

FOUNDATION INVESTIGATION REPORT
FOR
OLD WANUP ROAD UNDERPASS
SITE 46-498
GWP 5556-02-00, DISTRICT 54
HIGHWAY 69
SUDBURY, ONTARIO

Distribution:

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TABLE 1 - ROCK CORE DESCRIPTION

FOUNDATION INVESTIGATION REPORT

for
Old Wanup Road Underpass
Site 46-498
GWP 5556-02-00, District 54
Highway 69
Sudbury, Ontario

INTRODUCTION

This report summarizes the results of the foundation investigation carried out for the proposed underpass structure at Old Wanup Road and Highway 69 in Sudbury, Ontario. The investigation was conducted for Totten Sims Hubicki Associates on behalf of the Ontario Ministry of Transportation.

Old Wanup Road will pass over Highway 69 at approximate Station 15+095, Highway 69 chainage.

The report pertains to the proposed bridge structure and approaches within about 20 m of the abutments.

SITE DESCRIPTION

The site is situated at the Old Wanup Road crossing of the proposed new alignment of Highway 69. The structure will carry Old Wanup Road traffic over the proposed new Highway 69. At the location of the proposed structure, Highway 69 runs roughly north-south.

Old Wanup Road was built on an approximate 3 m high embankment at the proposed structure location. Rock outcrops exist west and south of the proposed crossing. The area to the north of Old Wanup Road is heavily forested.

The area is part of the Precambrian Laurentian peneplane. In general, the topography is relatively flat but quite irregular in detail with many small lakes separated by steep rock ridges.

The soil cover in the region is typically shallow, but can vary substantially in thickness over short distances. The soil in low areas between rock ridges typically consists of lake and/or alluvial deposits with local areas comprising sand and gravel deposits. Soil on the rock outcrops is generally sparse. Swamp environments have developed in areas of poor drainage. The area is generally wooded with open sections in the swamps.

The bedrock formations are of Precambrian age and are largely composed of veined, banded and homogeneous pink and grey gneisses produced by injection and granitization of metamorphic gneisses of various types.

INVESTIGATION PROCEDURES

The field work was carried out in two stages. The first stage, conducted during the period May 23 to 26, 2001, comprised seven boreholes drilled to depths of 0.6 to 16.2 m and six unsampled probeholes advanced to depths of 2.1 to 14.4 m. The second stage was conducted on April 10 and 11, 2003 and comprised three boreholes drilled to depths of 1.4 to 6.7 m and three unsampled probeholes advanced to depths of 1.9 to 4.1 m to provide supplemental stratigraphic data at the central pier and west abutment areas. The boreholes and probeholes were numbered sequentially with the holes drilled in 2001. Further details are summarized in the following table. The locations of the boreholes are indicated on Drawing ST2-1, appended.

Location	Depth, m (not including rock core)	
	Boreholes	Probeholes
West Approach	1 to 0.6	—
West Abutment	1 to 1.4	1 to 1.9
	1 to 3.1	1 to 2.1
	1 to 6.7	1 to 3.2
		1 to 4.1
Centre Pier	1 to 6.2	1 to 4.6
	1 to 11.3	1 to 4.8
	1 to 14.0	1 to 5.2
East Abutment	1 to 16.2	1 to 13.2
East Approach		1 to 14.4
	1 to 1.1 (Refusal)	—
	1 to 15.9	

During the initial investigation one borehole at the centre pier and both abutments was extended 3.1 to 3.4 m into bedrock using NQ diamond rock coring equipment. During the supplementary investigation, two boreholes were drilled 3.0 and 3.1 m into bedrock at the west abutment and one borehole 3.0 m into bedrock at the centre pier.

The boreholes advanced in the approaches along Old Wanup Road were located some 20 m beyond the abutments. The hole in the east approach was extended to 15.9 m depth and was terminated in a very dense gravelly sand deposit. The hole in the west approach was terminated at 0.6 m depth due to auger refusal on probable bedrock.

The alignment of the abutments, centre pier and approach holes were staked in the field by Totten Sims Hubicki Associates. The position of the boreholes along the staked alignments was selected by Peto MacCallum Ltd. with regard to access limitations and utility lines. The locations of and ground surface elevations at the boreholes were determined by Peto MacCallum Ltd. relative to the survey stakes.

The boreholes were advanced using continuous flight hollow stem augers, powered by a track-mounted CME-75 drill rig, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of our engineering staff.

Representative samples of the overburden were recovered at frequent depth intervals using a conventional split spoon sampler during drilling. Standard penetration tests were conducted simultaneously with the sampling operation to assess the strength characteristics of the substrata. A dynamic cone penetration test was also conducted in probehole ST2-AP4 below a depth of 10.7 m and terminated at 14.4 m upon practical refusal to penetration.

The groundwater conditions in the boreholes were closely monitored during the course of the field work.

All of the recovered samples were returned to our laboratory for detailed visual examination, classification and routine moisture content determinations. Grain size distribution analyses and Atterberg Limits tests were conducted on selected samples.

SUMMARIZED SUBSURFACE CONDITIONS

Reference is made to the appended Record of Borehole sheets for details of the subsurface conditions including soil classifications, inferred stratigraphy, boundary elevations, standard and dynamic cone penetration test values, rock core descriptions and groundwater observations. The results of laboratory moisture content determinations, grain size distribution analyses and Atterberg Limits tests are also shown on the logs.

The borehole locations and stratigraphic profiles prepared from the borehole data are presented on Drawings ST2-1 and ST2-2.

The subsurface stratigraphy revealed at the site generally comprised a surficial roadway fill (overlain by asphaltic concrete at the east abutment and approach) overlying discontinuous deposits of native clayey/sandy silt and sand. The relative density of the native predominantly non-cohesive deposits were typically loose to very dense, generally compact. Numerous cobbles/boulders were encountered in the sandy soil. The cohesive deposits were typically firm to stiff. Bedrock was contacted below the silt/sand deposits at depths of 0.6 to 16.2 m. The strata encountered are summarized below.

Fill/Topsoil

The surficial fill (covered with 100 mm of topsoil in probehole ST2-AP3) typically comprised compact sand and gravel, sandy gravel or gravelly sand. Numerous cobbles/boulders were encountered in this unit. At the east abutment and approach, asphaltic concrete was present surficially. The granular material was penetrated at confirmed depths of 1.2 to 3.6 m (elevation 244.6 to 248.8).

The fill was not identified in boreholes ST2-7, ST2-9 and in probeholes ST2-AP2, ST2-AP5, ST2-AP7 drilled on the north side of Old Wanup Road at the west and east abutments, respectively.

Topsoil was encountered in probeholes ST2-AP2, ST2-AP3 and ST2-AP5.

