DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 41K-41

DIST. 18 REGION

W.P. No. 148-65-00

CONT. No. 84-214

W. O. No.

STR. SITE No. 38S-41

HWY. No. 532

LOCATION Adrigan Creek

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

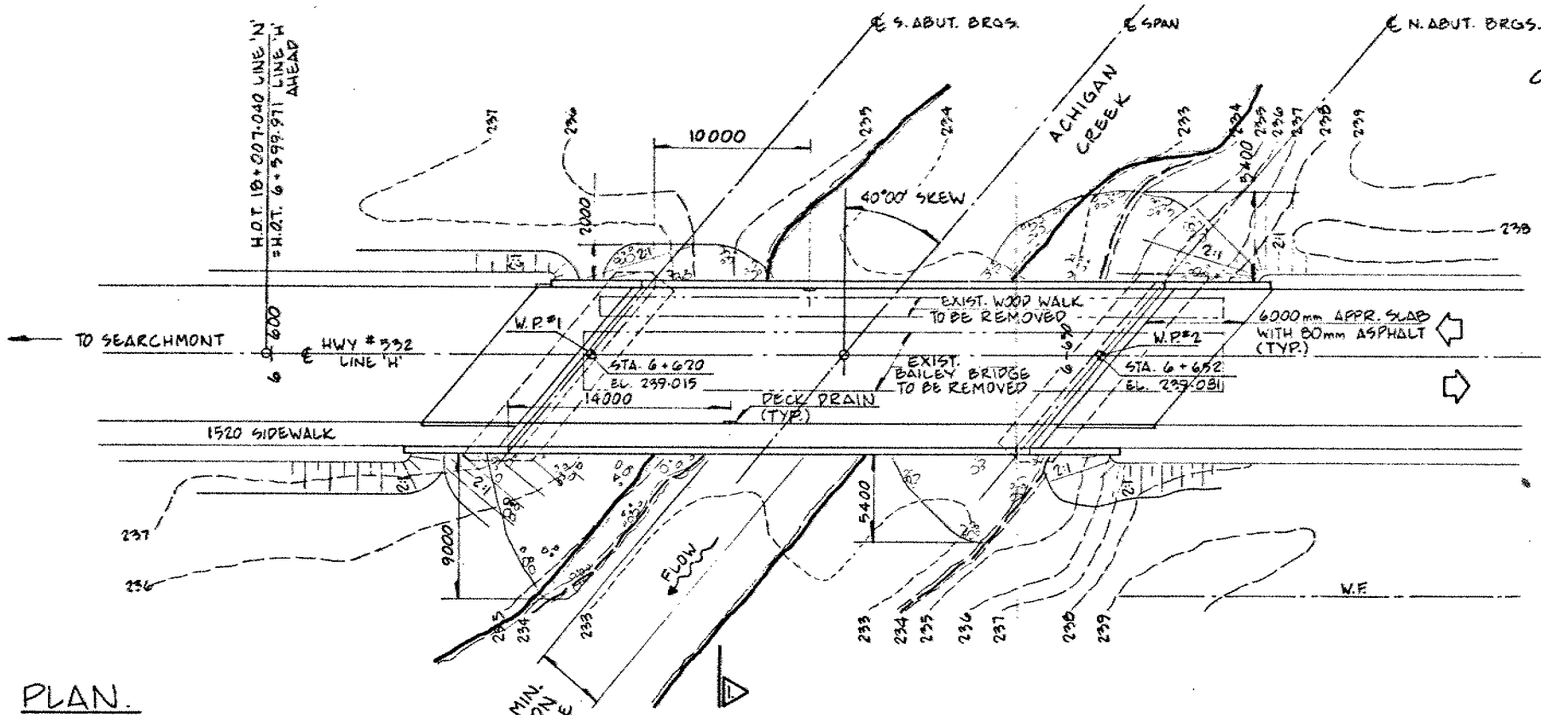
REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DB-BR (SM 79 04)

DIST. Nº 18	
CONT No	
WP No 148-65-00	
ACHIGAN CREEK BRIDGE GENERAL ARRANGEMENT	SHEET

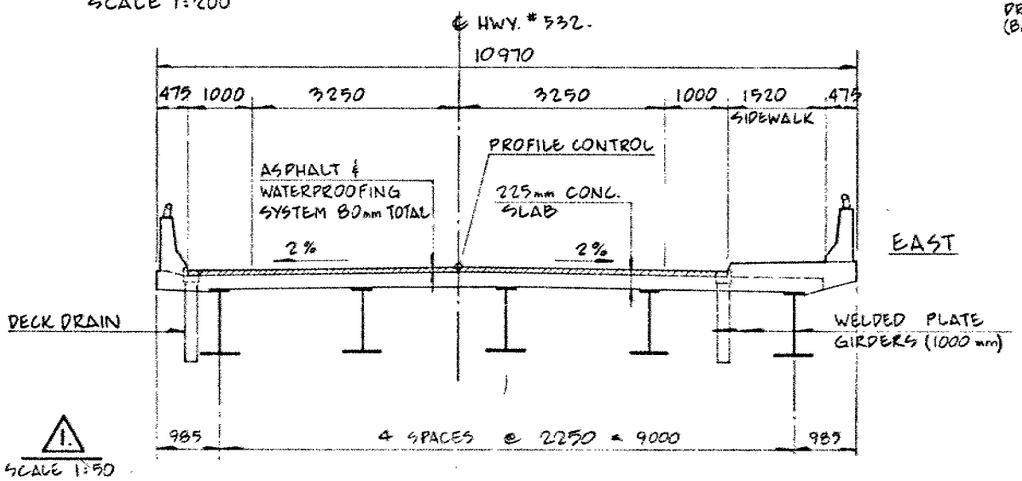
METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.



PLAN.
SCALE 1:200

ELEVATION.
SCALE 1:200



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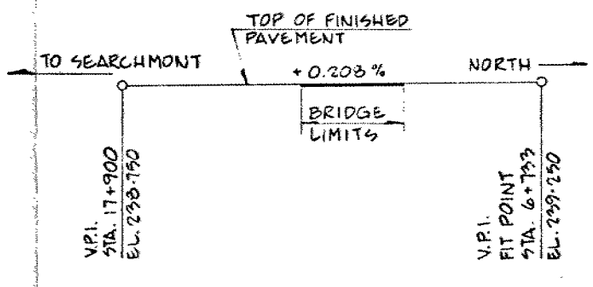


PROFILE @ ℄ HWY. # 532 'H'
N.T.S.

BM 238.955
GEODETIC DATUM
N. & W. IN FACE OF HYDRO POLE 8.9 LT 17+966.0

NOTES.

CLASS OF CONCRETE.
DECK, BARRIER WALLS, ABUTMENTS AND WINGWALLS — 30 MPa
REMAINDER — 20 MPa

REINFORCING STEEL.
GRADE 400 EXCEPT AS NOTED.
BARS MARKED WITH SUFFIX 'C' SHALL BE COATED BARS.

