APPENDIX A

GEOTECHNICAL REPORT

DYREGROV CONSULTANTS
Consulting Geotechnical Engineers

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March 9, 2009

File #283116

MMM Group
Suite 111 - 93 Lombard Avenue
Winnipeg, Manitoba
R3B 3B1

Attention: Mr. Grantley King, P.Eng.

Dear Sir:

Re: City of Winnipeg
Albany Street Crossing of Truro Creek

As authorized by e-mail of November 28, 2008 from the MMM Group under the signature of Mr. Jim Lukashenko, P.Eng., Dyregrov Consultants have undertaken a geotechnical investigation for a replacement of the Albany Street Culvert Crossing of Truro Creek.

General

The existing crossing of Truro Creek, south of Ness Avenue, consists of dual corrugated steel arch culverts which are 34 metres long and each have a span to rise of 1.65 to 1.11 metres. The culverts are in poor condition and the crossing is hydraulically deficient. The culverts cross Albany Street diagonally.

Field and Laboratory Studies

On January 23, 2009 two test holes were drilled using equipment supplied by Subterranean (Manitoba) at the locations illustrated on Figure 1. The test holes were 508 mm in diameter and were carried to auger refusal at depths of 9.91 and 9.76 metres. In Test Hole 1, the action of the

drilling suggested that the refusal could be on the limestone bedrock which is presumed to underlay the site. During the advancement of the test holes, disturbed samples were taken from the auger cuttings and undisturbed samples were recovered in 75 mm diameter thin walled steel tube samplers. The samples were tested for moisture content, undrained shear strength and soil unit weights.

The logs of the test holes are attached as Figures 2 and 3. The soil stratigraphy is illustrated and the laboratory test results are included. The ground elevations at the test holes were estimated from a site survey which was provided.

It should be noted that the roof of an abandoned concrete box culvert was encountered on the west side of Albany Street at a depth of about 600 mm. The top of the culvert, which at the time was thought to be concrete debris, was cored. It is identified as Probe 1 on Figure 1A. The internal width of the culvert measured at approximately 1.37 metres. The internal height of the culvert could not be measured due to soil deposits on its invert, however, it was expected to be about the same as its width. Probes 3 and 2 were drilled about 1.5 and 3.9 metres to the north of Probe1 in an effort to locate the outside limits of this culvert so that the test hole could be drilled. The soil cover at these two probes was also about 600 mm. The culvert was not shown on any available record drawings.

The Soil Profile

Beneath a surface covering of topsoil is a highly plastic medium to stiff brown silty clay. It became grey near a depth of about 5.0 to 5.5 metres and it extended to depths of 8.84 metres in each of the test holes. At this depth, a soft glacial silt till was encountered. It is extended to the depths of auger refusal.

The silty clay had moisture contents generally in the 50 to 60 percent range. This range is common in the Winnipeg area. The undrained shear strength of the silty clay in the brown upper part of the soil profile is in the stiff range (in excess of 50 kPa) and the grey silty clay in the firm to stiff range of approximately 35 kPa.

The underlying glacial till is known to be a heterogeneous mixture of sand, gravel, cobble and boulder-size materials in a silt and clay matrix. The glacial till was visually described as soft which is quantified by moisture contents in excess of 10 percent.

Discussion and Recommendations

General

It is our understanding that consideration is being given to the installation of a single box culvert as a replacement of the existing corrugated steel arch culverts. It is understood that the preferred alternative for the replacement will be precast concrete segments which will have an invert elevation of approximately 229.4 metres. It will be about 1.5 metres high and 3.0 metre in width. A cast-in-place concrete culvert with a similar configuration may be considered. The 229.4 metre invert is approximately the same as the existing Truro Creek channel.

Foundations

The preferred foundation for the support of the precast concrete segmental culvert is a gravel mat which would be placed on a prepared compacted silty clay subgrade. The subgrade surface should be compacted to a uniform density of at least 95 percent of Standard Proctor Density at optimum moisture content. The excavated surface should not be allowed to dry out or become inundated. It should not be allowed to freeze if winter construction is required. Immediately after the subgrade preparation, it should be covered with 300 mm of crushed granular base course

compacted to a uniform density of 98 percent of Standard Proctor Density. The subgrade preparation and the base course materials should extend at least 1.0 metre beyond the limit of the base of the precast concrete units as well as any cast-in-place concrete inlet and outlet structures. These comments are also appropriate in preparations for a base slab if a cast-in-place concrete culvert is used.