Clayey Silt

The clayey silt was encountered below the surficial fill/topsoil layer in boreholes ST2-2 to ST2-4 as well as in probeholes ST2-AP1, ST2-AP4 and ST2-AP5. At the location of borehole ST2-6A it underlay silty sand. This unit varied in thickness between 1.6 and 4.2 m and was typically penetrated at depths of 3.1 to 4.7 m (elevation 245.1 to 245.7), locally at 7.8 m (elevation 242.2) in borehole ST2-3. Probehole ST2-AP1 was terminated in the unit at 4.6 m depth (elevation 245.5).

In general, the consistency of the clayey silt was stiff with localized firm and very stiff zones. The shear strength measured with vane testing equipment at a depth of 5.6 m in borehole ST2-3 was in excess of 100 kPa. The results of the Atterberg Limits tests and grain size distribution analyses are presented in Figures 1 and 2.

Sandy Silt/Silt

The native deposits primarily consisted of non-cohesive silt and sand. A 0.9 to 2.4 m thick layer of non-cohesive sandy silt (silt in borehole ST2-8) was present surficially in boreholes ST2-7, ST2-9 and revealed below the fill in boreholes ST2-1, ST2-6A. The sandy silt underlay clayey silt at elevation 245.1 to 245.7 in boreholes ST2-2, ST2-4, ST2-6A and had a thickness of 1.2 to 4.0 m. In addition, a 1.6 m thick layer of loose silt was identified below silty sand at 7.1 m depth (elevation 243.2) in borehole ST2-6A. This unit was not encountered in borehole ST2-3.

A 1.9 m thick layer of sandy silt was identified surficially in probehole ST2-AP7. A 1.1 to 2.9 m thick layer of sandy silt was revealed directly beneath the fill or topsoil in probeholes ST2-AP2, ST2-AP6 and ST2-AP8. The sandy silt was also identified below the clayey silt in probehole ST2-AP5 and had a thickness of 1.5 m. This unit was not encountered at the location of probehole ST2-AP4.

The sandy silt was typically compact ("N" values varying between 2 and 25). The moisture content of this unit was in a range of 20 to 24%. The results of laboratory grain size distribution analysis carried out in the sandy silt/silt are presented in Figure 3.

Sand

Sand of various granulometric composition was identified in six boreholes (Nos. ST2-2 to ST2-4, ST2-6A, ST2-8 and ST2-9) and inferred in four probeholes (Nos. ST2-AP2 to ST2-AP5). The thickness of this unit identified in boreholes ST2-2, ST2-4 and ST2-8 ranged from 3.8 to 7.5 m. The sand was penetrated at depths of 6.2 to 16.2 m (elevation 233.9 and 243.3). The relative density was generally compact, varying from very loose to very dense ("N" values of 1 to 89). The moisture content of the unit ranged from 7 to 24%. The grain size distribution analysis results are provided in Figure 4.

The remaining boreholes/probeholes were terminated within this unit or after meeting refusal on cobbles or probable bedrock. Probeholes ST2-AP2 and ST2-AP3 drilled on the north side of the west abutment and centre pier, respectively, penetrated 0.9 and 1.8 m of sand before termination of drilling at elevation 242.8 and 246.8. Boreholes ST2-3, ST2-6A and probeholes ST2-AP3A, ST2-AP4, ST2-AP5 penetrated 5.2 to 8.6 m of sand before termination of drilling at elevation 234.4 to 242.4. The dynamic cone penetration test was extended a further 3.7 m in probehole ST2-AP4 to elevation 235.9.

Bedrock

Bedrock/probable bedrock represented by gneiss, biotite gneiss, granitic gneiss and granite pegmatite was contacted below the silt/sand deposits at the following depths and elevations:

Location	Depth to Rock (m)	Bedrock Elevation
West Approach	ST2-5 – 0.6	249.1
West Abutment	ST2-1 – 3.1*	246.7*
	ST2-7 – 1.4*	247.8*
	ST2-8 – 6.7*	243.3*
	ST2-AP1 – 4.6	245.5
	ST2-AP2 – 2.1	246.8
	ST2-AP6 – 4.1	245.9
	ST2-AP7 – 1.9	247.5
	ST2-AP8 – 3.2	246.4
Centre Pier	ST2-2 – 11.3*	238.4*
	ST2-3 – 14.0	236.0
	ST2-9 – 6.2*	241.4*
	ST2-AP3 – 4.8	242.8
	ST2-AP3A – 5.2	242.4
East Abutment	ST2-4 – 16.2*	233.9*
	ST2-AP4 – 14.4	235.9
	ST2-AP5 – 13.2	235.1
East Approach	ST2-6 – 1.1	**
	ST2-6A – 15.9	234.4

* confirmed by rock core

**borehole refusal on probable boulder

The measured core recovery was typically 95 to 100% (67 to 76% at two locations). The RQD determined from the rock cores was typically in a range of 63 to 100% (23% in the initial 660 mm in the east abutment), indicating a fair to excellent quality rock. Details of the rock core description are presented in Table 1, appended.

Groundwater

Groundwater was observed in six boreholes and three probeholes during drilling.

Boreholes ST2-3, ST2-6, ST2-7 and probeholes ST2-AP1, ST2-AP3A, ST2-AP4, ST2-AP6 to ST2-AP8 were dry during and on completion of drilling.

A summary of the groundwater measurements across the site is provided in the following table:

Borehole	Water Level Observed in Borehole	
	Depth (m)	Elevation
ST2-1	2.4*	247.4*
ST2-2	1.2*	248.5*
ST2-4	3.7*	246.4*
ST2-6A	2.8** (9.2*)	247.5** (241.1*)
ST2-8	3.2** (3.7*)	246.8** (246.3*)
ST2-9	0.3*	247.3*
ST2-AP2	0.8*	248.1*
ST2-AP3	0.6**	247.0**
ST2-AP5	0.3**	248.0**

*water level observed during drilling

**water level measured after drilling

Observed groundwater levels are subject to seasonal fluctuations and rainfall patterns.

CLOSURE


The field work was carried out under the supervision of Mr. Frank Portela and Mr. David Baigent, P.Eng., and direction of Mr. Carlos Nascimento, P.Eng. The equipment was supplied by Marathon Drilling Co. Ltd.

The report was prepared by Mr. G.O. Degil, Senior Project Supervisor, and reviewed by Mr. D.W. Kerr, P.Eng., Manager of Geotechnical and Geo-Environmental Services, Hamilton. Mr. B.R. Gray, P.Eng. carried out an independent review of the report.

