

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 201-77-02

DIST 19

HWY 622

STR SITE 41E-112

Atikokan River Structure  
0.6 Mile North of Hwy. 11B, Atikokan

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ROCK CORES	78-03-28	1415

# FOUNDATION INVESTIGATION REPORT

For

Atikokan River Structure  
0.6 Mile North of Hwy. 11B, Atikokan  
Hwy. 622, District 19, Thunder Bay  
W.P. 201-77-02, Site 41E-112

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## INTRODUCTION

This report contains the results of a foundation investigation carried out for the proposed new structure at the crossing of Atikokan River and Secondary Hwy. 622 (Saturn Avenue) during the period of December 2-20, 1977. The fieldwork consisted of four sampled boreholes. The borings were advanced by employing 3¼ inch I.D. hollow stem augers and conventional washboring techniques (BX casing).

## SITE DESCRIPTION

The structure site is located at the crossing of Atikokan River and Secondary Hwy. 622, some 0.6 miles north of the junction of Hwy. 11B and Secondary Hwy. 622. The river passes through the Town of Atikokan, along a meandering course within a 0.25 mile wide valley. The channel at this location is about 100 feet wide and 6 to 7 feet deep. The profile grade of the north approach is about 5 feet higher than the original ground. The south approach in part is located within a 7 foot deep cut. The low ground (flood plain) is a marshland with light bush cover. The high ground in the vicinity of the south approach, west of the highway, is bush covered and on the east side the town's golf course is situated.

## SUBSURFACE CONDITIONS

### General

The original subsoil at the site was found to consist of alternate zones of cohesive and granular type deposits. The borings have indicated that the bedrock is located over 100 feet below the ground surface. The boundaries between the different strata, together with the obtained field and laboratory test results, are shown on the Record of Borehole Sheets contained in the Appendix. The estimated stratigraphical profile inferred from these data is shown on

Drawing No. 2017702-A. A detailed description of the encountered different subsoil types is given below.

#### Sand and Gravel - Fill Material

This sand and gravel stratum was encountered in boreholes put down through the existing roadway. The thickness on the south side is about 2 feet and on the north is 7-10 feet. It appears that the original surficial subsoil has been subexcavated to a depth of about 5 feet and backfilled with sand and gravel material.

#### Silty Sand

A surficial approximate 10 feet thick deposit of silty sand with occasional clayey silt layers was intersected in Borehole 3. The relative density may be described as loose.

#### Clayey Silt to Silty Clay

This deposit was encountered immediately below the sand and gravel and silty sand zones in all boreholes. The thickness was found to vary from 5 to 16 feet. The material consists of stratified clayey silt to silty clay with some sand. Occasionally, highly plastic clay layers were also found within the main deposit. The natural moisture content in general is about 22%. In-situ vane test results varied randomly between 640 and 2080 PSF, indicating that the consistency ranges from firm to very stiff. The extreme upper portion (about 12-18 inches) was found to be very soft.

#### Sandy Silt to Silty Sand

An extensive granular type deposit was found below the clayey silt to silty clay zone. The material in the deposit consists of sands and silts with some clay and traces of gravel. Thin layers (up to  $\frac{1}{2}$  inch) of clayey silt were also observed within the overall stratum. Mechanical analyses gave the following grain size distributions: Gravel - 0-3%, Sand-3-92%, Silt-7-8% and Clay-0-19%. The grain size distribution curves are plotted in envelope form on Figure 1. Based on the Standard Penetration Test 'N' values (8-24 blows per foot) the relative density may be described as loose to compact.

#### Silty Clay to Clayey Silt (Lower Zone)

The sandy silt to silty sand stratum is underlain by a second zone of silty clay to clayey silt for a minimum distance of 50 feet. In B.H. 4 the thickness is about 90 feet. The material in the deposit

consists of stratified silty clay to clayey silt with occasional sandy silt layers. The natural moisture content ranges from 30 to 40%. The consistency is estimated to vary between firm to very stiff.

#### Sand and Gravel With Boulders

A sand and gravel layer was encountered below the silty clay to clayey silt deposit. The thickness was found to vary between 3 and 20 feet. Drilling with a tri-cone bit was required to penetrate this zone. Frequent boulders were also in evidence.

#### Bedrock

Argillite type bedrock was encountered in Borehole 1 at elevation 1145+. The bedrock was proven at this location only. At other boring locations the bedrock surface was assumed to be at levels where refusal to tri-cone drilling was reached:

B.H. #3 Elev. 1151.8

B.H. #4 Elev. 1095.2

In Borehole 2 no refusal was reached within 141 feet below ground level (elev. 1132).

#### Groundwater Conditions

The following groundwater levels were observed during the field investigation:

B.H. #2 Elev. 1267.0

#3 Elev. 1267.5

#4 Elev. 1267.5

In Borehole 1 artesian conditions were encountered at elevation 1146 and stabilized at elevation 1275, some 4 feet above the existing ground level.

## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to erect a new sturcture over Atikokan River. The existing bridge is a 7 span timber trestle bridge with an overall length of 107 feet and supported on timber piles.

The proposed new structure will be a 3 span (40'-70'-40') concrete bridge and will be built on the existing alignment. The proposed new profile grade will be at elevation 1273, some 3.5 feet above the present grade.

The overburden was found to consist of alternate zones of granular and cohesive type deposits. The position of the bedrock surface varies from elevation 1152<sub>+</sub> to elevation 1095<sub>+</sub>, some 117-176 feet below ground level.

### Structure Foundation

The encountered subsurface conditions do not favor spread footing type foundations. Therefore, piled foundations are recommended. Two types of piling are being considered.

### End-Bearing Piles

The abutments and piers of the proposed new structure may be founded on end-bearing steel 'H' piles driven to bedrock. It is assumed that the piles may not reach the bedrock due to the overlying bouldery zone. Hard driving is expected within this zone, therefore, reinforcement of the pile tips is recommended. It is difficult to predict accurate pile lengths at a given footing location due to the great differences in bedrock surface elevations. At the time of the fieldwork the exact footing positions were not known, consequently no borings could have been carried out at the required locations. It is estimated, however, that the piles will reach the required load carrying capacity between elevation 1150 and elevation 1140 at the south abutment location and between elevation 1105 and elevation 1115 on the north side. The refusal levels at the pier locations may be interpolated from the borings:

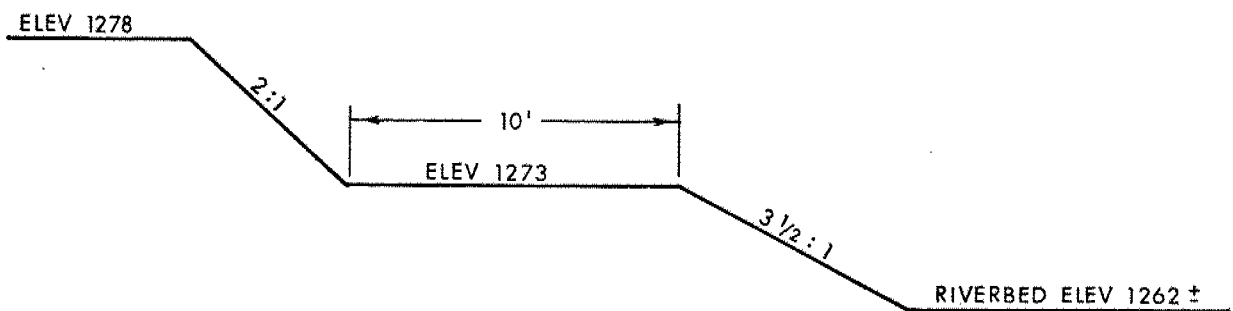
South Pier	Elev. 1140-1130
North Pier	Elev. 1120-1110

For piles driven to refusal the maximum allowable design loads for the particular pile section adopted may be assumed. As an alternative timber piles driven to elevation 1220-1225 may be considered. Design loads up to 30 tons per pile are recommended.

The pile caps should be protected against frost action with a minimum of 8 feet of earth cover.

#### Approach Embankments

The maximum height of the proposed approaches is in the order of 16 feet above the riverbed. It is recommended that the forward slopes be built according to the following geometry:



N T S

The side slopes should not be built steeper than with 2:1 slopes. No stability problems are anticipated.

The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven and it is recommended that this portion of the fill contain grain sizes not larger than 3 inches.

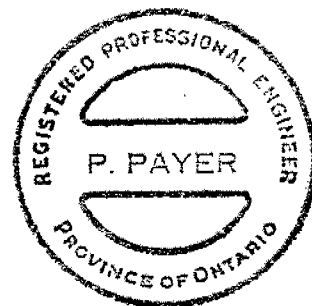
The slopes should be protected against erosion by rip-rap at least 2 feet above the observed high water level.

MISCELLANEOUS

The fieldwork performed during the period of December 2 to 20, 1977 was supervised by Mr. P. Payer, Senior Engineer, who also prepared this report. Mr. K.G. Selby, Supervising Engineer, reviewed the report.