CLEAR COVER TO REINFORCING STEEL.
FOOTINGS. — 100 ± 25mm
DECK BOTTOM. — 40 ± 10mm
DECK TOP. — 70 ± 20mm
ABUTMENTS, WINGWALLS FRONT FACE. — 80 ± 20mm
REMAINDER OR AS NOTED ON DRAWINGS. — 70 ± 20mm

CONSTRUCTION NOTES.

THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ±3 mm.

LIST OF DRAWINGS.

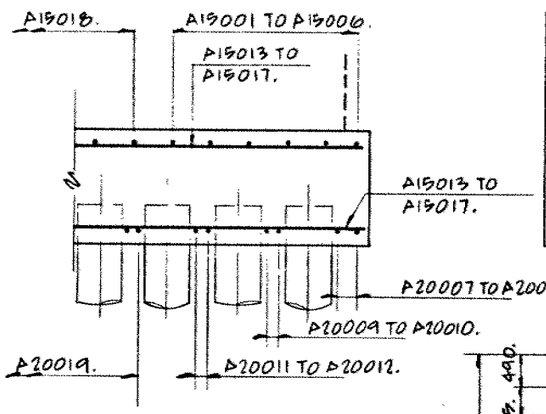
DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN DCB	CHECK AH	LOADING SHBD 79-3	DATE 82-07
DRAWING LV	CHECK DCB	SITE No 3355-41	DWG 1

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO OSB-BR 1341 81-08

PILE DATA.			PILE DESIGN DATA.	
LOCATION.	No.	LENGTH.	LOAD & SLS TYPE ☐	FACTORED CAPACITY @ ULS
SOUTH ABUTMENT 1:4.	26	16.000.	185.KN	320.KN
1:10.	14	15.300.	185.KN	320.KN
NORTH ABUTMENT 1:4.	26	16.000.	185.KN	320.KN
1:10.	14	15.300.	185.KN	320.KN



SOUTH ABUTMENT FOOTING AND PILE LAYOUT.

NORTH ABUTMENT SIMILAR BUT OPPOSITE HAND. EXCEPT AS NOTED.
SCALE 1:50.

NORTH ABUTMENT FOOTING REINFORCEMENT.

SOUTH ABUTMENT SIMILAR BUT OPPOSITE HAND.
SCALE 1:50.

METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

DIST No 18.
CONT No
WP No 48-65-00.

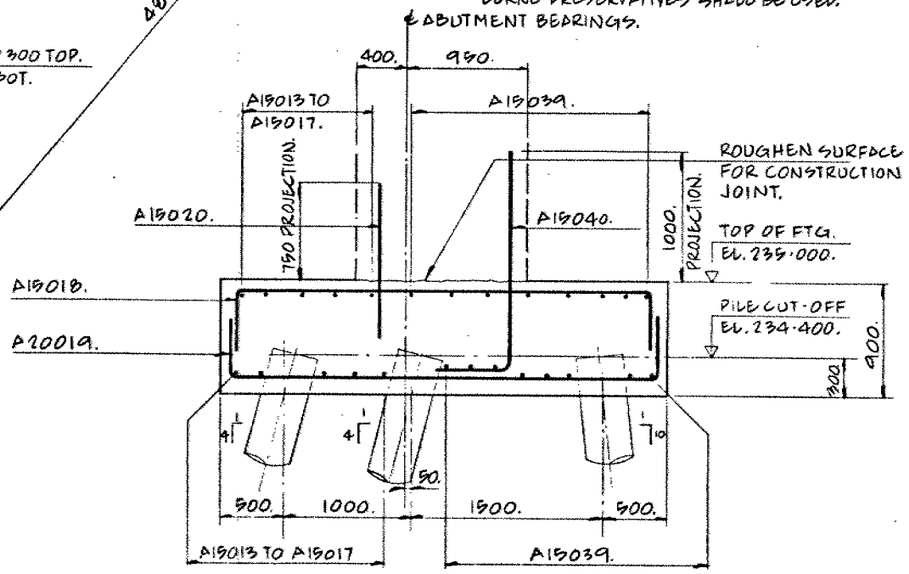
ACHIGAN CREEK BRIDGE
FOOTING LAYOUT AND DETAILS

SHEET

REGISTERED PROFESSIONAL ENGINEER — CIVIL — D. C. BATCHELOR — PROVINCE OF ONTARIO

NOTES

1. ALL PILES #36 TIMBER PILES.
2. PILE LENGTH ON DRAWING IS THEORETICAL LENGTH BELOW CUT-OFF.
3. DRIVING SHOES TO BE PROVIDED IN ACCORDANCE WITH STANDARD DD-3303.
4. PILES TO BE TREATED WITH CREOSOTE-RETENTION OF 130 KG/M³. TREATMENT SHALL BE IN ACCORDANCE WITH CSA STANDARDS O80.14 AND AWPA STANDARDS M1, M2 AND M4. ONLY OIL BORNE PRESERVATIVES SHALL BE USED.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN JCB	CHECK DW	LOADING 2+22+79+C	DATE 82-07	
DRAWING JTT	CHECK JCB	SITE 58-7-31	DWG 3	

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 84-214

Ontario
Ministry of
Transportation and
Communications

INDEX

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

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
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

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 = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

FOUNDATION INVESTIGATION REPORT

For

ACHIGAN CREEK CROSSING AND HIGHWAY 532
W. P. 148-65-00, Site 38S-41
District 18, Sault Ste. Marie

INTRODUCTION

This report contains the results of a foundation investigation that was performed at the above-mentioned site. The investigation was commenced on September 5, 1981 and continued to completion on September 6, 1981. Two boreholes were advanced using hollow stem continuous flight augers. The boreholes ranged in depth from 26.1 metres to 26.8 metres. One dynamic cone penetration test was also conducted and advanced to a depth of 27.5 metres. Bedrock was not encountered in any of the borings to the depths investigated at the site.

SITE DESCRIPTION AND GEOLOGY

The site is located 28.2 kilometres east of secondary Highway 552 just north of Searchmont in the Townships of Hodgins and Gaudette, District of Algoma.

The existing structure is a single lane, approximately 23 metre span bailey bridge founded on timber pads. The existing bailey bridge has been assembled directly over an old timber trestle bridge which shows signs of being reinforced, however, has lost much of its structural integrity. The wood walk shows signs of severe deterioration and it is recommended that in the interim some of the timber decking be replaced.

Achigan Creek is a slow meandering creek with negligible velocities at the time of the investigation, however, velocities are known to be quite high at peak runoff periods. The creek is approximately 20 metres

wide and 0.5 to 1 metre deep at this location with relatively steep banks. Some river bank distress caused by erosion and undercutting of the creek bank has been observed both upstream and downstream from the bridge, however, due to the amount of growth on these slopes, this erosion does not present any serious problem.

The topography at the site is relatively flat to gently rolling and the vicinity of the crossing is heavily wooded, although there are scattered residential areas both north and south of this location. The Achigan Creek is located in an ancient glacial river valley with the relative relief in the distance greater than 60 metres.

