DIAM NQ (0.76 - 4.72 m)  
LOCATION: diamond drilling  
LATITUDE N 4804,296.3  
DEPARTURE E 283,671.1  
BEARING -  
INITIAL DIP 90°  
OTHER DIPS -  
ELEVATIONS: DATUM GEODETIC  
DRILL PLATFORM  
GROUND SURFACE 101.86  
ROCK SURFACE 101.36  
BOTTOM OF HOLE 97.14  
WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE			DEPTH	RET'D	PENE- TRATION TEST
			*TYPE	NO.	SIZE			
0.00	Silty clay	Reddish brown silty clay with some subangular to subrounded sand and gravel size particles of shale, firm to stiff, greasy to floury texture, moist, low plasticity, traces of fibrous organics.	AQ	1	38	0.30 to 0.76	380	3 20 30
		Some sand and gravel size particles are greyish weathered fragments and can be broken down by hand.						
0.50	Bedrock	For description see following page.						
4.72		End of Borehole.						

## SAMPLING METHOD

\*A - split tube      E - auger  
B - thin wall tube      F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert      R - cloth bag  
O - tube      S - plastic bag  
P - water content tin      Y - core box  
Q - glass jar      Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03



# Drilling Report

JOB P7078.00

HOLE BH-287

SHEET 2 OF 2

CLIENT Ministry of Transportation and Communications, Ontario.PROJECT GO-ALRT Program - West SectionSITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton

DEPTH	ROCK TYPE	DESCRIPTION (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	LENGTH OF RUN	CORE REC'Y (RQD)
0.00	Overburden	For description see previous page		
0.50	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale with occasional thin fine gravel horizons, fine to very fine grained, moderately weak to moderately strong, slightly weathered, RQD increasing with depth from poor to good, thin to medium bedded with limonite coatings on some bedding planes.	0.76 to 1.68 1.68 to 3.20 3.20 to	100 (36)  100 (88)  100 (85)
		3.9 - Weak highly weathered parting up to 3 cm in thickness parallel to bedding	4.72	
		3.00 - 4.70 - Some smooth to slick tight joints inclined at 70° to core axis.		
4.72		End of Borehole.		

## NOTES:

- 1 - High blow count in SPT test is due to penetration into bedrock from about 0.5 m.
- 2 - Uniaxial compressive strength of a sample from a depth of 3.7 m = 42.3 Mpa.



# Drilling Report

JOB P7078.00  
HOLE BH-288  
SHEET 1 OF 2

CLIENT Ministry of Transportation and Communications, Ontario  
PROJECT GO-ALRT Program - West Section  
SITE Appleby Creek Bridge, W.O. 82-26025, District 4, Hamilton  
CONTRACTOR Longyear Canada Inc.      STARTED 0900h 1984 02 15  
FINISHED 1100h 1984 02 17  
METHOD OF SOIL CME 55 with solid stem augers CASING DIAM NW (0.00 - 1.22 m)  
DRILLING: ROCK Double tube wireline CORE DIAM NQ (1.10 - 2.60 m)  
LOCATION: diamond drilling  
LATITUDE N 4804,321.7  
DEPARTURE E 283,691.1  
BEARING 90°  
INITIAL DIP 90°  
OTHER DIPS -  
ELEVATIONS: DATUM GEODETIC  
DRILL PLATFORM  
GROUND SURFACE 102.75  
ROCK SURFACE 101.65  
BOTTOM OF HOLE 100.15  
WATER LEVEL Not observed

DEPTH	SOIL TYPE	DESCRIPTION	SAMPLE					PENE- TRATION TEST
			*TYPE	NO.	SIZE	DEPTH	RET'D	
0.00	Silty clay	Reddish brown silty clay with traces of subangular to subrounded sand and gravel size particles of shale,, soft to firm, greasy to floury texture, saturated, low plasticity, fair amount of decayed roots and fibrous organics in the top 0.5 m.	AQ	1	38	0.30 to 0.76	450	2 2 1
		Some of the sand and gravel size particles are possibly weathered iron or manganese oxide.	BO	2	50	0.76 to 1.10	250	
1.10	Bedrock	For description see following page.						
2.60		End of Borehole.						