Equipment used was owned and operated by D.S.I.L. Drilling Inc. (Thunder Bay).

*P. Payer*  
P. Payer, P. Eng.  
Senior Engineer



*K.G. Selby*  
K.G. Selby, P. Eng.  
Supervising Engineer

March, 1978

## APPENDIX





# RECORD OF BOREHOLE No 1

W P 201-77-02 LOCATION Sta. 130+89 o/s 25' Lt. V. Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger, Washbore and BX Rock COMPILED BY PP  
DATING Geodetic DATE December 2, 7, 8, 9 and 12, 1977 Coring CHECKED BY

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							SHEAR STRENGTH PSF	WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE							
1271.0	Ground Level													GR SA SI CL		
1269.0	Sand & Gravel - Fill						1270									
2.0	Stratified Silt Clay to Clayey Silt		1	SS	4											
	Reddish Brown		2	TW	PH		1260		+ S=9							
	Trace of Sand								+ S=4							
	Occasional Clay Layers		3	SS	7									0 3 81 16		
1253.0	Firm to Very Stiff															
18.0	Sandy Silt to Silty Sand		4	SS	8		1250									
	Some Clay		5	SS	17											
	Trace of Gravel		6	SS	21		1240							0 26 64 10		
	Occasional Clayey Silt Layers		7	SS	17											
	Compact		8	SS	18		1230							0 15 71 14		
			9	SS	14		1220									
			10	SS	14		1210							0 8 80 12		
1206.0	Silty Clay to Clayey Silt															
45.0	Sandy Silt Layers		11	SS	3		1200									
	Firm to Very Stiff															
			12	SS	10		1190									
							1180							0 1 69 30		
			13	SS	19		1170									
							1160									
1150.5																

Continued

+3, +5: Numbers refer to  
Sensitivity

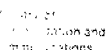
20  
15-5 (%) STRAIN AT FAILURE  
10



## RECORD OF BOREHOLE No 1 Continued

P 201-77-02 LOCATION Sta. 130+89 o/s 25' Lt. of Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger, Washbore & BX Rock Coring COMPILED BY PP  
DATUM Geodetic DATE December 2, 7, 8, 9 and 12, 1977 CHECKED BY

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					
1152.5																	
115.5																	
120.1	Sand & Gravel Very Dense						1150										
1145.0	Boulders		14	BXL REC		Encountered											
126.0	Bedrock Argillite		15	RG	75%												
1138.4	Sound		16	BXL REC	100%		1140										
132.6	End of Borehole																



## RECORD OF BOREHOLE No 2

V P 201-77-02 LOCATION Sta. 132+59 o/s 17' Lt. & Hwy. 622 ORIGINATED BY PP  
 DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore COMPILED BY PP  
 DATUM Geodetic DATE December 3, 1977 CHECKED BY LS

[illegible]

Continued

+3, x5: Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

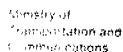


# RECORD OF BOREHOLE No 2 Continued

W P 201-77-02 LOCATION Sta. 132+59 o/s 17' Lt. & Hwy. 622 ORIGINATED BY PP  
 DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore COMPILED BY PP  
 DATUM Geodetic DATE December 3, 1977 CHECKED BY

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				
1134.5																
118.5																
							1150									
							1140									
1132.0																
141.0	End of Borehole															
	Note:  From 50 feet downward the borehole was advanced by washboring without sampling															

OFFICE REPORT ON SOIL EXPLORATION



## RECORD OF BOREHOLE No 3

W F 201-77-02 LOCATION Sta. 130+96 o/s 38' Rt. & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 4-6, 1977 CHECKED BY JS

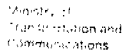
[illegible]

End of Borehole

+3, x5 : Numbers refer to Sensitivity

20  
15 - 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



## RECORD OF BOREHOLE No 4

W P 201-77-02 LOCATION Sta. 132+57, o/s 19' Rt & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 14-20, 1977 CHECKED BY PP

[illegible]

+3, x5; Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

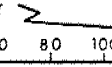



Ministry of  
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HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4 Continued

W P 201-77-02 LOCATION Sta. 132+57, o/s 19' Rt. & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 14-20, 1977 CHECKED BY CS

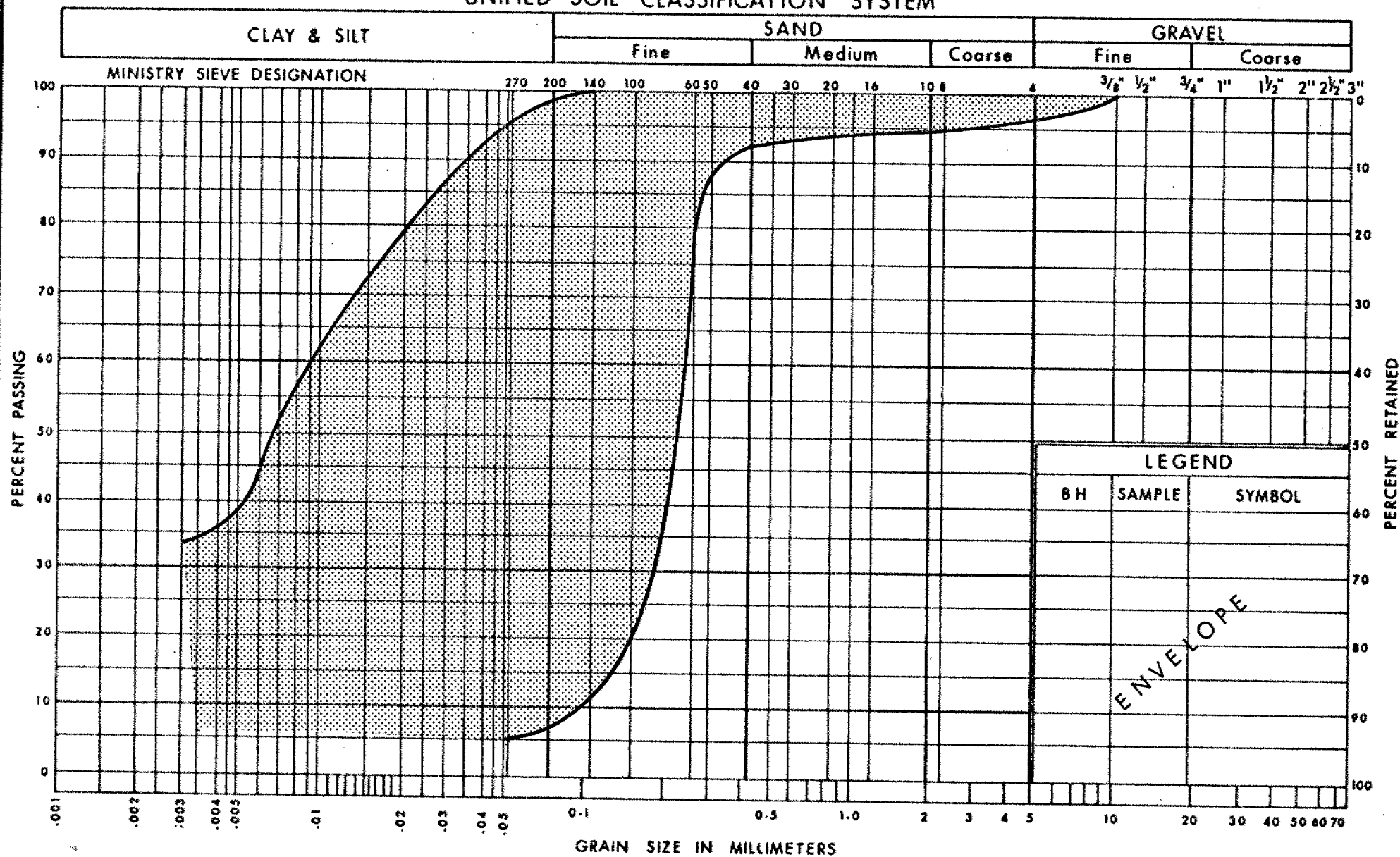
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
1153.5														
118.5														
			5	SS	17		1150							
							1140							
							1130							
							1120							
1117.0							1110							
1110							1100							
155.0	Sand & Gravel Frequent Boulders													
1095.6	(Refusal)													
176.4	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

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Communications

GRAIN SIZE DISTRIBUTION  
SANDY SILT TO SILTY SAND  
SOME CLAY, TRACE OF GRAVEL

FIG No 1

WP 201-77-02



# EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS  $N_c$ .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE HELL HDS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

$S_u$ (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS & SYMBOLS

### LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG.  $\bar{C}U$  = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

### FIELD SAMPLING

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

### EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_A$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_P$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE  
 $w$  SLOPE ANGLE-BACKFACE OF WALL  
 $\beta$  ANGLE OF SLOPE  
 $N_q, N_c$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
B, L FOOTING DIMENSIONS