Consideration could be given to the installation of high density rigid insulation between the granular base course and the culvert to prevent frost penetration into the subgrade soils. The thickness of Styrofoam HI required for a Design Freezing Index of 1950° Days is 100 mm.

Excavations

The excavation for the culvert will be in the order of 2.5 metres for the 1.5 by 3.0 metre culvert. These depths take into account the approximate thickness of the culvert base and 300 mm of crushed granular base course. The alignment of the old concrete box culvert is not known and as such its impact on the excavations is not known. There are municipal utilities present on the street right-of-way which will be impacted.

A visual inspection of the banks of the Creek both upstream and downstream of the crossing indicated that they have been undergoing slope instability movements. There is concern that excavation could reactivate some of the slopes movements near the inlet and outlet and possibly any former slides that were encountered during the existing steel culvert installation. It is understood that any slope which does move will be reconstituted.

Wall Design

The backfill of the culvert excavation should be with selected silty clay materials. The design of the walls of the culvert and retaining walls can be based on lateral earth pressures equivalent to:

$$p = k (\gamma D + q) \text{ kn/m}^2$$

where

p = lateral pressure at depth D (kn/m²)
D = depth of backfill to point of pressure (m)
k = earth pressure coefficient = 0.5
γ = unit weight of backfill = 21 kn/m³
q = surcharge load in kn/m²

To avoid excessive lateral earth pressures, the compaction of the backfill adjacent to the walls should be undertaken by relatively light compaction equipment.

Seepage Control

Consideration could be given to the installation of seepage cutoff to prevent erosion from beneath the culvert. A vertical concrete cutoff could extend to a depth of 1.0 metre below the culvert invert. It would be desirable to pour the cutoff in direct contact with the native silty clay.

Erosion Protection

The invert and side slopes of the inlet and outlet channels of the culvert should be protected from erosion.

Other

All concrete in contact with the soil should be manufactured with sulphate resistant cement and should be of high quality.

The materials selection and construction requirements for the replacement of the road surfacing should be as set out in the City of Winnipeg Standard Specifications.