According to available information, the bedrock in parts of the Goulais River Valley, which encompasses Achigan Creek, is covered by extensive deposits of thick overburden. The underlying materials in the Goulais River Valley are of a glaciofluvial landform (outwash) and vary from varied silt and clay to glacial till and bedrock. The bedrock is of the Middle Precambrian era and consists of a felsic intrusive and metamorphic rock.

SUBSURFACE CONDITIONS

The predominant deposit underlying the site is a grey stratified silty clay (CL - CI). This silty clay deposit was explored to a maximum depth of 27.5 metres below the ground surface, i. e., elevation 210.8. The lower boundary of this deposit was not established.

The overlying material consists of a fine sandy silt to a fine sand with some silt, with traces of clay, gravel and organics. This non-cohesive material was encountered for a maximum thickness of 6.2 metres of which 2.0 metres is a native fill material.

The boundaries between the various soil types, insitu and laboratory test results are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, are shown on Drawing No. 2.

The various subsoil types encountered are briefly described in the following paragraphs.

Surficial Material

Overlying the site in the vicinity of the approaches to the river, and encountered for depths ranging from 2.8 metres to 6.2 metres, is a brown non-cohesive fine sandy silt to a fine sand with some silt, with traces of clay, gravel and organics. The south bank consists of a surficial deposit of fill approximately 2 metres in depth. This fill material is a native soil and consists of a fine sandy silt with traces of gravel and clay.

Based on the interpretation of the 'N' values obtained from the Standard Penetration Test, it can be inferred that the surficial material is in a very loose to loose state.

Typical grain size distribution curves obtained in this strata are shown in envelope form on Figure 1.

Silty Clay

The predominate strata underlying the surficial material and explored to a maximum depth of 27.5 metres, i. e., elevation 210.8, is a grey stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity (CL - CI). The silty clay

deposit behaved in a brittle manner with moderately high sensitivity.

Typical grain size distribution curves obtained in this strata are shown in envelope form on Figure 1. Results of insitu vane testing and laboratory testing indicate shear strengths for this deposit ranging from a low of 49 kPa in the upper portion of the deposit to greater than 106.7 kPa in the lower portion of the deposit. Based on these values, the consistency of this silty clay deposit can be described as stiff in the upper portion of the deposit to very stiff in the lower portion of the deposit.

The results of the Atterberg Limit Tests are plotted on the Plasticity Chart, Figure 2, and indicate the deposit to be an inorganic silty clay of low to medium plasticity.

The following is a summary of the foundation field and laboratory results obtained for the silty clay stratum.

	Range	Average
Natural Moisture Content (W)%	32-50	38
Liquid Limit (W_L)%	28-40	35
Plastic Limit (W_P)%	18-20	19
Plasticity Index (I_P)%	10-20	16
Bulk Unit Weight (γ) kN/m^3	17.7-18.6	18.2
Shear Strength (Cu) kPa		
- field vane test	61->106.7	95
- unconfined compression test	49-68	54.5
- triaxial compression test	68.6-106.0	80.5
Sensitivity (field)	2-10	6

GROUNDWATER CONDITIONS

Groundwater elevations were obtained in both Borehole No. 1 and Borehole No. 2 at the time of the investigation and were found to be at elevation 234.1 and 233.5 respectively. As can be seen, a more stabilized groundwater level, as is the case in Borehole No. 1, generally

reflects the creek water levels at the crossing which varied from elevation 234.1 (81 09 05) to 234.2 (81 09 06). According to available information, normal creek water levels are approximately elevation 233.5 with a 3.5 metre flood rise.

Brian Ruck
Trainee Engineer

M. Devata, P. Eng.
Senior Foundations Engineer

BR:MD:syc

83 03 08

APPENDIX

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC 9

W P 148-65-00 LOCATION Sta. 6+624.1; o/s 6.1 m Lt. of ℄ Highway 532 ORIGINATED BY N. S.

DIST 18 HWY 532 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.

DATUM Geodetic DATE 81 09 05 CHECKED BY GP

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Ground Surface							20 40 60 80 100	20 40 60		
0.0	Fine sandy silt with traces of clay and gravel and organics Very loose to loose Brown		1	SS	3		236				4 39 48 9
			2	SS	5	*					
			3	SS	3		234				2 40 52 6
			4	SS	1						
231.6			5	SS	4		232				
6.2	Stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity Moderately high sensitivity stiff very stiff		6	SS	5			+ 8, +4			
			7	TW	PH		230	+ 2, +4		18.5	0 0 60 40
			8	TW	PH		228	+7, + 7			
							226	+ 8, +4			
			9	TW	PH		224	+10, +5, >+		17.7	0 0 54 46
	Brittle Grey		10	TW	PH		222				
							220	>+			
			11	SS	2		218	>+	o		
							216				
			12	SS	4		214	>+			
211.0			13	SS	5		212	>+	10		
26.8	End of Borehole *Water level obtained on 81 09 06										

+³, ×⁵ : Numbers refer to Sensitivity

20 / 15 ◇ 5 (%) STRAIN AT FAILURE / 10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC 10

W P 148-65-00 LOCATION Sta. 6+657.2; o/s 6.9 m Rt. of ℄ Highway 532 ORIGINATED BY N. S.
DIST 18 HWY 532 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.
DATUM Geodetic DATE 81 09 06 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Ground Surface										
0.0	Fine sand with some silt and traces of clay and organics		1	SS	5						0 77 15 8
			2	SS	5		236				
235.0	Loose Brown										
2.8	Stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity		3	SS	6	*					
			4	SS	4		234				
							232				
			5	TW	PH		230			18.6	0 1 54 45
	Very stiff										
			6	SS	3		228				
	Brittle						226				
	Grey		7	SS	1		224				
			8	SS	5		222				
							220				
			9	SS	3		218				
							216				
			10	TW	PH					18.0	0 1 50 49
211.7							214				
			11	SS	9		212				
26.1	End of Borehole										
	*Water level obtained on 81 09 06										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 (%) STRAIN AT FAILURE / 10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3

METRIC 11

W P 148-65-00 LOCATION Sta. 6+661.7; o/s 4.8 m Lt. of ℄ Highway 532 ORIGINATED BY N. S.

DIST 18 HWY 532 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N. S.