### INDEX PROPERTIES

$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$   $e$  IN LOOSEST STATE  
 $e_{min}$   $e$  IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_P$  PLASTIC LIMIT  
 $w_S$  SHRINKAGE LIMIT  
 $I_P$  PLASTICITY INDEX =  $w_L - w_P$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_P}{I_P}$   
 $I_c$  CONSISTENCY INDEX =  $\frac{w_L - w}{I_P}$   
 $A_c$  ACTIVITY =  $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ soil fraction}}$   
 $O_m$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

### STRENGTH PARAMETERS

$\phi$  ANGLE OF SHEARING RESISTANCE  
 $\tau_f$  PEAK SHEAR STRENGTH  
 $\tau_R$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_a$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $m, n$  STABILITY COEFFICIENTS  
A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'$  = EFFECTIVE NORMAL STRESS

### HYDRAULIC TERMS

$h$  HYDRAULIC HEAD OR POTENTIAL  
 $q$  RATE OF DISCHARGE  
 $v$  VELOCITY OF FLOW  
 $i$  HYDRAULIC GRADIENT  
 $j$  SEEPAGE FORCE PER UNIT VOLUME  
 $\eta$  COEFFICIENT OF VISCOSITY  
 $k$  COEFFICIENT OF HYDRAULIC CONDUCTIVITY  
 $k_h$   $k$  IN HORIZONTAL DIRECTION  
 $k_v$   $k$  IN VERTICAL DIRECTION  
 $m_v$  COEFFICIENT OF VOLUME CHANGE  
 $c_v$  COEFFICIENT OF CONSOLIDATION  
 $C_c$  COMPRESSION INDEX  
 $C_r$  RECOMPRESSION INDEX  
 $d$  DRAINAGE PATH DISTANCE  
 $T_v$  TIME FACTOR  
 $U$  DEGREE OF CONSOLIDATION  
 $O_c$  OVERCONSOLIDATION RATIO (OCR)

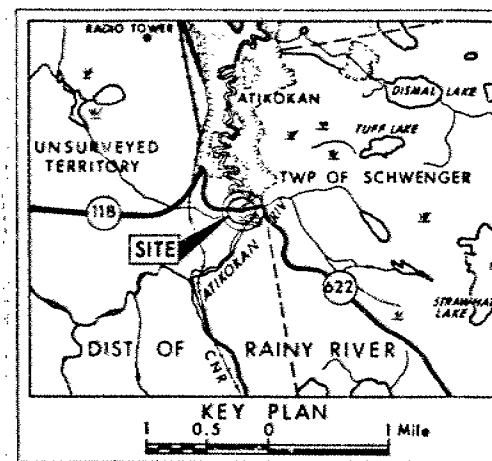
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO  
08-51-508 10-15

CONT No  
WP No 201-77-02



ATIKOKAN RIVER  
0.6 Mi North of Hwy 118  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



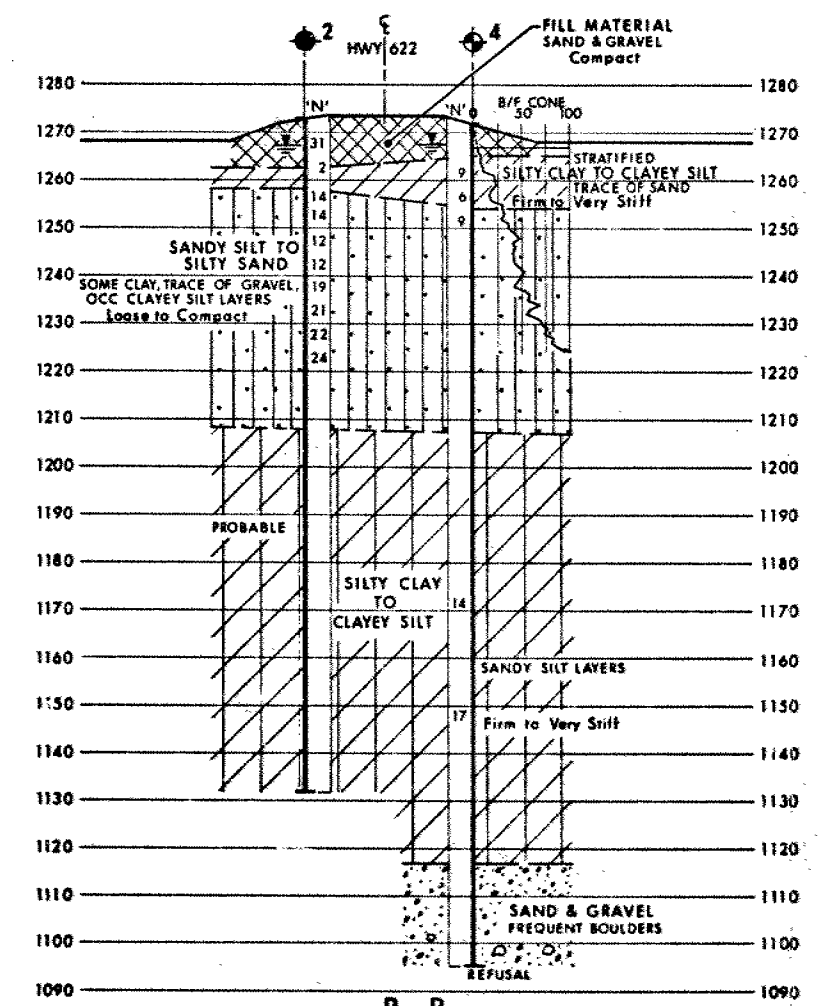
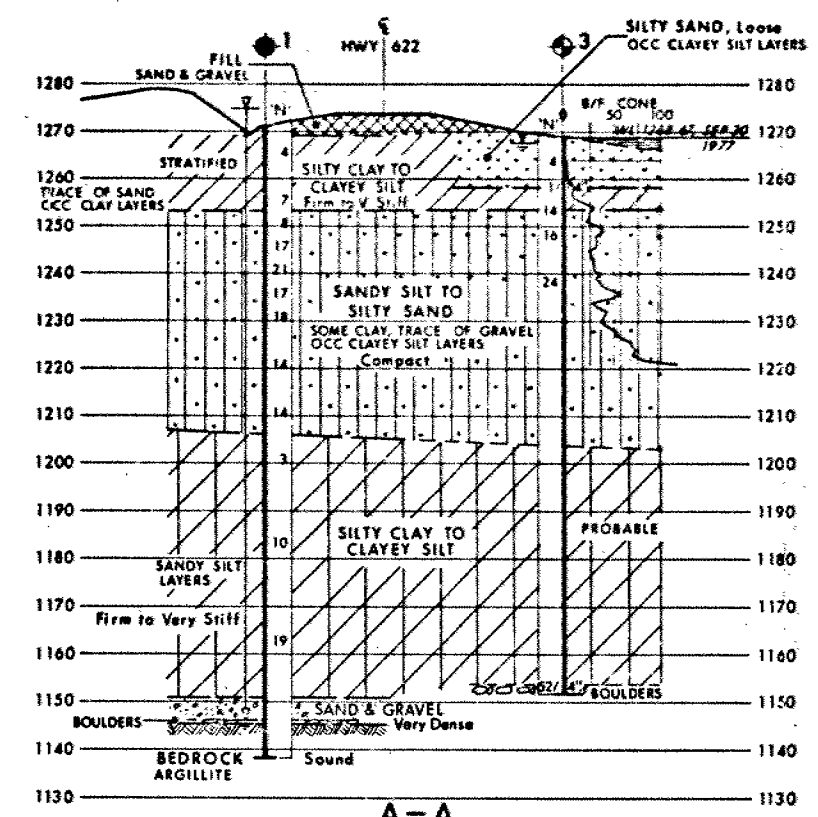
- LEGEND**
- Bore Hole
  - ⊕ Dynamic Cone Penetration Test (Cone)
  - ⊙ Bore Hole & Cone
  - N' Blows/ft (Std Pen Test 350ft lbs energy)
  - CONE Blows/ft (60° Cone, 350ft lbs energy)
  - W.L. at time of investigation Dec 1977
  - Head
  - ARTESIAN WATER
  - Encountered