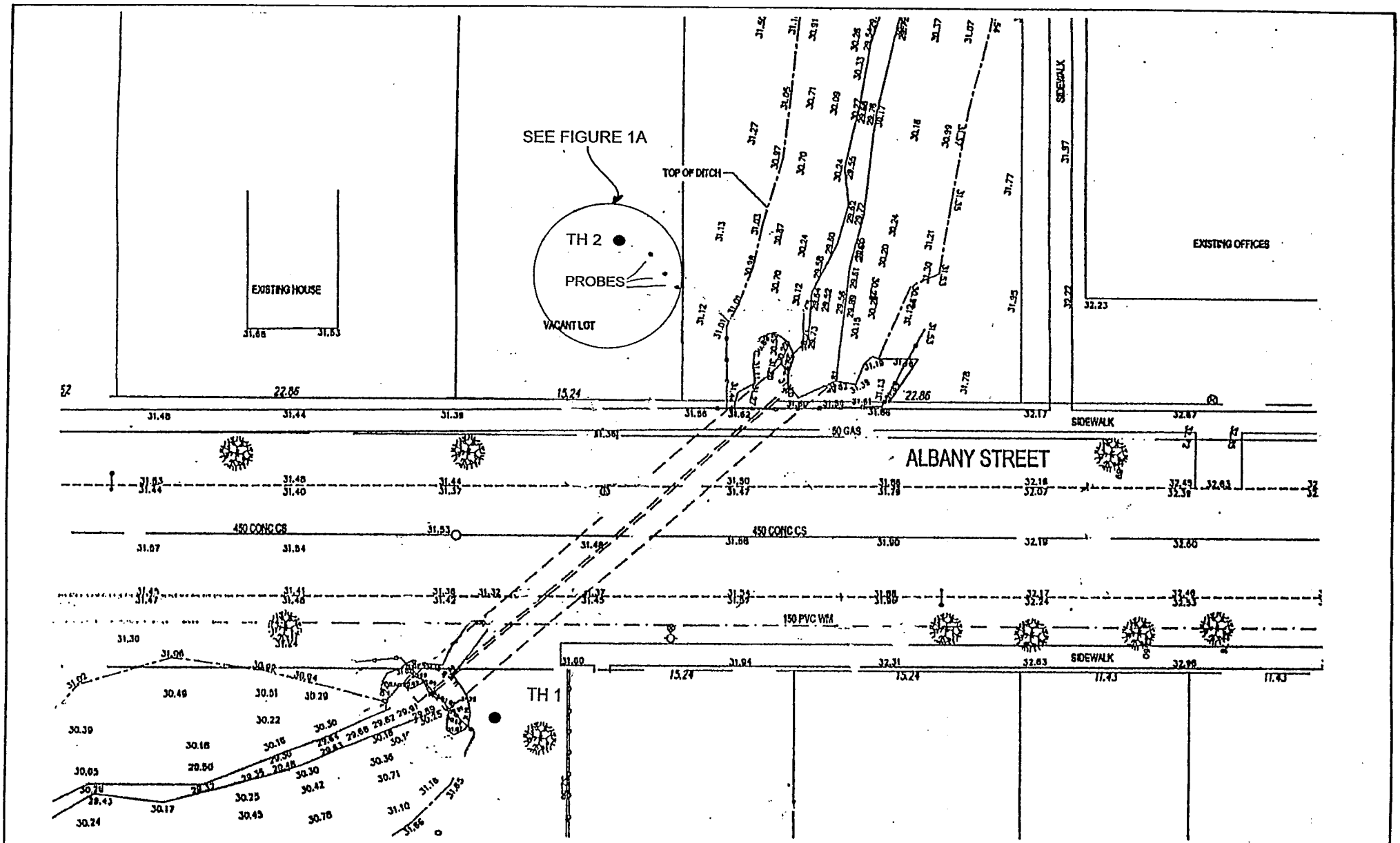
Yours truly,

DYREGROV CONSULTANTS

Per:

A.O. Dyregrov, P.Eng.

Attch.



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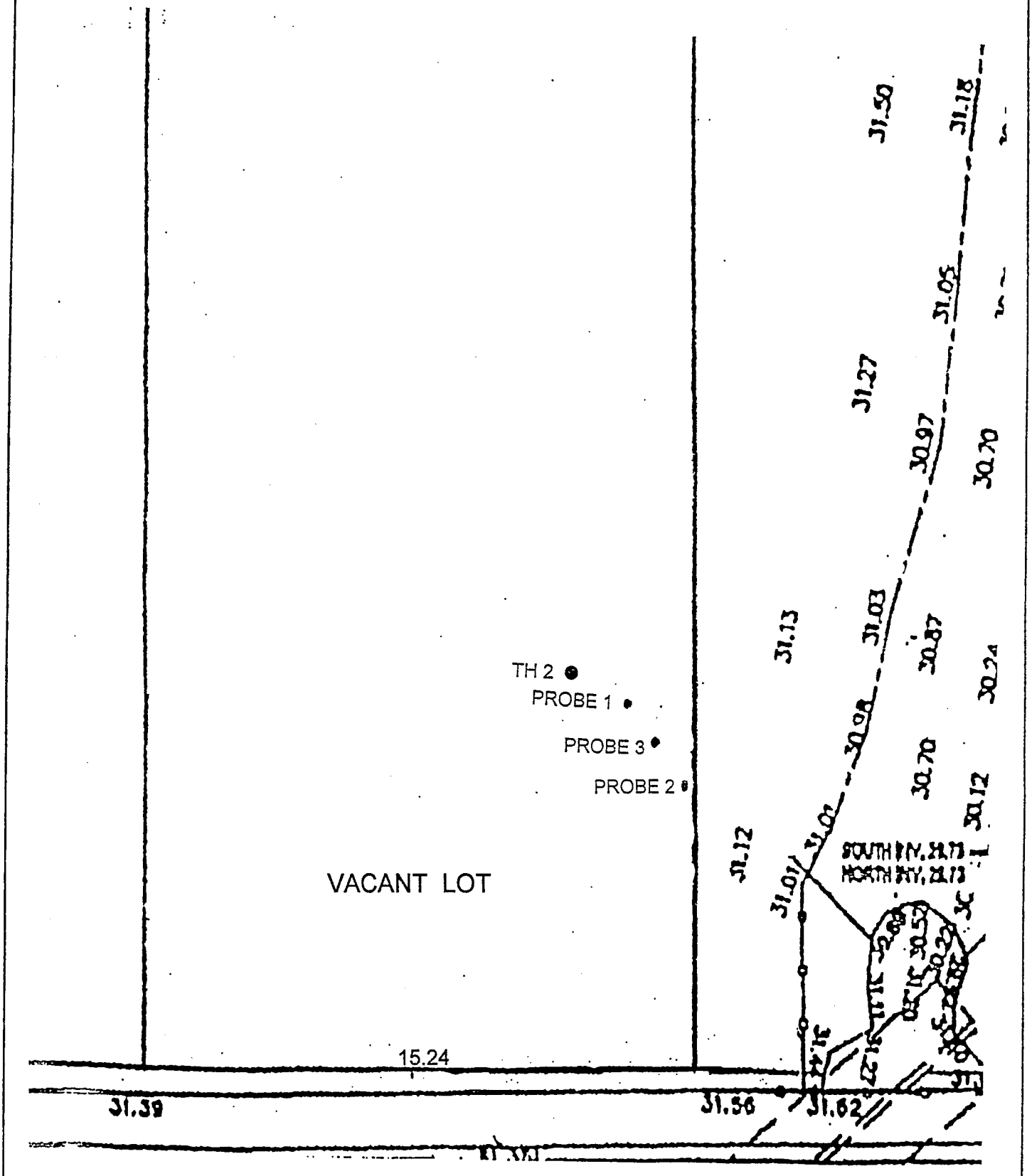
CONSULTING GEOTECHNICAL ENGINEERS