DATUM Geodetic DATE 81 09 06 CHECKED BY

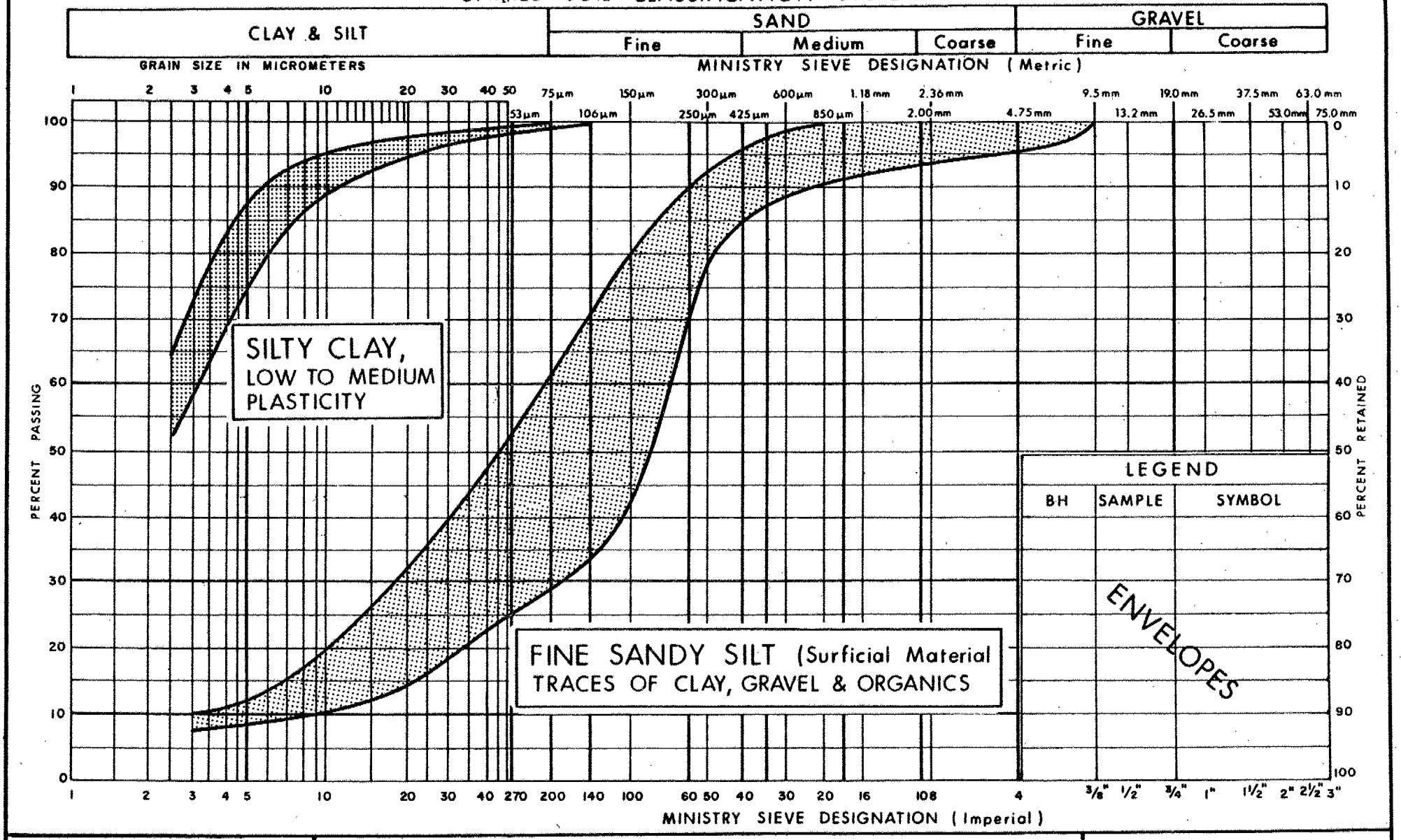
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT W_p / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
238.3	Ground Surface										
0.0							238				
							236				
							234				
							232				
							230				
							228				
							226				
							224				
							222				
							220				
							218				
							216				
							214				
							212				
210.8											
27.5	End of Cone Test							100/76 mm			

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

UNIFIED SOIL CLASSIFICATION SYSTEM



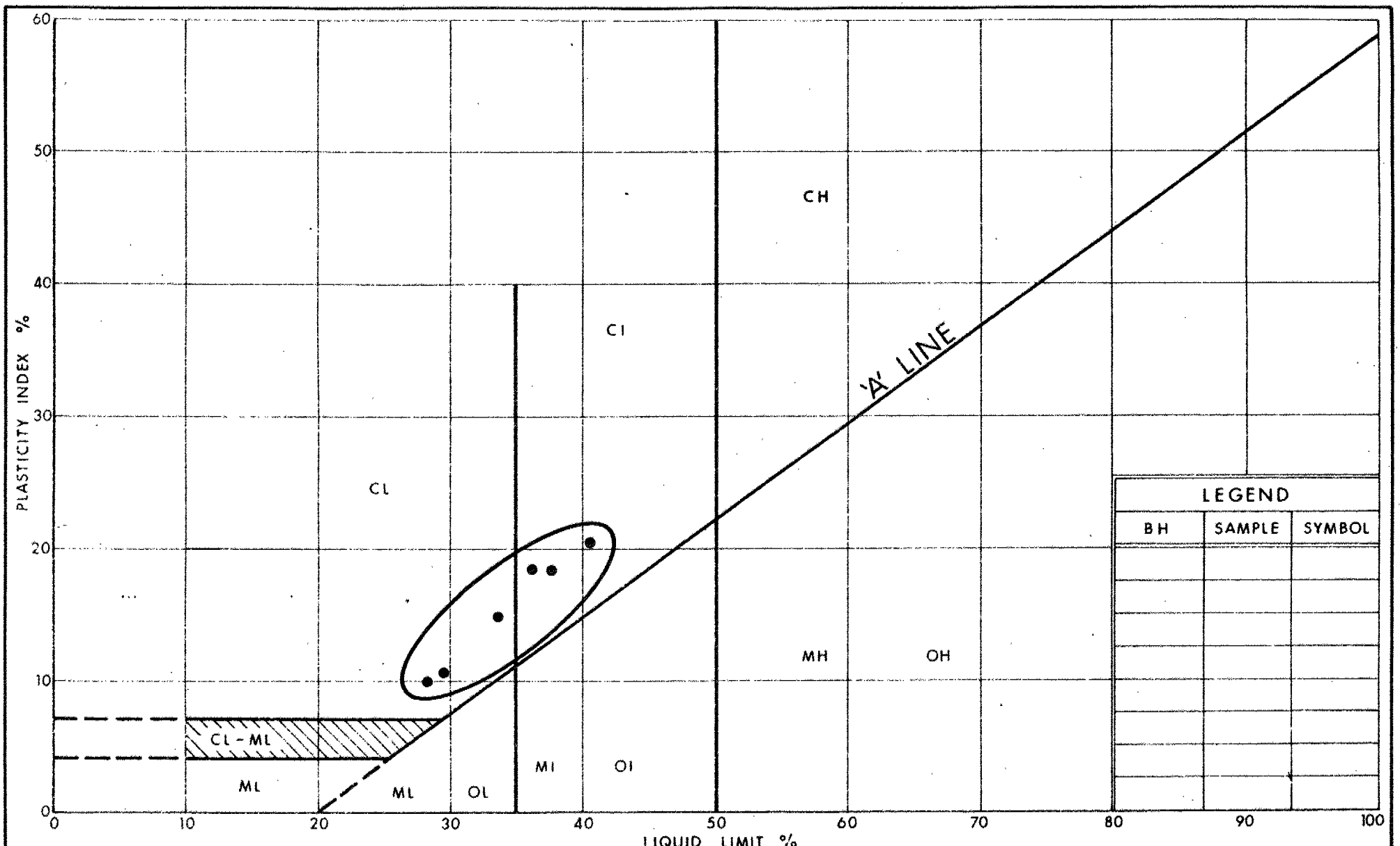
Ontario Ministry of Transportation and Communications