No	ELEVATION	STATION	OFFSET
1	1271.0	130+89	25' LT
2	1273.0	132+59	17' LT
3	1269.0	130+96	38' RT
4	1272.0	132+57	19' RT

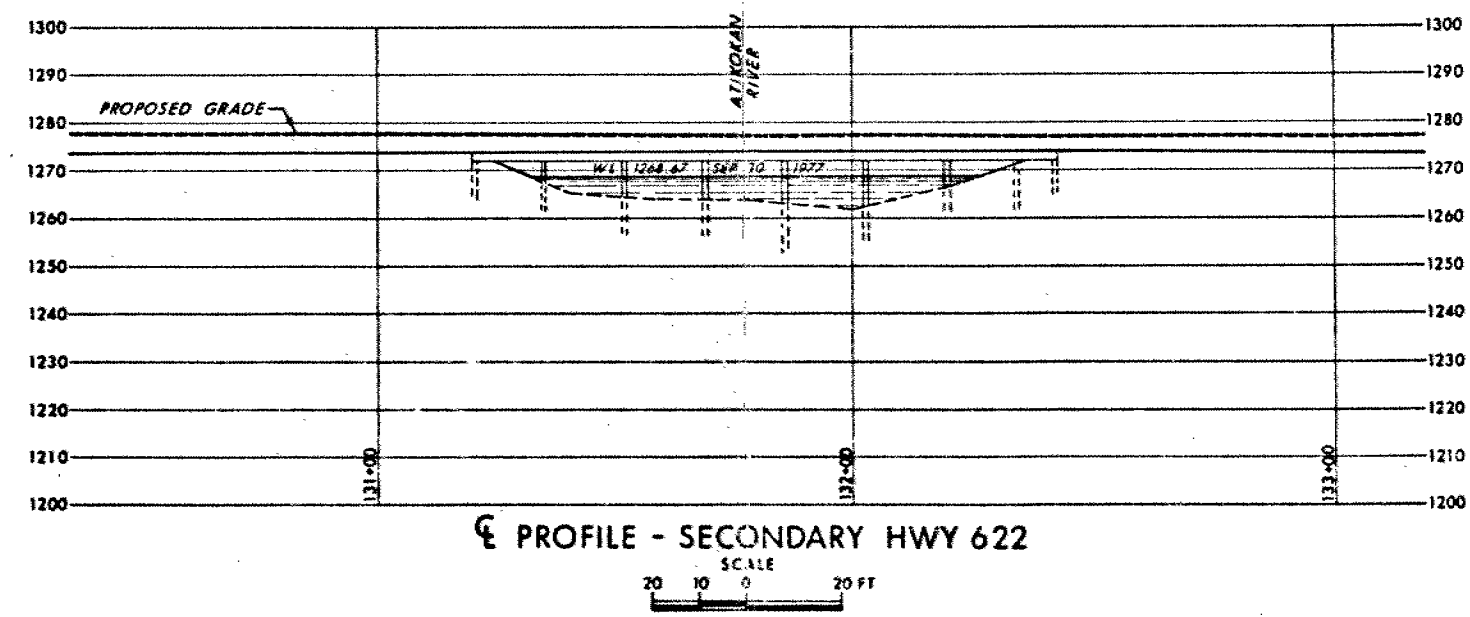
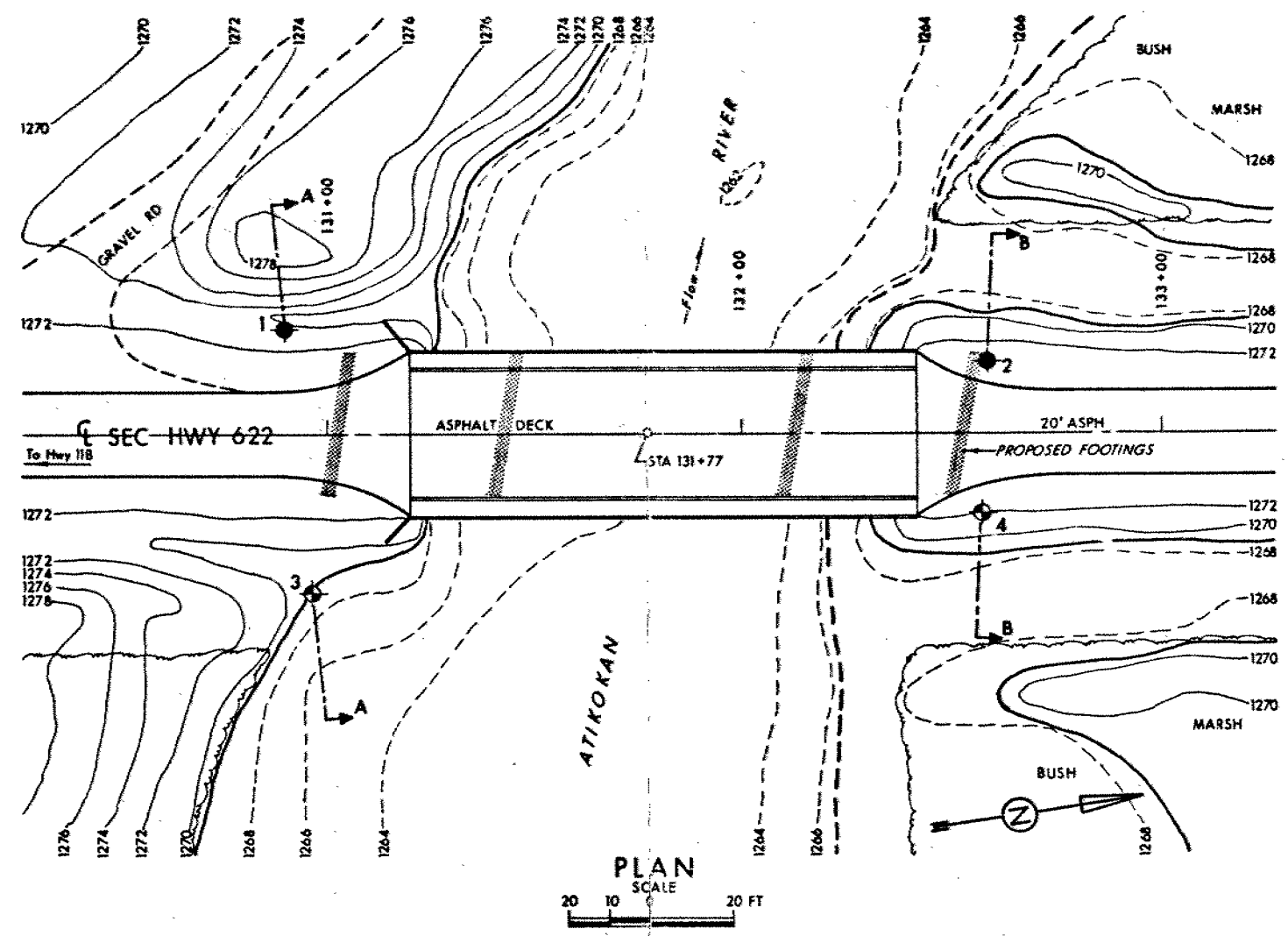
**-NOTE-**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRE No 328-5  
HWY No SECONDARY 622  
S.B.M.D. P.P. CHECKED DATE Mar 10, 1978 SITE 43-112  
DRAWN B.S. CHECKED DATE  
CWO 2017702-A



