

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 93-201



Ontario

**Ministry of
Transportation**

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

EXPLANATION OF TERMS USED IN REPORT

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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

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	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
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	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT

For

Culverts Along Hwy. 11
from 2.0 km North of Hwy. 534

Northerly 9.9 km

W.P. 73-74-00

District 13, North BayINTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned sites between 91 08 13 and 91 08 31. The investigation was carried out upon the request of Northern Region Structural Section for the proposed widening of Highway 11. The proposed works from 2.0 km north of Hwy. 534, northerly 9.9 km would require extending existing culverts approximately 40 m west. Two existing culverts are also proposed to be replaced.

The following culverts are addressed:

- 1) Bear Creek east of Hwy. 11 and Pinetree Way. (Replacement)
- Site 44 - 317C, 3.1 km North of Secondary Hwy. 534.
- 2) Bear Creek and Hwy. 11
- Site 44 - 317C, 3.1 km North of Secondary Hwy. 534.
- 3) Unnamed Creek East of Hwy. 11 and Pinetree Way (Replacement)
- Site 44 - 318C, 3.7 km North of Secondary Hwy. 534.
- 4) Unnamed Creek and Hwy. 11
- Site 44 - 318C, 3.7 km North of Secondary Hwy. 534.
- 5) Boleau Creek and Hwy. 11 (Two Options)
- Site 44 - 264C, 5.8 km South of Secondary Hwy. 654.
- 6) Windsor Creek and Hwy. 11
- Site 44 - 319C, 2.5 km South of Secondary Hwy. 654.

A total of 23 boreholes were advanced as part of this project by means of 82 mm I.D. hollow stem augers. In 11 selected boreholes rock core samples were retrieved utilizing BW casings and BXL core barrels. In addition, 18 cone penetration tests, 2 hand-dug holes and 2 auger probes were conducted.

GEOLOGY

Physiographically, the sites are located in the geological domain known as the Algonquin Highlands (after Chapman and Putnam, 1984). This region in much of the area is underlain by granite and other hard precambrian rocks. There are frequent outcrops of bare rock but they do not amount to more than 5% of the total area. Bedrock is generally shallow, however the thickness of the overburden varies greatly over short distances. Highway 11 from Gravenhurst to North Bay follows a narrow strip in which sand, silt and clay deposits occupy the hollows. The deep soils developed on the fine sand, silt and clay have been cleared and support farming settlements.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by the in situ and laboratory testing. The procedures employed are discussed below.

The fieldwork for the site investigations were carried out between 91 08 13 and 91 08 31 and consisted of boreholes placed along the length of the proposed culverts or in the case of the replacement culverts surrounding the existing culvert. The boreholes were advanced using conventional hollow stem augering techniques. Two track mounted continuous flight auger drill rigs were employed for the operation. Conventional rock coring techniques were applied in retrieving rock core samples for rock quality determination and classification purposes. Standard BXL Core Barrels and BW casings were utilized. In general, split spoon subsoil samples were retrieved at 0.7 m intervals. These disturbed samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). All the samples collected were for identification and laboratory testing purposes. In situ vane tests were also conducted in cohesive silty clay deposits to determine the undisturbed and remoulded undrained shear strengths. The test was conducted employing the Standard MTO 'N' vane. Dynamic Cone Penetration Test were carried out in some boreholes to determine the soil layers and strength of the materials.

All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

Water levels monitored throughout the duration of the investigation were obtained in the open boreholes. All boreholes were backfilled upon completion of the

fieldwork.

Survey information related to the location and elevation of boreholes was provided by the Northern Region Surveys and Plans Section.

LABORATORY ANALYSIS

The following laboratory tests were carried out on selected soil samples:

- 1) Atterberg Limit Test
- 2) Grain Size Distribution
- 3) Unit Weight Determination
- 4) Natural Moisture Content.

Laboratory Test Results are given in the following sections of this report and are illustrated on figures and borehole log sheets included in the Appendix.

CULVERT 1

Site Description

The site is located to the east of Highway 11, about 3.1 km north of Highway 534. The area is generally flat to gently undulating with the land in the immediate vicinity residential. The existing culvert to be replaced lies under Pinetree way with fills of 3.7 m placed on either side of the culvert. Pinetree way becomes a dead end just south of the site. Highway 11 lies just west of the culvert.

Subsurface Conditions

Two sampled boreholes and two cone penetration tests were placed on each corner of the existing culvert. At one location rock core samples were taken to confirm bedrock.

The subsoil stratigraphy at the site was found to consist of a silty sand (possible fill), which contained a greater percentage of gravel approaching the bedrock surface. A biotite-hornblende gneiss bedrock was encountered at depths ranging from 3.4 m to 4.1 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-A.

Specific description of the materials encountered are given below.

Silty Sand, trace Gravel, trace Clay -

A non-cohesive material composed of silty sand, trace gravel (Possible Fill) was encountered at the surface and it extended to bedrock, at a depth of 3.4 m to 4.1 m.

The two Grain Size Distribution tests carried out at this location indicate that this deposit comprised of 1-7% gravel, 54-60% sand, 32-35% silt and 4-7% clay. Figure 1 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

The 'N' values obtained from the Standard Penetration test in this material ranged from 1-12 blows/0.3 m.

Bedrock -

Bedrock was cored at an elevation of 253.1 m in one borehole (BH 1) utilizing rock coring techniques with a 1.5 m rock core retrieved. The probable bedrock surface encountered in the remaining boreholes and cone test locations ranged from El. 253.2 m to El. 254.0 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recovery (CR) and Rock Quality Designation (RQD) were found to be 94% and 44% respectively. The bedrock can be classified as strong, unweathered to slightly weathered.

Groundwater -

Observations of the groundwater level were carried out by measuring the water level in open boreholes. At this culvert location, it was found to vary from El. 253.6 m to El. 255 m, approximately at the elevation of Bear Creek. Seasonal fluctuations are expected.

CULVERT 2

Site Description

The site lies to the west of Culvert 1 and Highway 11. The area is a heavily

forested ravine with the ground surface sloping up rather steeply (about 3:1) to the north and south. The existing embankment fill of Highway 11 rises to the east. Bear Creek is approximately 15 cm deep with outcrops of bedrock at places. The existing culvert appears to rest on bedrock.

Subsurface Conditions

Two sampled boreholes and two probe holes were placed along the length of the proposed culvert. Bedrock was cored in one of the boreholes. The probe holes were hand dug to locate bedrock surface elevations.

The subsoil stratigraphy at this site typically consisted of a non-cohesive stratum of silty sand, trace clay, trace gravel with traces of organics near the surface. In the shallow hand dug boreholes, the overburden consisted of gravel and sand, trace silt. Bedrock was encountered at depths ranging from 15 cm (within the creek) to 1.0 m (on the north bank).

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-B.

Specific descriptions of the subsoil conditions encountered is given below.

Silty Sand, trace Clay, trace Gravel -

A non-cohesive layer of silty sand, trace clay, trace gravel was encountered in the sampled boreholes to a depth of 1 m. Some organics were found surficially. The material contacted in the shallow hand dug boreholes consisted of gravel and sand, trace silt. These boreholes were located within the creek, thus the material recovered has had its fines washed away.

The 'N' values obtained from the Standard Penetration Test in this material were greater than 120/8 cm. It is considered that the high 'N' values are due to the presence of shallow bedrock and as such are not indicative of the relative density of the overburden.

Laboratory testing carried out on a representative sample indicates the material has 12% moisture content, with grain size distribution of 60% gravel, 35% sand, 3% silt and 1% clay. Figure 1 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

Bedrock -

Bedrock was cored at an elevation of 251.8 m in one borehole (BH 3), utilizing rock coring techniques with a 1.5 m sample of rock retrieved. The probable bedrock surface encountered in the remaining boreholes and probe holes ranged from El. 251.1 m to El. 252.0 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Designation".

Core Recovery (CR) and Rock Quality Designation (RQD) obtained were found to be 87% and 83% respectively. The bedrock is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water level in open boreholes. Ground water elevations were found to be El. 251.4 m - El. 252.4 m, approximately at the same elevation of Bear Creek. Seasonal fluctuations are expected.

CULVERT 3

Site Description

The site is located along Pinetree Way 1 km south of its intersection with Highway 11. This area is flat to gently undulating with residential housing to the north and south. The existing culvert at this location is to be replaced by another culvert of similar dimensions underneath Pinetree Way to carry the unnamed creek through. Fills of up to 2.3 m were placed on either side of the existing culvert up to the grade of Pinetree Way.

Subsurface Conditions

Two boreholes and two cone penetration tests were placed around the corners of the existing culvert. The two boreholes were sampled down to bedrock. 1.3 m of rock core was retrieved from one of the boreholes.

The subsoil stratigraphy at this site consists of 1.4 m to 2.4 m of a surficial silty sand, with gravel, trace clay (possible Fill) underlain by a clayey silt to silty clay, trace sand with a thickness of 3.2 m to 5 m. Bedrock was encountered beneath the above two deposits at depths of 5.6 m to 6.4 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-C.

Specific descriptions of the material encountered are given below.

Silty Sand, trace Clay, with Gravel(Possible Fill) / Sandy Silt (Fill) -

A non-cohesive stratum composed of silty sand, trace clay, with gravel (Possible Fill) / sandy silt (Fill), was contacted to a depth of 1.4 m to 2.4 m.

Laboratory testing on a representative sample indicates a unit weight of 20.4 kN/m³ and moisture content of 17%. The two Grain Size Distribution Tests carried out at this location indicate that this deposit comprised of 10-19% gravel, 23-56% sand, 20-53% silt and 5-14% clay. Figure 1 illustrates a typical Grain Size Distribution curve for the silty sand material, based on representative samples from all the culvert locations. Figure 2 illustrates the Grain Size Distribution curve for the sandy silt material.

The 'N' values obtained from the Standard Penetration Test in this material varied from 6 blows/0.3 m to 12 blows/0.3 m indicating a loose to compact state of denseness.

Clayey Silt to Silty Clay, trace Sand -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered underlying the above layer to depths of 5.6 m to 6.4 m above bedrock. A 0.6 m thick layer of Heterogeneous Mixture of Silt, Sand and Gravel was encountered in BH 3 above bedrock.

Three Grain Size Distribution Test were carried out in this deposit. One of the tests was done on a sample from the layer of Heterogeneous Mixture of Silt, Sand and Gravel. The resulting gradation comprises 31% gravel, 45% sand, 20% silt and 4% clay. The other two tests were carried out on this cohesive deposit and the gradation is composed of 0% gravel, 3-8% sand, 72-79% silt and 18-20% clay. Figure 3 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

The results from the Atterberg Limit Test and a unit weight determination performed on the fine fraction of this material indicated natural moisture content, liquid limit and plastic limit of 31%, 33% and 22% respectively, with a unit weight of 18.7 kN/m³. This indicates that this material had a low plasticity. However, Figure 4 in the Appendix illustrates this material across

all the culvert locations typically has an intermediate plasticity. In-situ vane tests conducted within this deposit varied from 10 kPa to 29 kPa with sensitivities of 3 to 10 recorded, indicating that the consistency of the material is soft to firm.

The 'N' values obtained from the Standard Penetration Test typically ranged from 2 to 14 blows/0.3 m. High N value of 120/3cm was recorded in the layer of Heterogeneous Mixture of Silt. Sand and Gravel.

Bedrock -

Bedrock was cored in one borehole (BH 1) from elevation 250.7 m utilizing rock coring techniques with a 1.3 m sample of rock retrieved. The probable bedrock surface was encountered in the remaining boreholes ranged from El. 250.4 m to El. 251.4 m.

The bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core recovery (CR) and rock quality designation (RQD) were found to be 100 % and 90% respectively. It is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water levels in open boreholes. Groundwater levels varied from 254.6 m to 254.8 m approximately at the same elevation as the unnamed creek. Seasonal fluctuations are expected.

CULVERT 4

Site Description

The site is located just west of Highway 11 and culvert 3. The area is generally flat with highway embankment fills of approximately 7 m to the east. The immediate vicinity contains rolling grasslands with deciduous trees surrounding the site.

Subsurface Conditions

A total of three boreholes and two cone penetration tests were placed along the length of the proposed culvert. Bedrock was cored at two of the boreholes.

The subsoil stratigraphy at this site consists of a 5.3 to 6.1 m thick deposit of clayey silt to silty clay, trace sand underlain by bedrock. Pockets of Silty Sand were encountered throughout this stratum.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-D.

Specific descriptions of the material encountered are given below.

Clayey Silt to Silty Clay, trace to some Sand -

A cohesive deposit composed of clayey silt to silty clay, trace to some sand was encountered to depths of 5.3 m to 6.1 m. Pockets of silty sand were contacted throughout this stratum.

Six Grain Size Distribution Test results were carried out in this deposit. One of them was carried out in a sample taken from a silty sand pocket, and the resulting gradation comprises 43% gravel, 35% sand, 17% silt and 5% clay. The results of the other five tests carried out on this material indicate that it is typically composed of 0% gravel, 1-19% sand, 54-68% silt and 24-44% clay. Figure 3 in the Appendix illustrates a typical Grain Size Distribution curve for this material based on representative samples collected at all the culvert locations.

The results of the other laboratory tests performed on this material is summarized as follows :

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	28.5-31%	3
Liquid Limit (w_L)	25-40%	3
Plastic Limit (w_P)	16-19%	3
Unit Weight (kN/m^3)	17.4-19.3%	3

The Atterberg Limit Tests carried out indicate the material has a low plasticity. Figure 4 in the Appendix illustrates the plasticity of the representative samples tested at all the culvert locations to be generally intermediate. In situ vane tests conducted within this deposit varied from 16 kPa to 50 kPa, with sensitivities of 3 to 8 recorded, indicating soft to firm consistency.

The 'N' values obtained from the Standard Penetration Test ranged from 2 to 11 blows/0.3 m.

Bedrock -

Bedrock was cored at BH 1 from elevation 249.3 m utilizing rock coring techniques with a 1.5 m sample of rock retrieved. The probable bedrock surface encountered in the remaining boreholes ranges from El. 248.7 m to El. 249.2 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recovery (CR) and Rock Quality Designation (RQD) were found to be 96% and 81% respectively. The rock is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water levels in open boreholes. Groundwater levels varied from El. 253.1 m to El. 252.9 m approximately at the same elevation as the unnamed creek. Seasonal fluctuations are expected.

CULVERT 5

Site Description

The site is located at Highway 11, about 5.8 km south of Highway 654. The area is generally flat to gently undulating with ditches on either side of Highway 11. An industrial complex and a residential home lie west and south of the site respectively. Boreholes were located in the front lawn of the industrial complex and within the marshy fields surrounding the Boleau Creek and Highway 11.

Subsurface Conditions

Two alignments were considered for the proposed culvert. Boreholes were located along the length of the proposed culvert for both alignments. A total of 12 sampled boreholes were drilled. Rock coring was carried out in six of them. In addition, two auger probe holes and eight cone tests were carried out to delineate the bedrock surface throughout the sites.

The subsoil stratigraphy at this site consists of a 0.8 m to 3 m surficial layer of clayey silt to silty clay, trace sand with organics near the surface. Pockets of silty sand were encountered throughout this stratum. Underlying this stratum is a non-cohesive silty sand, trace gravel, trace sand which contained larger

percentages of gravel near bedrock surface. Bedrock was encountered at depths of 2.7 to 6.1 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-E.

Specific descriptions of the material encountered are given below.

Clayey Silt to Silty Clay, trace Sand -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered to depths of 0.8 m to 3.0 m. Pockets of silty sand were encountered throughout this stratum.

Typical properties of the material at this location, as determined by laboratory tests of representative samples are summarized as follows :

<u>Property</u>	<u>No. of Tests</u>	<u>Range</u>
Moisture Content (w)	9	25.5 - 43.5
Liquid Limit (w_L)	9	18.0 - 46.0
Plastic Limit (w_p)	9	16.0 - 27.0
Unit Weight (kN/m^3) γ	6	15.1 - 18.6
Grain Size Distribution	11	
- Gravel		0 - 1
- Sand		3 - 57
- Silt		37 - 65
- Clay		6 - 53

Figure 4 illustrates a typical plasticity chart for this material, based on representative samples from all the culvert locations. It indicates that the material is of low to intermediate plasticity.

In situ vane tests conducted within this deposit varied from 20 kPa to 38 kPa with sensitivities of 2 to 10 recorded, indicating a soft to firm consistency.

The 'N' values obtained from the Standard Penetration Test ranged from 2 blows/0.3 m to 22 blows/0.3 m.

Silty Sand, trace Gravel, trace Clay -

Underlying the above layer is a 1 m - 3.9 m thick layer of silty sand, trace gravel, trace clay. The ten Grain Size Distribution tests carried out indicate

that this deposit comprises 0-36% gravel, 41-83% sand, 2-49% silt and 2-8% clay. Figure 1 illustrates a typical Grain Size Distribution envelope for this material, based on representative samples from all culvert locations. Three moisture content tests were done and values of 23, 26.5 and 30% were obtained.

The 'N' values obtained from the Standard Penetration Test in this material ranged from 1 blows/0.3 m to 68 blows/0.3 m. The 'N' values indicate a very loose to very dense state of denseness, but generally compact with a higher density near the bedrock surface.

Bedrock -

Bedrock was cored in six borehole locations from elevations 255.5 m to 259.0 m. Length of rock cores retrieved ranges from 0.9 to 1.5 m.

The bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recoveries (CR) and Rock Quality Designations (RQD) range from 80 to 100% and 37 to 100% respectively. The rock is classified as strong, slightly weathered to unweathered.

Groundwater

Observations of the groundwater level were carried out by measuring the water levels in open boreholes. Groundwater levels varied from El. 262.3 m - El. 259.5 m which was slightly higher than the nearby Boleau Creek. Seasonal fluctuations are expected.

CULVERT 6

Site Description

The site is located just west of Highway 11 at Windsor creek. The area is a swampy marsh at the bottom of the Highway 11 embankment. The existing culvert is to be lengthened by 40 m to the northwest for the widening of the Highway.

Subsurface Conditions

Three sampled boreholes and three probe holes with Cone Penetration Tests were conducted along the proposed culvert extension. Bedrock was cored at one of the boreholes.

The subsoil stratigraphy encountered comprises a 3.4 m to 2.1 m clayey silt to silty clay, trace sand underlain by a heterogeneous mixture of sand and gravel above bedrock. Pockets of silty sand were encountered within the clayey silty to silty clay strata. Bedrock was encountered at depths of 6.1 m to 8.1 m. Random boulders were encountered near the bedrock surface.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-F.

Specific descriptions of the subsurface conditions encountered are given below:

Clayey Silt to Silty Clay -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered throughout the site from the surface down to depths of 2.1 - 3.4 m. This deposit contained pockets of silty sand.

Typical properties of the material at this location, as determined by laboratory tests are summarized as follows :

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	30-62%	3
Liquid Limit (w_L)	34-57%	3
Plastic Limit (w_p)	17-21%	3
Unit Weight (kN/m^3) γ	17 & 18.2%	2
Grain Size Distribution (%)		3
Gravel	0-14%	
Sand	2-32%	
Silt	24-53%	
Clay	30-70%	

The relatively large variations in the grain size distribution are due to the presence of sand pockets in the material. Figure 3 illustrates a typical Grain Size Distribution envelope for this material based on representative samples from all the culvert locations. Figure 4 illustrates a typical Plasticity chart for this material based on representative samples from all the culvert locations. One in-situ vane test was performed in this deposit with a shear strength of 50 kPa and a sensitivity of 6 recorded. The results were probably affected by the presence of the sand pockets and may not be indicative of the consistency of the material.

The 'N' values obtained from the Standard Penetration Test ranged from 3

blows/0.3 m to 13 blows/0.3 m.

Heterogeneous Mixture of Sand and Gravel, trace Clay, trace Silt -

A non-cohesive heterogeneous mixture of sand and gravel, trace clay, trace silt was encountered underlying the above layer. This deposit had a thickness of 2.8 m to 6 m and extended down to bedrock. Random boulders were encountered upon approaching the bedrock surface.

Two Grain Size Distribution Tests were carried out and the results indicate that the deposit is composed of 38-46% gravel, 45-61% sand, 1-7% silt and 0-2% clay. Figure 5 illustrates a typical envelope for this material.

In this stratum, the 'N' values ranged from 4 blows/0.3 m to 131 blows/0.3 m. The compactness of the material ranges widely from very loose to very dense, but generally compact to dense with increasing denseness towards the bedrock surface. The low blowcounts may be due to disturbance of the material under differential water heads in a submerged state during drilling, whereas the high blowcounts may be due to boulder obstructions.

Bedrock -

Bedrock was cored in BH 3 at an elevation of 237.6 m, utilizing rock coring techniques with a 1.5 m rock core retrieved. The probable bedrock surface was encountered in the remaining boreholes/probe holes ranging from El. 236.3 m to El. 239.3 m.

The bedrock is classified as a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced.

Core Recovery (CR) and Rock Quality Designation (RQD) were determined on site to be 100% and 100% respectively. The bedrock is classified as strong, unweathered to slightly weathered.

Groundwater -

Observations of the groundwater level were carried out by measuring the water levels in open boreholes. Groundwater levels varied from 243.9 m - 244.1 m which were higher than the nearby Windsor Creek. Seasonal variations are expected.

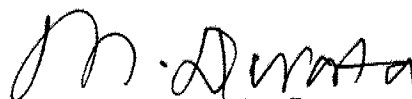
MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Michalek, Junior Foundation Engineer, and P. Thase, Student Engineer. The equipment was owned and operated by Master Soil Investigations, Toronto. Bedrock was examined and classified by MTO petrographer, D. Williams

The report was written by M. Michalek under the general supervision of B. Iyer, Senior Foundation Engineer and reviewed by M. Devata, Chief Foundation Engineer.