GRAIN SIZE DISTRIBUTION

FIG No 1

W P 148-65-00

12



Ministry of Transportation and Communications
Ontario

PLASTICITY CHART

SILTY CLAY, OF LOW TO MEDIUM PLASTICITY

FIG No 2
W P 148-65-00

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 148-65-00 DIST 18

HWY 532 STR SITE 38S-41

ACHIGAN CREEK CROSSING AND HIGHWAY 532

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Files

GEOCRES 41K-41

DATE NOV 04 1981

FOUNDATION INVESTIGATION REPORT
For
ACHIGAN CREEK CROSSING AND HIGHWAY 532
W. P. 148-65-00, Site 38S-41
District 18, Sault Ste. Marie

INTRODUCTION

This Report contains the results of a foundation investigation that was performed at the above-mentioned site and provides recommendations to the structure foundations and the related earthworks. The investigation was commenced on September 5, 1981 and continued to completion on September 6, 1981. Two boreholes were advanced using hollow stem continuous flight augers. The boreholes ranged in depth from 26.1 metres to 26.8 metres. One dynamic cone penetration test was also conducted and advanced to a depth of 27.5 metres. Bedrock was not encountered in any of the borings to the depths investigated at the site.

SITE DESCRIPTION AND GEOLOGY

The site is located 28.2 kilometers east of secondary Highway 552 just north of Searchmont in the Townships of Hodgins and Gaudette, District of Algoma.

The existing structure is a single lane, approximately 23 metre span bailey bridge founded on timber pads. The existing bailey bridge has been assembled directly over an old timber trestle bridge which shows signs of being reinforced, however, has lost much of its structural integrity. The wood walk shows signs of severe deterioration and it is recommended that in the interim some of the timber decking be replaced.

Achigan Creek is a slow meandering creek with negligible velocities at the time of the investigation, however, velocities are known to be quite high at peak runoff periods. The creek is approximately 20 metres

wide and 0.5 to 1 metre deep at this location with relatively steep banks. Some river bank distress caused by erosion and undercutting of the creek bank has been observed both upstream and downstream from the bridge, however, due to the amount of growth on these slopes, this erosion does not present any serious problem.

The topography at the site is relatively flat to gently rolling and the vicinity of the crossing is heavily wooded, although there are scattered residential areas both north and south of this location. The Achigan Creek is located in an ancient glacial river valley with the relative relief in the distance greater than 60 metres.

According to available information, the bedrock in parts of the Goulais River Valley, which encompasses Achigan Creek, is covered by extensive deposits of thick overburden. The underlying materials in the Goulais River Valley are of a glaciofluvial landform (outwash) and vary from varied silt and clay to glacial till and bedrock. The bedrock is of the Middle Precambrian era and consists of a felsic intrusive and metamorphic rock.

SUBSURFACE CONDITIONS

The predominant deposit underlying the site is a grey stratified silty clay (CL - CI). This silty clay deposit was explored to a maximum depth of 27.5 metres below the ground surface, i. e., elevation 210.8. The lower boundary of this deposit was not established.

The overlying material consists of a fine sandy silt to a fine sand with some silt, with traces of clay, gravel and organics. This non-cohesive material was encountered for a maximum thickness of 6.2 metres of which 2.0 metres is a native fill material.

The boundaries between the various soil types, insitu and laboratory test results are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, are shown on Drawing No. 1486500-A.

The various subsoil types encountered are briefly described in the following paragraphs.

Surficial Material

Overlying the site in the vicinity of the approaches to the river, and encountered for depths ranging from 2.8 metres to 6.2 metres, is a brown non-cohesive fine sandy silt to a fine sand with some silt, with traces of clay, gravel and organics. The south bank consists of a surficial deposit of fill approximately 2 metres in depth. This fill material is a native soil and consists of a fine sandy silt with traces of gravel and clay.

Based on the interpretation of the 'N' values obtained from the Standard Penetration Test, it can be inferred that the surficial material is in a very loose to loose state.

Typical grain size distribution curves obtained in this strata are shown in envelope form on Figure 1.

Silty Clay

The predominate strata underlying the surficial material and explored to a maximum depth of 27.5 metres, i. e., elevation 210.8, is a grey stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity (CL - CI). The silty clay

deposit behaved in a brittle manner with moderately high sensitivity.

Typical grain size distribution curves obtained in this strata are shown in envelope form on Figure 1. Results of insitu vane testing and laboratory testing indicate shear strengths for this deposit ranging from a low of 49 kPa in the upper portion of the deposit to greater than 106.7 kPa in the lower portion of the deposit. Based on these values, the consistency of this silty clay deposit can be described as stiff in the upper portion of the deposit to very stiff in the lower portion of the deposit.

The results of the Atterberg Limit Tests are plotted on the Plasticity Chart, Figure 2, and indicate the deposit to be an inorganic silty clay of low to medium plasticity.

The following is a summary of the foundation field and laboratory results obtained for the silty clay stratum.

		Range	Average
Natural Moisture Content	(W)%	32-50	38
Liquit Limit	(W_L)%	28-40	35
Plastic Limit	(W_P)%	18-20	19
Plasticity Index	(I_P)%	10-20	16
Bulk Unit Weight	(γ) kN/m^3	17.7-18.6	18.2
Shear Strength	(Cu) kPa		
- field vane test		61- >106.7	95
- unconfined compression test		49-68	54.5
- triaxial compression test		68.6-106.0	80.5
Sensitivity (field)		2-10	6

GROUNDWATER CONDITIONS

Groundwater elevations were obtained in both Borehole No. 1 and Borehole No. 2 at the time of the investigation and were found to be at elevation 234.1 and 233.5 respectively. As can be seen, a more stabilized groundwater level, as is the case in Borehole No. 1, generally

reflects the creek water levels at the crossing which varied from elevation 234.1 (81 09 05) to 234.2 (81 09 06). According to available information, normal creek water levels are approximately elevation 233.5 with a 3.5 metre flood rise.

DISCUSSION AND RECOMMENDATIONS

A new permanent structure, maintaining the same alignment, is proposed to replace the existing single lane bailey bridge carrying Highway 532 over Achigan Creek. The new single span structure will be approximately 30 metres long and 11 metres wide. A grade raise in the order of 1.0 metre (i. e., profile elevation of 239.0) is also contemplated for the proposed bridge.

Recommendations pertaining to the foundations of the replacement structure and related earthworks follow.

Structure Foundations

It is recommended that the structure be supported on friction piles driven a sufficient depth to mobilize the required capacity. A size 36 treated timber pile driven to a minimum embeddment of 12.0 metres can be designed for a safe design loading of 145 kN/pile. Alternatively, the same pile embedded a minimum of 15 metres can be designed for 185 kN/pile. Net settlements of the pile foundations under these recommended loads should not exceed 25 mm.