**B-B SECTIONS**  
SCALE  
20 10 0 10 20 FT



**PROFILE - SECONDARY HWY 622**  
SCALE  
20 10 0 10 20 FT

DOCUMENT NO. 100-111111-1111

GEOCRES No. 52B-5

DIST 19 REGION NORTHWESTERN

W.P. No. 201-77-02

CONT. No. 78-100

W. O. No. \_\_\_\_\_

STR. SITE No. 45-112

HWY. No. 622

LOCATION Atikokan River  
Bridge

OVERALL DISTANCE FROM REPT. NO. 100-111111-1111 5

REMARKS \_\_\_\_\_

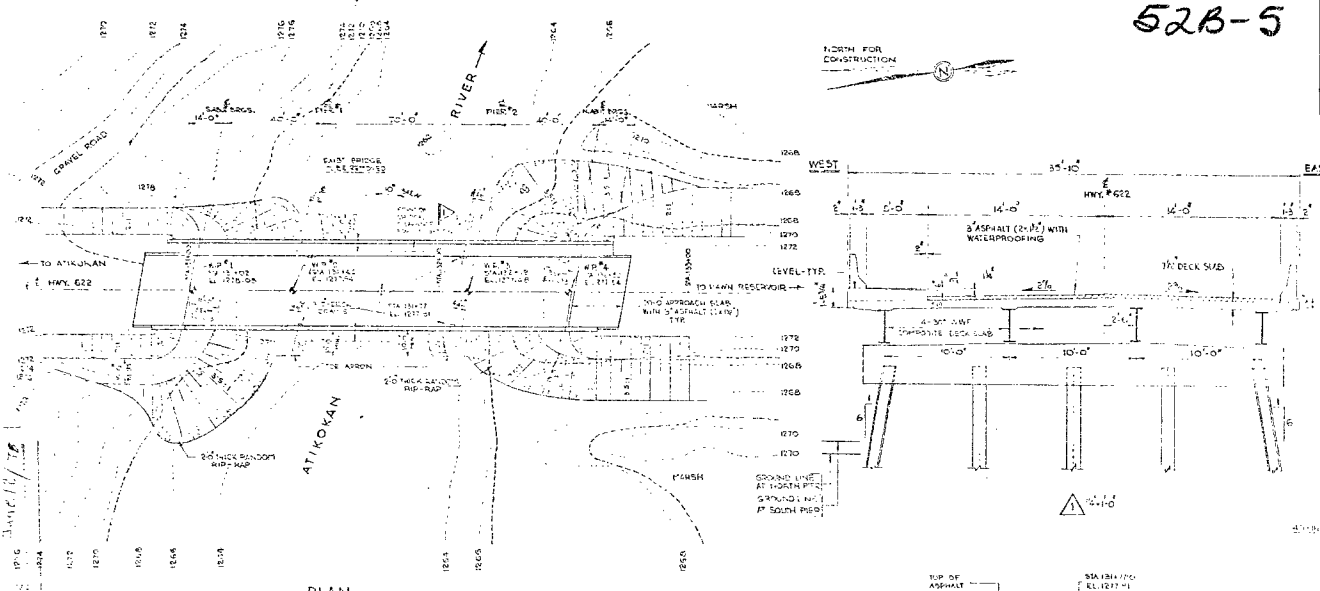
\_\_\_\_\_

\_\_\_\_\_

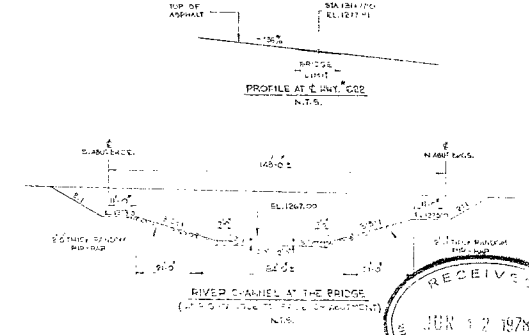
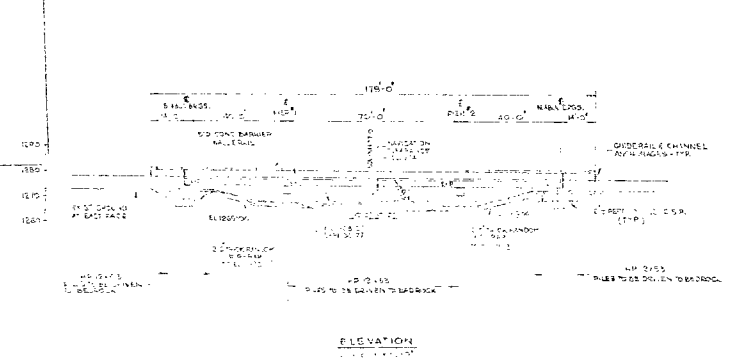
\_\_\_\_\_

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS DEPT. OF HIGHWAYS

FOR REVIEWING  
PURPOSES ONLY



NOTES:  
1. R. DENOTES WORKING POINT



52B-5

DIST. 19	
CONT No	
WP No 201-77-52	
ATIKOKAN RIVER BRIDGE	
AT SECONDARY HWY 622	
GENERAL PLAN	

SHEET

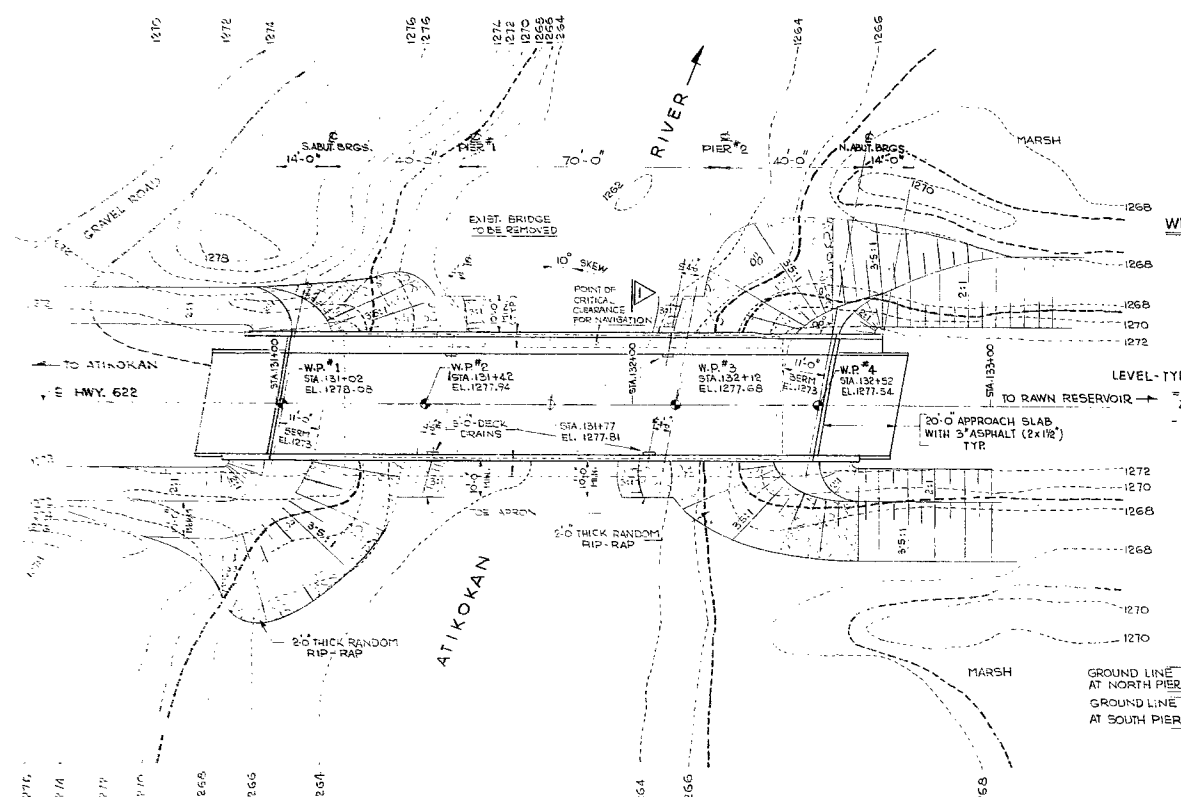
- GENERAL NOTES
- CLASS OF CONCRETE
1. 3" ASPHALT (2" MIN) WITH WATERPROOFING
2. 12" DECK SLAB
3. 4" ST. AWT IMPROVED DECK SLAB
4. 10' DECK SLAB
5. 10' DECK SLAB
6. 10' DECK SLAB
7. 10' DECK SLAB
8. 10' DECK SLAB
9. 10' DECK SLAB
10. 10' DECK SLAB
11. 10' DECK SLAB
12. 10' DECK SLAB
13. 10' DECK SLAB
14. 10' DECK SLAB
15. 10' DECK SLAB
16. 10' DECK SLAB
17. 10' DECK SLAB

RECEIVED  
JUN 12 1978  
SIN. MICH.  
MINISTRY OF TRANSPORTATION

FOR REDUCED PLAN  
ONE SCALE BELOW  
2"=1" ON ORIGINAL PLAN

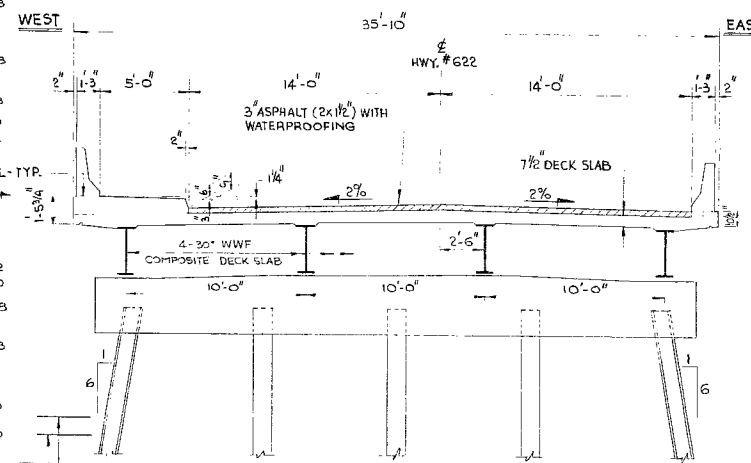
520-5

DIST. 19	CONT No	SHEET
WP	No 201-77-02	
ATIKOKAN RIVER BRIDGE AT SECONDARY HWY. 622 GENERAL PLAN		



PLAN  
SCALE: 1"=20'-0"

NOTES:  
• W.P. DENOTES WORKING POINT



GENERAL NOTES

**CLASS OF CONCRETE:**  
DECK, BARRIER WALLS & PIER CAPS - 4000 P.S.I.  
REMAINDER - 3000 P.S.I.  
AND/OR AS NOTED ON DRAWINGS.

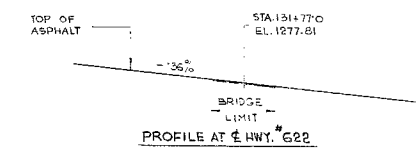
**CLEAR COVER TO REINFORCING STEEL:**  
FOOTINGS, ABUTMENTS & PIER COLUMNS 3"  
PIER CAPS 2 1/2"  
DECK TOP 2", BOTTOM 1" AND/OR AS NOTED  
ON DRAWINGS.