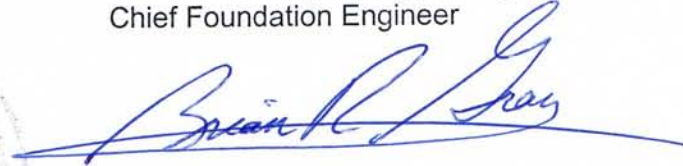


Yours very truly

Peto MacCallum Ltd.



Dennis W. Kerr, M.Eng., P.Eng.
Chief Foundation Engineer



Brian R. Gray, M.Eng., P.Eng.
President

GD:lad

TABLE 1

ROCK CORE DESCRIPTION
HIGHWAY 69 FOUR-LANING
FROM 6.7 KM NORTH OF HIGHWAY 537 NORTHERLY 2.8 KM
DISTRICT 54, TOWNSHIP OF DILL, SUDBURY, ONTARIO
G.W.P. 5556-02-00

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	RUN NO.	DEPTH (m)	RECOVERY %	RQD %	DEPTH (m)	DESCRIPTION
ST2-1	4	3.10 – 4.65	95	95	3.10 – 6.20	BIOTITE GNEISS: green to black; fine to medium crystalline; medium strong to strong; unweathered; moderately to widely spaced dipping partings; smooth planar; fracture index >2 and orientation of 45° and 60°; moderately tight; excellent quality.
	5	4.65 – 6.20	100	100		
ST2-2	9	11.30 – 12.50	76	100	11.30 – 12.50	GRANITE PEGMATITE: pink; fine crystalline; unweathered; medium strong to strong; moderately to widely spaced dipping partings; smooth to rough planar; fracture index of >3 and orientation of 15° and 45°; tight; excellent quality.
	10	12.50 – 14.00	100	100		
	11	14.00 – 14.70	100	100		
ST2-4	12	16.20 – 16.90	100	23	12.50 – 14.70	GNEISS: pink and black; unweathered; medium strong to strong; moderately to widely spaced dipping partings; rough planar; fracture index of >2 and orientation of 30° and 45°; tight; excellent quality.
	13	16.90 – 18.05	100	80		
	14	18.05 – 19.50	100	80		

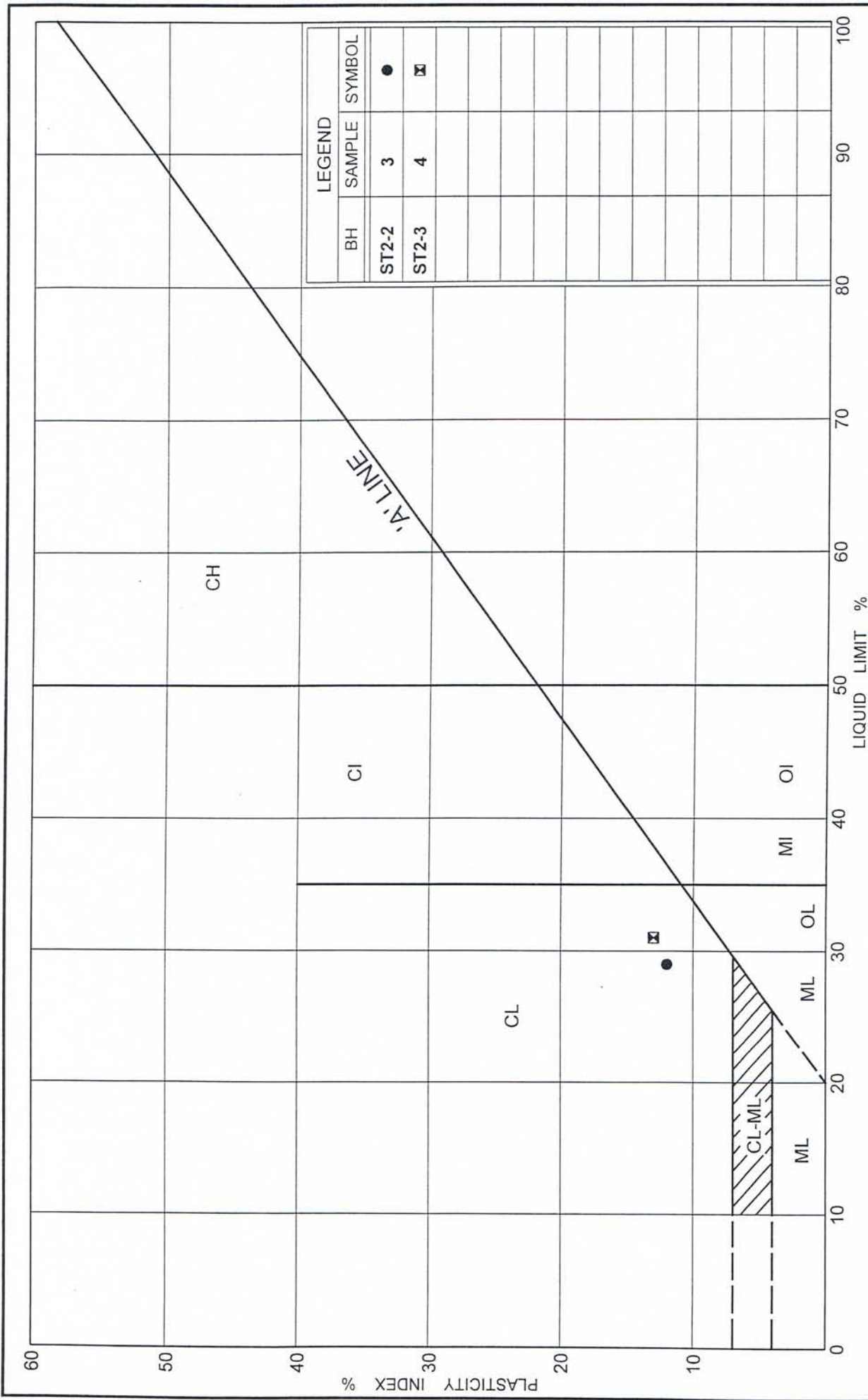
Originated: F.P.
Compiled: R.S./J.W.
Checked: G.D./C.N

TABLE 1 (CONT'D)

ROCK CORE DESCRIPTION
HIGHWAY 69 FOUR-LANING
FROM 6.7 KM NORTH OF HIGHWAY 537 NORTHERLY 2.8 KM
DISTRICT 54, TOWNSHIP OF DILL, SUDBURY, ONTARIO
G.W.P. 5556-02-00