Recommended design parameters based on the O. H. B. D. C. are as follows:

Size 36 Treated Timber Pile Embedded	Factored Capacity at U. L. S.	Capacity at S. L. S. Type II
12 metres	260 kN	145 kN
15 metres	320 kN	185 kN

Construction Considerations

Removal of the existing piles in the vicinity of the proposed abutments is required before placement of the new timber piles.

Although the subsurface soils investigation shows no signs of cobbles or boulders being encountered at the borehole locations, a surficial obeervation indicates that some difficulty may be anticipated in advancing the timber piles through the existing fills due to the presence of cobbles and boulders. In order to facilitate pile penetration through the fill, it is recommended that pre-augering techniques in the fill material or removal of the existing fill materials be employed in order to prevent any damage to the timber piles. If the existing fill material is removed, it should be backfilled with well compacted granular material having a maximum gradation of 150 mm.

Earth pressures should be computed as per Subsection 6.6.1.2.2 of the O. H. B. D. C.

For frost protection purposes, the underside of the pile caps should have a minimum 1.8 metres of earth cover.

No stability problems are anticipated for the proposed embankments, provided they are constructed not steeper than 2:1.

Adequate precautions should be taken to protect the river banks and approach embankment from river scour action. This may be achieved by a suitably placed rip rap scheme.

Dewatering difficulties are anticipated for excavation of the pile caps carried down below prevailing water level due to the pervious nature of the surficial material. In order to minimize major dewatering difficulties, the base of the pile cap should not be built below prevailing water levels. If high water levels in Achigan Creek prevail during excavation operations, a more elaborate procedure to prevent water infiltration must be implemented. This could be achieved by driving temporary sheet piles into the impervious silty clay stratum.

MISCELLANEOUS

The fieldwork for this investigation was carried out and written by Mr. N. Stea, Project Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.

The equipment used for the investigation was owned and operated by Master Soil Investigation Ltd., Sudbury.

N. Stea, P. Eng.,
Project Foundations Engineer

M. Devata, P. Eng.,
Senior Foundations Engineer

APPENDIX

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC

W P 148-65-00 LOCATION Sta. 6+624.1; o/s 6.1 m Lt. of ℄ Highway 532 ORIGINATED BY N. S.

DIST 18 HWY 532 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.

DATUM Geodetic DATE 81 09 05 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Ground Surface										
0.0	Fine sandy silt with traces of clay and gravel and organics Very loose to loose		1	SS	3						
			2	SS	5		236				4 39 48 9
			3	SS	3	*					
			4	SS	1	▼	234				2 40 52 6
	Brown		5	SS	4						
231.6							232				
6.2	Stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity Moderately high sensitivity stiff very stiff		6	SS	5			+8 +4			
			7	TW	PH		230	○ ● +2 +4	⊢○	18.5	0 0 60 40
			8	TW	PH		228	+7 +7			
							226	+8 +4			
			9	TW	PH		224	○ ● +10 +5 >+	⊢●	17.7	0 0 54 46
	Brittle Grey						222				
			10	TW	PH		220	>+			
			11	SS	2		218	>+	⊢○		
							216				
			12	SS	4		214	>+			
211.0			13	SS	5		212	>+	⊢○		
26.8	End of Borehole *Water level obtained on 81 09 06										

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 148-65-00 LOCATION Sta. 6+657.2; o/s 6.9 m Rt. of ℄ Highway 532 ORIGINATED BY N. S.

DIST 18 HWY 532 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.

DATUM Geodetic DATE 81 09 06 CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.8	Ground Surface										
0.0	Fine sand with some silt and traces of clay and organics		1	SS	5						0 77 15 8
			2	SS	5		236				
	Loose										
235.0	Brown										
2.8			3	SS	6	*					
	Stratified silty clay with alternating layers of silty clay of low plasticity and silty clay of medium plasticity						234				
			4	SS	4			>+			
							232				
			5	TW	PH			b ● +5			18.6 0 1 54 45
							230				
	Very stiff										
							228				
			6	SS	3						
							226				
	Brittle										
	Grey		7	SS	1		224	+5			
							222				
			8	SS	5						
								>+			
							220				
			9	SS	3		218				
							216				
			10	TW	PH			a ● >+			18.0 0 1 50 49
							214				
211.7											
			11	SS	9		212				
26.1	End of Borehole										
	*Water level obtained on 81 09 06										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
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RECORD OF BOREHOLE No 3 METRIC

W P 148-65-00 LOCATION Sta. 6+661.7; o/s 4.8 m Lt. of ℄ Highway 532 ORIGINATED BY N. S.

DIST 18 HWY 532 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY N. S.

DATUM Geodetic DATE 81 09 06 CHECKED BY

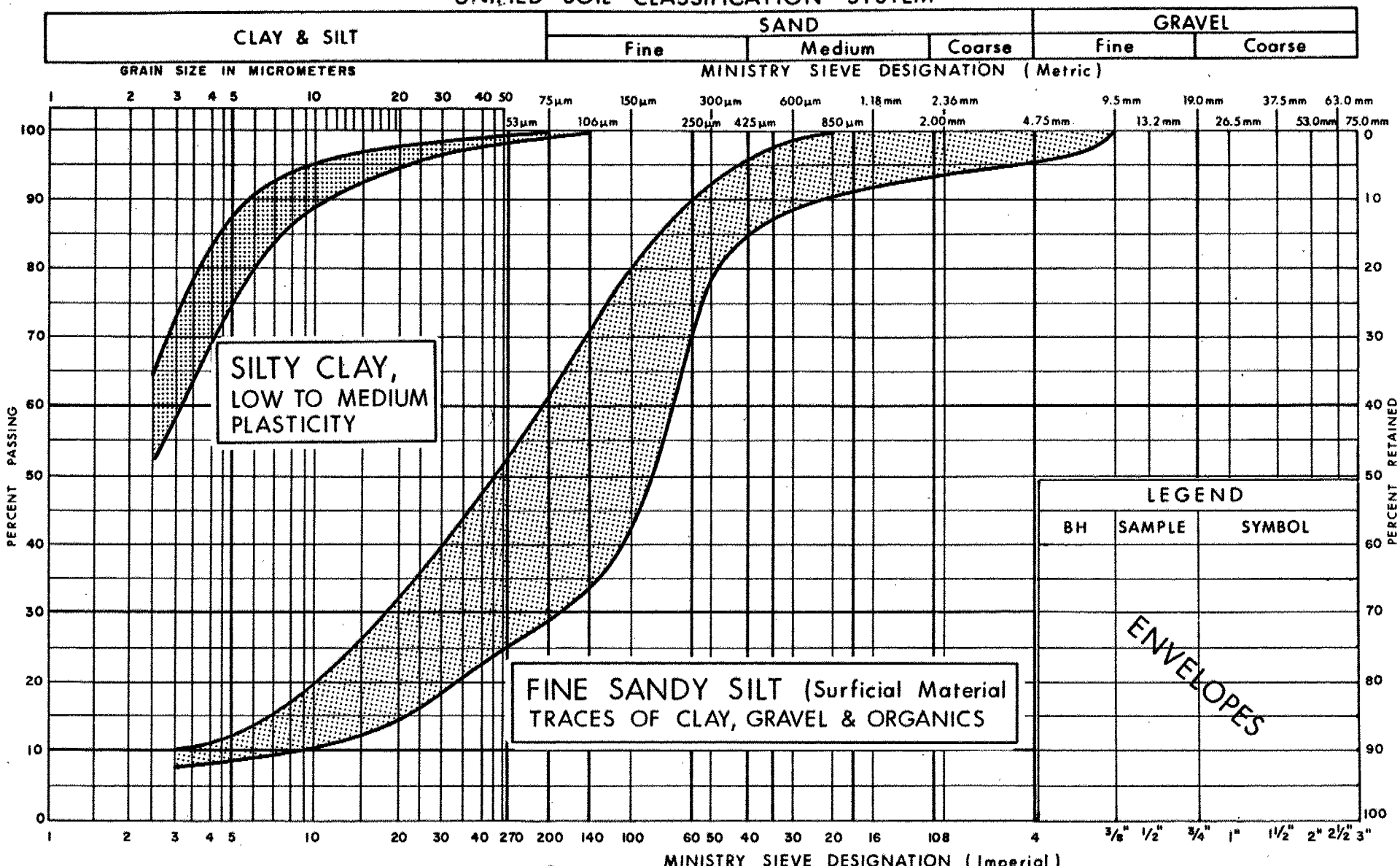
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
238.3	Ground Surface										
0.0							238				
							236				
							234				
							232				
							230				
							228				
							226				
							224				
							222				
							220				
							218				
							216				
							214				
							212				
210.8											
27.5	End of Cone Test							100/76 mm			