**CONSTRUCTION NOTES:**  
THE CONTRACTOR IS RESPONSIBLE FOR  
FINISHING THE BEARING SEATS DEAD LEVEL  
TO THE SPECIFIED ELEVATIONS WITH A  
TOLERANCE OF ± 1/8".  
NO CONCRETE SHALL BE PLACED ABOVE THE  
BEARING SEATS UNTIL CONCRETE IN THE DECK  
HAS BEEN PLACED.  
FORMWORK FOR THE BALLAST WALLS (E.G. EXPANDED  
POLYSTYRENE) NEXT TO END OF DIAPHRAGMS  
SHALL BE REMOVED.

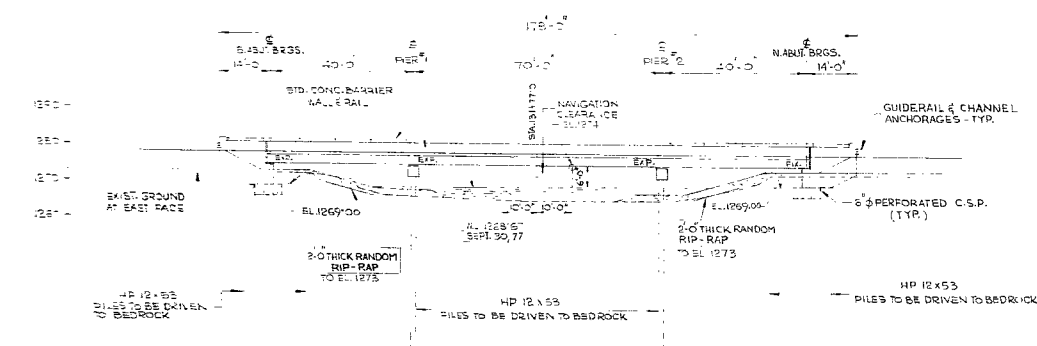
**REINFORCING STEEL GRADE:**  
60 K.S.I.

LIST OF DRAWINGS:

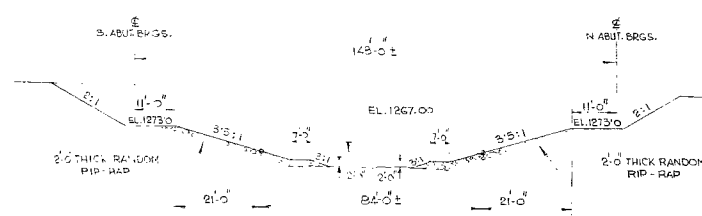
- 15-112-1 GENERAL PLAN
- 2 BOREHOLE LOCATIONS & SOULS
- 3 FOOTINGS AND PIERS
- 4 SOUTH ABUTMENT
- 5 NORTH ABUTMENT
- 6 STRUCTURAL STEEL DETAILS
- 7 BEARING AND SPICE DETAILS
- 8 DECK DETAILS & REINFORCEMENT
- 9 BARRIER WALL WITH SIDEWALK
- 10 BARRIER WALL
- 11 STEEL RAILING (SINGLE TUBE)
- 12 20' APPROACH SLAB
- 13 STANDARD DETAILS I
- 14 STANDARD DETAILS II
- 15 STANDARD DETAILS III
- 16 STANDARD DETAILS IV
- 17 AS CONSTRUCTED ELEV. 4' DIM.



PROFILE AT HWY. 622  
N.T.S.



ELEVATION  
SCALE: 1"=20'-0"



RIVER CHANNEL AT THE BRIDGE  
(AT RIGHT ANGLE TO FACE OF ABUTMENT)  
N.T.S.

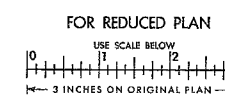
CONCRETE QUANTITIES FOR LUMP SUM TENDER ITEMS	
CONCRETE IN ABUTMENTS, WING WALLS & PIER CAPS	
3000 P.S.I. - - - - -	75.0 CU. YD.
4000 P.S.I. - - - - -	24.0 CU. YD.
CONCRETE IN DECK	
4000 P.S.I. - - - - -	118.0 CU. YD.
CONCRETE IN BARRIER WALLS	
4000 P.S.I. - - - - -	28.0 CU. YD.
CONCRETE IN APPROACH SLABS	
4000 P.S.I. - - - - -	37.0 CU. YD.

STRUCT. STEEL QUANTITY - 47.0 TONS



BM 1270.18  
GEODETIC DATUM  
N. 6° W. IN ROOT 0.6 POPLAR  
54' LT. 129+43

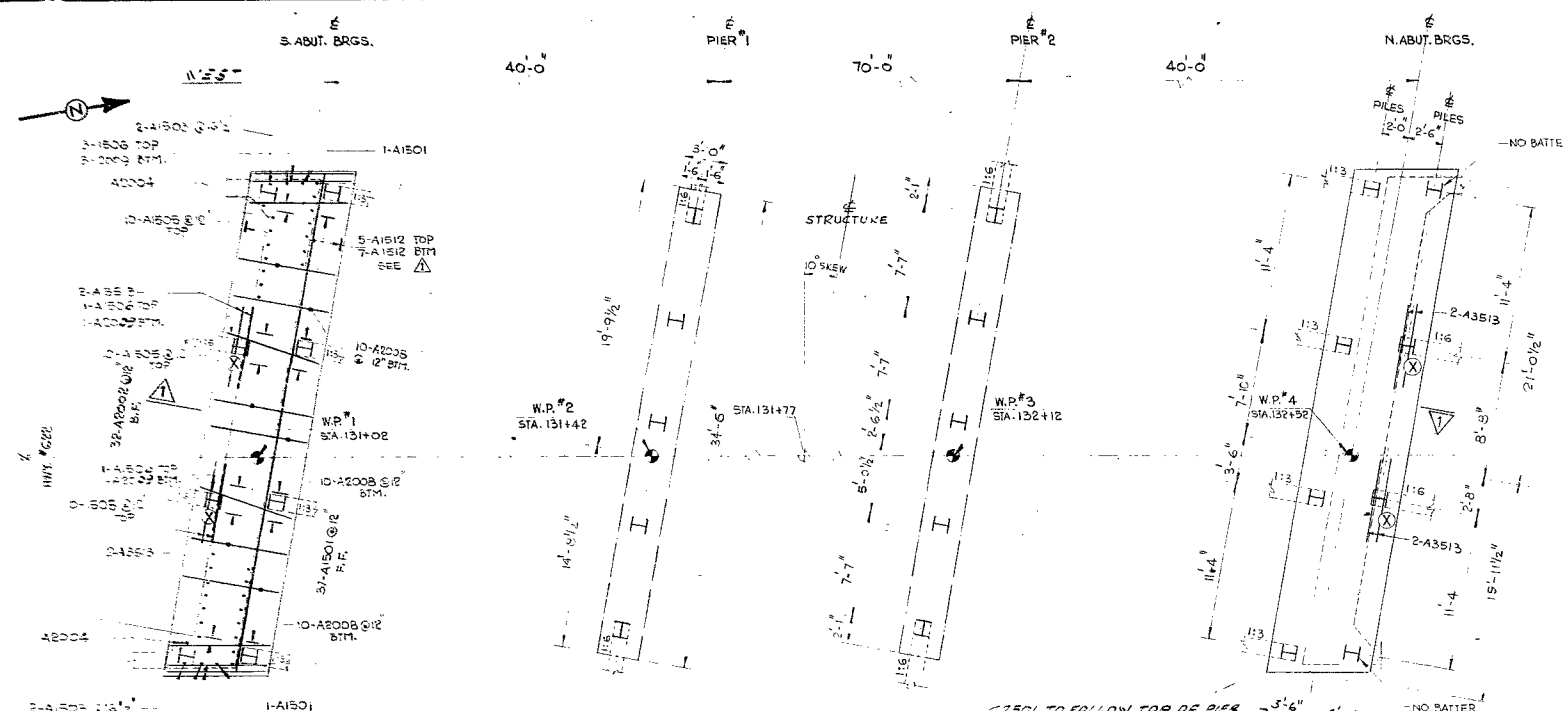
SKREW 10' 00' 00"  
SIN. 0.173648  
COS. 0.984808  
TAN. 0.176327



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	1/2	CHECK	LOADINGS 20-44
DRAWING	1/2	CHECK	SITE No 45-112
			DWG 1

528-5

DIST. 19	CONT No	SHEET
WP	No 201-77-02	
ATIKOKAN RIVER BRIDGE AT SECONDARY HWY. 622 FOOTINGS AND PIERS		



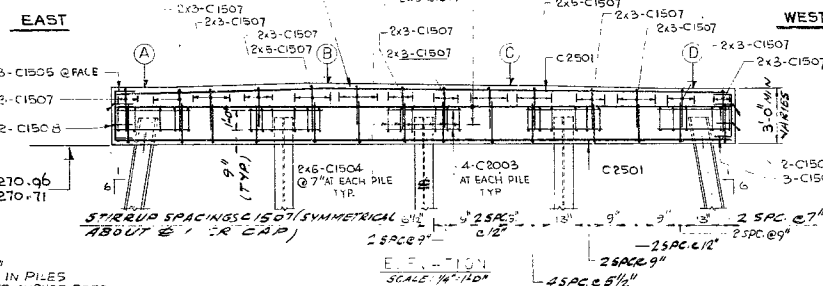
STEEL W PILES				
LOCATION	TYPE	Nº PROD.	PILE LENGTH	REMARKS
S. ABUT.	HP 12x53	8	125'-0"	DRIVING SHOES
PIER #1	HP 12x53	5	130'-0"	DO
PIER #2	HP 12x53	5	118'-0"	DO
N. ABUT.	HP 12x53	8	174'-0"	DO

NOTE:  
PILES TO BE DRIVEN TO BED ROCK.  
PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING.  
REINFORCING STEEL IN NORTH ABUTMENT.  
FOOTING SIMILAR TO SOUTH ABUTMENT FOOTING.