## SAMPLING METHOD

\*A - split tube      E - auger  
B - thin wall tube      F - wash  
C - piston sampler  
D - core barrel

## SHIPPING CONTAINER

N - insert      R - cloth bag  
O - tube      S - plastic bag  
P - water content tin      Y - core box  
Q - glass jar      Z - discarded

INSPECTOR P. Valliappan

APPROVED

LOGGED BY P. Valliappan

DATE 1984 03





# Drilling Report

JOB P7078.00

HOLE BH-288

SHEET 2 OF 2

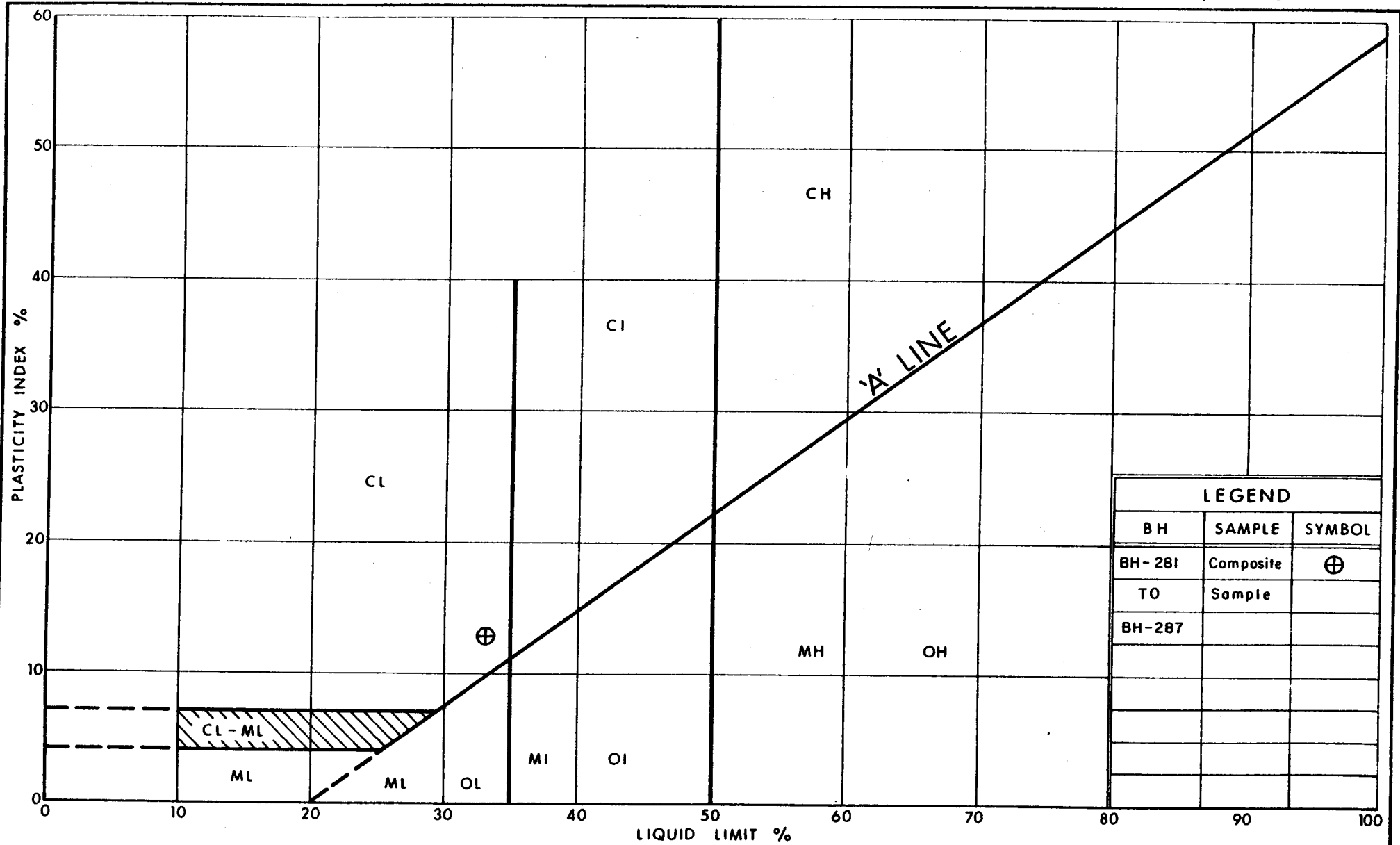
CLIENT Ministry of Transportation and Communications, Ontario