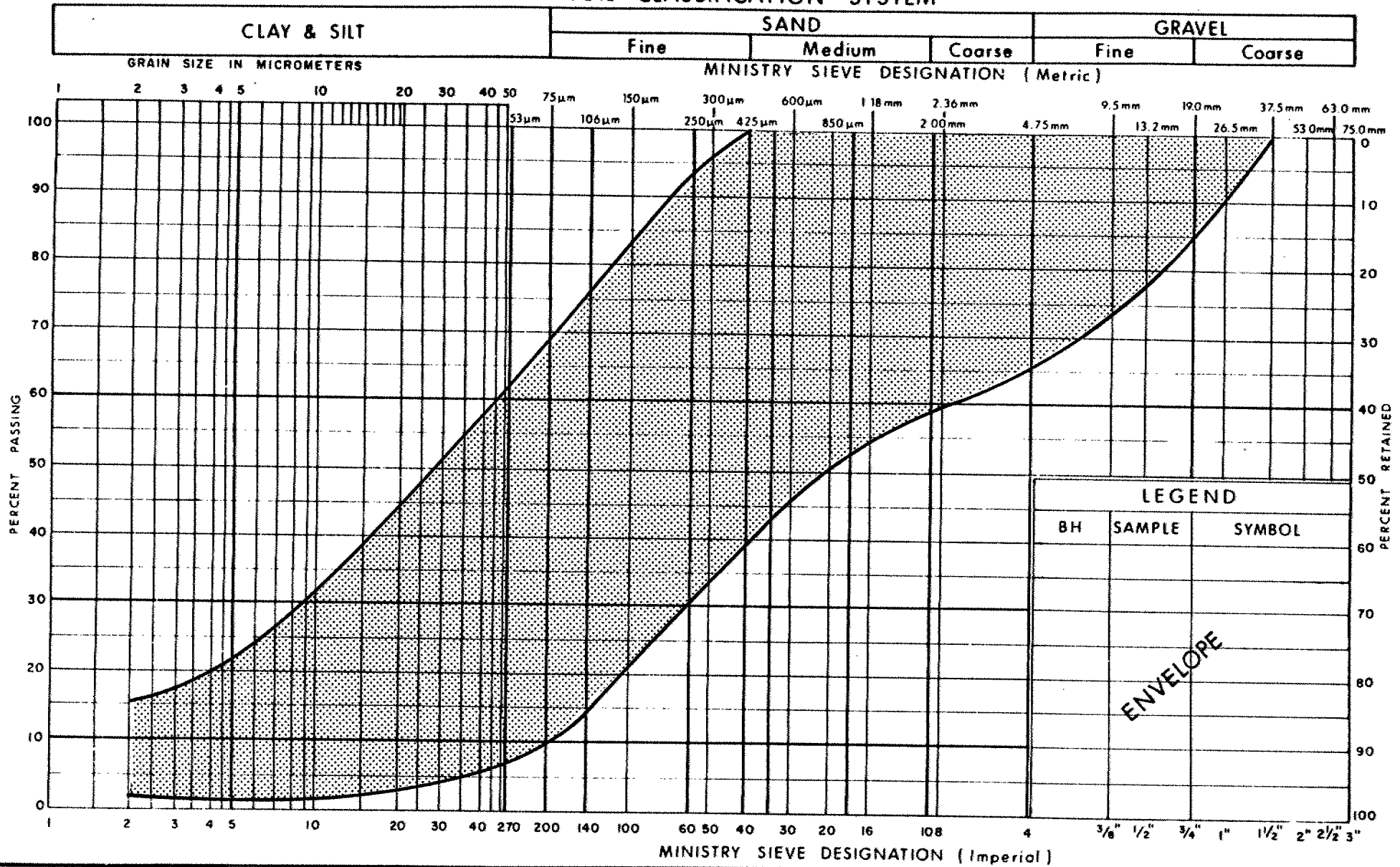
B. Iyer, P. Eng.
Senior Foundation Engineer



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

A P P E N D I X

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

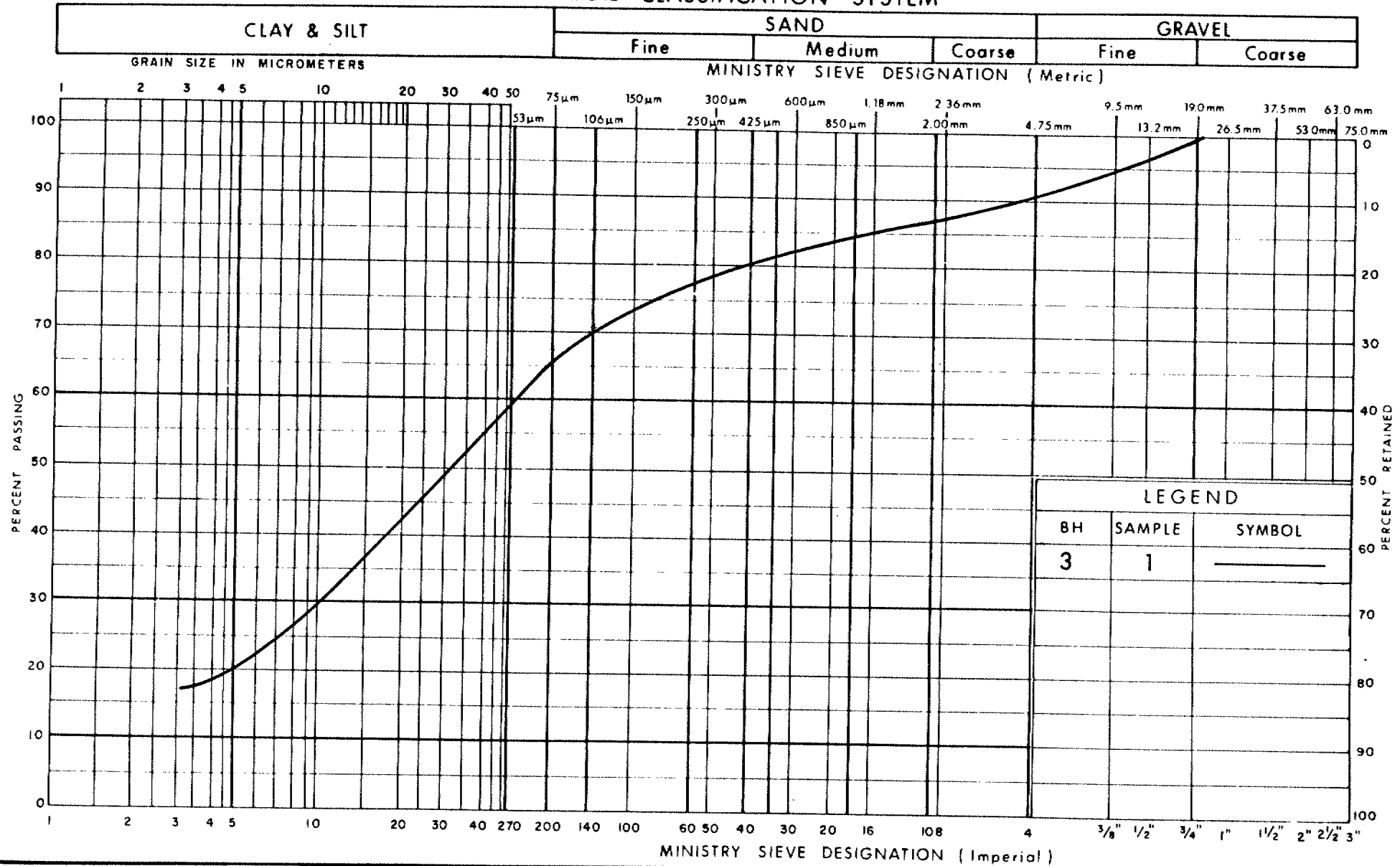
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL

FIG No 1

W P 73-74-00

UNIFIED SOIL CLASSIFICATION SYSTEM

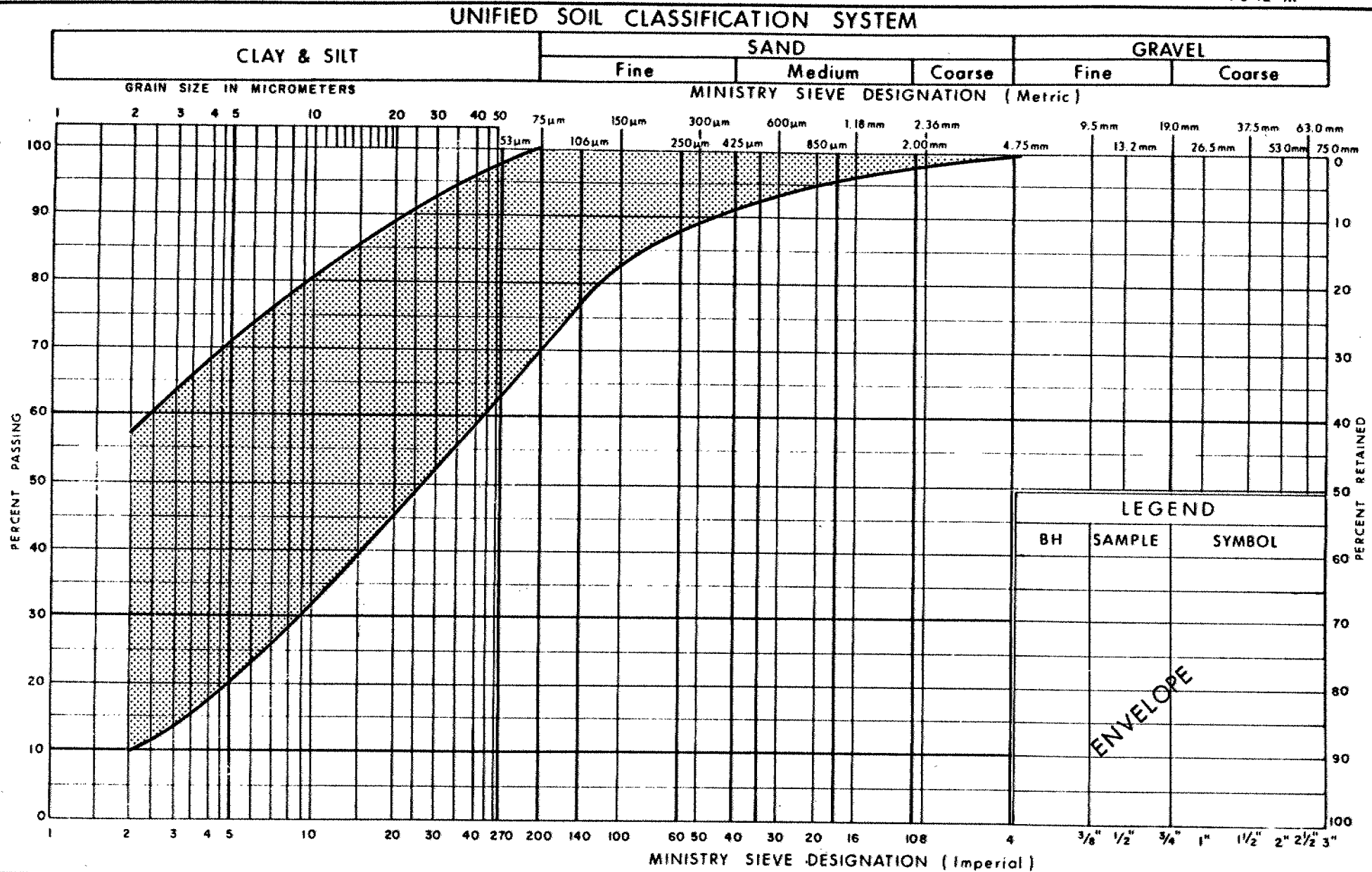


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT

FIG No 2

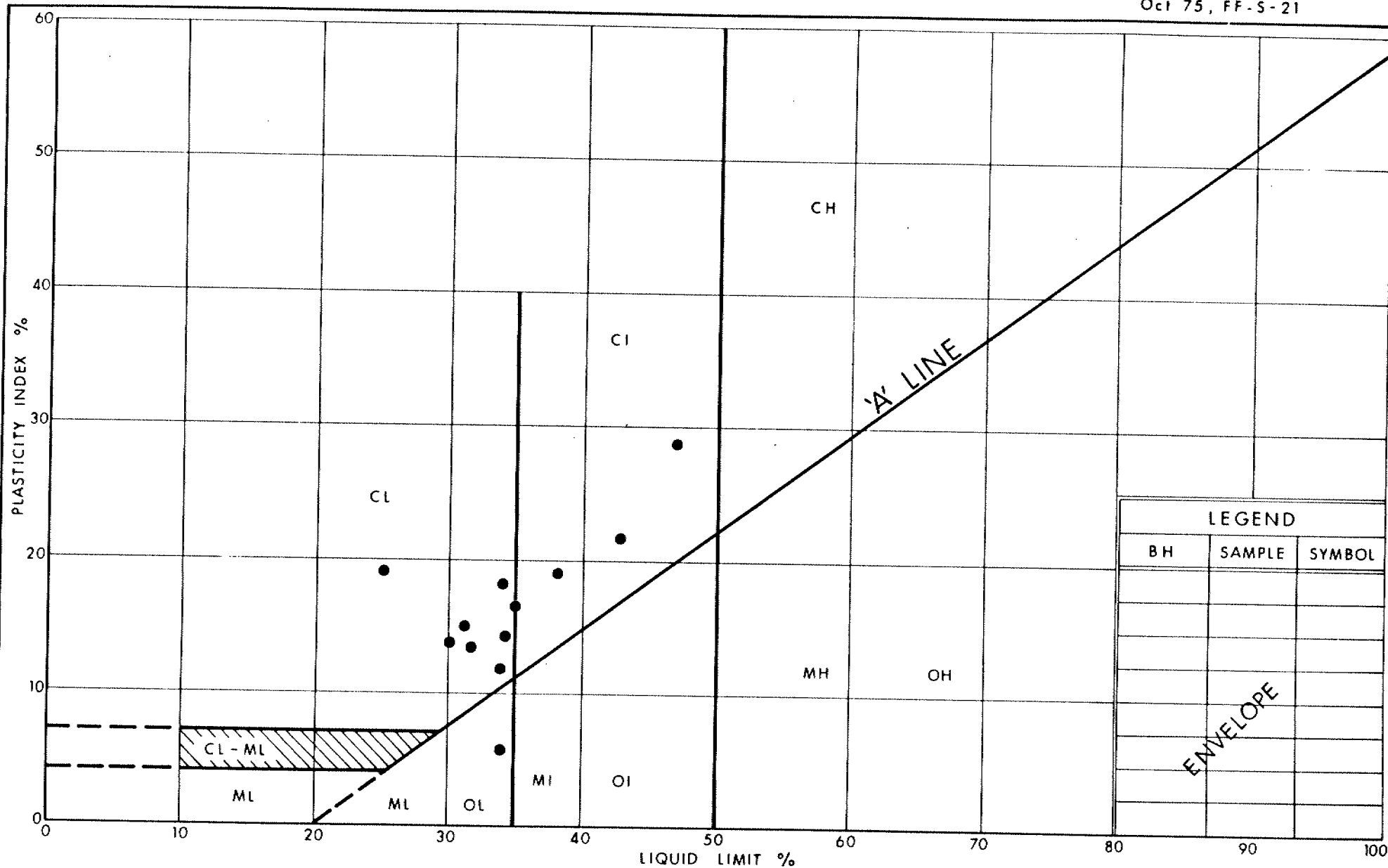
W P 73-74-00

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILTY CLAY
TRACE SAND

FIG No 3

W P 73-74-00

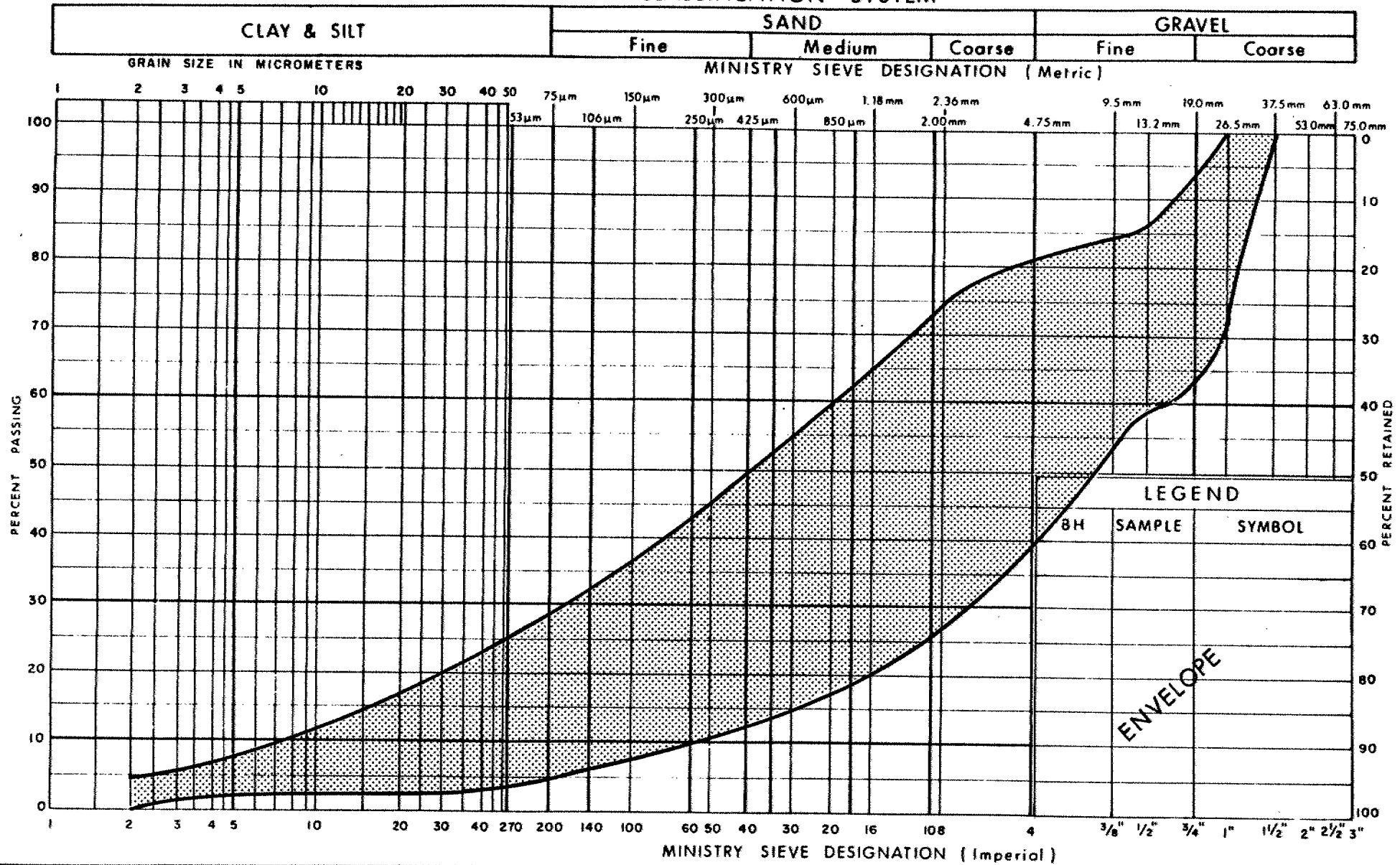
Ministry of
Transportation

PLASTICITY CHART
CLAYEY SILT TO SILTY CLAY
TRACE SAND

FIG No 4

W P 73-74-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF SAND & GRAVEL
 TRACE CLAY, TRACE SILT

FIG No 5

W P 73-74-00

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 484.3; E 315 178.7 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, BW Casing COMPILED BY M.M.
DATUM Geodetic DATE 91/08/23 CHECKED BY B.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W	W _L		
257.2	Ground Surface															
0.0	Silty Sand Trace Gravel Trace Clay (Possible Fill) Brown ----- Grey Some Gravel		1	SS	5											
			2	SS	2											
			3	SS	1											
			4	SS	12											
			5	SS	120											
253.1	Bedrock Biotite-Hornblende Gneiss Weathered to Slightly Weathered		6	RC BXL	REC 94%											
4.1																
251.7	End of Borehole															
5.5																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 472.2; E 315 177.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/24 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
257.2	Ground Surface																
0.0																	
	Silty Sand Trace Gravel Trace Clay (Possible Fill)		1	SS	5		256										
			2	SS	6		255										1 60 35 4
			3	SS	1												
	Some Gravel Organics Dark Brown		4	SS	8		254										
253.5																	
3.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 484.4; E 315 173.9 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY M.M.
DATUM Geodetic DATE 91/08/24 CHECKED BY B.I.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W _P	W		
257.2	Ground Surface - Asphalt															
0.0																
	Probable Silty Sand Trace Gravel Trace Clay															
253.2																
4.0	End of Cone Test Probable Bedrock										120	20cm				

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 470.0; E 315 168.8 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY M.M.
DATUM Geodetic DATE 91/08/24 CHECKED BY B.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
257.4	Ground Surface																
0.0	Probable Silty Sand Trace Gravel Trace Clay						257										
							256										
							255										
254.0																	
3.4	End of Cone Test Probable Bedrock											120	10	cm			

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 525.9; E 315 094.8 ORIGINATED BY M.M.
 DIST 1.3 HWY 11 BOREHOLE TYPE Hand Dug COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/30 CHECKED BY B.I.

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					
251.4	Creek Surface																
0.0	Gravel and Sand	Trace Silt	1	CS													60 36 3 1
251.1	End of Probehole	Probable Bedrock															
0.3																	

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 518.4; E 315 119.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H5 Auger COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L			
253.0	Ground Surface																	
0.0	Organics																	
	Silty Sand, Trace Clay																	
252.0	Trace Gravel		1	SS	120													
1.0	End of Borehole																	
	Probable Bedrock																	

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 520.8; E 315 112.2 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY M.M.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L		
252.8	Ground Surface															
0.0	Silty Sand, Trace Clay Trace Gravel															
251.8			1	SS	120											
1.0	Bedrock Biotite-Hornblende Gneiss Slightly Weathered to Unweathered		2	RC BXL	REC 87%											
250.2																
2.6	End of Borehole															

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 520.0; E 315 100.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Hand Dug COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
251.5	Creek Surface																
251.3	Gravel and Sand	Trace Silt	1	CS													
0.2	End of Probehole	Probable Bedrock															

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(3) LOCATION Culvert #3 Coords: N 5 108 145.1; E 315 306.0 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Rock Core COMPILED BY M.M.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
256.9	Ground Surface																
0.0	Silty Sand, Trace Clay With Gravel Brown (Possible Fill)		1	SS	6		256										19 56 20 5
254.8			2	SS	12		255										
2.1	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Firm		3	SS	14		254									18.7	0 8 72 20
			4	SS	7		253										
			5	SS	7		252										0 3 79 18
			6	SS	6		251										
250.7			7	SS	120 120 120		250										
6.2	Bedrock Biotite-Hornblende Gneiss Slightly Weathered to Unweathered		8	RC BXL	REC 100%												RQD 90%
249.4																	
7.5	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

METRIC

+3, x5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(3) LOCATION Culvert #3 Coords: N 5 108 132.3; E 315 309.8 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY M.M.
DATUM Geodetic DATE 91/08/23 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kP _o ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE										WATER CONTENT (%)
256.8	Ground Surface							20	40	60	80	100						
0.0	Sandy Silt Trace Gravel With Clay (Possible Fill)		1	SS	12		256									20.4	10 23 53 14	
255.4			2	SS	9		255											
1.4			3	SS	9		254											
			4	SS	6		253											
			5	SS	2		252											
			6	SS	2		251											
250.4	Het. Mix. of Si, So, Gr.		7	SS	120												31 45 20 4	
6.4	End of Borehole Probable Bedrock				15cm													

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00(3) LOCATION Culvert #3 Coords: N 5 108 143.0; E 315 313.1 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY M.M.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	W _p	W		
256.9	Ground Surface						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					
0.0	Probable Silty Sand Trace Clay With Gravel (Possible Fill)											
254.5												
2.4	Probable Clayey Silt to Silty Clay Trace Sand											
251.3												
5.6	End of Cone Test Probable Bedrock						120/15cm					

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(4) LOCATION Culvert #4 Coords: N 5 108 178.8 E 315 170.7 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Rock Core COMPILED BY M.M.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

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					
254.6	Ground Surface																
0.0	Cloyey Silt to Silty Clay Trace to some Sand Pockets of Silty Sand Soft Brown Grey		1	SS	6		254									17.9	0 19 57 24
			2	SS	4		253										
			3	SS	3		252										
			4	SS	2		251										0 7 68 25
			5	SS	2		250										
			6	SS	11		249										
249.3	Bedrock Biotite-Hornblende Gneiss Slightly Weathered to Unweathered		7	RC BXL	REC 96%		249										RQD 51%
5.3							248										
247.8	End of Borehole																
6.8																	

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4 Coords: N 5 108 182.3; E 315 177.7 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM GEODETIC DATE 91/08/22 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
254.5	Ground Surface													
0.0	Probable Clayey Silt to Silty Clay Trace Sand													
248.7														
5.8	End of Cone Test	Probable Bedrock												

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(4) LOCATION Culvert #4 Coords: N 5 108 170.8, E 315 184.6 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.J.