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



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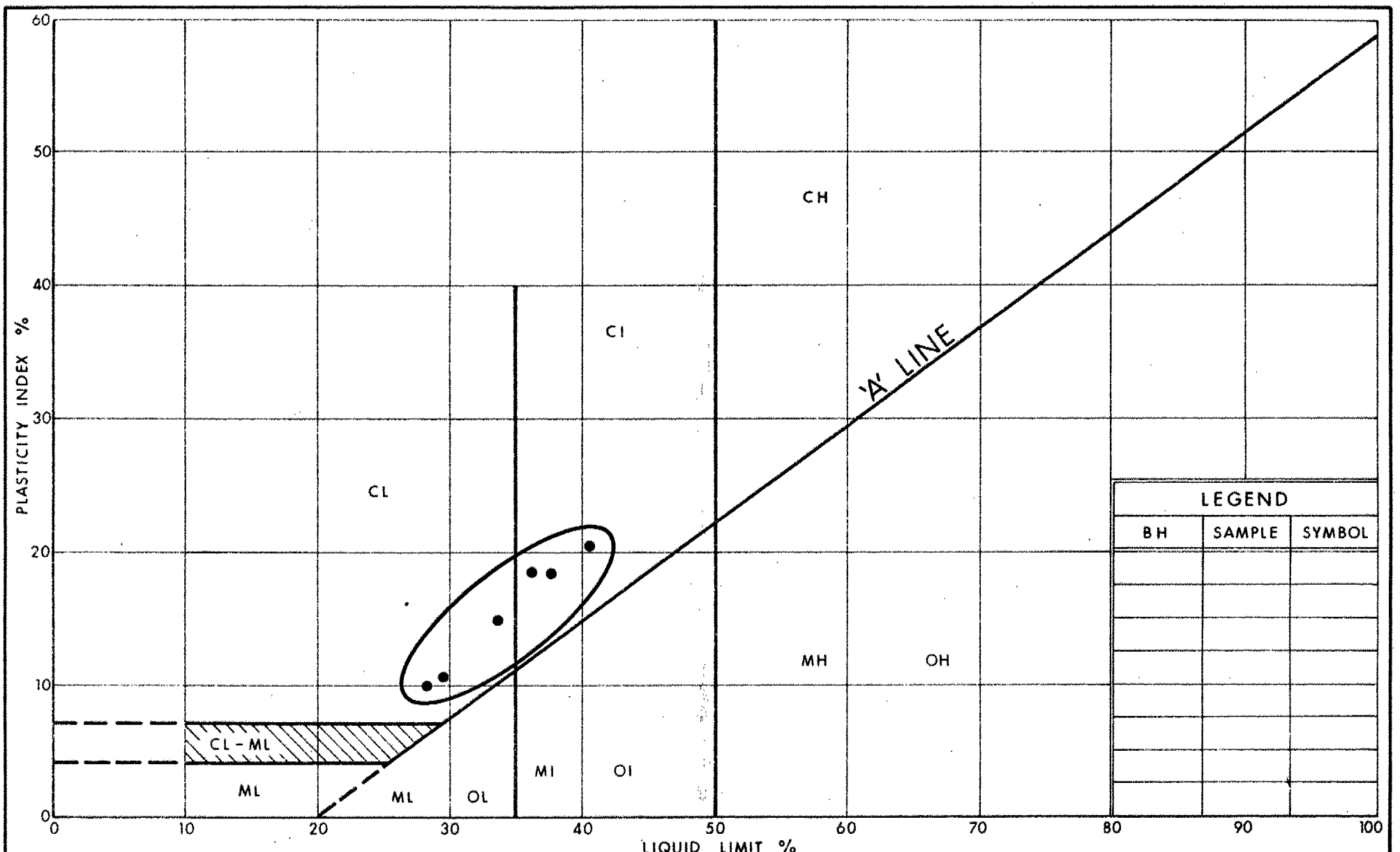
GRAIN SIZE DISTRIBUTION

FIG No 1
W P 148-65-00



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PLASTICITY CHART

SILTY CLAY, OF LOW TO MEDIUM PLASTICITY

FIG No 2

W P 148-65-00

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 (R Q D), 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
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

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 = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