CORE RECOVERY					CORE DESCRIPTION	
HOLE NO.	RUN NO.	DEPTH (m)	RECOVERY %	RQD %	DEPTH (m)	DESCRIPTION
ST2 – 7	2	1.40 – 2.90	100	92	1.40 – 4.40	GRANITIC GNEISS: banded black and white fine to medium crystalline, high strength, unweathered, close to moderate spaced dipping joints, smooth to rough planar, generally tight, occasional with rust coloured oxidation on parting surface, good to excellent quality.
	3	2.90 – 4.40	100	77		
ST2 – 8	5	6.70 – 7.55	97	66	6.70 – 9.80	GRANITIC GNEISS: banded white or light grey and black, occasional pink, fine to medium crystalline, high strength, weathered, close to moderate spaced flat to dipping joints, rough planar, generally tight, occasional, with rust coloured oxidation on parting surface, fair to excellent quality.
	6	7.55 – 9.05	98	90		
	7	9.05 – 9.80	100	63		
ST2– 9	5	6.20 – 7.45	100	100	6.20 – 9.20	GRANITIC GNEISS: banded light grey and pink, fine to medium crystalline, high strength, unweathered, moderate to wide spaced, dipping joints, rough planar, generally tight, occasional with pyrite on partings, excellent quality.
	6	7.45 – 8.55	100	100		
	7	8.55 – 9.20	100	90		

Originated: F.P.
Compiled: R.S./J.W.
Checked: G.D./C.N



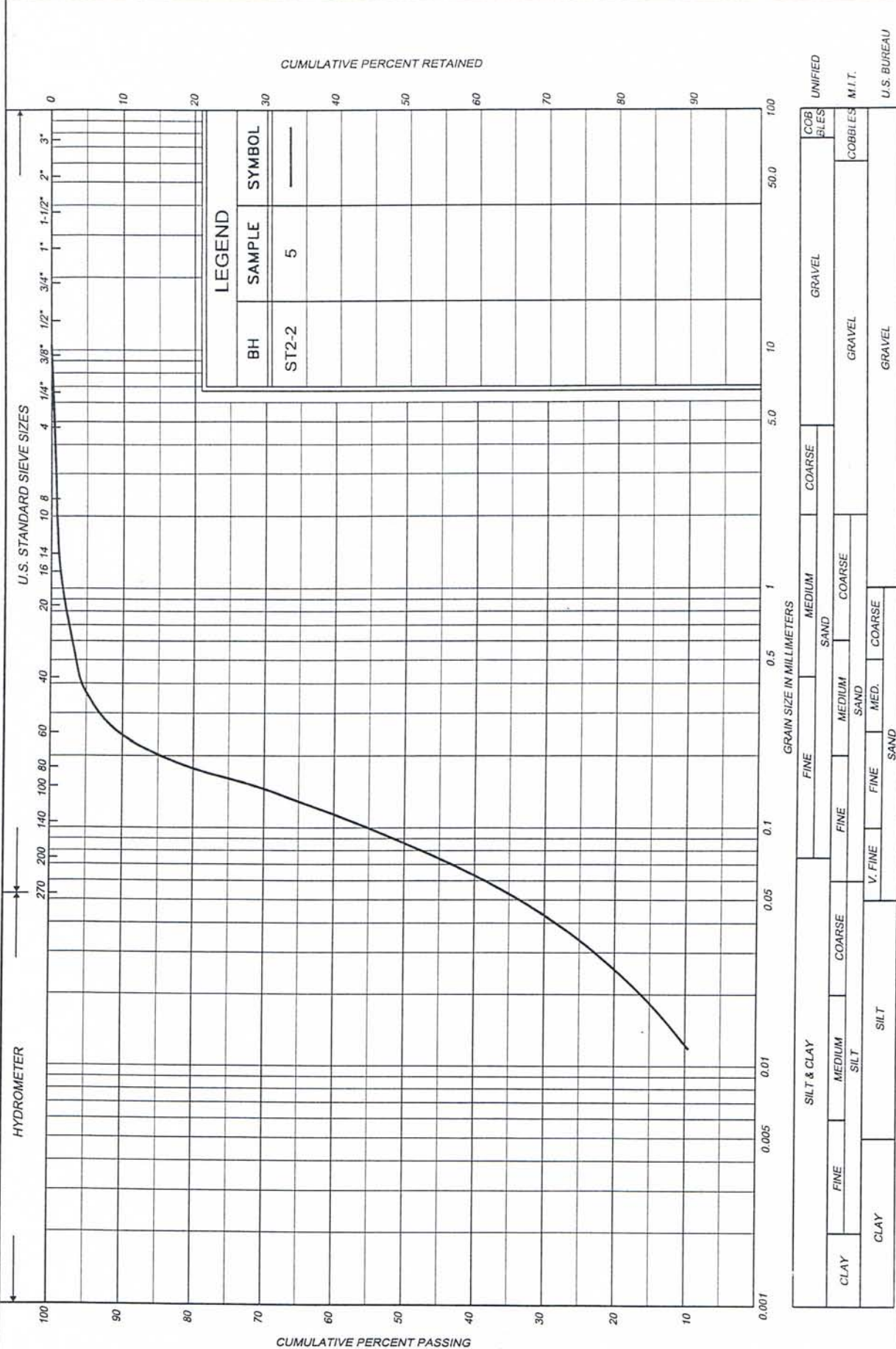
PLASTICITY CHART

CLAYEY SILT, trace sand and gravel (CL)

FIG No. 1

HWY69 Old Wanup Road Structure

G.W.P. No. 327-91-00



GRAIN SIZE DISTRIBUTION

SILTY FINE SAND, trace gravel

FIG No 4

HIGHWAY 69
Old Wanup Road
Structure

G.W.P No. 327-91-00

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 (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'_{v0}	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	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 ²	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No ST2-1

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 444 N; 315 416 E. ORIGINATED BY EP
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY EP
DATUM Geodetic DATE May 24, 2001 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
249.8 0.0	Ground Surface													
	Sand and gravel (crushed rock) Compact (FILL)		1	SS	12									
248.3 1.5	Sandy silt trace clay Interbedded silty fine sand seams Compact Brown Moist		2	SS	19									
246.7 3.1	Biotite Gneiss sound Bedrock		3	SS	1/hcm									
			4	RC NQ	REC 95%									RQD 95%
			5	RC NQ	REC 100%									RQD 100%
243.6 6.2	End of borehole													
	Water level observed during drilling													

RECORD OF BOREHOLE No ST2-2

1 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 450 N; 315 455 E. ORIGINATED BY FP
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY FP
DATUM Geodetic DATE May 24, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
249.7	Ground Surface													
0.0	Sand and gravel trace silt (crushed rock) Compact Brown Moist (FILL)		1	SS	28		249			o				
			2	SS	8		248			o				
246.7							247							
3.0	Clayey silt trace sand Stiff Grey Moist		3	SS	11		246			1-1				0 5 72 23
245.1							245			o				
4.6	Sandy silt trace clay Interbedded silty fine sand seams Compact Grey Moist		4	SS	12		244							
243.6							243			o				1 57 42 0
6.1	Silty fine sand trace gravel Loose Grey Saturated		5	SS	5**		242			o				
242.1							241							
7.6	Gravelly sand Compact Grey Saturated		6	SS	29		240							
			7	SS	13		239							
			8	SS	50		238							
238.4							237							
11.3	Granite Pegmatite sound Bedrock		9	RC NQ	REC 76%		236							RQD 100%
237.2							235							
12.5	Gneiss Bedrock sound		10	RC NQ	REC 100%									RQD 100%
235.0	End of borehole		11	RC NQ	REC 100%									RQD 100%
14.7	Cont'd													