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					
254.6	Ground Surface																
0.0	with Sand																
			1	SS	7		254										
			2	SS	6		253										0 2 54 44
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Firm		3	SS	2		252		+7							17.4	
			4	SS	3		251										
			5	SS	2		250										0 1 59 40
			6	SS	4				+5								
249.2																	
5.4	End of Borehole Probable Bedrock																

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4, Coords: N 5 108 174.3, E 315 202.4 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								20 40 60 80 100	20 40 60 80 100						
255.0	Ground Surface							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE							
0.0	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Firm		1	SS	11	*	254						19.3	0 5 57 38	
2			SS	6	253										
3			SS	3	252										
4			SS	3	251		5								
5			SS	1	250										
6			SS	4	248										
248.9															
6.1	End of Borehole	Probable Bedrock													
	• WL Not Determined														

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4 Coords: N 5 108 172.2; E 315 206.0 ORIGINATED BY J.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.J.




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 × 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								
254.8	Ground Surface												
0.0													
	Probable Clayey Silt to Silty Clay Trace Sand												
248.7													
6.1	End of Cone Test	Probable Bedrock											

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 564.2; E 315 581.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/19 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							W _p	W	W _L
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE									
262.3	Ground Surface																
0.0	Clayey Silt to Silty Clay Trace Sand Soft to Firm Pockets of Silty Sand		1	SS	13		262							18.9	1 6 63 30		
			2	SS	6		261										
			3	SS	5		260										
259.4																	
2.9	Silty Sand Trace Gravel Trace Clay Compact to Very Dense		4	SS	10		259							8 52 35 5	ROD 62%		
			5	SS	30		258										
			6	SS	61		257										
256.8																	
5.5	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		7	RC BXL	REC 100%		256										
255.3																	
7.0	End of Borehole																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 565.3; E 315 594.3 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/19 CHECKED BY B.L.

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					
262.1	Ground Surface																
0.0	Silty Sand																
	Clayey Silt to Silty Clay		1	SS	12		261									18.1	0 9 64 27
	Trace Sand		2	SS	4		260										
	Firm																
	Pockets of Silty Sand		3	SS	3												
259.2							259										
2.9	Silty Sand		4	SS	15												
	Trace Gravel																
	Trace Clay		5	SS	51		258										
	Compact to Very Dense																
	With Gravel		6	SS	68												18 74 6 2
256.8							257										
5.3	End of Borehole																
	Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 563.6; E 315 602.4 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
262.0	Ground Surface																
0.0	Silty Sand																
	Cloyey Silt to Silty Clay		1	SS	13		261									18.9	1 5 49 45
	Trace Sand		2	SS	5		260										
	Firm																
	Pockets of Silty Sand		3	SS	22												
259.1							259										
2.9			4	SS	25												
	Silty Sand						258										
	Trace Gravel		5	SS	40												
	Trace Clay																
	Compact to Very Dense		6	SS	120												12 41 40 7
257.0																	
5.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION CULVERT #5 COORDS: N 5 111 553.6; E 315 604.5 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _P	W	W _L		
262.0	Ground Surface																
0.0	Probable Clayey Silt to Silty Clay Trace Gravel Trace Clay																
259.0																	
3.0	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		1	RC BXL	REC 80%											RQD 37%	
257.5																	
4.5	End of Borehole																
262.0																	

0.0 End of Borehole

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 559.9; E 315 594.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Auger Probe COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
262.1	Ground Surface																
0.0	Probable Clayey Silt to Silty clay Trace Sand						262										
							261										
259.9							260										
2.2	Probable Silty Sand Trace Gravel Trace Clay						259										
258.1																	
4.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 566.4; E 315 587.6 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Auger Probe COMPILED BY A.H.
DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
262.2	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262										
259.9							261										
2.3	Probable Silty Sand Some Gravel						260										
							259										
							258										
							257										
256.4																	
5.8	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 620.7; E 315 583.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	10 20 30				
261.4	GROUND SURFACE														
0.0	Organics						261							0 57 37 6	
260.6	Clayey Silt to Silty Clay Trace Sand														
0.8	Silty Sand Trace Clay Very Loose to Compact		1	SS	3		260								
			2	SS	17										
		3	SS	14	259										
258.2		4	SS	120											
3.2	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		5	RC BXL	REC 97%	258								RQD 50%	
257.3															
4.1	End of Borehole														

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 617.8; E 315 592.1 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
261.5	GROUND SURFACE																			
0.0	Organics						261													
	Clayey Silt to Silty Clay With Sand Pockets of Silty Sand Soft		1	SS	2		260									0 23 61 16				
259.4			2	SS	4															
2.1	Sand With Gravel Trace Silt Trace Clay Loose		3	SS	9		259									13 83 2 2				
258.3																				
3.2	End of Borehole Probable Bedrock																			

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 615.4; E 315 615.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.1	Ground Surface																
0.0	Clayey Silt to Silty Clay Some Sand Trace Organics Soft		1	SS	3		260										0 28 65 7
260.0			2	SS	5												
1.1	Silty Sand Trace Gravel Trace Clay Very Loose to Dense		3	SS	18		259										1 71 24 4
			4	SS	21		258										
			5	SS	8		257										
	Some Gravel		6	SS	146												
256.1					2.3cm												
5.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 603.0; E 315 621.6 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	w _p	w	w _L		
261.4	Ground Surface																
0.0	Clayey Silt to Silty Clay Some Sand Organics Pockets of Silty Sand Soft		1	SS	3												
260.0			2	SS	4												
1.4	Silty Sand With Gravel Very Loose to Very Dense		3	SS	6												
			4	SS	1												
			5	SS	32												
	Some Gravel		6	SS	42												
256.1																	
5.3	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 11

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5, Coords: N 5 11 632.2 E 315 582.0 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.J.

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 × 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								
261.3	Ground Surface												
0.0	Probable Clayey Silt to Silty Clay Some Sand Pockets of Silty Sand Organics						261						
258.9							260						
2.4	Probable Silty Sand With Gravel						259						
257.5							258						
3.8	End of Cone Test Probable Bedrock							120/8cm					

RECORD OF BOREHOLE No 12

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 599.4; E 315 610.0 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'IN' VALUES	20	40	60	80	100	W _P	W		
261.4	GROUND SURFACE															
0.0	Probable Clayey Silt to Silty Clay Some Sand															
260.1																
1.3	Probable Silty Sand With Gravel															
257																
258																
259																
260																
261																
5.3	End of Cone Test Probable Bedrock										120/8cm					

RECORD OF BOREHOLE No 13

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 616.1; E 315 622.7 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
261.2	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay With Sand													
260.1														
1.1														
	Probable Silty Sand With Gravel													
256.3														
4.9	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 14

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 601.3; E 315 655.3 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100					
261.6	GROUND SURFACE															
0.0																
	Clayey Silt to Silty Clay Trace Sand Firm		1	SS	5										18.1	0 3 44 53
			2	SS	2											
			3	SS	5											
258.7																
2.9	Silty Sand With Gravel Loose to Compact		4	SS	14											
			5	SS	8											
			6	SS	10											1 68 27 4
255.5																
6.1	Bedrock Biotite-Hornblend Gneiss Unweathered		7	RC BXL	REC 100%											RQD 93%
254.1																
7.5	End of Borehole															

RECORD OF BOREHOLE No 15

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 557.0; E 315 661.8 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.8	GROUND SURFACE																
0.0	Organics																
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Stiff		1	SS	9		261									17.3	0 9 59 32
259.7			2	SS	17		260										
2.1	Silty Sand Trace Gravel Compact		3	SS	19		259										
258.3			4	SS	17												36 49 13 2
3.5	Bedrock Biotite-Hornblend Gneiss Unweathered		5	RC BXL	REC 100%		258										RQD 100%
256.8							257										
5.0	End of Borehole																

RECORD OF BOREHOLE No 16

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 600.8; E 315 662.4 ORIGINATED BY P.T.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	w _p	w	w _L		
762.4	GROUND SURFACE							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262						
260.1							261						
2.3	Probable Sandy Silt Trace Clay Trace Gravel						260						
							259						
							258						
257.1													
5.3	End of Cone Test Probable Bedrock							50/15cm					

+ 3, x 5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 17

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 590.8; E 315 663.1 ORIGINATED BY P.T.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
262.3	GROUND SURFACE																
0.0							262										
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft		1	SS	10		261										1 10 52 37
			2	SS	9		260	10									
259.4			3	SS	2												
2.9	Silty Sand Trace Gravel Trace Clay Very Loose		4	SS	3		259										
258.4			5	SS	21												3 51 44 2
3.9					/5cm		258										
	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		6	RC BXL	REC 95%		257										RQD 95%
256.9																	
3.4	End of Borehole																

RECORD OF BOREHOLE No 18

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 571.7; E 315 656.4 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.4	Ground Surface																
0.0	Organics						261										
	Clayey Silt to Silty Clay																
	Trace Sand																
260.0	Very Stiff		1	SS	16		260										0 5 48 47
1.4	Sandy Silt		2	SS	22												
	Trace Clay																
	Compact																
258.7			3	SS	17		259										0 45 49 6
2.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 19

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 594.8; E 315 662.7 ORIGINATED BY P.T.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
262.4	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262							
260.2							261							
2.2	Probable Silty Sand Trace Clay						260							
258.3							259							
4.1	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 20

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 583.7; E 315 654.2 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

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					
261.5	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand						261										
259.8							260										
1.7	Probable Silty Sand Trace Clay						259										
257.8							258										
3.7	End of Cone Test Probable Bedrock																

RECORD OF BOREHOLE No 21

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 571.4; E 315 662.9 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
262.2	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262							
260.1							261							
2.1	Probable Silty Sand Trace Clay						260							
258.8							259							
3.4	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 22

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 555.8; E 315 656.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _P	W	W _L		
261.2	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand																
259.9																	
1.3	Probable Silty Sand Trace Clay																
257.4																	
3.8	End of Cone Test Probable Bedrock																

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 771.2; E 315 624.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/17 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.2	GROUND SURFACE																
0.0	Organics						244										
	Some Gravel		1	SS	5		243										14 32 24 30
	Clayey Silt to Silty Clay With Sand Pockets of Silty Sand Soft to Stiff		2	SS	3		242										
241.3			3	SS	13		241										
2.9			4	SS	12		240										
			5	SS	25		239										
			6	SS	32		238										
	Heterogeneous Mix of Sand and Gravel Trace Silt Trace Clay Random Boulders Compact to Very Dense		7	SS	131												46 45 7 2
237.5																	
6.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 772.5; E 315 631.3 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/15 CHECKED BY B.I.

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.4	GROUND SURFACE																
0.0	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Stiff		1	SS	4		244									18.2	0 3 27 70
242.3			2	SS	11		243										
2.1			3	SS	48		242										
			4	SS	42		241										
			5	SS	18		240										
			6	SS	12		239										
			7	SS	79		238										
236.3							237										
8.1	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 763.8; E 315 635.1 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		w _p w w _L				
								SHEAR STRENGTH kPa		WATER CONTENT (%)				
							○ UNCONFINED + FIELD VANE							
							● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	10 20 30					
244.3	GROUND SURFACE													
0.0	Organics													
	Clayey Silt to Silty Clay		1	SS	5							17.0		
	Trace Sand													
	Pockets of Silty Sand		2	SS	4								0 2 53 45	
	Firm													
	Silt		3	SS	4									
241.4	Some Sand													
2.9			4	SS	9									
			5	SS	16									
			6	SS	4								38 61 1 0	

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 762.6; E 315 650.2 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
DATUM Geodetic DATE 91/08/19 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
244.8	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand																
242.0																	
2.8	Probable Heterogeneous Mix of Sand and Gravel Trace Silt Trace Clay Random Boulders																
238.7																	
6.1	End of Cone Test Probable Bedrock																

METRIC

+3, x5: Numbers refer to Sensitivity

METRIC

+3, x5: Numbers refer to Sensitivity

ROCK CORE DESCRIPTION WP 73-74-00

Page 1 of 3

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1-1	6	4.11-5.49	94	44	4.11-5.49	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth.
2-3	2	1.04-2.57	87	83	1.04-2.57	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth to rough.
3-1	8	6.22-7.52	100	90	6.22-7.52	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to close spaced, dipping to flat, undulating, smooth.
4-1	7	5.33-6.78	96	81	5.33-6.78	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

ROCK CORE DESCRIPTION **WP 73-74-00**

Page 2 of 3

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
5-1	7	5.49-7.01	100	62	5.49-7.01	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-4	1	3.05-4.27	100	46	3.05-4.27	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-7	5	3.20-4.11	97	50	3.20-4.11	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-14	7	6.10-7.47	100	93	6.10-7.47	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

ROCK CORE DESCRIPTION **WP 73-74-00**

Page 3 of 3

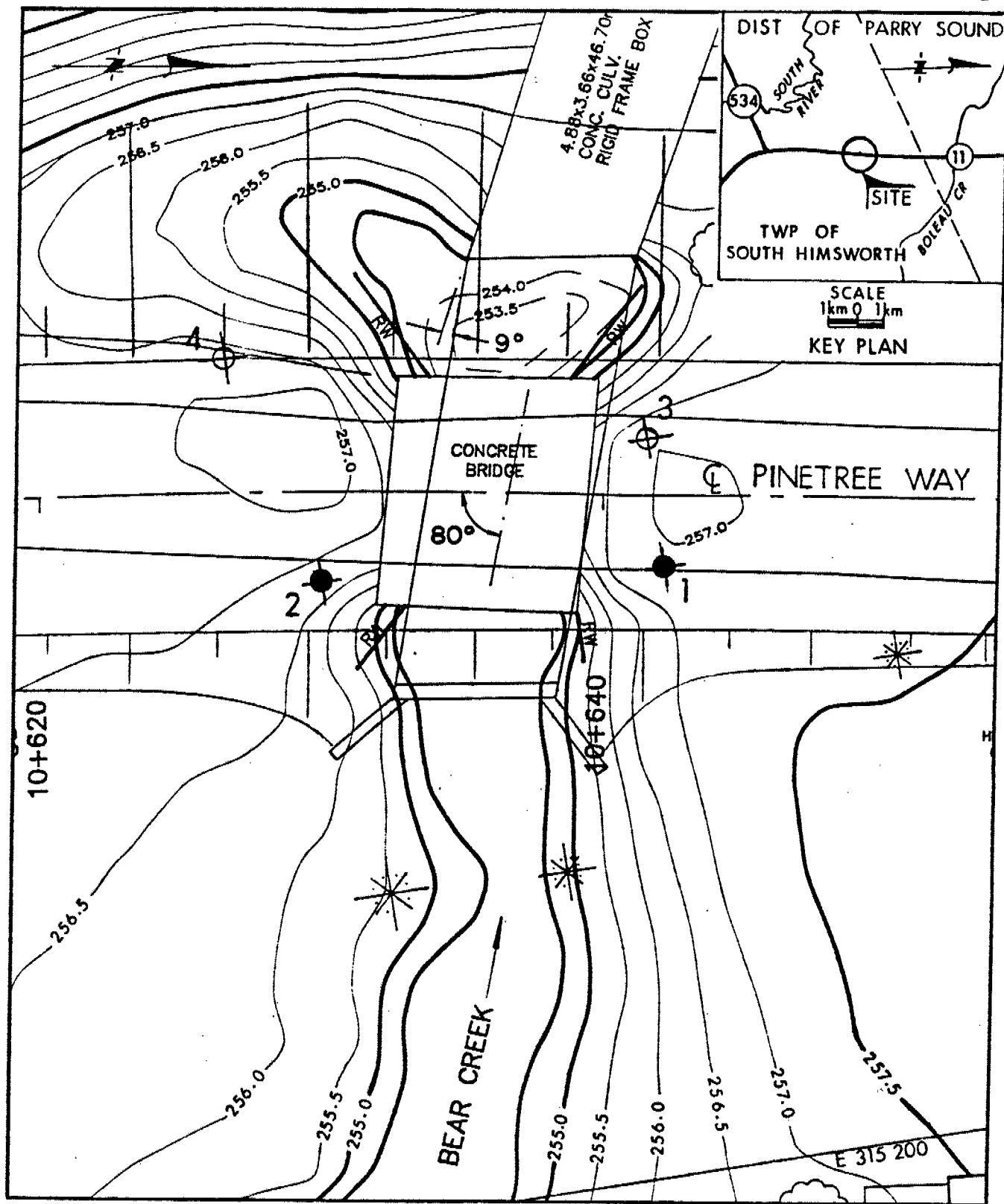
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
5-15	5	3.51-5.03	100	100	3.51-5.03	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, flat to near vertical, undulating, smooth.
5-17	6	3.86-5.39	95	95	3.86-5.39	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, dipping to flat, planar to undulating, smooth.
6-3	8	6.71-8.23	100	100	6.71-8.23	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, dipping to flat, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section



LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN

SCALE

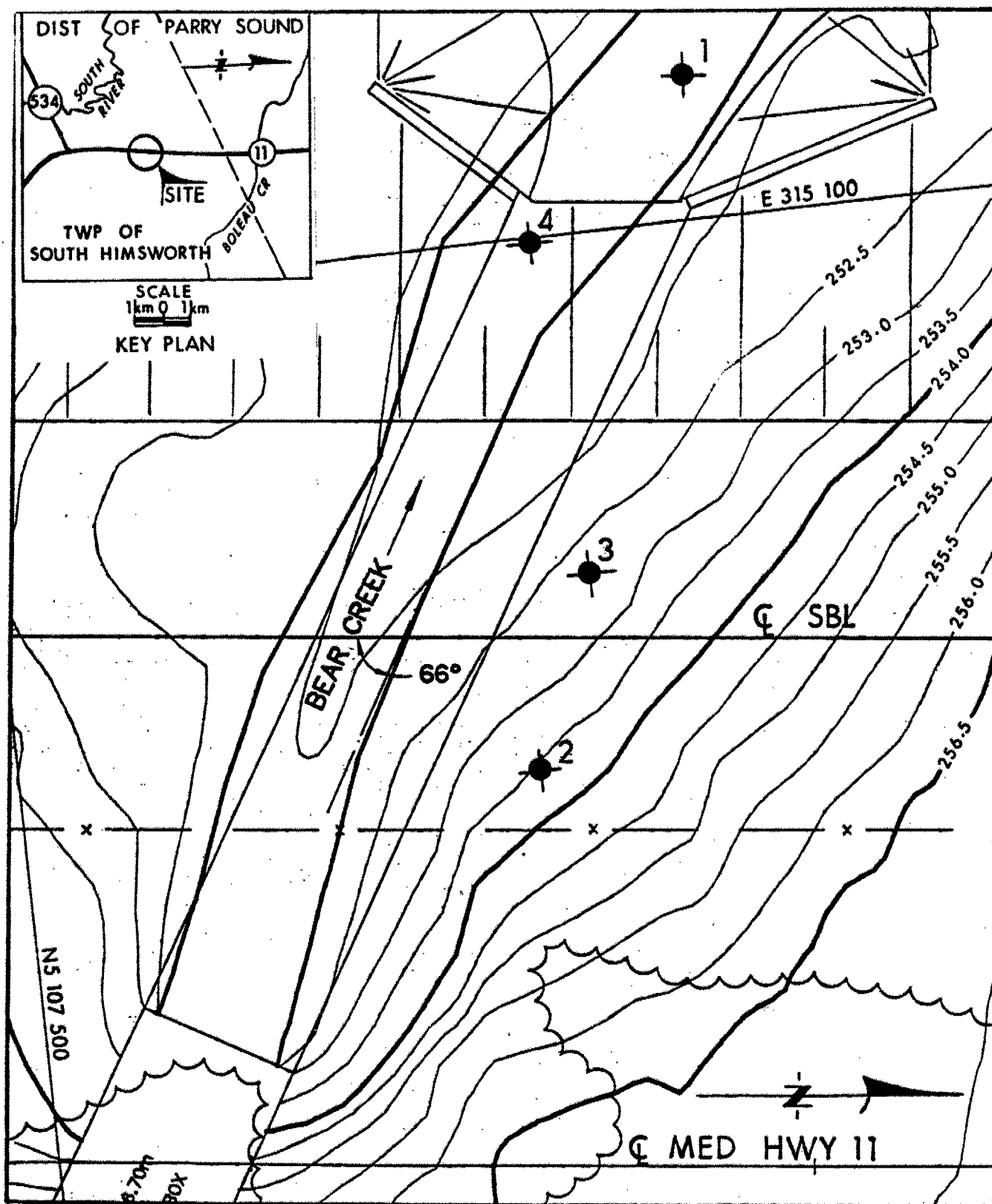


CULVERT No 1

Site 44-317-C

WP 73-74-00

Dwg No 737400-A

**LEGEND**

- BOREHOLE
- ⊕ CONE TEST

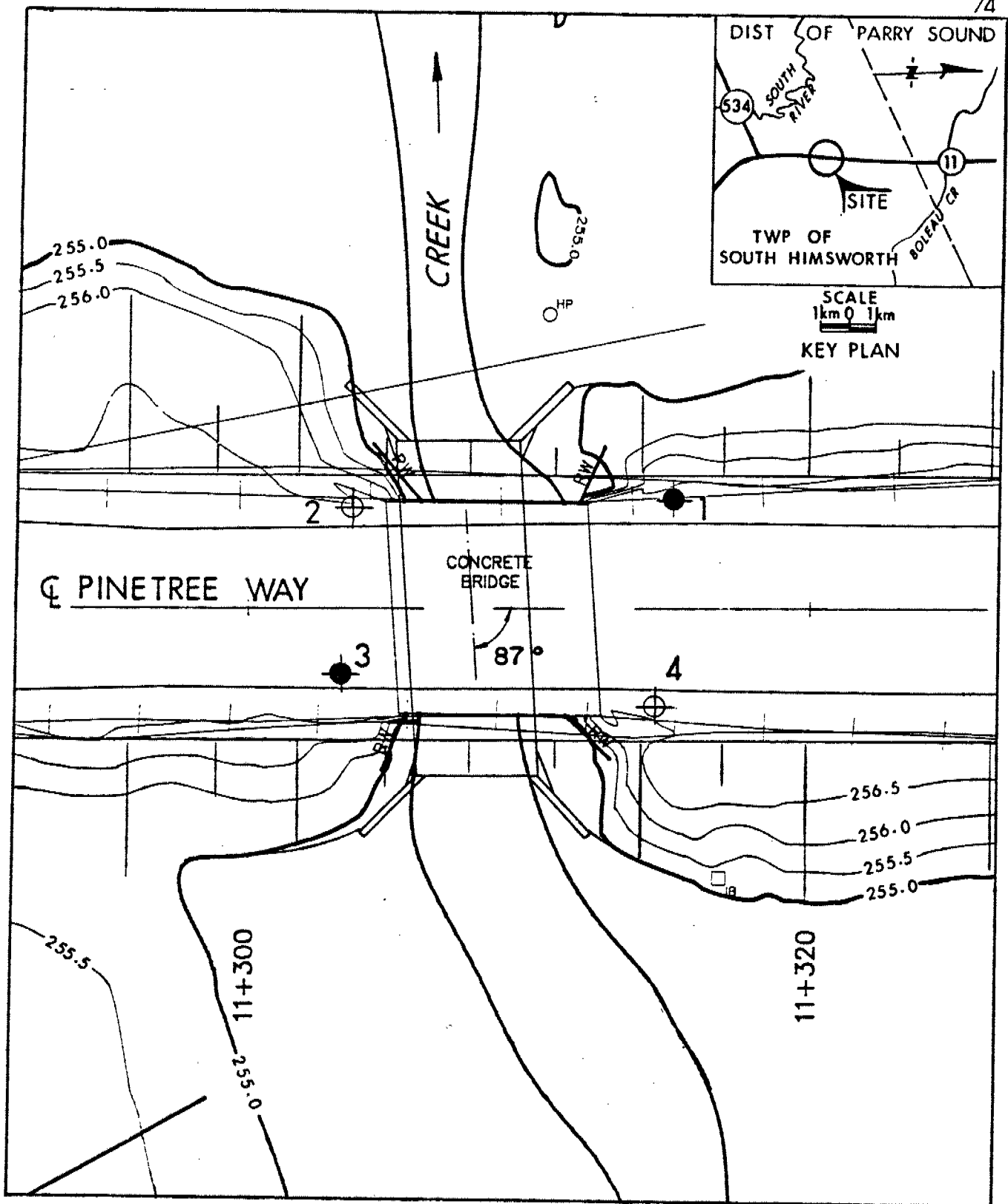
NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN
SCALE



CULVERT No 2
Site 44-317-C
WP 73-74-00
Dwg No 737400-B



LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

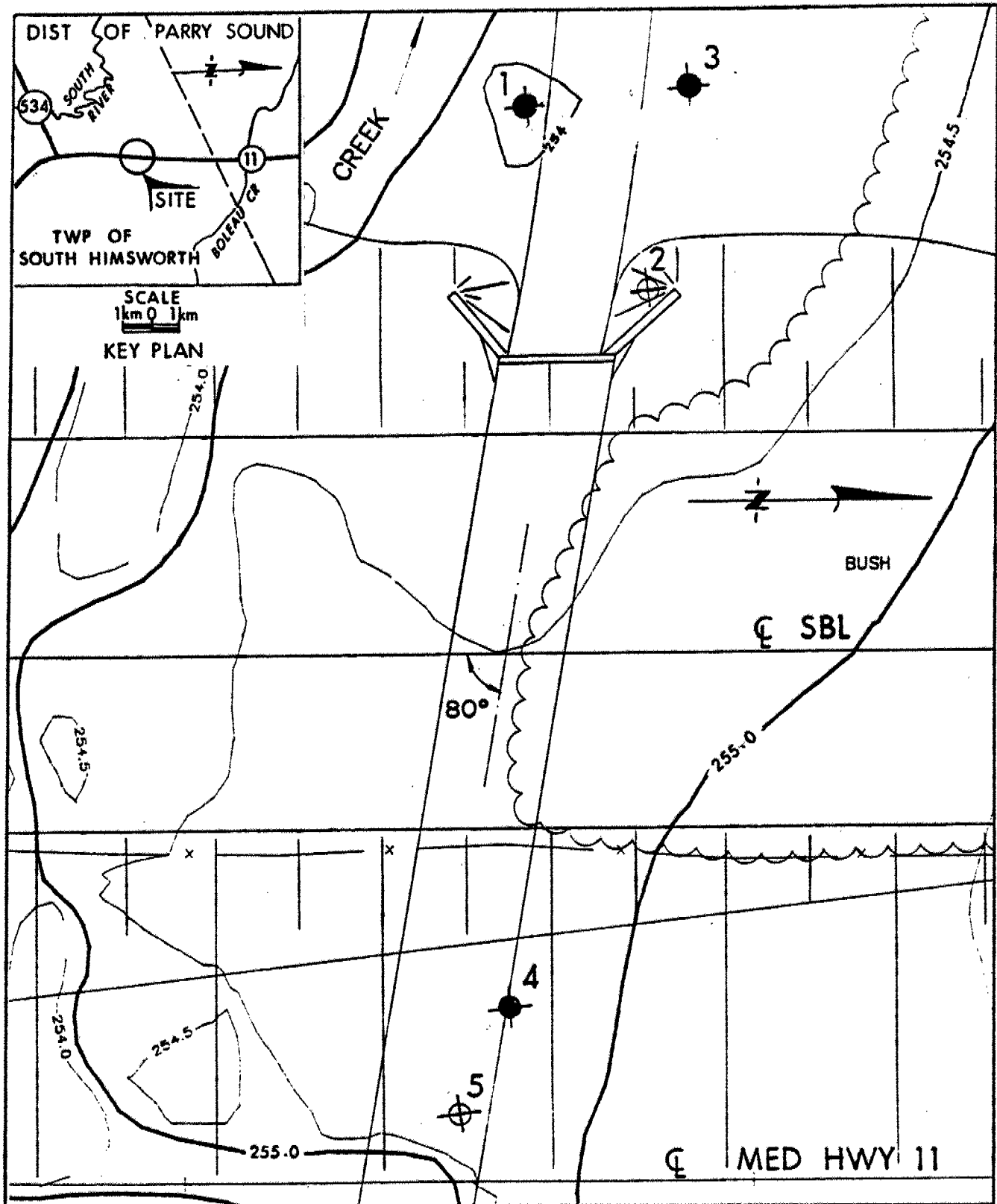
FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

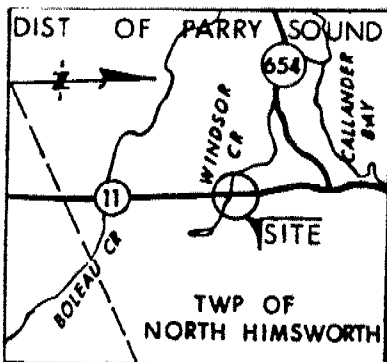
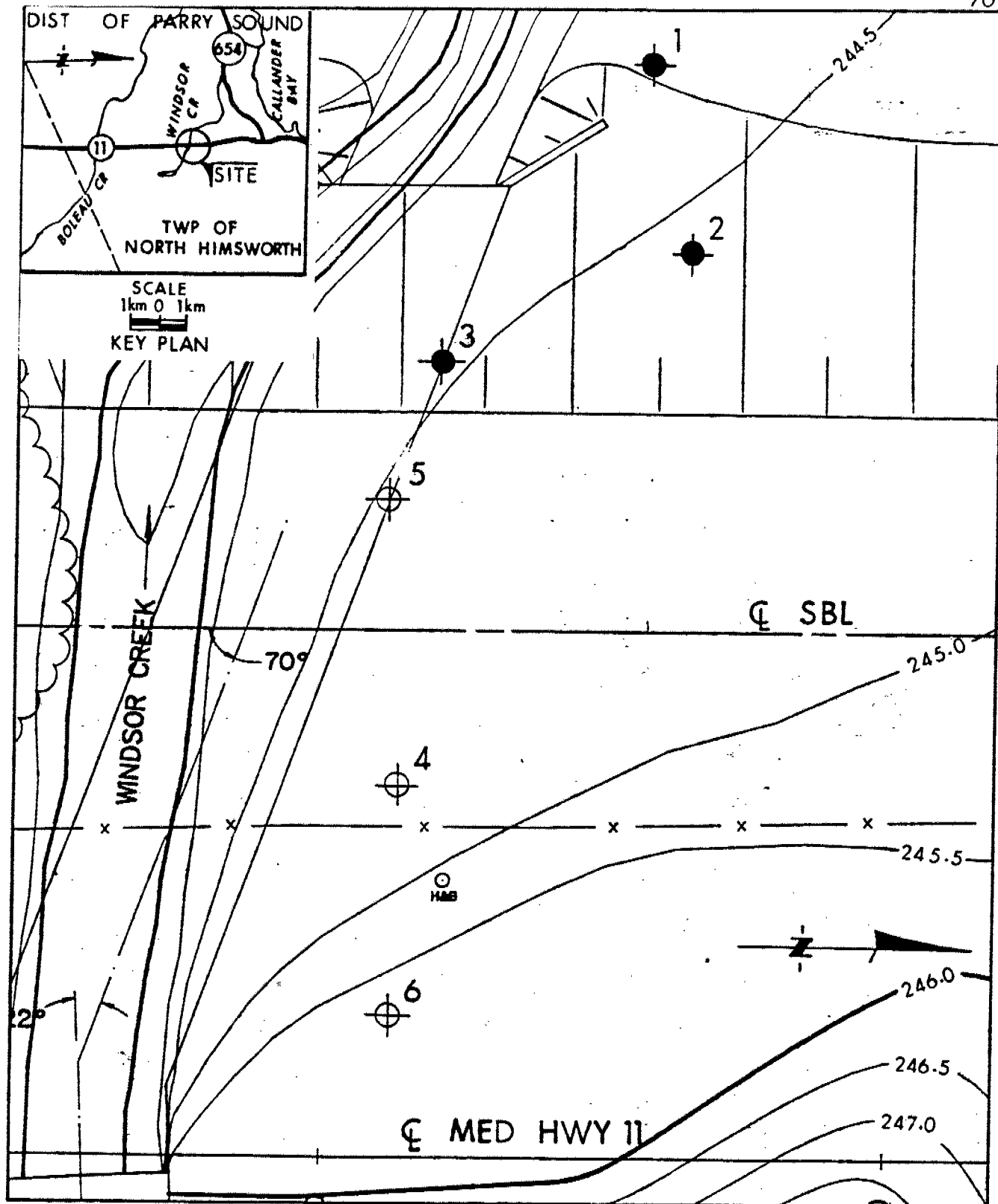
PLAN

SCALE



CULVERT No -3
Site 44 -318 C
WP 73-74-00
Dwg No 737400-C





SCALE
1km 0 1km
KEY PLAN

LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN

SCALE



CULVERT No 6
Site 44-319C
WP 73-74-00
Dwg No 737400-F

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONT 93-201

WP 73-74-00 DIST 13

HWY 11 STR SITE -

Culverts Along Hwy. 11
from 2.0 km North of Hwy. 534
Northerly 9.9 km

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FOUNDATION INVESTIGATION REPORT

For

Culverts Along Hwy. 11
from 2.0 km North of Hwy. 534

Northerly 9.9 km

W.P. 73-74-00

District 13, North Bay

INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned sites between 91 08 13 and 91 08 31. The investigation was carried out upon the request of Northern Region Structural Section for the proposed widening of Highway 11. The proposed works from 2.0 km north of Hwy. 534, northerly 9.9 km would require extending existing culverts approximately 40 km west. Two existing culverts are also proposed to be replaced.

The following culverts are addressed:

- 1) Bear Creek east of Hwy. 11 and Pinetree Way. (Replacement)
- Site 44 - 317C, 3.1 km North of Secondary Hwy. 534.
- 2) Bear Creek and Hwy. 11
- Site 44 - 317C, 3.1 km North of Secondary Hwy. 534.
- 3) Unnamed Creek East of Hwy. 11 and Pinetree Way (Replacement)
- Site 44 - 318C, 3.7 km North of Secondary Hwy. 534.
- 4) Unnamed Creek and Hwy. 11
- Site 44 - 318C, 3.7 km North of Secondary Hwy. 534.
- 5) Boleau Creek and Hwy. 11 (Two Options)
- Site 44 - 264C, 5.8 km South of Secondary Hwy. 654.
- 6) Windsor Creek and Hwy. 11
- Site 44 - 319C, 2.5 km South of Secondary Hwy. 654.

A total of 23 boreholes were advanced as part of this project by means of 82 mm I.D. hollow stem augers. In 11 selected boreholes rock core samples were retrieved utilizing BW casings and BXL core barrels. In addition, 18 cone penetration tests, 2 hand-dug holes and 2 auger probes were conducted.

GEOLOGY

Physiographically, the sites are located in the geological domain known as the Algonquin Highlands (after Chapman and Putnam, 1984). This region in much of the area is underlain by granite and other hard precambrian rocks. There are frequent outcrops of bare rock but they do not amount to more than 5% of the total area. Bedrock is generally shallow, however the thickness of the overburden varies greatly over short distances. Highway 11 from Gravenhurst to North Bay follows a narrow strip in which sand, silt and clay deposits occupy the hollows. The deep soils developed on the fine sand, silt and clay have been cleared and support farming settlements.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by the in situ and laboratory testing. The procedures employed are discussed below.

The fieldwork for the site investigations were carried out between 91 08 13 and 91 08 31 and consisted of boreholes placed along the length of the proposed culverts or in the case of the replacement culverts surrounding the existing culvert. The boreholes were advanced using conventional hollow stem augering techniques. Two track mounted continuous flight auger drill rigs were employed for the operation. Conventional rock coring techniques were applied in retrieving rock core samples for rock quality determination and classification purposes. Standard BXL Core Barrels and BW casings were utilized. In general, split spoon subsoil samples were retrieved at 0.7 m intervals. These disturbed samples were retrieved by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). All the samples collected were for identification and laboratory testing purposes. In situ vane tests were also conducted in cohesive silty clay deposits to determine the undisturbed and remoulded undrained shear strengths. The test was conducted employing the Standard MTO 'N' vane. Dynamic Cone Penetration Test were carried out in some boreholes to determine the soil layers and strength of the materials.

All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

Water levels monitored throughout the duration of the investigation were obtained in the open boreholes. All boreholes were backfilled upon completion of the

fieldwork.

Survey information related to the location and elevation of boreholes was provided by the Northern Region Surveys and Plans Section.

LABORATORY ANALYSIS

The following laboratory tests were carried out on selected soil samples:

- 1) Atterberg Limit Test
- 2) Grain Size Distribution
- 3) Unit Weight Determination
- 4) Natural Moisture Content.

Laboratory Test Results are given in the following sections of this report and are illustrated on figures and borehole log sheets included in the Appendix.

CULVERT 1

Site Description

The site is located to the east of Highway 11, about 3.1 km north of Highway 534. The area is generally flat to gently undulating with the land in the immediate vicinity residential. The existing culvert to be replaced lies under Pinetree way with fills of 3.7 m placed on either side of the culvert. Pinetree way becomes a dead end just south of the site. Highway 11 lies just west of the culvert.

Subsurface Conditions

Two sampled boreholes and two cone penetration tests were placed on each corner of the existing culvert. At one location rock core samples were taken to confirm bedrock.

The subsoil stratigraphy at the site was found to consist of a silty sand (possible fill), which contained a greater percentage of gravel approaching the bedrock surface. A biotite-hornblende gneiss bedrock was encountered at depths ranging from 3.4 m to 4.1 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-A.

Specific description of the materials encountered are given below.

Silty Sand, trace Gravel, trace Clay -

A non-cohesive material composed of silty sand, trace gravel (Possible Fill) was encountered at the surface and it extended to bedrock, at a depth of 3.4 m to 4.1 m.

The two Grain Size Distribution tests carried out at this location indicate that this deposit comprised of 1-7% gravel, 54-60% sand, 32-35% silt and 4-7% clay. Figure 1 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

The 'N' values obtained from the Standard Penetration test in this material ranged from 1-12 blows/0.3 m.

Bedrock -

Bedrock was cored at an elevation of 253.1 m in one borehole (BH 1) utilizing rock coring techniques with a 1.5 m rock core retrieved. The probable bedrock surface encountered in the remaining boreholes and cone test locations ranged from El. 253.2 m to El. 254.0 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recovery (CR) and Rock Quality Designation (RQD) were found to be 94% and 44% respectively. The bedrock can be classified as strong, unweathered to slightly weathered.

Groundwater -

Observations of the groundwater level were carried out by measuring the water level in open boreholes. At this culvert location, it was found to vary from El. 253.6 m to El. 255 m, approximately at the elevation of Bear Creek. Seasonal fluctuations are expected.

CULVERT 2

Site Description

The site lies to the west of Culvert 1 and Highway 11. The area is a heavily

forested ravine with the ground surface sloping up rather steeply (about 3:1) to the north and south. The existing embankment fill of Highway 11 rises to the east. Bear Creek is approximately 15 cm deep with outcrops of bedrock at places. The existing culvert appears to rest on bedrock.

Subsurface Conditions

Two sampled boreholes and two probe holes were placed along the length of the proposed culvert. Bedrock was cored in one of the boreholes. The probe holes were hand dug to locate bedrock surface elevations.

The subsoil stratigraphy at this site typically consisted of a non-cohesive stratum of silty sand, trace clay, trace gravel with traces of organics near the surface. In the shallow hand dug boreholes, the overburden consisted of gravel and sand, trace silt. Bedrock was encountered at depths ranging from 15 cm (within the creek) to 1.0 m (on the north bank).

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-B.

Specific descriptions of the subsoil conditions encountered is given below.

Silty Sand, trace Clay, trace Gravel -

A non-cohesive layer of silty sand, trace clay, trace gravel was encountered in the sampled boreholes to a depth of 1 m. Some organics were found surficially. The material contacted in the shallow hand dug boreholes consisted of gravel and sand, trace silt. These boreholes were located within the creek, thus the material recovered has had its fines washed away.

The 'N' values obtained from the Standard Penetration Test in this material were greater than 120/8 cm. It is considered that the high 'N' values are due to the presence of shallow bedrock and as such are not indicative of the relative density of the overburden.

Laboratory testing carried out on a representative sample indicates the material has 12% moisture content, with grain size distribution of 60% gravel, 35% sand, 3% silt and 1% clay. Figure 1 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

Bedrock -

Bedrock was cored at an elevation of 251.8 m in one borehole (BH 3), utilizing rock coring techniques with a 1.5 m sample of rock retrieved. The probable bedrock surface encountered in the remaining boreholes and probe holes ranged from El. 251.1 m to El. 252.0 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Designation".

Core Recovery (CR) and Rock Quality Designation (RQD) obtained were found to be 87% and 83% respectively. The bedrock is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water level in open boreholes. Ground water elevations were found to be El. 251.4 m - El. 252.4 m, approximately at the same elevation of Bear Creek. Seasonal fluctuations are expected.

CULVERT 3

Site Description

The site is located along Pinetree Way 1 km south of its intersection with Highway 11. This area is flat to gently undulating with residential housing to the north and south. The existing culvert at this location is to be replaced by another culvert of similar dimensions underneath Pinetree Way to carry the unnamed creek through. Fills of up to 2.3 m were placed on either side of the existing culvert up to the grade of Pinetree Way.

Subsurface Conditions

Two boreholes and two cone penetration tests were placed around the corners of the existing culvert. The two boreholes were sampled down to bedrock. 1.3 m of rock core was retrieved from one of the boreholes.

The subsoil stratigraphy at this site consists of 1.4 m to 2.4 m of a surficial silty sand, with gravel, trace clay (possible Fill) underlain by a clayey silt to silty clay, trace sand with a thickness of 3.2 m to 5 m. Bedrock was encountered beneath the above two deposits at depths of 5.6 m to 6.4 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-C.

Specific descriptions of the material encountered are given below.

Silty Sand, trace Clay, with Gravel(Possible Fill) / Sandy Silt (Fill) -

A non-cohesive stratum composed of silty sand, trace clay, with gravel (Possible Fill) / sandy silt (Fill), was contacted to a depth of 1.4 m to 2.4 m.

Laboratory testing on a representative sample indicates a unit weight of 20.4 kN/m³ and moisture content of 17%. The two Grain Size Distribution Tests carried out at this location indicate that this deposit comprised of 10-19% gravel, 23-56% sand, 20-53% silt and 5-14% clay. Figure 1 illustrates a typical Grain Size Distribution curve for the silty sand material, based on representative samples from all the culvert locations. Figure 2 illustrates the Grain Size Distribution curve for the sandy silt material.

The 'N' values obtained from the Standard Penetration Test in this material varied from 6 blows/0.3 m to 12 blows/0.3 m indicating a loose to compact state of denseness.

Clayey Silt to Silty Clay, trace Sand -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered underlying the above layer to depths of 5.6 m to 6.4 m above bedrock. A 0.6 m thick layer of Heterogeneous Mixture of Silt, Sand and Gravel was encountered in BH 3 above bedrock.