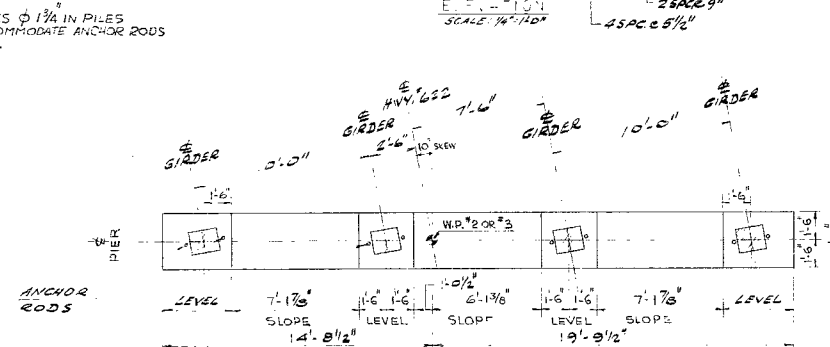
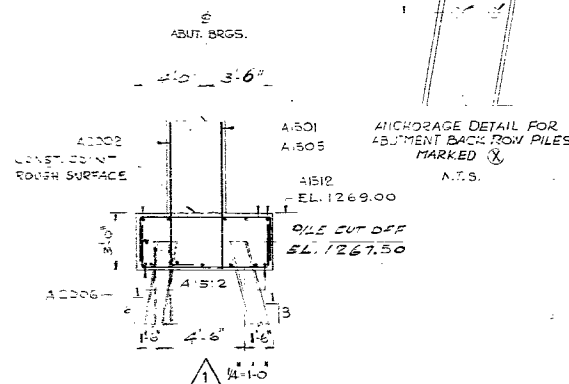
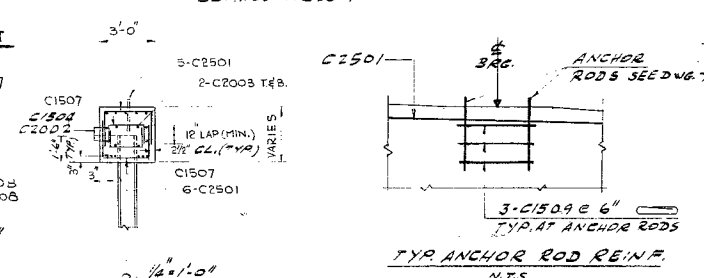
NOTE FOR DIMENSIONS  
SEE NORTH ABUTMENT

FOOTING LAYOUT  
SCALE: 3/16"=1'-0"

PIER CAP ELEVATIONS				
	A	B	C	D
PIER #1	1274.09	1274.28	1274.17	1273.96
PIER #2	1273.83	1274.03	1273.92	1273.71

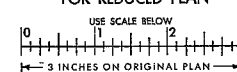


ANCHOR RODS SEE  
DETAILS ON DWG. 7



PLAN  
SCALE: 1/4"=1'-0"

FOR REDUCED PLAN



REVISIONS		DESCRIPTION	
DATE	BY	LOADINGS	20-44
DESIGN	CHECK	CHECK	DATE 78
DRAWING	CHECK	CHECK	SITE No 45-112 DWG 5



DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 52B-5

DIST. 19 REGION Northwestern

W.P. No. 201-77-02

CONT. No. 78-100

W. O. No. \_\_\_\_\_

STR. SITE No. 45-112

HWY. No. 622

LOCATION Atikokan River  
Bridge

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 3

REMARKS: documents to be unfolded  
before microfilming

## FOUNDATION INVESTIGATION REPORT

For

Atikokan River Bridge  
0.6 Mile North of Hwy. 11B, Atikokan  
Hwy. 622, District 19, Thunder Bay  
W.P. 201-77-02, Site 45-112

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INTRODUCTION

This report contains the results of a foundation investigation carried out for the proposed new structure at the crossing of Atikokan River and Secondary Hwy. 622 (Saturn Avenue) during the period of December 2-20, 1977. The fieldwork consisted of four sampled boreholes. The borings were advanced by employing 3½ inch I.D. hollow stem augers and conventional washboring techniques (BX casing).

SITE DESCRIPTION

The structure site is located at the crossing of Atikokan River and Secondary Hwy. 622, some 0.6 miles north of the junction of Hwy. 11B and Secondary Hwy. 622. The river passes through the Town of Atikokan, along a meandering course within a 0.25 mile wide valley. The channel at this location is about 100 feet wide and 6 to 7 feet deep. The profile grade of the north approach is about 5 feet higher than the original ground. The south approach in part is located within a 7 foot deep cut. The low ground (flood plain) is a marshland with light bush cover. The high ground in the vicinity of the south approach, west of the highway, is bush covered and on the east side the town's golf course is situated.

SUBSURFACE CONDITIONSGeneral

The original subsoil at the site was found to consist of alternate zones of cohesive and granular type deposits. The borings have indicated that the bedrock is located over 100 feet below the ground surface. The boundaries between the different strata, together with the obtained field and laboratory test results, are shown on the Record of Borehole Sheets contained in the Appendix.



The estimated stratigraphical profile inferred from this data is shown on Drawing No. 45-112-2 of the Contract Drawings. A detailed description of the different subsoil types is given below.

#### Sand and Gravel - Fill Material

This sand and gravel stratum was encountered in boreholes put down through the existing roadway. The thickness on the south side is about 2 feet and on the north is 7-10 feet. It appears that the original surficial subsoil has been subexcavated to a depth of about 5 feet and backfilled with sand and gravel material.

#### Silty Sand

A surficial approximate 10 foot thick deposit of silty sand with occasional clayey silt layers was intersected in Borehole 3. The relative density may be described as loose.

#### Silty Clay to Clayey Silt

This deposit was encountered immediately below the sand and gravel and silty sand zones in all boreholes. The thickness was found to vary from 5 to 16 feet. The material consists of stratified silty clay to clayey silt with some sand. Occasionally, highly plastic clay layers were also found within the main deposit. The natural moisture content in general is about 22%. In-situ vane test results varied randomly between 640 and 2080 PSF, indicating that the consistency ranges from firm to very stiff. The extreme upper portion (about 12-18 inches) was found to be very soft.

#### Sandy Silt to Silty Sand

An extensive granular type deposit was found below the silty clay to clayey silt zone. The material in the deposit consists of sands and silts with some clay and traces of gravel. Thin layers (up to  $\frac{1}{2}$  inch) of clayey silt were also observed within the overall stratum. Mechanical analyses gave the following grain size distributions: Gravel - 0-3%, Sand - 3-92%, Silt - 7-81% and Clay - 0-19%. The grain size distribution curves are plotted in envelope form on Figure 1. Based on the Standard Penetration Test 'N' values (8-24 blows per foot) the relative density may be described as loose to compact.

### Silty Clay to Clayey Silt (Lower Zone)

The sandy silt to silty sand stratum is underlain by a second zone of silty clay to clayey silt for a minimum distance of 50 feet. In B.H. 4 the thickness is about 90 feet. The material in the deposit consists of stratified silty clay to clayey silt with occasional sandy silt layers. The natural moisture content ranges from 30 to 40%. The consistency is estimated to vary between firm to very stiff.

### Sand and Gravel With Boulders

A sand and gravel layer was encountered below the silty clay to clayey silt deposit. The thickness was found to vary between 3 and 20 feet. Drilling with a tri-cone bit was required to penetrate this zone. Frequent boulders were also evident.

### Bedrock

Argillite type bedrock was encountered in Borehole 1 at elevation 1145+. The bedrock was proven at this location only. At other boring locations the bedrock surface was assumed to be at levels where refusal to tri-cone drilling was reached:

B.H. #3      Elev. 1151.8

B.H. #4      Elev. 1095.2

In Borehole 2 no refusal was reached within 141 feet below ground level (elev. 1132).

