

G.I.-30 SEPT. 1976

REMARKS: _____

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 94-450



Ontario

**Ministry of
Transportation**

INDEX

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Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

2

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 = $\frac{w_L - w_p}{w - w_p}$	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^3	SEEPAGE FORCE
γ'	KN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

Foundation Investigation Report
For

Spragge Truck Inspection Station
W.P. 2507-75-02, Site N/A
Hwy. 17, District 17, Sudbury

Inspection

This report is applicable to the proposed weigh scale and station house for the truck inspection station at the above-noted location.

Subsurface Condition

A field investigation was carried out on October 10, 1991. It consisted of 3 boreholes (Appended BH #1 to 3).

The native material at the site essentially consists of a surficial layer of organic clay, 0.5 m thick, underlain by 2 m of clay then silty sand. At the Hwy. 17 embankment, the native overburden is overlain by 1.5m of silty sand fill. The groundwater elevation was near original ground surface ($194.5 \pm m$) at the time of the field investigation.

Miscellaneous

The field investigation was carried out by R. Freymond, Engineering Student. The report was prepared by D. Dundas, Sr. Foundation Engineer and reviewed by M. Devata, Chief Foundation Engineer



D. Dundas
D. Dundas, P.Eng
Chief Foundation Engineer (Acting)

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 2507-75-02 LOCATION Sta 19+069.50 29.75 m south ORIGINATED BY RF
DIST 17 HWY 17 BOREHOLE TYPE Hollow Stem Auger, Cone COMPILED BY DK
DATUM Geodetic DATE 91 10 10 CHECKED BY DD

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 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					
196.7	Ground Surface																
0.0	Silty Sand with Organic Inclusions Very Loose, Brown (Fill)		1	SS	1		196										
195.1			2	SS	3		195										
1.5	Organic Clay, Some Silt Trace Sand and Gravel Brown, Soft		3	SS	4		194										
194.4			4	SS	4		193										
2.3	Varved Clay (Cl/CL) Frequent Sandy Silt Seams Brown and Grey, Very Soft (Lacustrine)		5	SS	1		192										
192.1			6	SS	2		191										
4.6	Silt, Trace sand Very Loose, Brown		7	SS	0		190										
191.3			8	SS	0		189										
5.3	Silty Sand Occasional Clay Pockets Very Loose, Brown		9	SS	3		188										
			10	SS	1												
			11	SS	2												
187.0																	
9.6	End of Borehole																
	* 91 10 10																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 2507-75-02 LOCATION Sta 19+069.50 31.25 m south ORIGINATED BY RF
DIST 17 HWY 17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY DK
DATUM Geodetic DATE 91 10 10 CHECKED BY DD

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 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					
196.7	Ground Surface																
0.0	Probable Silty Sand with Organic Inclusions (Fill)						196										
195.1							195										
1.5	Probable Organic Clay						194										
194.4							193										
2.3	Varved Clay		1	TW	PM		192										
192.4			2	TW	PM												
4.3	Probable Silt																
191.6																	
5.0	Silty Sand																
191.0																	
5.6	End of Borehole																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 2507-75-02 LOCATION Sta 19+069.50 43 m south ORIGINATED BY RF
DIST 17 HWY 17 BOREHOLE TYPE Hollow Stem Auger, Cone COMPILED BY DK
DATUM Geodetic DATE 91 10 10 CHECKED BY DD

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					
194.6	Ground Surface		1	SS	0												
0.0	with organic inclusions Varved Clay (CI/CL) Frequent Sandy Silt Seams Brown and Grey, Very Soft (Lacustrine)		2	SS	1												
192.6			3	SS	0												
2.0	Silt		4	SS	11												
			5	SS	2												
	Silty Sand		6	SS	4												
			7	SS	4												
	Occasional Clay Pockets		8	SS	2												
			9	SS	3												
	Very Loose to Compact		10	SS	6												
			11	SS	0												
184.9																	
9.6	End of Borehole																
	* 91 10 10																

memorandum



Geocres No: 41J-52

To: J. McDougall
Head
Geotechnical Section
Northern Region

Date: 1991 10 21

From: Foundation Design Section
Room 315, Central Bldg.