Three Grain Size Distribution Test were carried out in this deposit. One of the tests was done on a sample from the layer of Heterogeneous Mixture of Silt, Sand and Gravel. The resulting gradation comprises 31% gravel, 45% sand, 20% silt and 4% clay. The other two tests were carried out on this cohesive deposit and the gradation is composed of 0% gravel, 3-8% sand, 72-79% silt and 18-20% clay. Figure 3 illustrates a typical grain size distribution curve for this material, based on representative samples from all the culvert locations.

The results from the Atterberg Limit Test and a unit weight determination performed on the fine fraction of this material indicated natural moisture content, liquid limit and plastic limit of 31%, 33% and 22% respectively, with a unit weight of 18.7 kN/m³. This indicates that this material had a low plasticity. However, Figure 4 in the Appendix illustrates this material across

all the culvert locations typically has an intermediate plasticity. In-situ vane tests conducted within this deposit varied from 10 kPa to 29 kPa with sensitivities of 3 to 10 recorded, indicating that the consistency of the material is soft to firm.

The 'N' values obtained from the Standard Penetration Test typically ranged from 2 to 14 blows/0.3 m. High N value of 120/3cm was recorded in the layer of Heterogeneous Mixture of Silt. Sand and Gravel.

Bedrock -

Bedrock was cored in one borehole (BH.1) from elevation 250.7 m utilizing rock coring techniques with a 1.3 m sample of rock retrieved. The probable bedrock surface was encountered in the remaining boreholes ranged from El. 250.4 m to El. 251.4 m.

The bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core recovery (CR) and rock quality designation (RQD) were found to be 100 % and 90% respectively. It is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water levels in open boreholes. Groundwater levels varied from 254.6 m to 254.8 m approximately at the same elevation as the unnamed creek. Seasonal fluctuations are expected.

CULVERT 4

Site Description

The site is located just west of Highway 11 and culvert 3. The area is generally flat with highway embankment fills of approximately 7 m to the east. The immediate vicinity contains rolling grasslands with deciduous trees surrounding the site.

Subsurface Conditions

A total of three boreholes and two cone penetration tests were placed along the length of the proposed culvert. Bedrock was cored at two of the boreholes.

The subsoil stratigraphy at this site consists of a 5.3 to 6.1 m thick deposit of clayey silt to silty clay, trace sand underlain by bedrock. Pockets of Silty Sand were encountered throughout this stratum.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-D.

Specific descriptions of the material encountered are given below.

Clayey Silt to Silty Clay, trace to some Sand -

A cohesive deposit composed of clayey silt to silty clay, trace to some sand was encountered to depths of 5.3 m to 6.1 m. Pockets of silty sand were contacted throughout this stratum.

Six Grain Size Distribution Test results were carried out in this deposit. One of them was carried out in a sample taken from a silty sand pocket, and the resulting gradation comprises 43% gravel, 35% sand, 17% silt and 5% clay. The results of the other five tests carried out on this material indicate that it is typically composed of 0% gravel, 1-19% sand, 54-68% silt and 24-44% clay. Figure 3 in the Appendix illustrates a typical Grain Size Distribution curve for this material based on representative samples collected at all the culvert locations.

The results of the other laboratory tests performed on this material is summarized as follows :

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	28.5-31%	3
Liquid Limit (w_L)	25-40%	3
Plastic Limit (w_p)	16-19%	3
Unit Weight (kN/m^3)	17.4-19.3%	3

The Atterberg Limit Tests carried out indicate the material has a low plasticity. Figure 4 in the Appendix illustrates the plasticity of the representative samples tested at all the culvert locations to be generally intermediate. In situ vane tests conducted within this deposit varied from 16 kPa to 50 kPa, with sensitivities of 3 to 8 recorded, indicating soft to firm consistency.

The 'N' values obtained from the Standard Penetration Test ranged from 2 to 11 blows/0.3 m.

Bedrock -

Bedrock was cored at BH 1 from elevation 249.3 m utilizing rock coring techniques with a 1.5 m sample of rock retrieved. The probable bedrock surface encountered in the remaining boreholes ranges from El. 248.7 m to El. 249.2 m.

Bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recovery (CR) and Rock Quality Designation (RQD) were found to be 96% and 81% respectively. The rock is classified as strong, slightly weathered to unweathered.

Groundwater -

Observations of the groundwater level was carried out by measuring the water levels in open boreholes. Groundwater levels varied from El. 253.1 m to El. 252.9 m approximately at the same elevation as the unnamed creek. Seasonal fluctuations are expected.

CULVERT 5

Site Description

The site is located at Highway 11, about 5.8 km south of Highway 654. The area is generally flat to gently undulating with ditches on either side of Highway 11. An industrial complex and a residential home lie west and south of the site respectively. Boreholes were located in the front lawn of the industrial complex and within the marshy fields surrounding the Boleau Creek and Highway 11.

Subsurface Conditions

Two alignments were considered for the proposed culvert. Boreholes were located along the length of the proposed culvert for both alignments. A total of 12 sampled boreholes were drilled. Rock coring was carried out in six of them. In addition, two auger probe holes and eight cone tests were carried out to delineate the bedrock surface throughout the sites.

The subsoil stratigraphy at this site consists of a 0.8 m to 3 m surficial layer of clayey silt to silty clay, trace sand with organics near the surface. Pockets of silty sand were encountered throughout this stratum. Underlying this stratum is a non-cohesive silty sand, trace gravel, trace sand which contained larger

percentages of gravel near bedrock surface. Bedrock was encountered at depths of 2.7 to 6.1 m.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-E.

Specific descriptions of the material encountered are given below.

Clayey Silt to Silty Clay, trace Sand -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered to depths of 0.8 m to 3.0 m. Pockets of silty sand were encountered throughout this stratum.

Typical properties of the material at this location, as determined by laboratory tests of representative samples are summarized as follows :

<u>Property</u>	<u>No. of Tests</u>	<u>Range</u>
Moisture Content (w)	9	25.5 - 43.5
Liquid Limit (w_L)	9	18.0 - 46.0
Plastic Limit (w_p)	9	16.0 - 27.0
Unit Weight (kN/m^3) γ	6	15.1 - 18.6
Grain Size Distribution	11	
- Gravel		0 - 1
- Sand		3 - 57
- Silt		37 - 65
- Clay		6 - 53

Figure 4 illustrates a typical plasticity chart for this material, based on representative samples from all the culvert locations. It indicates that the material is of low to intermediate plasticity.

In situ vane tests conducted within this deposit varied from 20 kPa to 38 kPa with sensitivities of 2 to 10 recorded, indicating a soft to firm consistency.

The 'N' values obtained from the Standard Penetration Test ranged from 2 blows/0.3 m to 22 blows/0.3 m.

Silty Sand, trace Gravel, trace Clay -

Underlying the above layer is a 1 m - 3.9 m thick layer of silty sand, trace gravel, trace clay. The ten Grain Size Distribution tests carried out indicate

that this deposit comprises 0-36% gravel, 41-83% sand, 2-49% silt and 2-8% clay. Figure 1 illustrates a typical Grain Size Distribution envelope for this material, based on representative samples from all culvert locations. Three moisture content tests were done and values of 23, 26.5 and 30% were obtained.

The 'N' values obtained from the Standard Penetration Test in this material ranged from 1 blows/0.3 m to 68 blows/0.3 m. The 'N' values indicate a very loose to very dense state of denseness, but generally compact with a higher density near the bedrock surface.

Bedrock -

Bedrock was cored in six borehole locations from elevations 255.5 m to 259.0 m. Length of rock cores retrieved ranges from 0.9 to 1.5 m.

The bedrock is a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced. Detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Description".

Core Recoveries (CR) and Rock Quality Designations (RQD) range from 80 to 100% and 37 to 100% respectively. The rock is classified as strong, slightly weathered to unweathered.

Groundwater

Observations of the groundwater level were carried out by measuring the water levels in open boreholes. Groundwater levels varied from El. 262.3 m - El. 259.5 m which was slightly higher than the nearby Boleau Creek. Seasonal fluctuations are expected.

CULVERT 6

Site Description

The site is located just west of Highway 11 at Windsor creek. The area is a swampy marsh at the bottom of the Highway 11 embankment. The existing culvert is to be lengthened by 40 m to the northwest for the widening of the Highway.

Subsurface Conditions

Three sampled boreholes and three probe holes with Cone Penetration Tests were conducted along the proposed culvert extension. Bedrock was cored at one of the boreholes.

The subsoil stratigraphy encountered comprises a 3.4 m to 2.1 m clayey silt to silty clay, trace sand underlain by a heterogeneous mixture of sand and gravel above bedrock. Pockets of silty sand were encountered within the clayey silty to silty clay strata. Bedrock was encountered at depths of 6.1 m to 8.1 m. Random boulders were encountered near the bedrock surface.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater level established at the time of the investigation, are shown on the attached Record of Borehole sheets in the Appendix. The locations of the boreholes are provided on Dwg. No. 737400-F.

Specific descriptions of the subsurface conditions encountered are given below:

Clayey Silt to Silty Clay -

A cohesive material composed of clayey silt to silty clay, trace sand was encountered throughout the site from the surface down to depths of 2.1 - 3.4 m. This deposit contained pockets of silty sand.

Typical properties of the material at this location, as determined by laboratory tests are summarized as follows :

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	30-62%	3
Liquid Limit (w_L)	34-57%	3
Plastic Limit (w_p)	17-21%	3
Unit Weight (kN/m^3) γ	17 & 18.2%	2
Grain Size Distribution (%)		3
Gravel	0-14%	
Sand	2-32%	
Silt	24-53%	
Clay	30-70%	

The relatively large variations in the grain size distribution are due to the presence of sand pockets in the material. Figure 3 illustrates a typical Grain Size Distribution envelope for this material based on representative samples from all the culvert locations. Figure 4 illustrates a typical Plasticity chart for this material based on representative samples from all the culvert locations. One in-situ vane test was performed in this deposit with a shear strength of 50 kPa and a sensitivity of 6 recorded. The results were probably affected by the presence of the sand pockets and may not be indicative of the consistency of the material.

The 'N' values obtained from the Standard Penetration Test ranged from 3

blows/0.3 m to 13 blows/0.3 m.

Heterogeneous Mixture of Sand and Gravel, trace Clay, trace Silt -

A non-cohesive heterogeneous mixture of sand and gravel, trace clay, trace silt was encountered underlying the above layer. This deposit had a thickness of 2.8 m to 6 m and extended down to bedrock. Random boulders were encountered upon approaching the bedrock surface.

Two Grain Size Distribution Tests were carried out and the results indicate that the deposit is composed of 38-46% gravel, 45-61% sand, 1-7% silt and 0-2% clay. Figure 5 illustrates a typical envelope for this material.

In this stratum, the 'N' values ranged from 4 blows/0.3 m to 131 blows/0.3 m. The compactness of the material ranges widely from very loose to very dense, but generally compact to dense with increasing denseness towards the bedrock surface. The low blowcounts may be due to disturbance of the material under differential water heads in a submerged state during drilling, whereas the high blowcounts may be due to boulder obstructions.

Bedrock -

Bedrock was cored in BH 3 at an elevation of 237.6 m, utilizing rock coring techniques with a 1.5 m rock core retrieved. The probable bedrock surface was encountered in the remaining boreholes/probe holes ranging from El. 236.3 m to El. 239.3 m.

The bedrock is classified as a biotite-hornblende gneiss of the Grenville Province. It is medium to coarse grained with fractures close to very close spaced.

Core Recovery (CR) and Rock Quality Designation (RQD) were determined on site to be 100% and 100% respectively. The bedrock is classified as strong, unweathered to slightly weathered.

Groundwater -

Observations of the groundwater level were carried out by measuring the water levels in open boreholes. Groundwater levels varied from 243.9 m - 244.1 m which were higher than the nearby Windsor Creek. Seasonal variations are expected.

DISCUSSION AND RECOMMENDATIONS

It is proposed to widen Highway 11 from two to four lanes. To facilitate this, it is required to extend four culverts along the proposed widening of Hwy. 11 from 2.0 km north of Hwy. 534, northerly 9.9 km. In addition, two culverts are proposed to be replaced along Pinetree Way which is an adjacent side-road to Hwy. 11. The existing culverts have to be extended approximately 40 m westward. All culverts are expected to be lengthened or replaced by structures of equivalent dimensions.

Structure foundation, slope stability and construction consideration recommendations are provided for each culvert. Lateral earth pressure coefficients are following, provided for all culverts.

Plans illustrating the borehole and proposed structure locations are illustrated on Dwg. No.'s 737400 (A, B, C, D, E, F) in the appendix.

Culvert 1- Bear Creek/ Pinetree Way (Sta. 27+125)

Culvert 1 located along Pinetree Way is to be replaced by a culvert of equivalent dimensions. The existing culvert is a rigid frame concrete box culvert which appears to rest on bedrock and is performing adequately.

A 4.88 x 3.66 m rigid frame box culvert with a proposed founding elevation of 252.9 m is to replace the existing culvert. The ground surface was found to range from El. 257.17 m - 257.35 m with the proposed grade of Pinetree Way at El. 258.2 m. Therefore the fill placed above the culvert and adjacent will be 1.0 and 5.3 m respectively.

The subsoil stratigraphy at the site consisted of shallow bedrock with a silty sand overburden. Boreholes were located at the grade of Pinetree Way encountering bedrock at 3.4 m to 4.1 m depths. Bedrock is very shallow at the toe of the culvert fill, near the creek surface.

Based on a review of the proposed founding elevations together with the subsurface soil and bedrock data, it is recommended that this culvert be founded on bedrock. For purposes of the O.H.B.D.C., a factored capacity at U.L.S. of 3000 kPa can be used. The bedrock is considered to be an unyielding foundation base and hence the bearing capacity at S.L.S. Type II will not govern.

If locally the bedrock surface is lower, it is recommended that the overburden material is excavated and replaced by mass concrete.

To achieve the profile grade of Pinetree Way a fill height of 5.3 m will be

required from the toe of the culvert. Prior to placement of the fill, all surficial organic or loose material should be removed under the plan limits of the embankments.

No slope stability problems are anticipated provided that 2H : 1V are maintained for fill heights up to 8 m. Existing fills in the vicinity of the culvert appears to be stable. Settlements within the fill are anticipated to be approximately 30 mm assuming 5.3 m fills. It is expected that the majority of these settlements will be realized during or immediately following the construction. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slopes, provided the excavated materials are not stockpiles near the crest of the slope.

Founding elevation of the culvert will place it below the water table. Excavations for foundation construction would involve creek diversion together with a pilot trench incorporated in the excavation. Alternatively, consideration may also be given to underwater construction using tremie concrete.

The culvert outlet should be treated with rock protection as per O.P.S.D. 810.01 type 'A'.

Any excavation of bedrock would require drilling and blasting techniques. Rock grading should be carried out in accordance with O.P.S.D. 201.01. Careful attention should be provided in order to prevent excessive fracturing of the bedrock slopes, and to prevent damage to adjacent structures. Controlled blasting techniques such as line blasting are recommended.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored coefficient of friction of 0.58 may be used for checking sliding resistance of footing on bedrock.

Culvert 2- Bear Creek/ Hwy. 11 (Sta. 10 + 636.6)

Culvert 2 is located at the intersection of bear creek and Hwy. 11 and is to be extended 40 m west to accommodate the proposed widening of Hwy. 11. The existing rigid frame concrete box culvert, which appears to be founded on bedrock, is performing adequately with no visible major cracks in its surface.

A 4.88 x 3.66 m rigid frame box culvert with a proposed founding elevation of 252.2 m is to extend the existing culvert. The ground surface was found to range

from El. 251.4 m to El. 252.9 m with the proposed grade of Hwy. 11 at El. 260.5 m. Therefore the fill placed above the culvert and adjacent will be 3.7 m and 8.3 m respectively.

The subsoil stratigraphy at this site consisted of shallow bedrock with a silty sand with traces of organic overburden. Bedrock depths ranged from 15 cm (within the creek) to 1.0 m (on the north bank).

Due to the shallow bedrock it is recommended that the culvert be founded on bedrock. For purposes of the O.H.B.D.C., a factored capacity at U.L.S. of 3000 kPa can be used. The bedrock is considered to be an unyielding foundation base and hence the bearing capacity at S.L.S. Type II will not govern.

If locally the bedrock surface is lower, it is recommended that the overburden material is excavated and replaced by mass concrete.

To achieve the profile grade of Pinetree Way a fill height of 8.6 m will be required from the toe of the culvert. Prior to placement of the fill, all surficial organic or loose material should be removed under the plan limits of the embankments.

No slope stability problems are anticipated provided that 2H : 1V slopes are maintained for fill heights up to 8 m. A 1 m mid-height berm should be incorporated for fill heights exceeding 8 m, but not over 10 m. The existing fills in the vicinity of the culvert appears to be stable. Settlements within the fill and native subsoil are anticipated to be approximately 50 mm assuming a 8.6 m high fill. It is expected that the majority of these settlements will be realized during or immediately following the construction. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slope provided the excavated materials are not stockpiled near the crest of the slope.

Founding elevation of the culvert will place it below the water table. Excavations for foundation construction would involve creek diversion together with a pilot trench incorporated in the excavation. Alternatively, consideration may also be given to underwater construction using tremie concrete.

The culvert outlet should be treated with rock protection as per O.P.S.D/ 810.01 type 'A'.

Any excavation of bedrock would require drilling and blasting techniques. Rock grading should be carried out in accordance with O.P.S.D. 201.01. Careful attention should be provided in order to prevent excessive fracturing of the bedrock slopes, and to prevent damage to adjacent structures. Controlled blasting techniques such as line blasting are recommended.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored coefficient of friction of 0.58 may be used for checking sliding resistance of footing resting on bedrock.

Culvert 3- Unnamed Creek/ Pinetree Way (Sta. 27 + 791.4)

Culvert 3 is located along Pinetree Way and is to be replaced by a culvert of equivalent dimensions. The existing rigid frame concrete box culvert appears to be performing adequately.

A 3.5 x 2.0 m rigid frame box culvert with a proposed founding elevation of 253.7 m is to replace the existing culvert. The ground surface elevation was found to range from El. 254.8 to El. 254.9 m with the proposed grade of Pinetree Way at El. 257.0 m. Therefore the fill placed above the culvert and adjacent will be 0.7 m and 3.3 m respectively.

The subsoil consisted at this site of 1.4 m to 2.4 m depth of a silty sand , with gravel, trace clay underlain by a clayey silt to silty clay , trace sand with a thickness of 3.2 m to 5.0 m. Bedrock was encountered beneath the above two deposits ranging in depth from 5.6 m to 6.4 m depths.

The proposed founding elevation of the culvert would place it approximately 5 m above the bedrock, within the cohesive clayey silt to silty clay, trace sand deposit. It is understood that the design bearing pressure at the founding level are 100 kPa at U.L.S. and 75 kPa at S.L.S Type II. The estimated settlement for the above loading condition is about 50 mm. The structure may differentially settle along the length of the culvert. The culvert should be designed and constructed to accommodate the above total and differential settlements. To compensate for the anticipated settlement the culvert should be constructed with appropriate camber utilizing articulated joints.

To achieve the profile grade of Pinetree Way a fill height of 3.3 m will be required from the toe of the culvert. Prior to placement of the fill, all surficial organics or loose material should be removed under the plan limits of the embankments. No slope stability problems are anticipated provided that 2H : 1V slopes are maintained for the proposed fill heights. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slope, provided the excavated materials are not stockpiled near the crest of the slope.

Founding elevation within the creek will place the culvert below the water table

within the cohesive silty clay to clayey silt. Provision should be made for creek diversion and sump pumping from within oversized excavations to facilitate construction of the culvert in the dry. It is recommended that a 150 mm thick working slab of lean concrete is placed immediately following the completion of the excavation to protect the base of the excavation from disturbance and softening prior to the culvert construction.

The culvert outlet should be treated with rock protection as per O.P.S.D. 810.01 type 'A'.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored sliding resistance of 20 kPa shall be used for footing design.

Culvert 4- Unnamed Creek and Hwy. 11 (Sta. 11 + 308)

Culvert 4 located at the intersection of the unnamed creek and Hwy. 11 is to be extended 40 m west to accommodate the proposed widening of Hwy. 11. The existing concrete rigid frame culvert appears to be performing adequately.

A 3.05 x 2.44 m rigid frame box culvert with a proposed founding elevation of 253.7 m is to extend the existing culvert. The ground surface was found to range from El. 254.5 m - El. 255.1 m with the proposed grade of Hwy. 11 at El. 258.2 m. Therefore the fill placed above the culvert and adjacent will be 1.5 m and 4.5 m respectively.

The subsoil stratigraphy at this site consists of a 5.3 to 6.1 m thick deposit of clayey silt to silty clay, trace sand underlain by bedrock.

The proposed founding elevation of the culvert would place it approximately 4 m above the bedrock within the cohesive clayey silt to silty clay, trace sand deposit. It is understood that the design bearing pressures at the founding level are 125 kPa at U.L.S. and 100 kPa at S.L.S. Type II. The estimated settlement for the above loading condition is about 200 mm. The structure may differentially settle along the length of the culvert. The culvert should be designed and constructed to accommodate the above total and differential settlements. To compensate for the anticipated settlement the culvert should be constructed with appropriate camber utilizing articulated joints.

To achieve the profile grade of Hwy. 11, a fill height of 4.5 m will be required from the toe of the culvert. Prior to placement of the fill, all surficial organics or loose material should be removed under the plan limits of the

embankments.

No slope stability problems are anticipated provided that 2H : 1V slopes are maintained for the proposed fill heights. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slope, provided the excavated materials are not stockpiled near the crest of the slope.

Founding elevation within the creek will place the culvert below the water table within the cohesive silty clay to clayey silt. Provision should be made for creek diversion and sump pumping from within oversized excavations to facilitate construction of the culvert in the dry. It is recommended that a 150 mm thick working slab of lean concrete is placed immediately following the completion of the excavation to protect the base of the excavation from disturbance and softening prior to the culvert construction.

The culvert outlet should be treated with rock protection as per O.P.S.D. 810.01 type 'A'.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored sliding resistance of 20 kPa shall be used for footing design.

Culvert 5- Boleau Creek and Hwy. 11

Culvert 5, located at the intersection of Boleau Creek and Hwy. 11 was investigated for two alternatives. Option 1 will extend the culvert under existing Hwy. 11 by 40 m under the proposed Hwy. 11 widening. Under option 2, the culvert will run along the existing Hwy. 11 and cross the Hwy. 11 widening at some 80 m. Recommendations included herein pertain to option 1 as further discussions with the design consultant rules out option 2.