### Groundwater

The following groundwater levels were observed during the field investigation:

B.H. #2      Elev. 1267.0

#3      Elev. 1267.5

#4      Elev. 1267.5

In Borehole 1 artesian conditions were encountered at elevation 1146 and stabilized at elevation 1275, some 4 feet above the existing ground level.

*P. Payer*  
P. Payer, P. Eng.  
Senior Engineer

*K. G. Selby*  
K.G. Selby, P. Eng.  
Supervising Engineer



June, 1978



RECORD OF BOREHOLE No 1

W P 201-77-02 LOCATION Sta. 130+89 o/s 25' Lt. of Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger, Washbore and BX Rock COMPILED BY PP  
DATUM Geodetic DATE December 2, 7, 8, 9 and 12, 1977 Coring CHECKED BY JES

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	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH PSF									
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE								
1271.0	Ground Level																
1269.0	Sand & Gravel - Fill						1270										
2.0	Stratified Silty Clay to Clayey Silt		1	SS	4				+ S=9			W <sub>L</sub> 82%					
	Raddish Brown		2	TH	PR		1260		+ S=4								
	Trace of Sand																
	Occasional Clay Layers		3	SS	7								0 3 81 16				
1253.0	Firm to Very Stiff																
18.0	Sandy Silt to Silty Sand		4	SS	8		1250										
	Some Clay		5	SS	17												
	Trace of Gravel																
	Occasional Clayey Silt Layers		6	SS	21		1240						0 26 64 10				
	Compact		7	SS	17												
			8	SS	18		1230						0 15 71 14				
			9	SS	14		1220										
			10	SS	14		1210						0 8 80 12				
1206.0	Silty Clay to Clayey Silt																
65.0	Sandy Silt Layers		11	SS	3		1200										
	Firm to Very Stiff																
							1190										
			12	SS	10		1180						0 1 69 30				
							1170										
			13	SS	19		1160										
1152.5																	
118.5																	

Continued

3, x<sup>2</sup>: Numbers refer to  
Sensitivity

20  
15 ± 5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 1 Continued

W P 201-77-02 LOCATION Sta. 130+89 o/s 25' Lt. & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger, Washbore & BX Rock Coring COMPILED BY PP  
DATUM Geodetic DATE December 2, 7, 8, 9 and 12, 1977 CHECKED BY -

[illegible]

**+3, x5:** Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

13

10

## RECORD OF BOREHOLE No 2

[illegible]

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26



## RECORD OF BOREHOLE No 2 Continued

W P 201-77-02 LOCATION Sta. 132+59 o/s 17' Lt. & Hwy. 622 ORIGINATED BY PP  
 DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore COMPILED BY PP  
 DATUM Geodetic DATE December 3, 1977 CHECKED BY

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					
1154.5																	
118.5																	
							1150										
							1140										
1132.0																	
141.0	End of Borehole																
	Note: From 50 feet downward the borehole was advanced by washboring without sampling																

 +3, x5: Numbers refer to  
Sensitivity

 20  
15  $\pm$  5 (%) STRAIN AT FAILURE  
10

## RECORD OF BOREHOLE No 3

W P 201-77-02 LOCATION Sta. 130+96 o/s 38' Rt. & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 4-6, 1977 CHECKED BY CS

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						SHEAR STRENGTH PSF	WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
1269.0	Ground Level														
0.0	Silty Sand Occasional Clayey Silt Layers														
	Loose		1	SS	4		Augered 5'								
1258.5			2	SS	1/14"										
10.5	Silty Clay to Clayey Silt														
1253.7	Firm		3	SS	14								1 26 61 12		
15.3	Sandy Silt to Silty Sand Some Clay Trace of Gravel		4	SS	16								3 35 51 19		
	Occasional Clayey Silt Layers														
	Compact		5	SS	24										
						</									

### 117.2 Refusal to Tri-Cone

End of Borehole

\*3, x5 : Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



## RECORD OF BOREHOLE No 4

W P 201-77-02 LOCATION Sta. 132+57, o/s 19' Rt & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 14-20, 1977 CHECKED BY RS

[illegible]

Continued

+3, x5: Numbers refer to Sensitivity

20  
15  $\phi$  5 (%) STRAIN AT FAILURE  
10



HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4 Continued

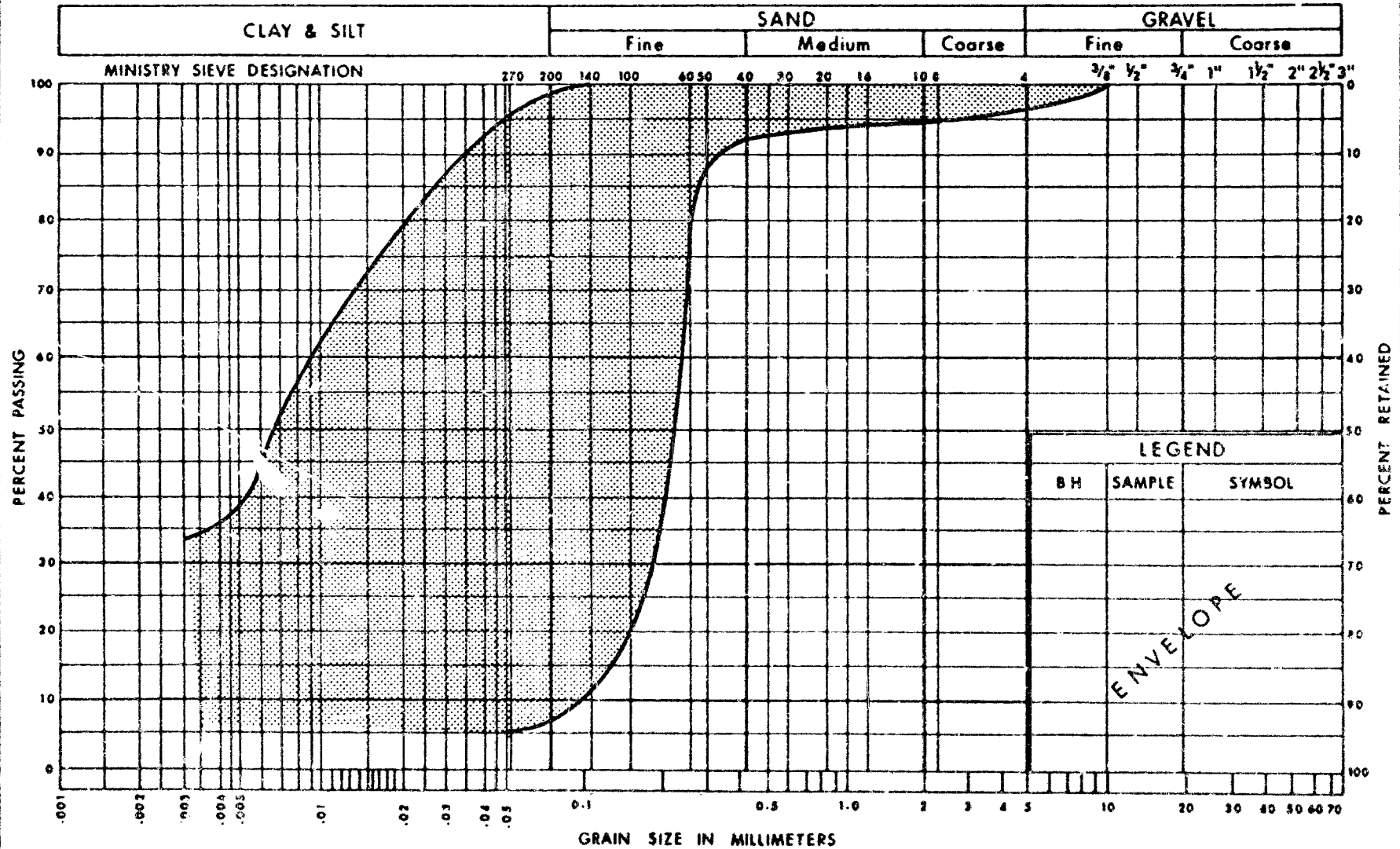
W P 201-77-02 LOCATION Sta. 132+57, o/s 19<sup>th</sup> Rt. & Hwy. 622 ORIGINATED BY PP  
DIST 19 HWY 622 BOREHOLE TYPE Continuous Flight Auger & Washbore & Cone Test COMPILED BY PP  
DATUM Geodetic DATE December 14-20, 1977 CHECKED BY RS

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				
1153.5																
118.5																
			5	SS	17		1150									
							1140									
							1130									
							1120									
1117.0							1110									
153.0	Sand & Gravel Frequent Boulders						1100									
1095.6	(Refusal)															
176.4	End of Borehole															

+3, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation and  
Communications

GRAIN SIZE DISTRIBUTION  
SANDY SILT TO SILTY SAND  
SOME CLAY, TRACE OF GRAVEL

FIG No 1

WP 201-77-02