RECORD OF BOREHOLE No ST2-2

2 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 450 N; 315 455 E. ORIGINATED BY FP
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY FP
DATUM Geodetic DATE May 24, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
249.7	Ground Surface													
	▽ Water level observed during drilling													
	** Suspect low N value due to hydraulic disturbance													

RECORD OF BOREHOLE No ST2-3

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 494 N; 315 458 E. ORIGINATED BY EP
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY EP
DATUM Geodetic DATE May 23, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
250.0	Ground Surface													
0.0	Sand and gravel trace silt		1	SS	24									
	Compact Brown Moist with cobbles													
			2	SS	4									
	with boulders													
	(FILL)													
246.4														
3.6	Clayey silt trace sand trace gravel		3	SS	10									
	Stiff Brown Wet													
			4	SS	4									
			5	SS	11									
242.2			6	SS	8									
7.8	Fine to medium sand trace silt trace gravel													
	Compact Brown Saturated													
	trace coarse sand		7	SS	10									
	with cobbles													
	Very dense													
			8	SS	50/15cm									
			9	SS	42									
236.0			10	SS	50/8cm									
14.0	End of borehole Refusal on probable bedrock													Borehole dry on completion of drilling

RECORD OF BOREHOLE No ST2-4

1 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 461 N; 315 494 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY DJB
DATUM Geodetic DATE May 23, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
250.1	Ground Surface						250							
0.0	20mm asphalt over 350 mm gravelly sand		1	SS	37		249							
	Dense Brown Moist (PAVEMENT)						248							
	Mixed gravelly sand, cobbles and boulders (crushed rock)						247							
	Compact Brown (FILL)		2	SS	15		246							
247.3							245							
2.8	Clayey silt some sand Very Stiff Mottled brown/grey Moist		3	SS	19		244							
	Brown Wet						243							
245.4							242							
4.7	Sandy silt trace clay Interbedded silty sand and silty clay seams Compact Brown Wet		4	SS	25		241							
							240							
			5	SS	12		239							
							238							
	Loose Grey		6	SS	6**		237							
241.4							236							
8.7	Sand some silt Loose Brown Wet		7	SS	6**									
239.9														
10.2	Silty sand trace gravel with cobbles and boulders Dense Brown Wet		8	SS	31									
	Very dense		9	SS	51									
236.8														
13.3	Sand trace gravel trace silt													
236.2	Dense Brown Wet													
13.9	Gravelly sand trace silt with cobbles and boulders Dense Grey Wet Cont'd		10	SS	32									

RECORD OF BOREHOLE No ST2-4

2 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 461 N; 315 494 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Hollow Stem Augers/NQ Diamond Coring COMPILED BY DJB
DATUM Geodetic DATE May 23, 2001 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
250.1	Ground Surface													
	Very dense		11	SS	89		235							
233.9 16.2	Gneiss Bedrock fractured sound		12	RC	REC 100%		234							RQD 23%
			13	RC	REC 100%		233							RQD 80%
			14	RC	REC 100%		232							RQD 80%
230.6 19.5	End of borehole						231							
	▽ Water level observed during drilling ** Suspect low N value due to hydraulic disturbance													

RECORD OF BOREHOLE No ST2-5

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 444 N; 315 396 E. ORIGINATED BY FP
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP
DATUM Geodetic DATE May 25, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
249.7	Ground Surface																
0.0	Gravelly sand		1	SS	34												
249.1	Dense Brown																
0.6	(FILL)																
	End of borehole																
	Refusal on probable bedrock																
	Borehole dry on completion of drilling																
	NOTE: Borehole drilled on shoulder of existing Old Wanup Road. Existing road cut into rock, both North and South sides of existing road.																

RECORD OF BOREHOLE No ST2-6

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 469 N; 315 511 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 23, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
250.3	Ground Surface																
0.0	20mm asphalt over 450mm sand and gravel																
249.8			1	SS	56		250										
0.5	Very dense Brown Moist (PAVEMENT)																
249.2	Mixed sand, gravel, cobbles and boulders (crushed rock)																
1.1	Compact Brown (FILL) End of borehole Refusal on probable boulder Borehole dry on completion of drilling																

RECORD OF BOREHOLE No ST2-6A

1 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 469 N; 315 512 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 23, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
250.3	Ground Surface						250							
0.0	20mm asphalt over 450mm sand and gravel													
	Very dense Brown Moist (PAVEMENT)													
	Mixed sand, gravel, cobbles and boulders (crushed rock)													
248.6	Compact Brown (FILL)		1	SS	19		249							
1.7	Silty fine sand some gravel						248							
247.7	Compact Brown Moist													
2.6	Clayey silt trace sand		2	SS	11		247							
	Stiff Brown Moist													
							246							
245.7	Sandy silt trace clay		3	SS	12		245							
4.6	Compact Brown Moist													
							244							
244.5	Silty fine sand		4	SS	12		243							
5.8	Compact Grey Wet													
							242							
243.2	Silt some clay trace sand		5	SS	4		241							
7.1	Interbedded seams of sandy silt													
	Loose Grey Wet						240							
241.6	Sand trace silt cobbles and boulders		6	SS	1**		239							
8.7	Loose Brown Wet													
			7	SS	5		238							
			8	SS	7		237							
							236							
			9	SS	26									
	Medium to coarse Compact													
	Cont'd													

RECORD OF BOREHOLE No ST2-6A

2 of 2 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 469 N; 315 512 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 23, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
250.3	Ground Surface																
234.4	Gravelly sand some silt	10	SS	82			235										
15.9	Very dense																
	End of borehole																
	Refusal on probable bedrock																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	** Low N value due to hydraulic disturbance																
	At 9.15m, 0.60m sand heave; at 10.65m, 1.50m sand heave																

RECORD OF BOREHOLE No ST2-7

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 449 N; 315 411 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY PC
DATUM Geodetic DATE April 10, 2003 CHECKED BY