PROJECT GO-ALRT Program - West Section

SITE Appleby Creek Bridge, W. O. 82-26025, District 4, Hamilton

<u>DEPTH</u>	<u>ROCK TYPE</u>	<u>DESCRIPTION</u> (color, texture, foliation, jointing, fracturing, faulting, alteration, water loss or gain, caving, lost core, cementing, etc)	<u>LENGTH</u> <u>OF RUN</u>	<u>CORE</u> <u>REC'Y</u> <u>(RQD)</u>
0.00	Overburden	For description see previous page.		
1.10	Shale	Reddish brown to pinkish compaction type calcareous shale grading locally to greyish calcareous silty shale, fine to very fine grained, moderately weak to moderately strong, slightly weathered, poor RQD, thin to medium bedded with limonite coating on some bedding planes, occasional sub- vertical joints with extremely narrow apertures.	1.10 to 2.60	100 (37)
		1.10 - 1.22 - Fragmented Zone.		
2.60		End of Borehole.		

FIGURES AND DRAWING



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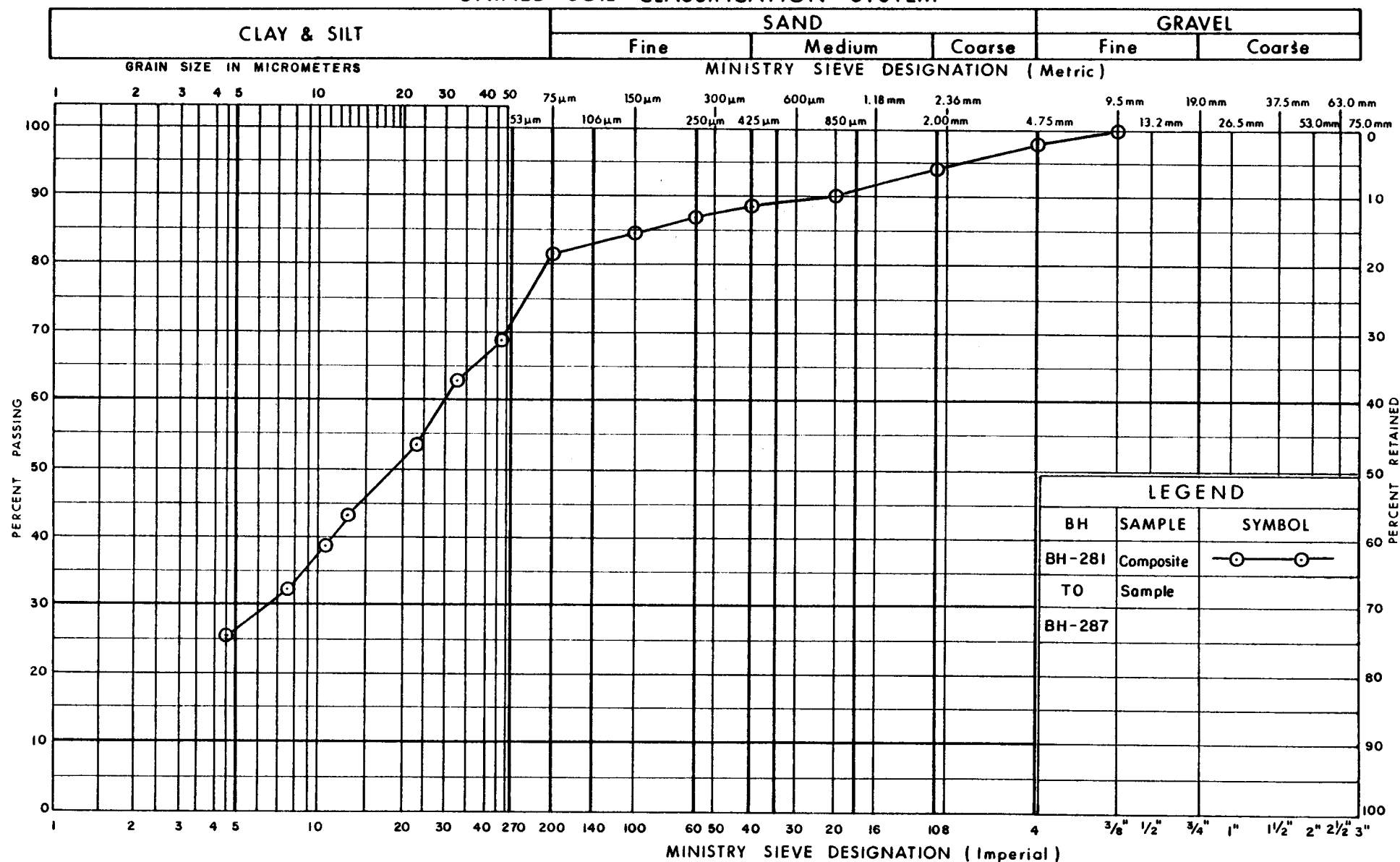
## PLASTICITY CHART SILTY CLAY