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METRIC

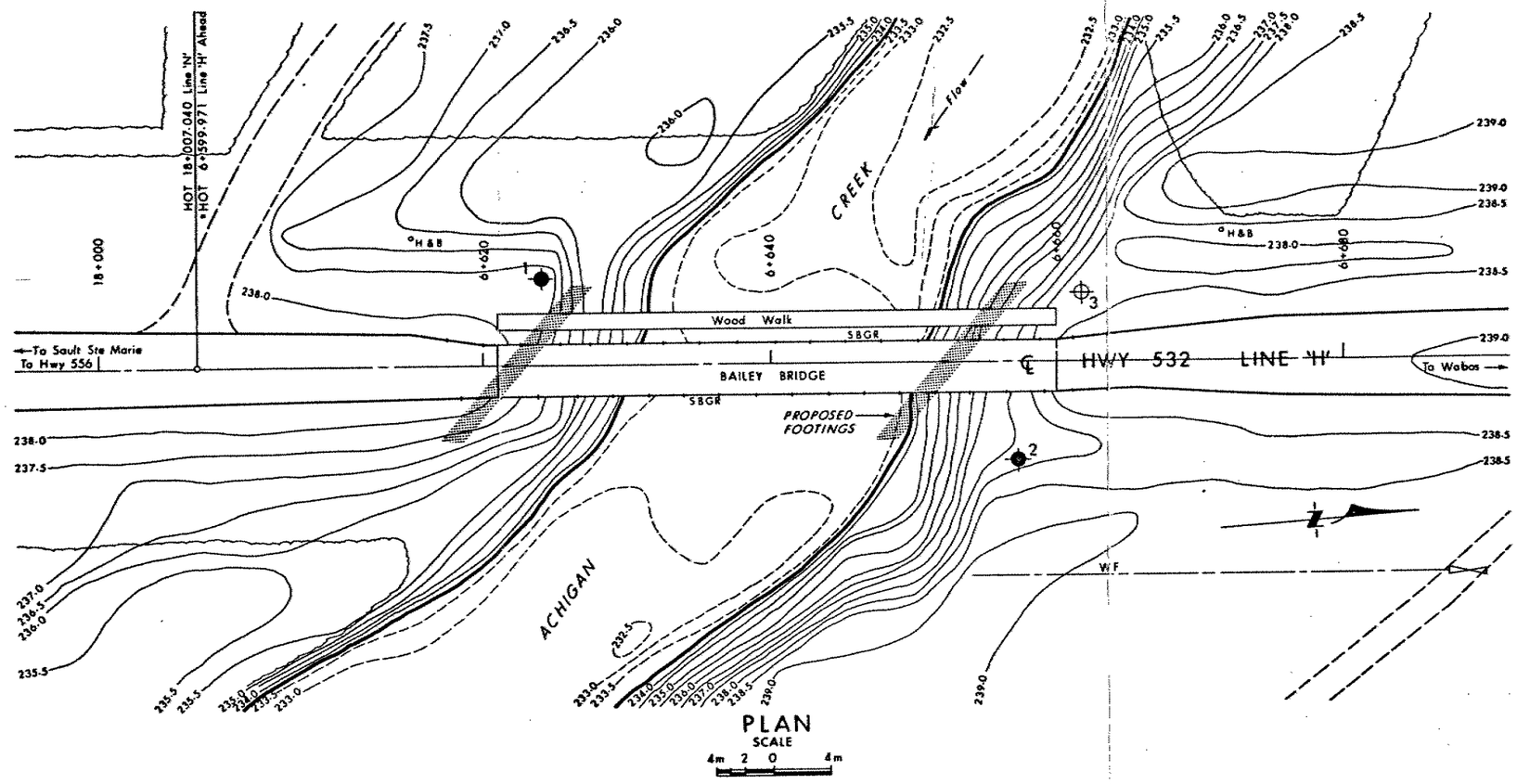
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS ARE IN KILOMETRES + METRES.

CONT No
WP No 148-65-00

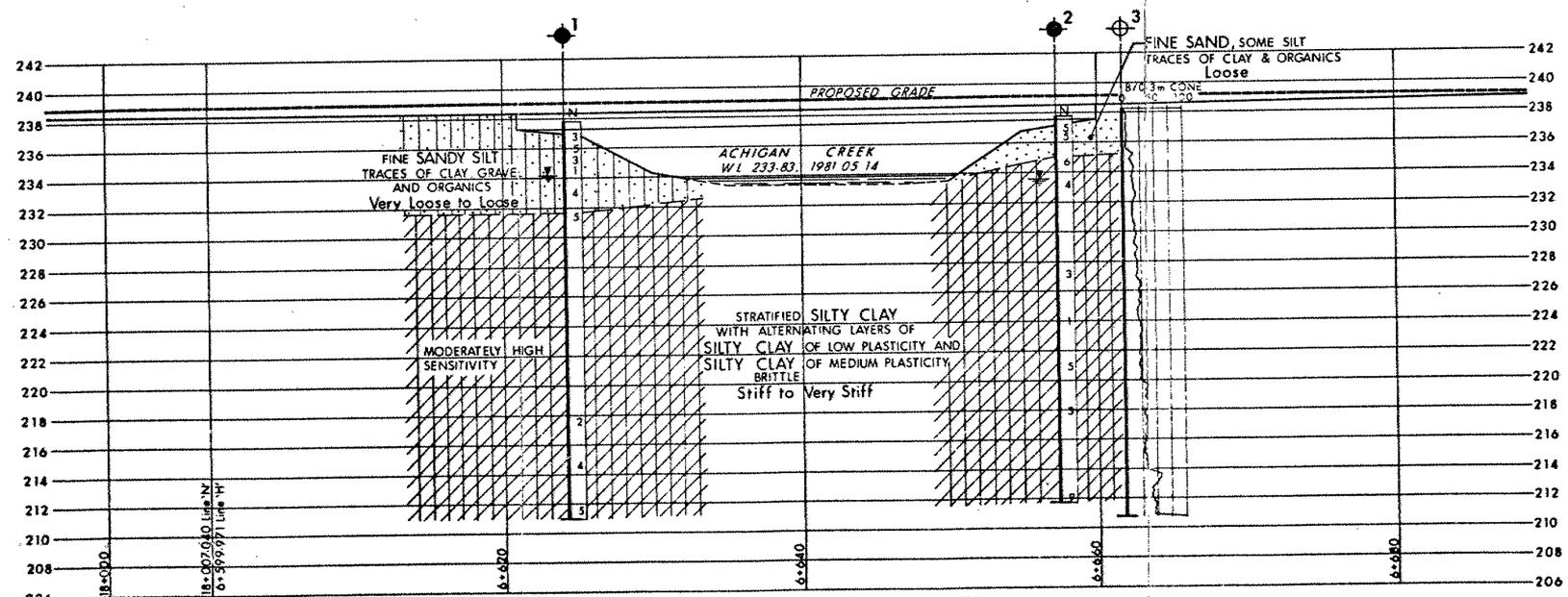
ACHIGAN CREEK BRIDGE

BORE HOLE LOCATIONS & SOIL STRATA

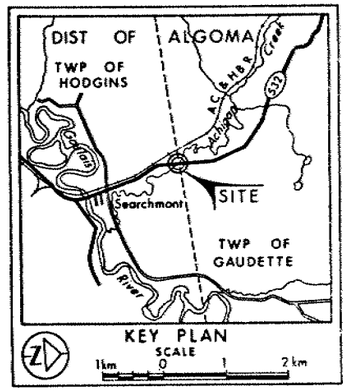
SHEET



PLAN
SCALE
4m 2 0 4m



℄ PROFILE HWY 532 LINE 'H'
SCALE
4m 2 0 4m



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 1981 09

No	ELEVATION	STATION	OFFSET
1	237.8	6+624.1	6.1m Lt
2	237.8	6+657.2	6.9m Rt
3	238.3	6+661.7	4.8m Lt

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

Geocres No 41K-41

HWY No 532			DIST 18
SUBM'D N S	CHECKED	DATE 1981 10 27	SITE 38S-41
DRAWN	CHECKED	APPROVED	DWG 148650O-A

REF No E-8002-1 ; 1981 06