Re: Spragge Truck Inspection Station (T.I.S)
W.P. 2507-75-02, Site N/A
Hwy. 17, District 17, Sudbury

As requested in your memo of September 16, 1991, we have carried out a foundation investigation for the proposed T.I.S. It is understood that this memo report is sufficient for your design and contract requirements. The recommendations in this memo are applicable to the proposed weigh scale and station house, subject to the assumptions noted below. If our assumptions are inaccurate, or if there are any questions, please advise.

ASSUMPTIONS

- It is proposed to construct a weigh scale and a station house at offsets of approximately 30 m and 45 m, respectively, at Sta. 19 + 069.5 (Hwy. 17 chainage).
- Platform elevation for the weigh scale and floor elevation for the station house will be similar to existing Hwy. 17 pavement elevation (196± m).
- The station house will be founded on a perimeter foundation incorporating a slab-on-grade without basement.
- The weigh scale will consist of a scale pit and platform.
- The weigh scale is intolerant to settlement.
- The approaches to the weigh scale will be designed by others.

SUBSURFACE CONDITIONS

A field investigation was carried out on October 10, 1991. It consisted of 3 boreholes. Reference is made to the attached:

- Figure 1, a profile at Sta. 19 + 070 illustrating borehole locations and surface contours.
- BH sheets #1, #2 and #3 illustrating subsurface conditions at the borehole locations.

The native overburden essentially consists of a surficial layer of organic clay, 0.5 m thick, underlain by 2 m of clay then silty sand. At the Hwy. 17 embankment, the native overburden is overlain by 1.5 m of silty sand fill. The groundwater elevation was near original ground surface ($194.5 \pm$ m) at the time of the field investigation.

RECOMMENDATIONS

Since they are weak and compressible, the organic clay and the clay strata are not suitable to support the proposed weigh scale or station house. Consequently, the foundation loads should be transferred to deeper strata by either:

- 1) piles
- or 2) granular pad

The selection of alternative will depend on allowable settlement. Option (1) will provide negligible settlement. Option (2) will provide settlements in the order of 25 mm.

Another consideration in the selection of foundation alternative would be to ensure compatibility with whatever requirements are recommended for the approaches to the weigh scale.

Piles

The weigh scale and station house may be founded on size 36 treated timber piles driven to elevation 185 m (i.e. at least 10 m long).

The following OHBDC loads may be assumed:

Factored Axial Capacity at ULS	-	150 kN
Axial Capacity at SLS Type II	-	100 kN
Factored Lateral Capacity at ULS	-	7.5 kN
Lateral Capacity at SLS Type II	-	5 kN

If necessary, lateral capacity may be supplemented with the horizontal component of battered piles.

Granular Pad

The weigh scale and station house may be founded on a granular pad. The granular pad should be constructed by subexcavation of weak and compressible material and backfilling with Granular "A". The subexcavation and backfilling operations should proceed without dewatering.

Subexcavation should extend, in plan at 1H:1V beyond the base of the foundations, and, in section to elevation 192 m. Although the subexcavation could be to neat dimensions, it is anticipated that cut slopes of 1H:1V or flatter will be required to control sloughing.

In order to facilitate compaction of the submerged backfill, the backfill should be surcharged by 1 m then excavated to founding elevation. Placement and compaction of fill above the prevailing groundwater elevation should be to MTO Standards. It would be preferable to maintain the surcharge for as long as practical, and preferably for a minimum of 3 months.

The following OHBDC bearing capacities may be assumed for design:

Factored Bearing Capacity at ULS	=	385 kPa
Bearing Capacity of SLS Type II	=	150 kPa

An unfactored angle of 30° may be assumed between concrete and granular pad for calculation of sliding resistance.

General Recommendations (Applicable to Both Options)

- Dewatering

Pile caps or spread footings should be constructed in the dry. If possible, base elevations for these elements should be above the groundwater table. Otherwise, dewatering will be required. A dewatering scheme could consist of sheet piles extending a depth below the base of pile cap/footing excavations equivalent to the height of water above the base of these excavations.

- Frost Protection

Frost protection is 2 m earth cover or equivalent, above the base of foundations. Each 25 mm of styrofoam may be assumed to supply an equivalent protection of 300 mm of earth cover.