FIG No 1

WO 82-26025

Appleby Creek

## UNIFIED SOIL CLASSIFICATION SYSTEM



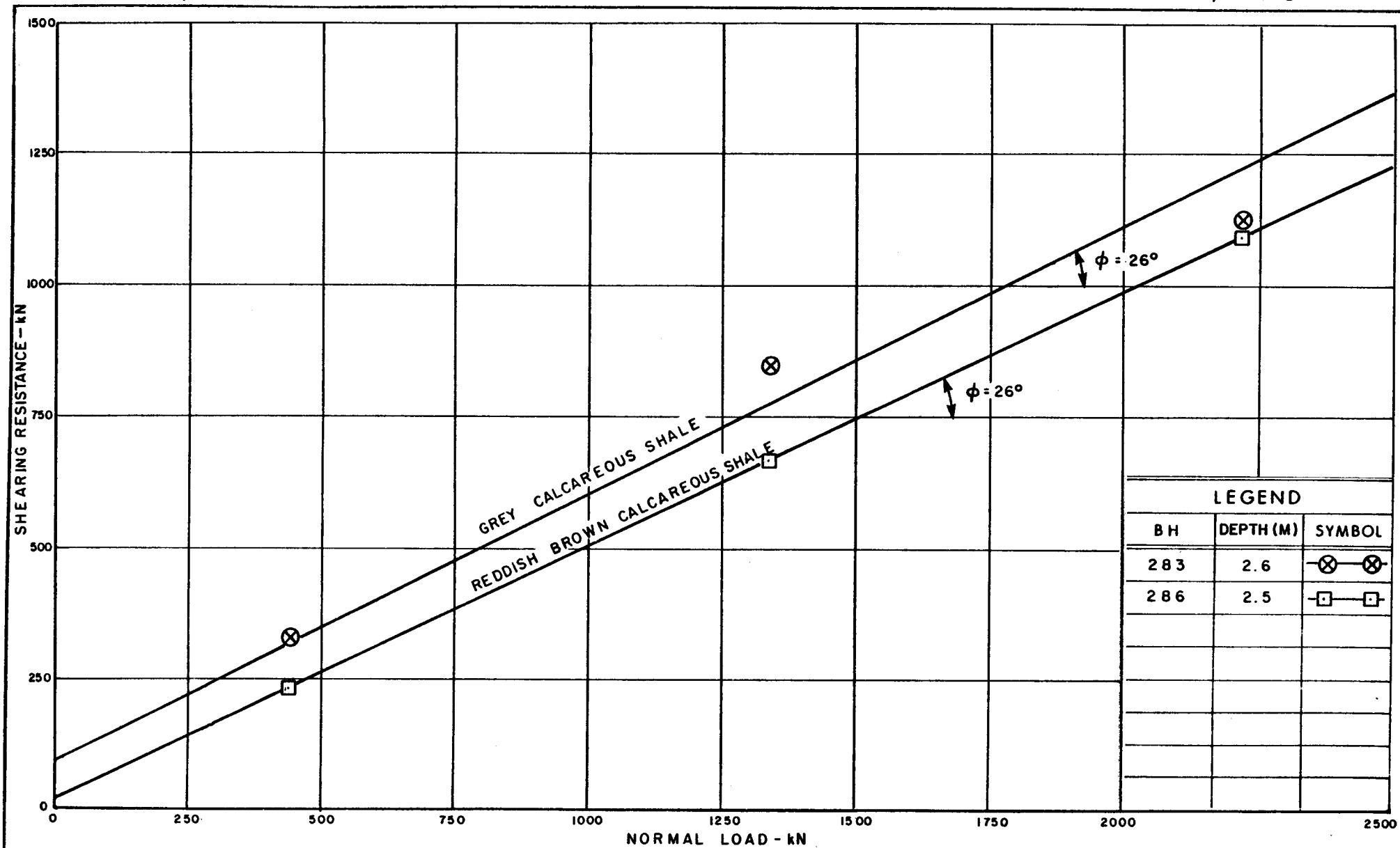
Ministry of  
Transportation and  
Communications