A 5.93 x 2.22 m rigid frame box culvert with a proposed founding elevation of 259.6 m is to extend the existing culvert. The ground surface was found to range from El. 262.4 m - El. 261.1 m with the proposed grade of Hwy. 11 at El. 263.4 m. Therefore the fill placed above the culvert and adjacent will be 1.1 m and 3.8 m respectively.

The subsoil stratigraphy at this site consists of a 0.8 m to 3 m of a clayey silt to silty clay, trace sand which contained organics near the surface. Underlying this stratum is a non-cohesive silty sand, trace gravel, trace sand which contained larger percentages of gravel near the bedrock surface. Thus bedrock for option one was encountered at depths of 3 to 5.8 m, it appears to slope

towards the south east. Bedrock for the second option was encountered at depths of 3.2 m to 5.3 m.

The proposed founding elevation of the culvert would place it approximately 0.6 to 3.5 m above the bedrock within the non-cohesive strata. It is understood that the design bearing pressure at the founding level are 125 kPa at U.L.S. and 100 kPa at S.L.S. Type II. The estimated settlement for the above loading condition is about 25 to 50 mm. The structure may differentially settle along the length of the culvert. The culvert should be designed to accommodate the above total and differential settlements. To compensate for the anticipated settlement the culvert should be constructed with appropriate camber utilizing articulated joints.

To achieve the profile grade of Hwy. 11 a fill height of 3.8 m will be required from the toe to the culvert. Prior to placement of the fill, all surficial organics or loose material should be removed under the plan limits of the embankments.

No slope stability problems are anticipated provided that 2H : 1V slopes are maintained for the proposed fill heights. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slope, provided the excavated materials are not stockpiled near the crest of the slope.

Founding elevation within the creek will place the culvert below the water table near the border between the top clayey silty to silty clay and the underlying non-cohesive sandy silt deposit. Provision should be made for creek diversion and sump pumping from within oversized excavations to facilitate construction of the culvert in the dry. It is recommended that a 150 mm thick working slab of lean concrete is placed immediately following the completion of the excavation to protect the base of the excavation to protect the base of the excavation from disturbance and softening prior to the culvert construction.

The bedrock surface was found to vary in depth throughout the site. If bedrock is found to protrude close to the founding excavated base, the natural material should be removed and replaced with a 1 m pad.

The culvert outlet should be treated with rock protection as per O.P.S.D. 810.01 type 'A'.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored coefficient of friction of 0.58 shall be used for footings located on existing granular strata.

Culvert 6- Windsor Creek and Hwy. 11

Culvert 6 located at the intersection of Windsor Creek and Hwy. 11 is to be extended and skewed at an angle 40 m west to accommodate the proposed widening of Hwy. 11. The existing concrete rigid frame culvert appears to be performing adequately.

A 5.50 x 1.52 rigid frame box culvert with a proposed founding elevation of 243.0 is to extend the existing culvert. The ground surface was found to range from El. 244.2 - El. 245.4 m. The proposed grade of Highway 11 is 250.0 m. Accordingly, the fill placed above the culvert and adjacent will be 4.4 and 7.0 m respectively.

The subsoil encountered include a 3.4 m to 2.1 m clayey silt to silty clay, trace sand underlain by a heterogeneous mixture of sand and gravel which rested on bedrock. Bedrock was encountered at depths of 6.1 m to 8.1 m.

The proposed founding elevation of the culvert would place it within the non-cohesive strata. It is understood that the design bearing pressures at the founding level are 200 kPa at U.L.S and 175 kPa at S.L.S Type II. The estimated settlement for the above loading condition is about 25 mm. The structure may differentially settle along the length of the culvert. The culvert should be designed and constructed to accommodate the above total and differential settlements. To compensate for the anticipated settlement the culvert should be constructed with the appropriate camber utilizing articulated joints.

To achieve the profile grade of Hwy. 11 a fill height of 7.0 m will be required from the toe of the culvert. Prior to placement of the fill, all surficial organics or loose material should be removed under the plan limits of the embankments.

No slope stability problems are anticipated provided that 2H : 1V slopes are maintained for the proposed fill heights. Temporary excavations to depths of 2 m or less below grade may be carried out using 1H:1V slope, provided the excavated material are not stockpiled near the crest of the slope.

Founding elevation within the creek will place the culvert below the water table near the boundary of the cohesive and non-cohesive strata. Provision should be made for creek diversion and sump pumping from within oversized excavations to facilitate construction of the culvert in the dry. It is recommended that a 150 mm thick working slab of lean concrete is placed immediately following the completion of the excavation to protect the base of the excavation for disturbance and softening prior to the culvert construction. The base could be

softened due to the presence of the non-cohesive strata beneath the cohesive layer and the highwater table.

The culvert outlet should be treated with rock protection as per O.P.S.D 810.01 type 'A'.

The minimum earth cover required for frost protection is 1.8 m, unless if the culvert is structurally designed to withstand frost pressures.

Unfactored coefficient of friction of 0.58 shall be used for footing design.

Lateral Earth Pressure

For backfill requirements, it is recommended to use free draining material such as Granular 'A' (backfill in accordance with Special Provision No. 109F031) to prevent hydrostatic pressure build-up. Design parameters of the soil are given below for purposes of the O.H.B.D.C..

<u>Backfill Properties</u>		
	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction (ϕ)	35°	30°
Unit Weight (kN/m ³) γ	22.8	21.2
*Coefficient of Earth Pressure at Rest (K_o)		
- S.L.S.	0.43	0.5
- U.L.S.	0.5	0.58

*Horizontal surface backfill only. Appropriate consideration must be given to sloping backfill.

It is considered that concrete box type culvert should be designed using the at rest earth pressure coefficients since they are considered to be rigid and unyielding.

Any backfill should be placed simultaneously on both sides of the culvert such that the maximum difference in backfill heights does not exceed 300 mm. In addition, the backfill should be placed in lifts not exceeding 300 mm in thickness.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Michalek, Junior Foundation Engineer, and P. Thase, Student Engineer. The equipment was owned and operated by Master Soil Investigations, Toronto. Bedrock was examined and classified by MTO petrographer, D. Williams

The report was written by M. Michalek under the general supervision of B. Iyer, Senior Foundation Engineer and reviewed by M. Devata, Chief Foundation Engineer.



A handwritten signature in cursive script, appearing to read "MARTIN MICHALEK".

M. Michalek

Junior Foundation Engineer

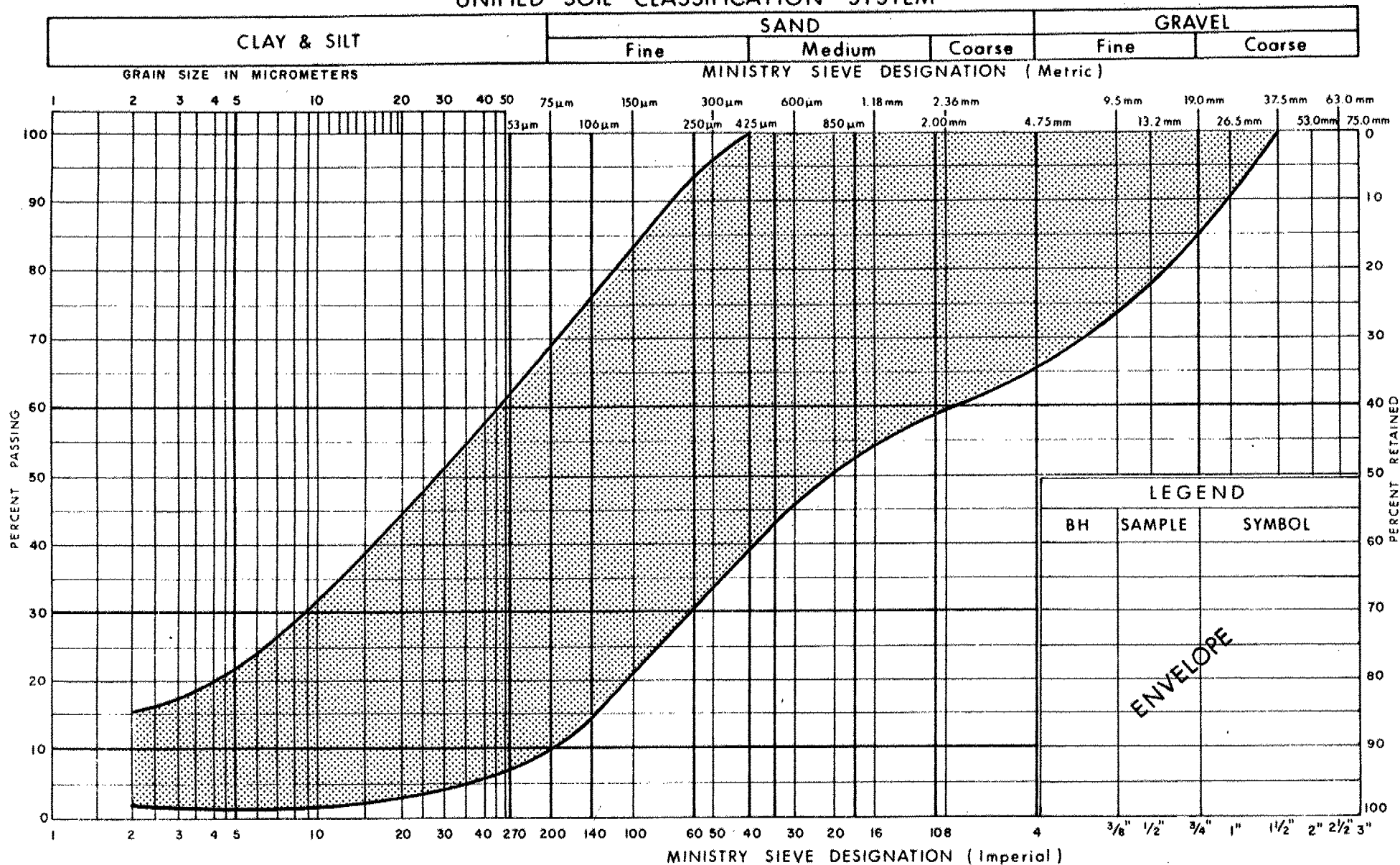
A handwritten signature in cursive script, appearing to read "M. Devata".

M. Devata, P.Eng.

Chief Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



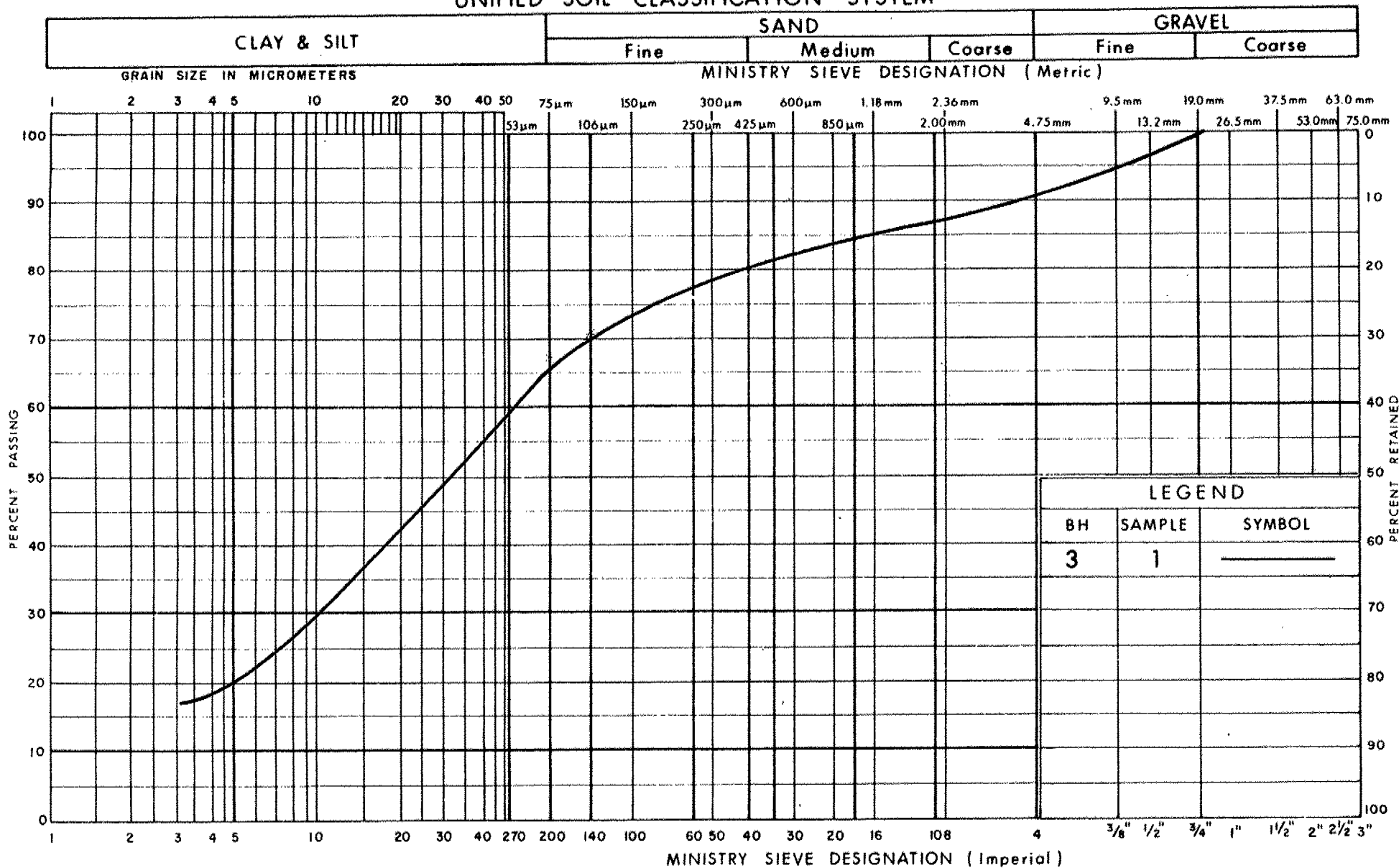
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY SAND, TRACE CLAY, TRACE GRAVEL

FIG No 1

W P 73-74-00

UNIFIED SOIL CLASSIFICATION SYSTEM



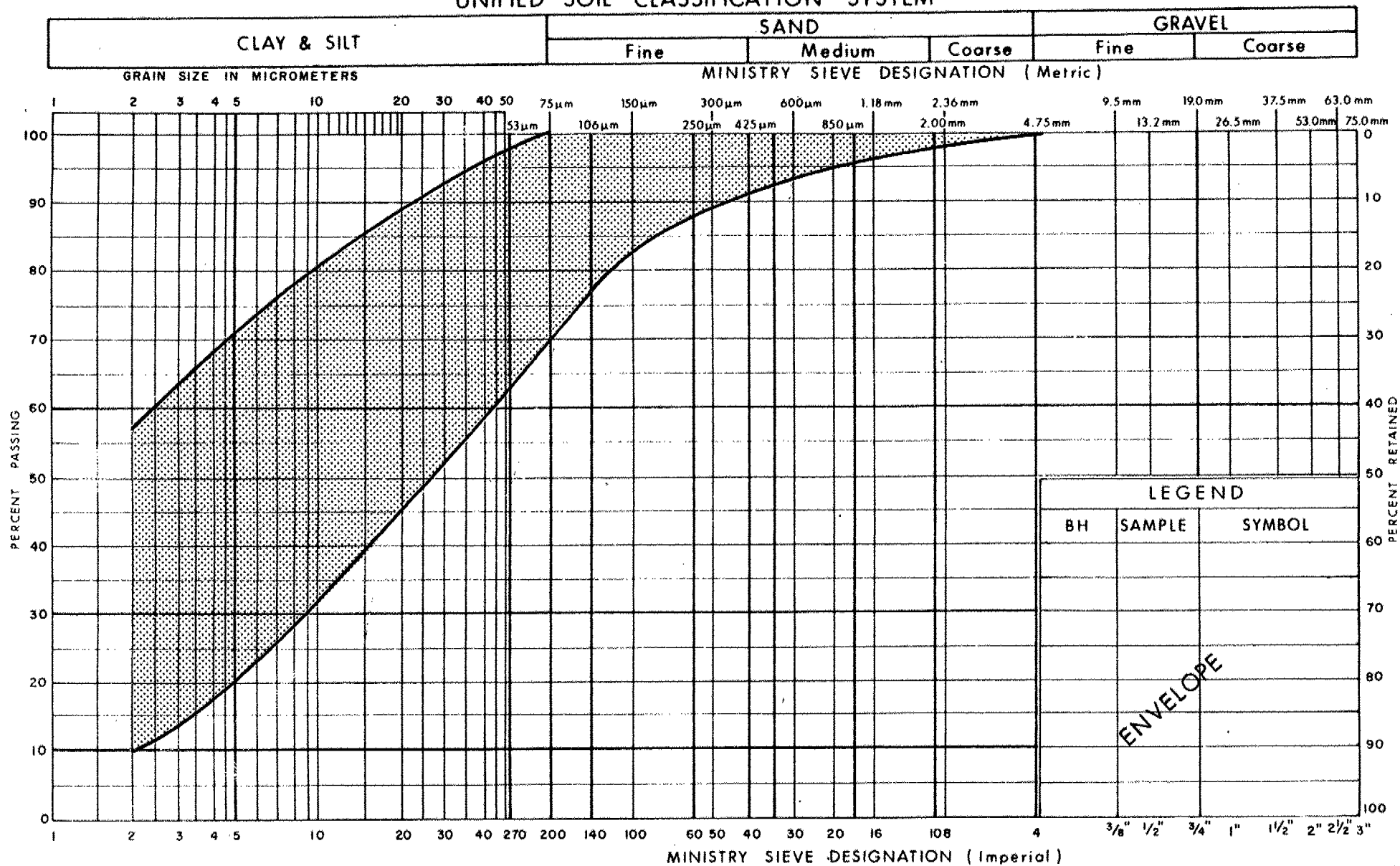
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT

FIG No 2

W P 73-74-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

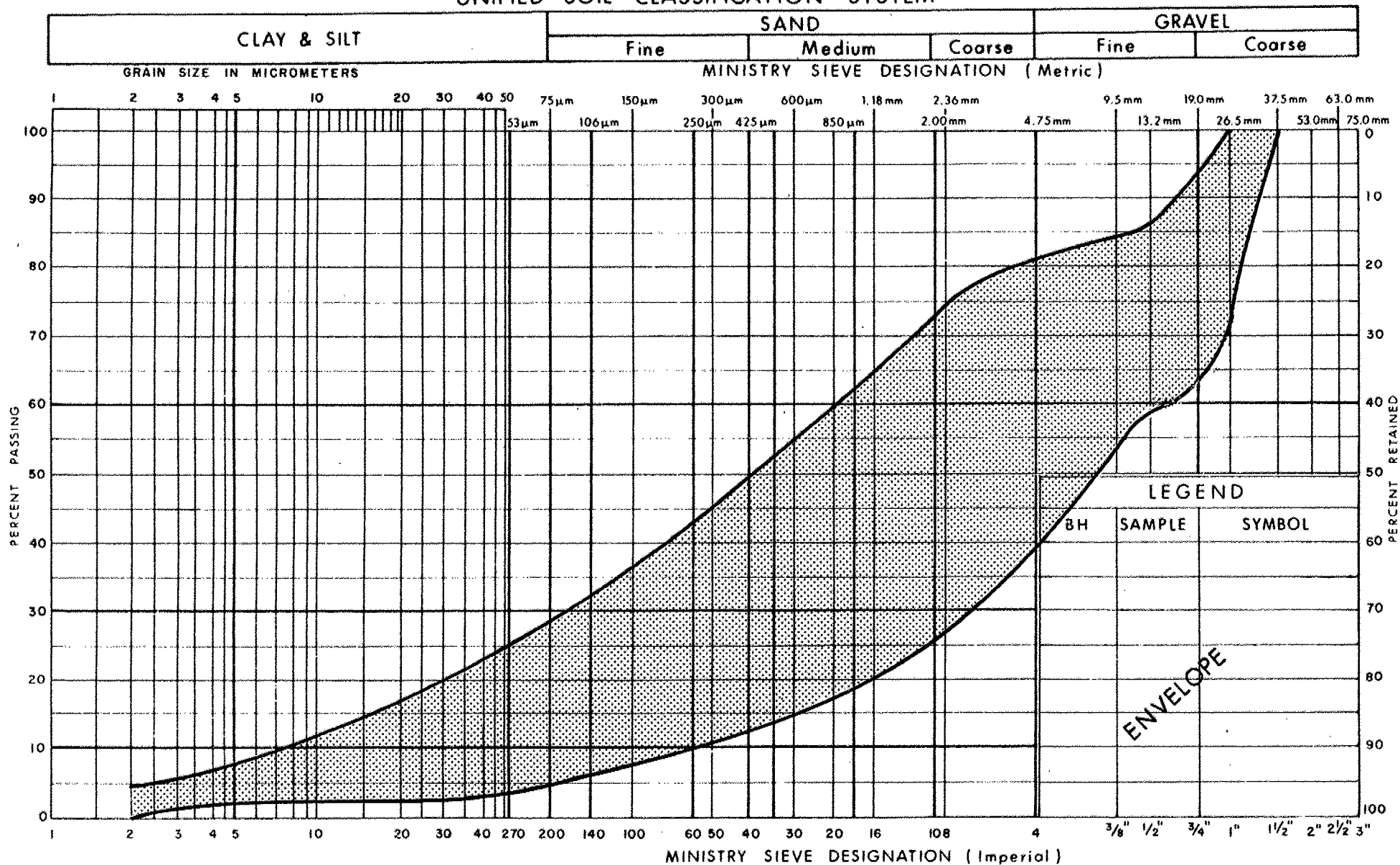
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILTY CLAY
TRACE SAND

FIG No 3

W P 73-74-00

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HETEROGENEOUS MIXTURE OF SAND & GRAVEL
 TRACE CLAY, TRACE SILT

FIG No 5

W P 73-74-00

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 ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 484.3; E 315 178.7 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, BW Casing COMPILED BY M.M.
DATUM Geodetic DATE 91/08/23 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
257.2	Ground Surface													
0.0	Silty Sand Trace Gravel Trace Clay (Possible Fill) Brown ----- Grey Some Gravel		1	SS	5		256							7 54 32 7
			2	SS	2		255							
			3	SS	1		254							
			4	SS	12		253							
			5	SS	120		252							
253.1	Bedrock Biotite-Hornblende Gneiss Weathered to Slightly Weathered		6	RC BXL	REC 94%									RQD 44%
4.1					15cm									
251.7	End of Borehole													
5.5														

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 472.2; E 315 177.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/24 CHECKED BY B.J.