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
249.2 0.0	Sandy silt, trace clay Loose Brown Moist Boulders		1	SS	7		249										
247.8 1.4	Granitic Gneiss Bedrock Sound		2	RC NQ	REC 100%		248										RQD 92%
			3	RC NQ	REC 100%		247										RQD 77%
244.8 4.4	End of borehole						246										
	Borehole dry on completion of drilling						245										

RECORD OF BOREHOLE No ST2-8

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 440 N; 315 421 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY PC
DATUM Geodetic DATE April 11, 2003 CHECKED BY

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
250.0								20	40	60	80	100				
0.1	Asphaltic Concrete															
	Sand, fine gravel															
	Dense Dry		1	SS	35											
	boulder						249									
	(FILL)															
248.3	Silt, trace clay		2	SS	19		248									
	Compact Brown Moist															
247.3	Silty sand,						247									
2.7	Dense Brown Wet		3	SS	30											
	boulders						246									
			4	RC NQ			245									
							244									
243.3	Granitic Gneiss		5	RC NQ	REC 97%		243									RQD 66%
6.7	Bedrock Sound		6	RC NQ	REC 98%		242									RQD 90%
			7	RC NQ	REC 100%		241									RQD 63%
240.2	End of borehole															
9.8																
	▽ Water level observed during drilling															
	▼ Water level measured after drilling															

RECORD OF BOREHOLE No ST2-9

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 458 N; 315 452 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE C.F.H.S.A. & NQ Rock Coring COMPILED BY PC
DATUM Geodetic DATE April 10, 2003 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
247.6 0.0	Sandy silt, trace clay Very Loose Brown Moist		1	SS	2	▽	247										
	Compact		2	SS	15		246										
245.2 2.4	Sand and Gravel, with silt with cobbles Compact Brown Wet		3	SS	22		245										
243.6 4.0	Silty sand, Very Loose Brown Wet		4	SS	1		243										
	Boulders						242										
241.4 6.2	Granitic Gneiss Bedrock Sound		5	RC NQ	REC 100%		241										RQD 100%
			6	RC NQ	REC 100%		240										RQD 100%
238.4 9.2	End of borehole		7	RC NQ	REC 100%		239										RQD 90%
	▽ Water level observed during drilling																

RECORD OF BOREHOLE No ST2-AP1

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 438 N; 315 419 E. ORIGINATED BY FP
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP
DATUM Geodetic DATE May 26, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
250.1	Ground Surface						250										
0.0	50mm asphalt over 300mm gravelly sand (PAVEMENT)		1	AS	-		249										
248.6	Mixed sand, gravel, cobbles and boulders (crushed rock)						248										
1.5	(FILL)						247										
	Clayey silt some sand trace gravel Brown Wet		2	AS	-		246										
	cobbles or boulders																
245.5																	
4.6	End of borehole Refusal on probable bedrock Borehole dry on completion of drilling																

RECORD OF BOREHOLE No ST2-AP2

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 451 N; 315 418 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 25, 2001 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
248.9	Ground Surface																
0.1	Topsoil																
	Sandy silt trace clay with cobbles, boulders																
247.7	Brown Wet						248										
1.2	Gravelly sand some silt with cobbles, boulders																
	Brown Wet																
246.8							247										
2.1	End of borehole Refusal on probable bedrock																
	Water level observed during drilling																

RECORD OF BOREHOLE No ST2-AP3

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 456 N; 315 452 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 25, 2001 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
247.6	Ground Surface													
0.0	Topsoil													
	Mixed sand, gravel, cobbles and boulders (crushed rock) Moist (FILL)		1	AS	-		247							
							246							
							245							
244.6							244							
3.0	Sand some silt, with cobbles and boulders Brown Wet		2	AS	-		243							
242.8	End of borehole Refusal on probable bedrock													
4.8														
	Water level measured after drilling Cave-in at 3.10m													

RECORD OF BOREHOLE No ST2-AP4

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 455 N; 315 497 E. ORIGINATED BY FP
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY FP
DATUM Geodetic DATE May 25, 2001 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
250.3	Ground Surface												
0.0	Mixed sand, gravel												
	with cobbles and boulders (crushed rock)												
	(FILL)												
247.3	Clayey silt trace sand												
3.0													
245.7	Silty fine sand and sandy silt												
4.6													
	with cobbles and boulders												
239.6	End of auger probe												
10.7													
235.9	End of dynamic cone Refusal on probable bedrock												
14.4													

ON_MOT_1A ST2.GPJ ON_MOT.GDT 04/17/2003 2:40:48 PM

+7, X⁵: Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

Borehole
dry on
completion
of grilling

RECORD OF BOREHOLE No ST2-AP5

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 467 N; 315 493 E. ORIGINATED BY DJB
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY DJB
DATUM Geodetic DATE May 25, 2001 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	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								
248.3	Ground Surface												
0.1	Topsoil												
	Clayey silt trace sand												
	Mottled Moist brown/grey												
	Wet		1	AS	-								
245.2	Sandy silt trace clay												
3.1	Brown Wet												
243.7	Silty sand												
4.6	Brown Wet												
	trace gravel with cobbles and boulders												
237.6	Gravelly sand some silt cobbles and boulders												
10.7	Brown Wet												
235.1	End of borehole		2	AS	-								
13.2	Refusal on probable bedrock												
	Water level measured after drilling												

ON_MOT_1A ST2.GPJ ON_MOT.GDT 04/17/2003 2:40:55 PM

+7 X⁵: Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ST2-AP6

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 439 N; 315 416 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY PC
DATUM Geodetic DATE April 11, 2003 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
250.0	Asphaltic Concrete													
0.1	Sand with gravel													
248.8	Brown Dry (FILL)													
1.2	Sandy Silt, trace clay													
	Grey Moist													
	boulders													
245.9	End of borehole													
4.1	Refusal on probable bedrock													
	Borehole dry on completion of drilling													

RECORD OF BOREHOLE No ST2-AP7

1 of 1 METRIC




G.W.P. 327-91-00 LOCATION Co-ords. 5 139 444 N; 315 413 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY PC
DATUM Geodetic DATE April 10, 2003 CHECKED BY

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
249.4 0.0	Sandy silt, trace clay Brown Wet						249							
247.5 1.9	End of borehole Refusal on probable bedrock Borehole dry on completion of drilling						248							

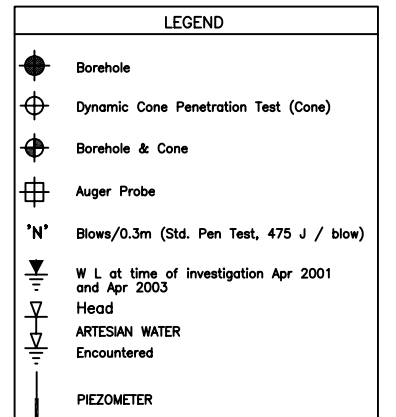
RECORD OF BOREHOLE No ST2-AP8

1 of 1 METRIC

G.W.P. 327-91-00 LOCATION Co-ords. 5 139 445 N; 315 419 E. ORIGINATED BY MR
DIST 54 HWY 69 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY PC
DATUM Geodetic DATE April 11, 2003 CHECKED BY