## GRAIN SIZE DISTRIBUTION SILTY CLAY

FIG No 2

W P 82-26025

Appleby Creek



Ministry of  
Transportation and  
Communications

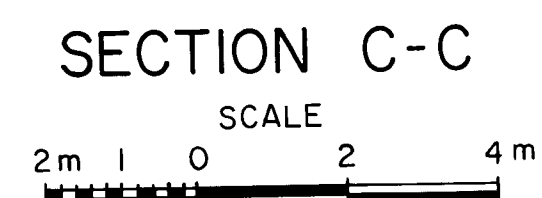
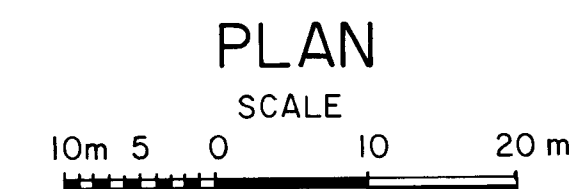
# SLIDING FRICTION TESTS SOUND BEDROCK (QUEENSTON SHALE)







FIG No 3

W P 82 - 26025

Appleby Creek

ALL DIMENSIONS SHOWN ARE  
IN METRES AND/OR MILLI-  
METRES UNLESS OTHERWISE  
NOTED.



	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)
	W.L. at time of investigation 1984 03
	W.L. Not Observed in BH No. 281, 283, 284, 286, 287 and 288
	W.L. in Piezometer
	Piezometer



Geocres No

≡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.

GO-ALRT REF PD2-300-

REFERENCE DRAWINGS		REVISIONS				DRAWN BY: T.T. 1984 03 28		DESIGNED BY: P.V. <i>[Signature]</i>		 ACRES CONSULTING SERVICES LTD.	 Ministry of Transportation and Communications OAKVILLE PROJECT - WEST EXTENSION  PROJECT MANAGER	HALTON REGION			
GO-ALRT DWG. No. P-018						CHK'D BY: P.V. <i>[Signature]</i>		APPROVED BY: T.B. <i>[Signature]</i>				APPLEBY CREEK BRIDGE			
						SCALE: FULL SIZE ONLY						BOREHOLE LOCATIONS & SOIL STRATA			
						AS SHOWN						CONTRACT NO	DWG NO 1	REV	SHEET