- Earth Pressure

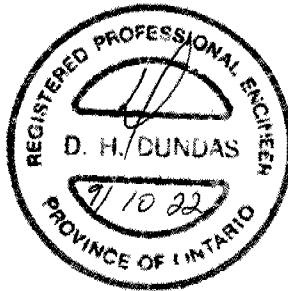
Backfill to structures should consist of granular material in accordance with MTO Standard Special Provision No. 121 (83 10).

Computation of earth pressure should be in accordance with Section 6-6.1.2 of the OHBDC. Foundations may be considered yielding and the active condition will govern earth pressure design. Unfactored properties of backfill materials are provided in the following table:

<u>Material</u>	<u>ϕ</u>	<u>γ</u>	<u>K_a</u>
Granular A	350	22.5 kN/m ³	0.27
Granular B	300	21.0 kN/m ³	0.33

MISCELLANEOUS

The field investigation was carried out by R. Freymond, Engineering Student. The memo report was written by D. Dundas, Sr. Foundation Engineer and reviewed by M. Devata, Chief Foundation Engineer.



D. Dundas
D. Dundas, P. Eng.
Sr. Foundation Engineer

for
M. Devata, P. Eng.
Chief Foundation Engineer

MD/DD/jb

Attach.

cc: J. McDougall (2)
P. Furst
G. Todd
S. Wilson (2)
K. Bassi
S.J. Dunham
E.A. Joseph
B. Sharpe (Cover Only)
F. Bacchus (Cover Only)
File (2)

RECORD OF BOREHOLE No 1

1 OF 1

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195.1			2	SS	3													
1.5	Organic Clay, Some Silt Trace Sand and Gravel Brown, Soft		3	SS	4													
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2.3	Varved Clay (Cl/CL) Frequent Sandy Silt Seams Brown and Grey, Very Soft (Locustrine)		5	SS	1													
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4.6	Silt, Trace sand Very Loose, Brown		7	SS	0													
191.3			8	SS	0													
5.3	Silty Sand Occasional Clay Pockets Very Loose, Brown		9	SS	3													
			10	SS	1													
187.0			11	SS	2													
9.6	End of Borehole																	
	• 91 10 10																	

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 2507-75-02

LOCATION Sta 19+069.50 31.25 m south

ORIGINATED BY RF

DIST 17

HWY 17

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY DK

DATUM Geodetic

DATE 91 10 10

CHECKED BY DD

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	W _p	W	W _L		
196.7	Ground Surface																
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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	W _P W W _L	WATER CONTENT (%)	20 40 60			
194.6	Ground Surface		1	SS	0									
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	Brown		9	SS	3									
			10	SS	6									
184.9			11	SS	0									
9.6	End of Borehole													
	* 91 10 10													

W.P. 2507-75-02

FIGURE 1

TRUCK INSPECTION STATION
SPRINGS OUT.

19-080-00

OL 197.22

7.1 97.04

EP 12.6 97.26

EP 16.3 97.25

EP 17 97.22

26 96.87

32 96.65

34.6 96.06

38.4 94.68

40.4 94.62

BD 41.2 94.27

BD 41.9 94.27

44.1 94.55

46.7 95.61

REMARKS: THIS IS THE COMPLETE X-SECTION WITHIN 50 METERS
OF THE & FOR THE PLYWOOD STRUCTURE

TEST HOLE
#2

TEST HOLE
#3

4070

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} .

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c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
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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
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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 (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	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
r_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 ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						



To: Bernie Chaisson
Northern Region Construction Office

Date: June 6, 1994

From: Foundation Design Section
Room 315, Central Bldg.

Tel: (416) 235-3731
Fax: (416) 235-5240

Re: Pile Driving
Spragge Truck Inspection Station
WP 2507-75-02, Site N/A
Hwy. 17, District 17, Sudbury

Further to our telephone conversation of June 6/94, this memo will confirm that size 36 timber piles are to be driven to elevation 185m or below, and that piles are to be at least 10 m long. The Hiley formula is not required.

If there are any questions, please call.

A handwritten signature in dark ink, appearing to read "D. Dundas".

D. Dundas

Acting Chief Foundation Engineer

A:\BET