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
249.6 0.0	Sandy silt Brown Moist (FILL)						249										
248.4 1.2	Sandy silt, trace clay Brown Wet						248										
246.4 3.2	boulders						247										
	End of borehole Refusal on probable bedrock																
	Borehole dry on completion of drilling																

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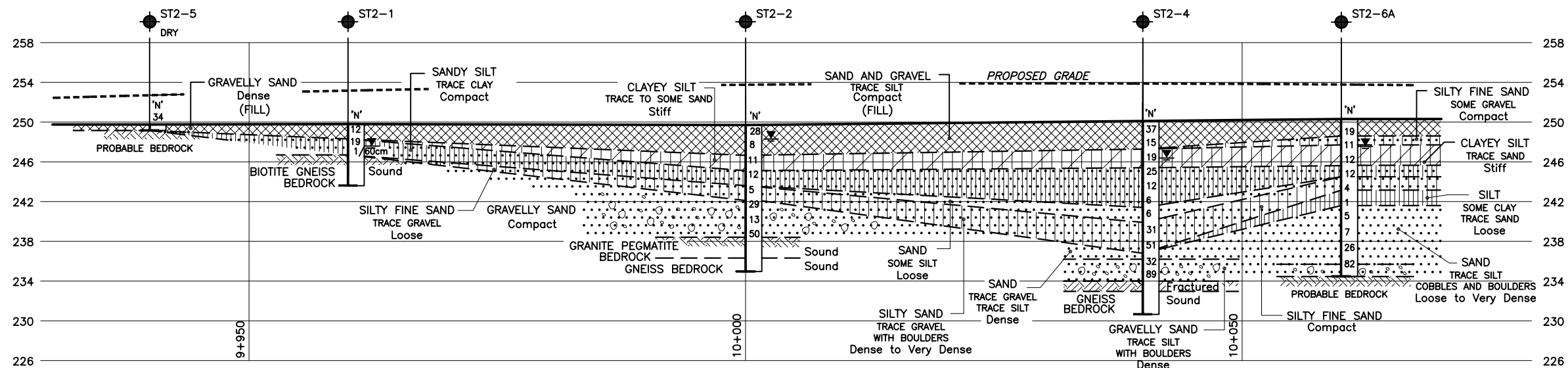
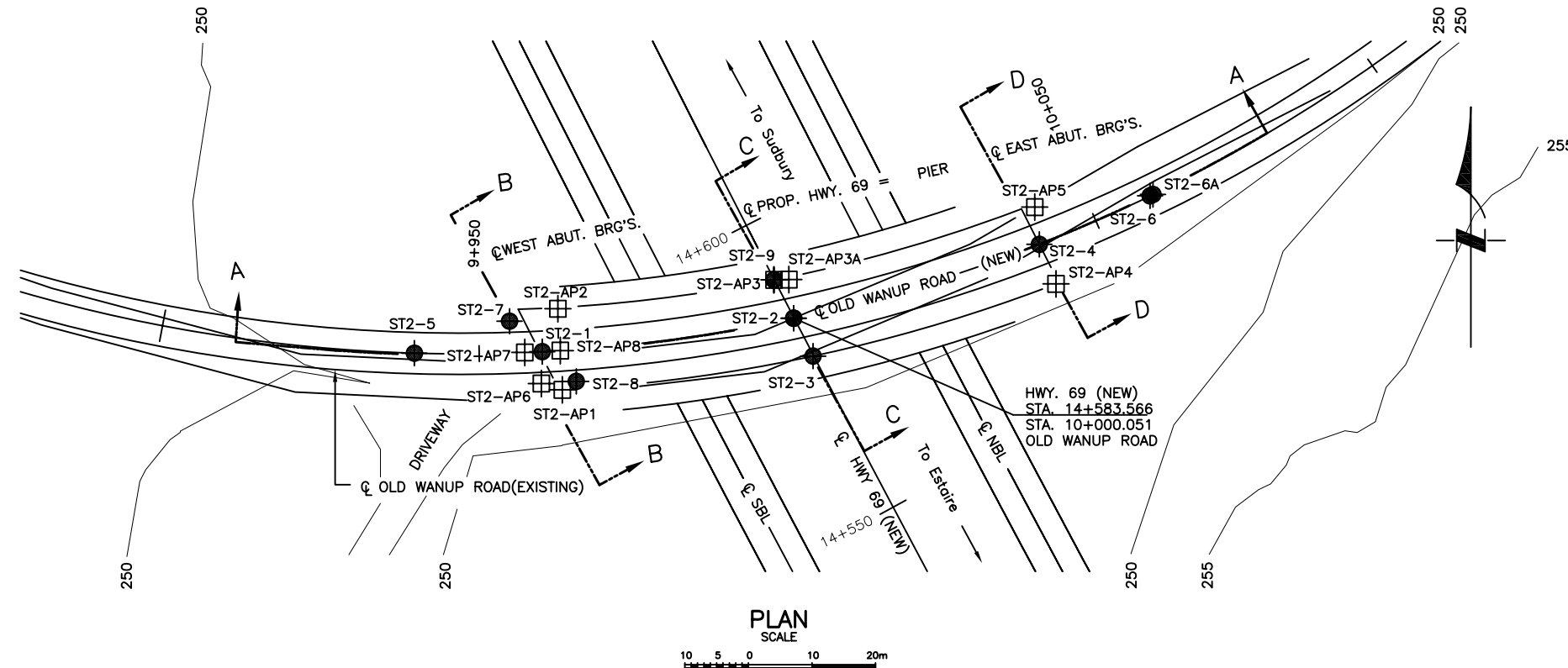
BH No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
ST2-1	249.8	5 139 444	315 416
ST2-2	249.7	5 139 450	315 455
ST2-3	250.0	5 139 494	315 458
ST2-4	250.1	5 139 461	315 494
ST2-5	249.7	5 139 444	315 396
ST2-6	250.3	5 139 469	315 511
ST2-6A	250.3	5 139 469	315 512
ST2-7	249.2	5 139 449	315 411
ST2-8	250.0	5 139 440	315 421
ST2-9	247.6	5 139 456	315 452
ST2-AP1	250.1	5 139 438	315 419
ST2-AP2	248.9	5 139 451	315 418
ST2-AP3	247.6	5 139 456	315 452
ST2-AP3A	247.6	5 139 456	315 455
ST2-AP4	250.3	5 139 455	315 497
ST2-AP5	248.3	5 139 467	315 493

(Legend Continued)

<p>— NOTE —</p> <p>The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.</p>
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REVISIONS			
	03-04-15	CN	ADDED ST2-8, 9 AND ST2-AP6, 7 8
	DATE	BY	DESCRIPTION

HWY No.		OLD WANUP ROAD		DIST 54	
SUBM'D	DH	CHECKED	CN	DATE 07 08 2001	SITE
DRAWN	MM	CHECKED	CN	APPROVED DWK	DWG ST2-1

[illegible]

A-A

SECTION
SCALE



NOTE:
REFER TO DRAWING ST2-2 FOR SECTIONS B-B, C-C AND D-D.