TRURO CREEK CMP REPLACEMENT

TRURO CREEK & ALBANY STREET

TEST HOLE LOCATION PLAN

SCALE	DATE	MADE	CHKD	JOB	FIGURE
NTS	12-2-09	TJH	AOD	283115	1



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TRURO CREEK CMP REPLACEMENT
TRURO CREEK & ALBANY STREET
TEST HOLE LOCATION PLAN

SCALE NTS	DATE 12-2-09	MADE TJH	CHKD AOD	JOB 283115	FIGURE 1A

DYREGROV CONSULTANTS	Logged/Dwn.: TH Checked: AOD	Test Hole No. 1	Project No. 283116
PROJECT: TRURO CREEK & ALBANY STREET CLIENT: MMM GROUP		DATE OF INVEST.: JANUARY 23, 2009 DRILL : SUBTERRANEAN 508 mm AUGER	

SAMPLE NO.	DEPTH (M)	ELEV. (M)	SYM	SOIL DESCRIPTION	
	0.00	32.00		0.00-0.15 TOPSOIL	
	0.50	31.50		0.15-8.84 CLAY DARK BROWN TO BROWN, HIGH PLASTIC, SILTY, MEDIUM TO STIFF TRACE ROOTLETS	
	1.00	31.00			
	1.50	30.50		SOME LAYERING, TRACE SULPHATES,	Qu-18.3 kPa Pp-45.4 kPa Tv-56.5 kPa W-17.11 KN/M
	2.00	30.00			
	2.50	29.50			
	3.00	29.00			Qu-39.2 kPa Pp-45.5 kPa Tv-51.1 kPa W-16.66 KN/M
	3.50	28.50		SAME, FINE GREY LAYERING, TRACE SILT AND FINE SAND INCLUSIONS	
	4.00	28.00			
	4.50	27.50			Qu-46.9 kPa Pp-50.3 kPa Tv-50.7 kPa W-16.65 KN/M
	5.00	27.00		TRANSITION TO GREY, MEDIUM TO STIFF	
	5.50	26.50			
	6.00	26.00			Qu-36.1 kP Pp-38.3 kPa Tv-43.1 kPa W-17.11 KN/M
	6.50	25.50			
	7.00	25.00			
	7.50	24.50		SAME WITH LARGER SILT TILL INCLUSIONS	Qu-35.8 kPa Pp-43.1 kPa Tv-45.0 kPa W-16.58 KN/M
	8.00	24.00			
	8.50	23.50			
	9.00	23.00		8.84-9.91 GLACIAL SILT TILL MATRIX OF SILT, SOME SAND AND GRAVEL SOFT, FEW COBBLES AND BOULDERS WATER COMING INTO TEST HOLE	
	9.50	22.50			
	10.00	22.00		END OF TEST HOLE AT 9.91 AT AUGER REFUSAL (ON PROBABLE BEDROCK)	
	10.50	21.50			
	11.00	21.00			