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					
257.2	Ground Surface																
0.0	Silty Sand Trace Gravel Trace Clay (Possible Fill)		1	SS	5												
			2	SS	6												
			3	SS	1												
	Some Gravel Organics Dark Brown		4	SS	8												
253.5																	
3.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 484.4; E 315 173.9 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/24 CHECKED BY B.I.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
257.2 0.0	Ground Surface - Asphalt												
	Probable Silty Sand Trace Gravel Trace Clay												
253.2 4.0	End of Cone Test Probable Bedrock												

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00(1) LOCATION Culvert #1 Coords: N 5 107 470.0; E 315 168.8 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/24 CHECKED BY B.I.

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					
257.4	Ground Surface																
0.0	Probable Silty Sand Trace Gravel Trace Clay																
254.0																	
3.4	End of Cone Test Probable Bedrock																

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 525.9; E 315 094.8 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Hand Dug COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/30 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80
251.4	Creek Surface															
0.0 251.1	Gravel and Sand Trace Silt		1	CS										60 35 3 1		
0.3	End of Probehole Probable Bedrock															

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 518.4; E 315 119.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
253.0	Ground Surface																
0.0	Organics																
	Silty Sand, Trace Clay																
252.0	Trace Gravel		1	SS	120 80												
1.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 520.8: E 315 112.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

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					
252.8	Ground Surface																
0.0	Silty Sand, Trace Clay Trace Gravel																
251.8			1	SS	120		252										
1.0	Bedrock Biotite-Hornblende Gneiss Slightly Weathered to Unweathered				13cm												
250.2			2	RC BXL	REC 87%		251										RQD 83%
2.6	End of Borehole																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00(2) LOCATION Culvert #2 Coords: N 5 107 520.0; E 315 100.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Hand Dug COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					
251.5	Creek Surface															
251.3	Gravel and Sand Trace Silt		1	CS												
0.2	End of Probehole Probable Bedrock															

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(3) LOCATION Culvert #3 Coords: N 5 108 145.1; E 315 306.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Rock Core COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

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					
256.9	Ground Surface																
0.0	Silty Sand, Trace Clay With Gravel Brown (Possible Fill)		1	SS	6		256										19 56 20 5
			2	SS	12		255										
254.8																	
2.1			3	SS	14		254									18.7	0 8 72 20
			4	SS	7												
			5	SS	7		253										
			6	SS	6		252										0 3 79 18
250.7	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Firm		7	SS	120 / 3cm		251										
6.2			8	RC BXL	REC 100%		250										RQD 90%
249.4																	
7.5	End of Borehole																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(3) LOCATION Culvert #3 Coords: N 5 108 132.3; E 315 309.8 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/23 CHECKED BY B.I.

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					
256.8	Ground Surface																
0.0	Sandy Silt Trace Gravel With Clay (Possible Fill)		1	SS	12		256							10		20.4	10 23 53 14
255.4			2	SS	9		255										
1.4			3	SS	9		254										
			4	SS	6		253										
			5	SS	2		252										
			6	SS	2		251										
			7	SS	120												
250.4	Het. Mix. of Si, So, Gr.																31 45 20 4
6.4	End of Borehole Probable Bedrock				15cm												

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00(4) LOCATION Culvert #4 Coords: N 5 108 178.8; E 315 170.7 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H5 Auger, Rock Core COMPILED BY M.M.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.I.

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					
254.6	Ground Surface																
0.0	Clayey Silt to Silty Clay Trace to some Sand Pockets of Silty Sand Soft Brown Grey		1	SS	6		254									17.9	0 19 57 24
			2	SS	4		253										
			3	SS	3		252										
			4	SS	2		251										0 7 68 25
			5	SS	2		250										
			6	SS	11		249										
249.3	Bedrock Biotite-Hornblende Gneiss Slightly Weathered to Unweathered		7	RC BXL	REC 96%		248										RQD 81%
247.8																	
6.8	End of Borehole																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4 Coords: N 5 108 182.3; E 315 177.7 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM GEODETIC DATE 91/08/22 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
254.5	Ground Surface													
0.0														
	Probable Clayey Silt to Silty Clay Trace Sand													
248.7														
5.8	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00(4) LOCATION Culvert #4 Coords: N 5 108 170.8, E 315 184.6 ORIGINATED BY M.M.
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY A.H.
DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100								10 20 30		
254.6	Ground Surface																	
0.0	with Sand						254							17.4	0 2 54 44			
			1	SS	7		253											
			2	SS	6		252											
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Firm		3	SS	2		251											
			4	SS	3		250											
			5	SS	2													
			6	SS	4													
249.2																		
5.4	End of Borehole Probable Bedrock																	

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4, Coords: N 5 108 174.3, E 315 202.4 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.J.

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					
255.0	Ground Surface																
0.0						*											
			1	SS	11		254									19.3	0 5 57 38
			2	SS	6		253										
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Firm		3	SS	3		252										
			4	SS	3		251										
			5	SS	1		250										
			6	SS	4		249										
248.9																	
6.1	End of Borehole Probable Bedrock																
	* WL Not Determined																

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 73-74-00 (4) LOCATION Culvert #4 Coords: N 5 108 172.2; E 315 206.0 ORIGINATED BY J.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/22 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L	10 20 30			
254.8	Ground Surface													
0.0	Probable Clayey Silt to Silty Clay Trace Sand													
248.7														
5.1	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 564.2; E 315 581.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/19 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
262.3	Ground Surface													
0.0	Clayey Silt to Silty Clay Trace Sand Soft to Firm Pockets of Silty Sand		1	SS	13		262						18.9	1 6 63 30
			2	SS	6		261							
			3	SS	5		260							
259.4	Silty Sand Trace Gravel Trace Clay Compact to Very Dense		4	SS	10		259						8 52 35 5	ROD 62%
2.9			5	SS	30		258							
			6	SS	61		257							
256.8	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		7	RC BXL	REC 100%		256							
5.5														
255.3	End of Borehole													
7.0														

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 565.3; E 315 594.3 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/19 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
262.1	Ground Surface													
0.0	Silty Sand													
	Clayey Silt to Silty Clay Trace Sand Firm Pockets of Silty Sand		1	SS	12		261						18.1	0 9 64 27
			2	SS	4		260	+3						
259.2			3	SS	3									
2.9	Silty Sand Trace Gravel Trace Clay Compact to Very Dense		4	SS	15		259							
			5	SS	51		258							
	With Gravel		6	SS	68		257							18 74 6 2
256.8														
5.3	End of Borehole Probable Bedrock													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 563.6; E 315 602.4 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

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					
262.0	Ground Surface																
0.0	Silty Sand																
	Cloyey Silt to Silty Clay		1	SS	13		261									18.9	1 5 49 45
	Trace Sand																
	Firm		2	SS	5		260										
	Pockets of Silty Sand																
259.1			3	SS	22												
2.9							259										
	Silty Sand		4	SS	25												
	Trace Gravel																
	Trace Clay		5	SS	40		258										
	Compact to Very Dense																
257.0			6	SS	120												12 41 40 7
5.0	End of Borehole																
	Probable Bedrock																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION CULVERT #5 COORDS: N 5 111 553.6; E 315 604.5 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
262.0	Ground Surface													
0.0	Probable Clayey Silt to Silty Clay Trace Gravel Trace Clay													
259.0														
3.0	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		1	RC BXL	REC 80%									RQD 37%
257.5														
4.5	End of Borehole													
262.0														

0.0 End of Borehole

+3, x⁵: Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 559.9; E 315 594.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Auger Probe COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	w _p	w	w _L		
262.1	Ground Surface																
0.0	Probable Clayey Silt to Silty clay Trace Sand																
259.9																	
2.2	Probable Silty Sand Trace Gravel Trace Clay																
258.1																	
4.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 566.4; E 315 587.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Auger Probe COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
262.2	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand																
259.9																	
2.3	Probable Silty Sand Some Gravel																
257																	
256.4																	
5.8	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 620.7; E 315 583.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.4	GROUND SURFACE																
0.0	Organics						261										
260.6	Clayey Silt to Silty Clay																
0.8	Trace Sand																
	Silty Sand		1	SS	3												0 57 37 6
	Trace Clay						260										
	Very Loose to Compact		2	SS	17												
			3	SS	14		259										
258.2			4	SS	120												
3.2	Bedrock						258										
	Biotite - Hornblende		5	RC	REC												RQD 50%
	Gneiss			BXL	97%												
257.3	Slightly Weathered to Unweathered																
4.1	End of Borehole																

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 617.8; E 315 592.1 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
261.5	GROUND SURFACE													
0.0	Organics													
	Clayey Silt to Silty Clay With Sand Pockets of Silty Sand Soft		1	SS	2		261							0 23 61 16
259.4			2	SS	4		260							
2.1	Sand With Gravel Trace Silt Trace Clay Loose		3	SS	9		259							13 83 2 2
258.3														
3.2	End of Borehole Probable Bedrock													

RECORD OF BOREHOLE No 9

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 615.4; E 315 615.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/20 CHECKED BY B.I.

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					
261.1	Ground Surface																
0.0	Cloyey Silt to Silty Clay Some Sand Trace Organics Soft		1	SS	3		260										0 28 65 7
1.1	Silty Sand Trace Gravel Trace Clay Very Loose to Dense		2	SS	5		259										1 71 24 4
			3	SS	18		258										
			4	SS	21		257										
	Some Gravel		5	SS	8												
256.1			6	SS	146												
					23cm												
5.0	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 10

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 603.0; E 315 621.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.4	Ground Surface																
0.0	Clayey Silt to Silty Clay Some Sand Organics Pockets of Silty Sand Soft		1	SS	3		261									15.1	0 35 55 10
260.0			2	SS	4		260										
1.4	Silty Sand With Gravel Very Loose to Very Dense		3	SS	6		259										
			4	SS	1		258										
			5	SS	32		257										33 44 19 4
256.1	Some Gravel		6	SS	42												
5.3	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 11

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5, Coords: N 5 11 632.2, E 315 582.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
261.3	Ground Surface												
0.0	Probable Clayey Silt to Silty Clay Some Sand Pockets of Silty Sand Organics												
258.9													
2.4	Probable Silty Sand With Gravel												
257.5													
3.8	End of Cone Test Probable Bedrock												

RECORD OF BOREHOLE No 12

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 599.4; E 315 610.0 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
261.4	GROUND SURFACE												
0.0	Probable Clayey Silt to Silty Clay Some Sand						261						
260.1							260						
1.3							259						
	Probable Silty Sand With Gravel						258						
							257						
256.1													
5.3	End of Cone Test Probable Bedrock							120/8cm					

RECORD OF BOREHOLE No 13

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 616.1; E 315 622.7 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.





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								
261.2	GROUND SURFACE												
0.0	Probable Clayey Silt to Silty Clay With Sand												
260.1													
1.1													
	Probable Silty Sand With Gravel												
256.3													
4.9	End of Cone Test Probable Bedrock												

RECORD OF BOREHOLE No 14

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 601.3; E 315 655.3 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							w _p w w _L		
261.6	GROUND SURFACE					20	40	60	80	100	10	20	30				
0.0	Clayey Silt to Silty Clay Trace Sand Firm		1	SS	5		261							18.1	0 3 44 53		
			2	SS	2		260										
			3	SS	5		259										
258.7	Silty Sand With Gravel Loose to Compact		4	SS	14		258									1 68 27 4	
2.9			5	SS	8		257										
			6	SS	10		256										
255.5	Bedrock Biotite-Hornblend Gneiss Unweathered		7	RC BXL	REC 100%	255								RQD 93%			
6.1																	
254.1																	
7.5	End of Borehole																

RECORD OF BOREHOLE No 15

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 557.0; E 315 661.8 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

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					
261.8	GROUND SURFACE																
0.0	Organics																
	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Stiff		1	SS	9		261									17.3	0 9 59 32
259.7			2	SS	17		260										
2.1	Silty Sand Trace Gravel Compact		3	SS	19		259										
258.3			4	SS	17												36 49 13 2
3.5	Bedrock Biotite-Hornblend Gneiss Unweathered		5	RC BXL	REC 100%		258										RQD 100%
256.8							257										
5.0	End of Borehole																

RECORD OF BOREHOLE No 16

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 600.8; E 315 662.4 ORIGINATED BY P.T.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
262.4	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262							
260.1							261							
2.3	Probable Sandy Silt Trace Clay Trace Gravel						260							
							259							
							258							
257.1														
5.3	End of Cone Test Probable Bedrock							50/15cm						

RECORD OF BOREHOLE No 17

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 580.8; E 315 663.1 ORIGINATED BY P.T.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
262.3	GROUND SURFACE													
0.0							262							
	Cloyey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft		1	SS	10		261							1 10 52 37
			2	SS	9		260	10						
259.4			3	SS	2		259							
2.9	Silty Sand Trace Gravel Trace Clay Very Loose		4	SS	3		258							
258.4			5	SS	21 /5cm		257							3 51 44 2
3.9	Bedrock Biotite - Hornblende Gneiss Slightly Weathered to Unweathered		6	RC BXL	REC 95%									RQD 95%
256.9														
5.4	End of Borehole													

RECORD OF BOREHOLE No 18

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 571.7; E 315 656.4 ORIGINATED BY M.M.

DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.

DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
261.4	Ground Surface																
0.0	Organics						261										
	Clayey Silt to Silty Clay		1	SS	16		260										0 5 48 47
260.0	Trace Sand																
1.4	Very Stiff		2	SS	22												
	Sandy Silt						259										
	Trace Clay		3	SS	17												0 45 49 6
258.7	Compact																
2.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 19

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 594.8; E 315 662.7 ORIGINATED BY P.T.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

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 7 kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA Si CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
262.4	GROUND SURFACE												
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262						
260.2							261						
2.2	Probable Silty Sand Trace Clay						260						
258.3							259						
4.1	End of Cone Test Probable Bedrock												

RECORD OF BOREHOLE No 20

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 583.7; E 315 654.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

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					
261.5	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay Trace Sand						261							
259.8							260							
1.7	Probable Silty Sand Trace Clay						259							
257.8							258							
3.7	End of Cone Test Probable Bedrock													

RECORD OF BOREHOLE No 21

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 571.4; E 315 662.9 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

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					
262.2	GROUND SURFACE																
0.0	Probable Clayey Silt to Silty Clay Trace Sand						262										
260.1							261										
2.1	Probable Silty Sand Trace Clay						260										
258.8							259										
3.4	End of Cone Test Probable Bedrock											120/18cm					

RECORD OF BOREHOLE No 22

1 OF 1

METRIC

W.P. 73-74-00 (5) LOCATION Culvert #5 Coords: N 5 111 555.8; E 315 656.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.I.

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 * 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								
261.2	GROUND SURFACE												
0.0	Probable Clayey Silt to Silty Clay Trace Sand												
259.9													
1.3	Probable Silty Sand Trace Clay												
257.4													
3.8	End of Cone Test Probable Bedrock							120/8cm					

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 771.2; E 315 624.6 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/17 CHECKED BY B.I.

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.2	GROUND SURFACE																
0.0	Organics						244										
	Some Gravel		1	SS	5		243										14 32 24 30
	Clayey Silt to Silty Clay With Sand Pockets of Silty Sand Soft to Stiff		2	SS	3		242										
241.3			3	SS	13		241										
2.9			4	SS	12		240										
	Heterogeneous Mix of Sand and Gravel Trace Silt Trace Clay Random Boulders Compact to Very Dense		5	SS	25		239										
			6	SS	32		238										
237.5			7	SS	131												46 45 7 2
6.7	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 772.5; E 315 631.3 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/15 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.4	GROUND SURFACE																
0.0	Clayey Silt to Silty Clay Trace Sand Pockets of Silty Sand Soft to Stiff		1	SS	4		244									18.2	0 3 27 70
242.3			2	SS	11		243										
2.1			3	SS	48		242										
			4	SS	42		241										
			5	SS	18		240										
	Heterogeneous Mix of Sand and Gravel Random Boulders Compact to Very Dense		6	SS	12		239										
			7	SS	79		238										
236.3							237										
8.1	End of Borehole Probable Bedrock																

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 763.8; E 315 635.1 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Rock Core COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/21 CHECKED BY B.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
244.3	GROUND SURFACE																
0.0	Organics						244										
	Clayey Silt to Silty Clay		1	SS	5		243									17.0	
	Trace Sand																
	Pockets of Silty Sand		2	SS	4												0 2 53 45
	Firm						242										
241.4	Silt		3	SS	4												
	Some Sand						241										
2.9			4	SS	9												
							240										
	Heterogeneous Mix of		5	SS	16												
	Sand and Gravel						239										
	Random Boulders		6	SS	4												38 61 1 0
	Loose to Very Dense						238										
237.6			7	SS	150 15cm												
6.7							237										
	Bedrock		8	RC	REC												
	Biotite - Hornblende			EXL	100%												RQD 100%
	Gneiss																
	Slightly Weathered to																
	Unweathered																
236.1																	
8.2	End of Borehole																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 762.6; E 315 650.2 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/19 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40						60	80
244.8	GROUND SURFACE															
0.0	Probable Clayey Silt to Silty Clay Trace Sand															
242.0																
2.8	Probable Heterogeneous Mix of Sand and Gravel Trace Silt Trace Clay Random Boulders															
238.7																
6.1	End of Cone Test Probable Bedrock															

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 73-74-00 (6) LOCATION Culvert #6 Coords: N 5 114 762.0; E 315 640.1 ORIGINATED BY M.M.
 DIST 13 HWY 11 BOREHOLE TYPE Dynamic Cone COMPILED BY A.H.
 DATUM Geodetic DATE 91/08/19 CHECKED BY B.J.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
244.5	GROUND SURFACE													
0.0	Probable Clayey Silt to Silty Clay Trace Sand						244							
242.0							243							
2.5	Probable Heterogeneous Mix of Sand and Gravel Trace Clay Random Boulders						242							
							241							
							240							
238.4							239							
6.1	End of Cone Test Probable Bedrock									120/5cm				

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	Liquid Limit W _L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 10 20 30		
245.4	GROUND SURFACE												
0.0	Probable Clayey Silt to Silty Clay Trace Sand	[Hatched Pattern]					245						
242.0							244						
3.4	Probable Heterogeneous Mix of Sand and Gravel Random Boulders	[Stippled Pattern]					243						
							242						
239.3							241						
							240						
6.2	End of Cone Test Probable Bedrock	[Diagonal Line Pattern]						120/8cm					

ROCK CORE DESCRIPTION

WP 73-74-00

Page 1 of 3

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1-1	6	4.11-5.49	94	44	4.11-5.49	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth.
2-3	2	1.04-2.57	87	83	1.04-2.57	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth to rough.
3-1	8	6.22-7.52	100	90	6.22-7.52	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to close spaced, dipping to flat, undulating, smooth.
4-1	7	5.33-6.78	96	81	5.33-6.78	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

ROCK CORE DESCRIPTION

WP 73-74-00

Page 2 of 3

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
5-1	7	5.49-7.01	100	62	5.49-7.01	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-4	1	3.05-4.27	100	46	3.05-4.27	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-7	5	3.20-4.11	97	50	3.20-4.11	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, flat to near vertical, undulating, smooth to rough.
5-14	7	6.10-7.47	100	93	6.10-7.47	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, flat to near vertical, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

ROCK CORE DESCRIPTION **WP 73-74-00**

Page 3 of 3

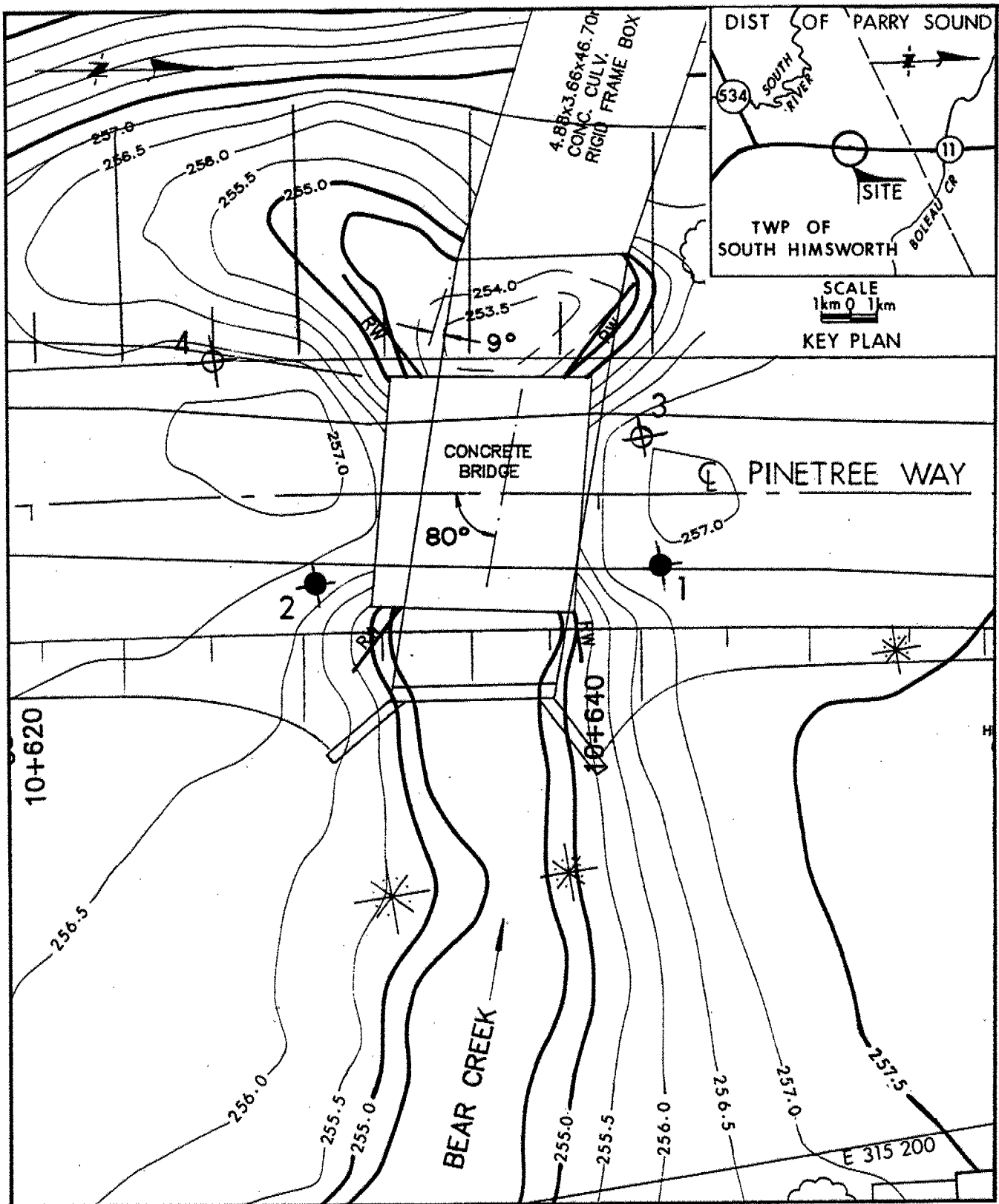
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
5-15	5	3.51-5.03	100	100	3.51-5.03	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, flat to near vertical, undulating, smooth.
5-17	6	3.86-5.39	95	95	3.86-5.39	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, dipping to flat, planar to undulating, smooth.
6-3	8	6.71-8.23	100	100	6.71-8.23	BIOTITE-HORNBLENDE GNEISS (chloritized and garnetiferous), moderate orange pink to dark greenish grey; medium to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, dipping to flat, undulating, smooth.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section



LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

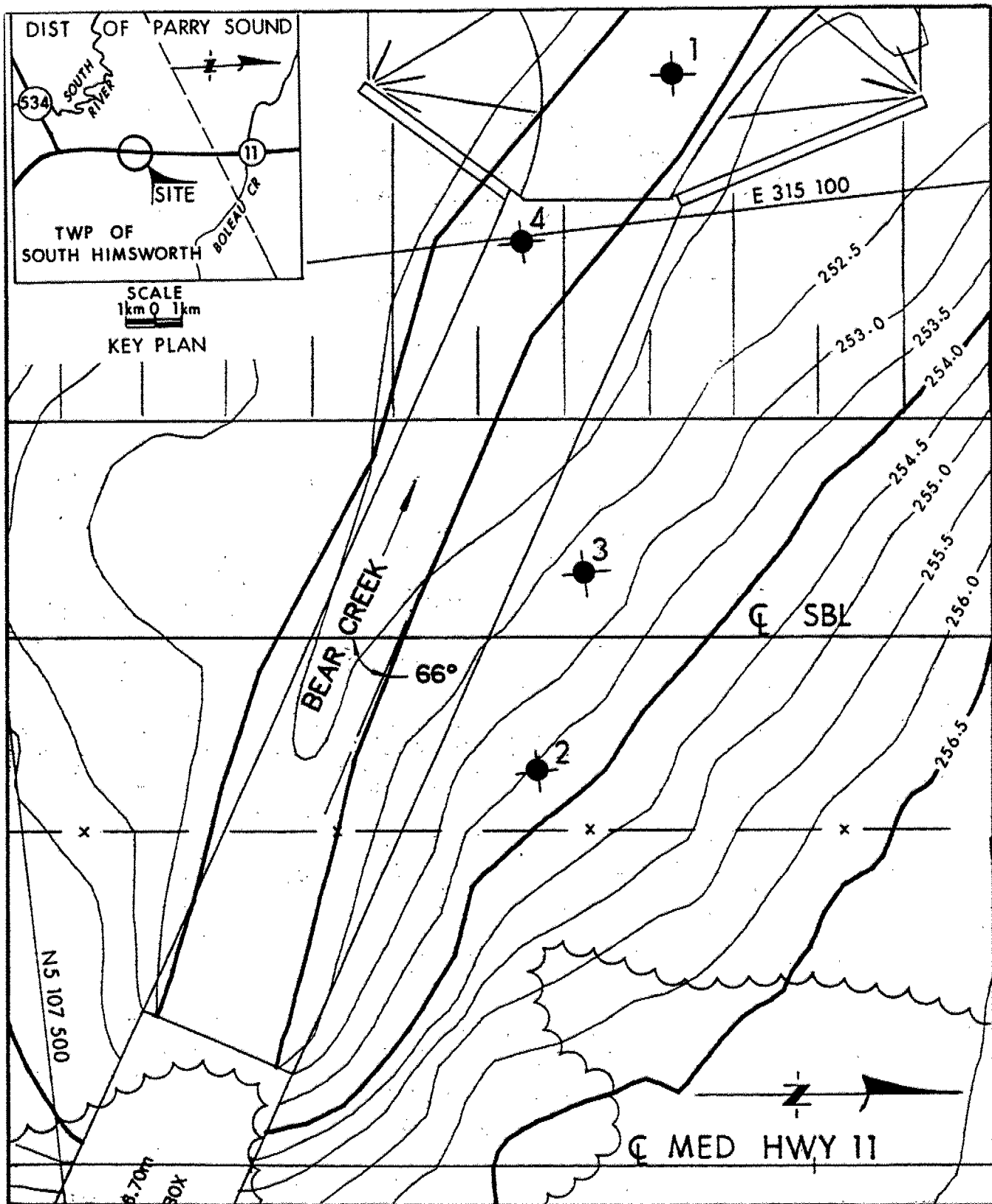
FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN

SCALE



CULVERT No 1
Site 44-317-C
WP 73-74-00
Dwg No 737400-A



LEGEND

- BOREHOLE
- ⊕ CONE TEST

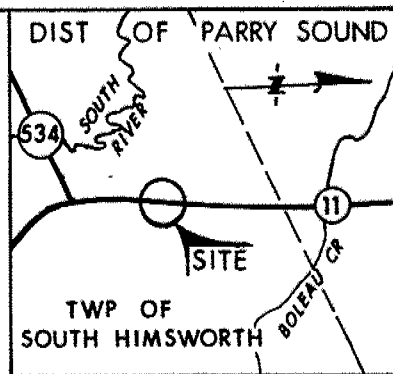
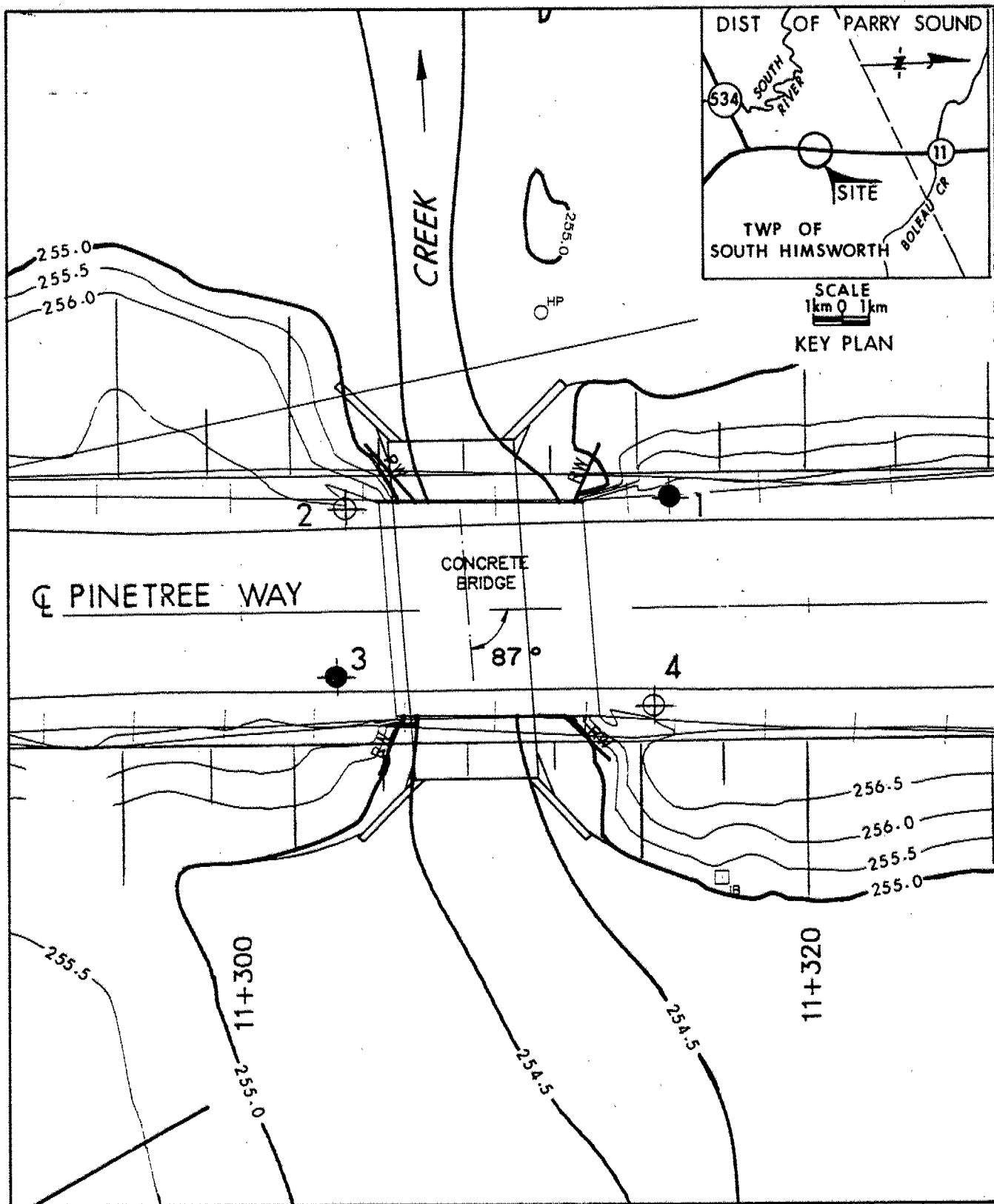
NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN SCALE



CULVERT No 2
Site 44-317-C
WP 73-74-00
Dwg No 737400-B



LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN

SCALE

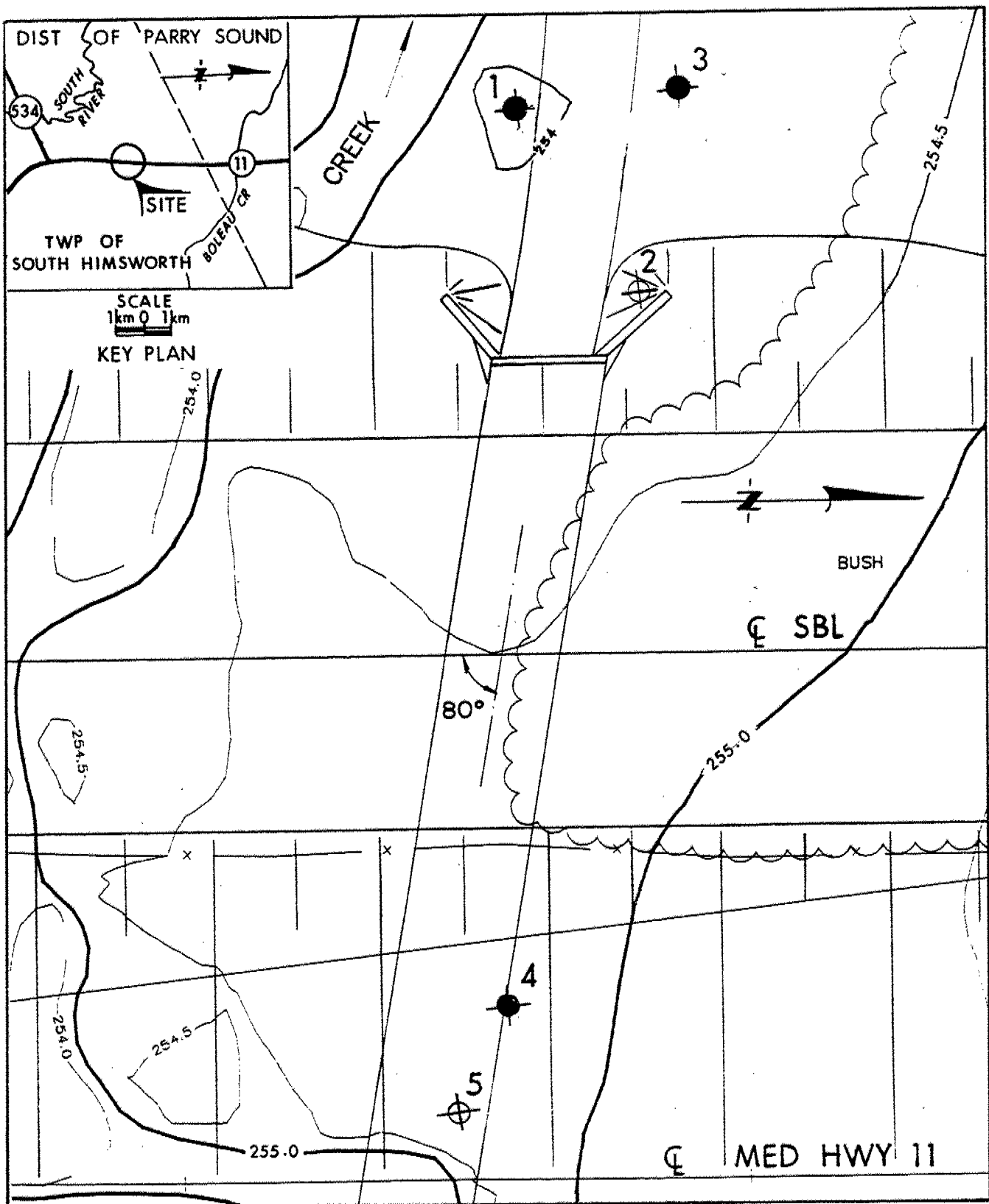


CULVERT No -3

Site 44 -318 C

WP 73-74-00

Dwg No 737400-C



LEGEND

- BOREHOLE
- ⊕ CONE TEST

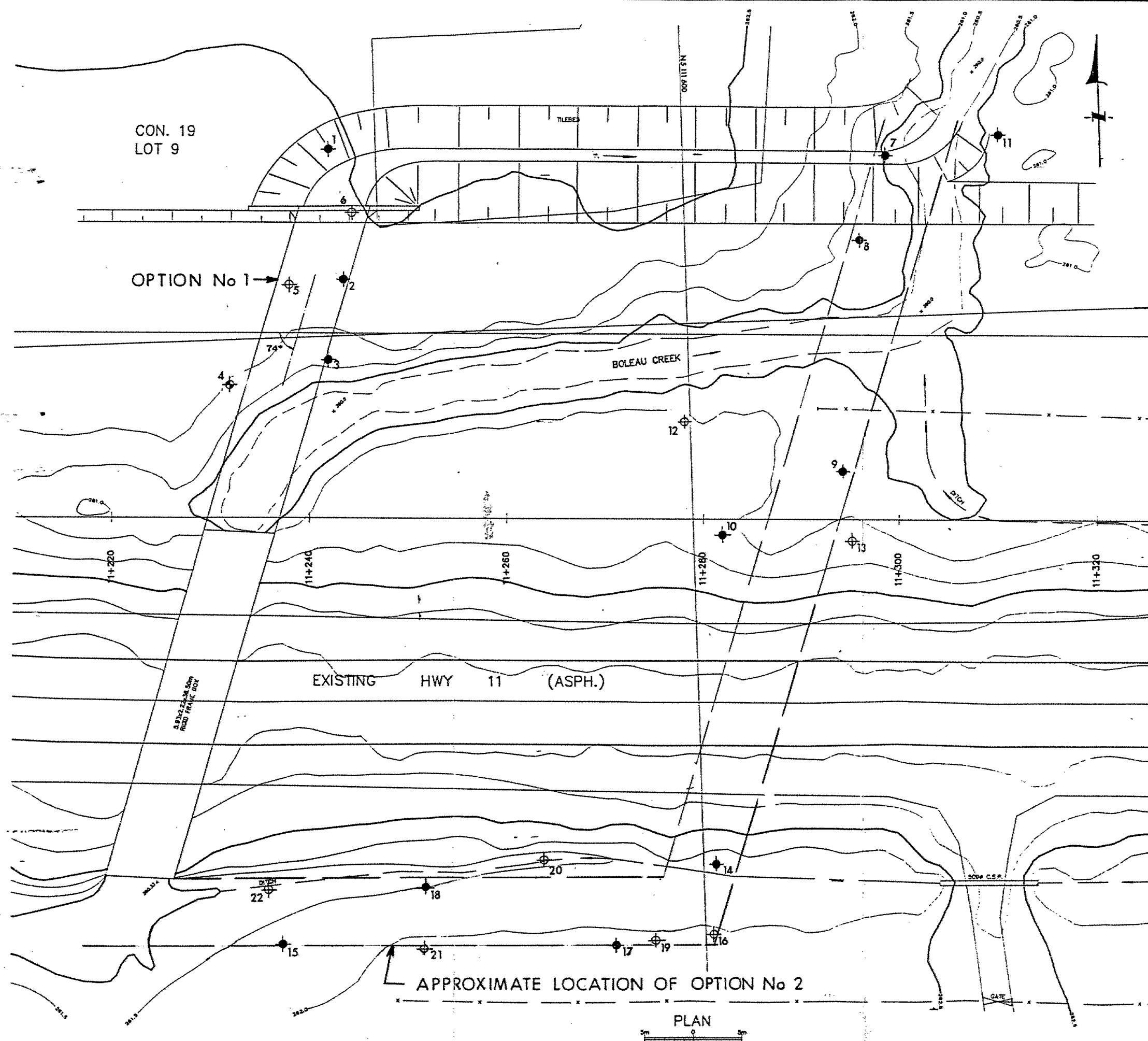
NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN SCALE



CULVERT No 4
Site 44 -318C
WP 73-74-00
Dwg No 737400-D



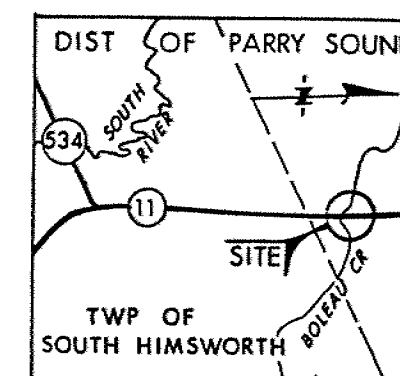
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 73-74-00

BOLEAU CREEK
CULVERT-5
BORE HOLE LOCATIONS & SOIL STRATA







SHEET



SCALE
1km 0 1km

KEY PLAN

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) |
|  | WL at time of investigation |

No	ELEVATION		
		For Elevations & Co-ordinates to Record of Bombhole sheets	refer

Note:
For Subsurface details
refer to Record of
Borehole sheets

==NOTE==

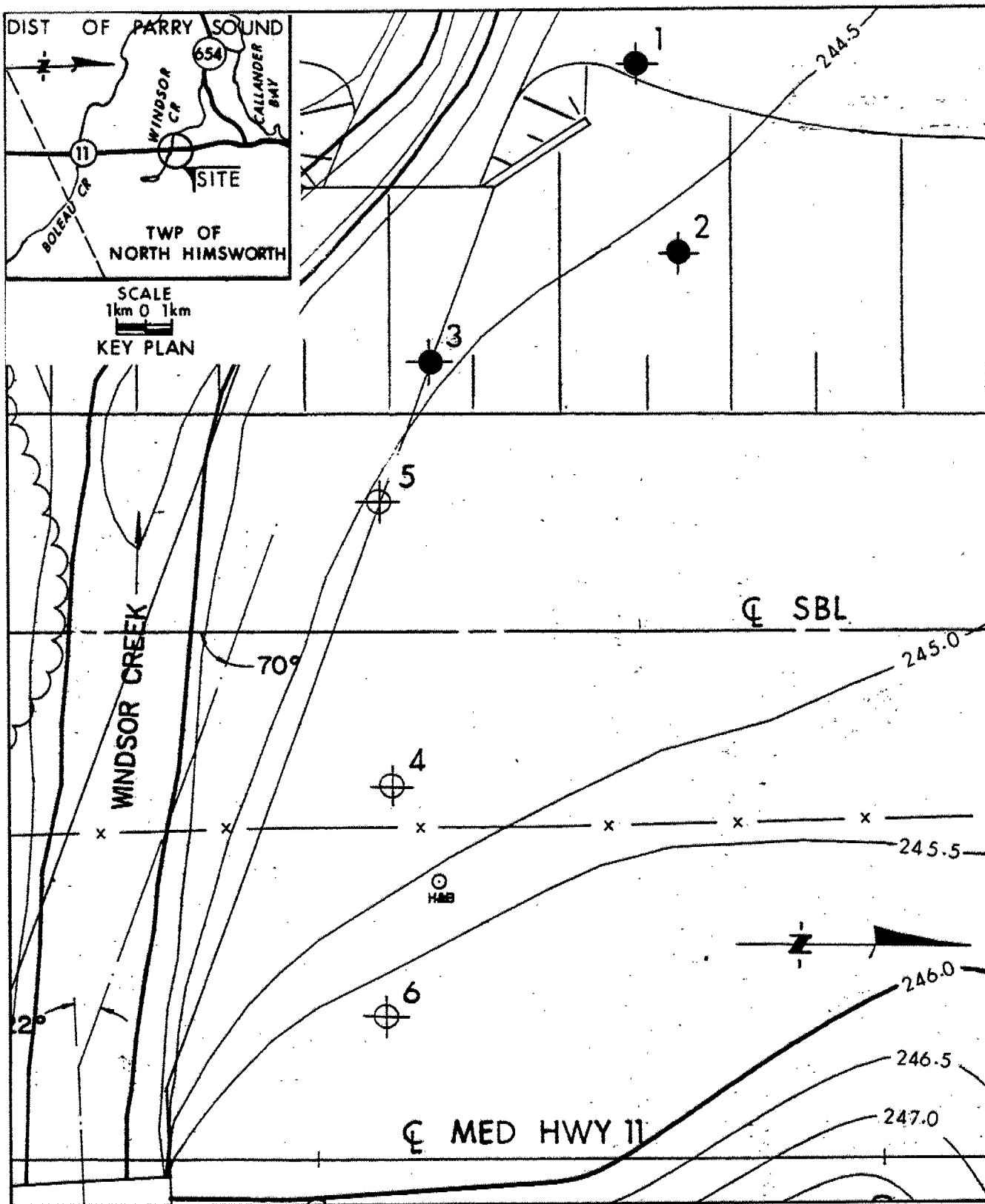
=NOTE=
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV.				
DATE	BY	DESCRIPTION		

Geocres No 31L-56

HWY No 11		DIST 13	
SUBNO MM	CHECKED	DATE 92 01 14	SITE 44-264
DRAWN DT	CHECKED	APPROVED	DWG 737400-1



LEGEND

- BOREHOLE
- ⊕ CONE TEST

NOTE

FOR SUBSOIL INFORMATION REFER
TO RECORD OF BOREHOLE SHEETS

PLAN SCALE



CULVERT No 6
Site 44 -319C
WP 73-74-00
Dwg No 737400-F