REF No. E-wanup-ga.dwg ; March, 2001

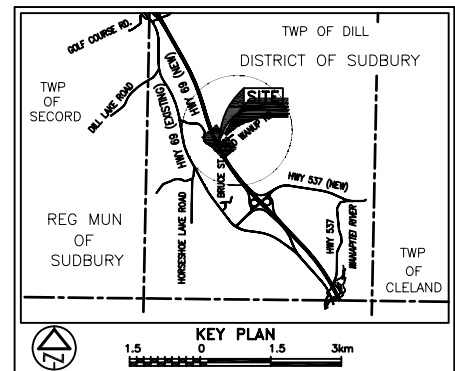
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. LOCATIONS
IN KILOMETRES - METRES

CONT No











GWP No 327-91-00

HIGHWAY 69 (NEW) UNDERPASS
From 0.3km North of HWY 537, Northerly 8.8km
OLD WANUP ROAD
BOREHOLE LOCATIONS & SOIL STRATA

Peto MacCallum Ltd.
CONSULTING ENGINEERS



LEGEND

- | | |
|---|---|
|  | Borehole |
|  | Dynamic Cone Penetration Test (Cone) |
|  | Borehole & Cone |
|  | Auger Probe |
|  | 'N' Blows/0.3m (Std. Pen Test, 475 J / blow) |
|  | W.L. at time of investigation Apr 2001 and Apr 2003 |
|  | Head |
|  | ARTESIAN WATER |
|  | Encountered |
|  | PIEZOMETER |

[illegible]

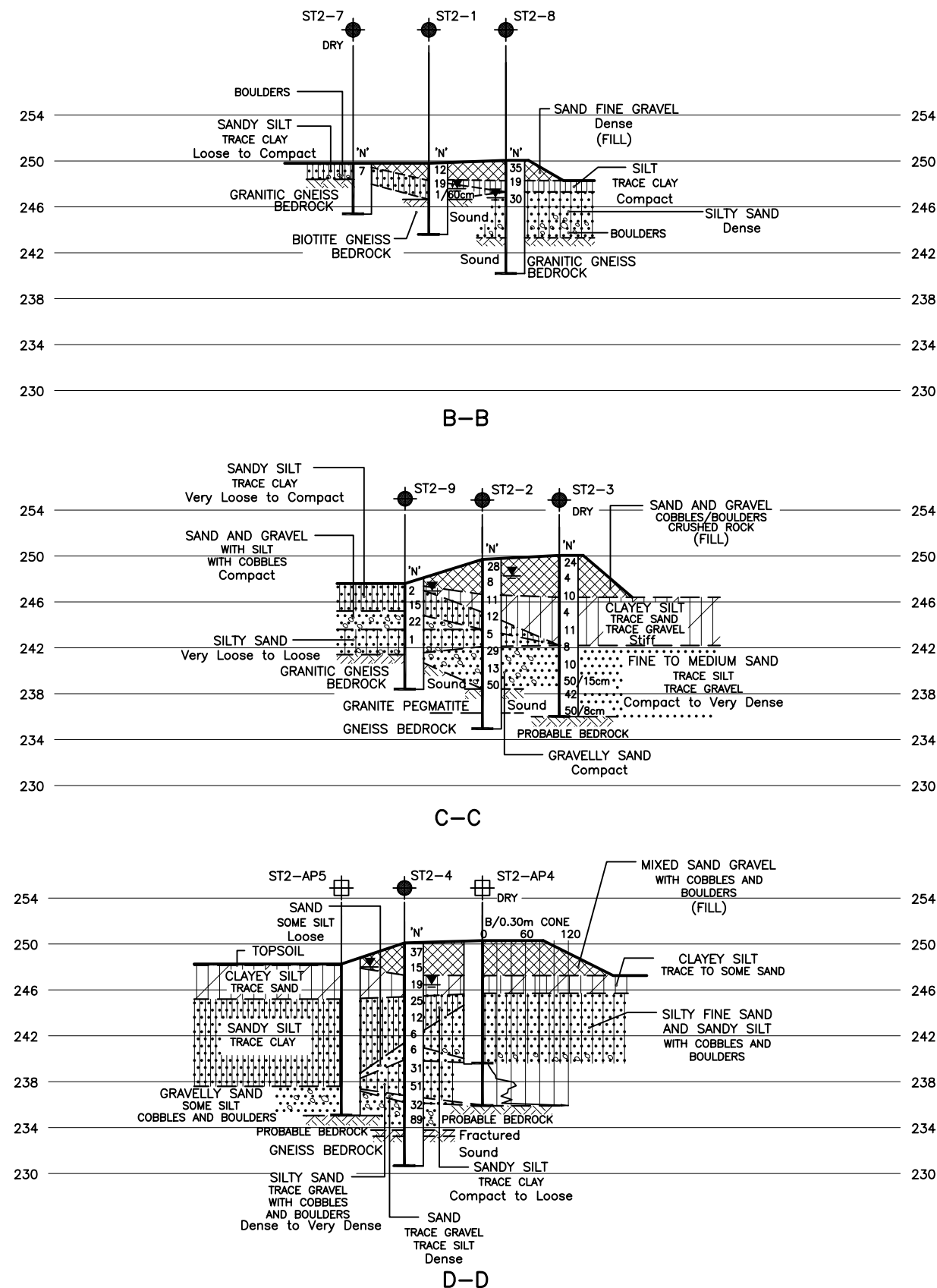
- NOTE -

The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS			
	03-04-15	CN	ADDED ST2-8, 9 AND ST2-AP6, 7 8
	DATE	BY	DESCRIPTION

Geocres No.

HWY No OLD WANUP ROAD				DIST 54	
SUBM'D	DH	CHECKED	CN	DATE 07 06 2001	SITE
DRAWN	MM	CHECKED	CN	APPROVED DWK	DWG ST2-2



NOTE:

REFER TO DRAWING ST2-1 FOR PLAN AND SECTION A-A.

REF No. E-wanup-ga.dwg ; March, 2001