MOISTURE CONTENT (%)

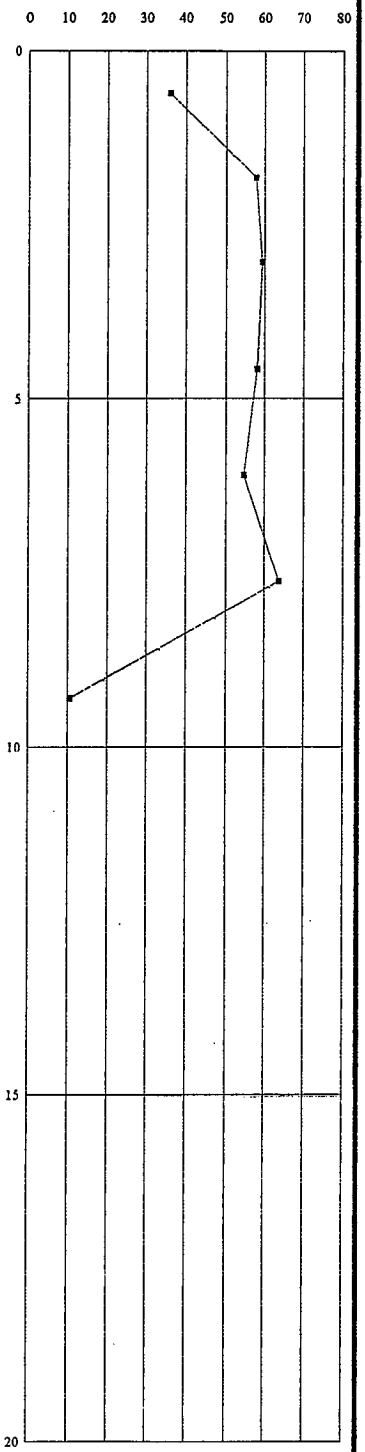

FIGURE 2

DYREGROV CONSULTANTS	Logged/Dwn.: TH Checked: AOD	Test Hole No. 2	Project No. 283115
PROJECT: TRURO CREEK & ALBANY STREET CLIENT: MMM GROUP		DATE OF INVEST.: JANUARY 23, 2009 DRILL : SUBTERRANEAN 508 mm AUGER	

SAMPLE NO.	DEPTH (M)	ELEV. (M)	SYM	SOIL DESCRIPTION	
	0.00	31.10			
	0.50	30.60		0.00-1.67 TOPSOIL CLAYEY, FROZEN, SOME TOPSOIL POSSIBLY FILL	
	1.00	30.10			
	1.50	29.60		1.67-2.45 CLAY AND ORGANICS LAYER OF ORGANICS 1.7 TO 1.85	
	2.00	29.10		DARK BROWN TO BLACK, TRACE ORGANICS, 'APPEARS TO OLD CREEK BED', FEW SMALL	Pp-47.8 kPa Tv-58.4 kPa
	2.50	28.60		SHELLS, 2.45-8.84 CLAY	
	3.00	28.10		BROWN, SILTY, STIFF, HIGH PLASTIC	Qu-25.5 kPa
	3.50	27.60		BROWN TO DARK BROWN LAYERING TRACE FINE GRAVEL INCLUSIONS	Pp-59.8 kPa Tv-55.1 kPa W -17.43 KN/M
	4.00	27.10			
	4.50	26.60			
	5.00	26.10			Qu-57.2 kPa Pp-62.2 kPa
	5.50	25.60		SAME, MEDIUM TO STIFF GREY	Tv-71.8 kPa W -18.08 KN/M
	6.00	25.10			
	6.50	24.60			
	7.00	24.10			
	7.50	23.60			
	8.00	23.10			
	8.50	22.60		8.84-9.76 GLACIAL SILT TILL MATRIX OF SILT, SOME SAND AND GRAVEL	
	9.00	22.10		SOFT, FEW COBBLES AND BOULDERS	
	9.50	21.60		NOTE: NO WATER	
	10.00	21.10			
	10.50	20.60		END OF TEST HOLE AT 9.76 ON AUGER REFUSAL	
	11.00	20.10			

MOISTURE CONTENT (%)

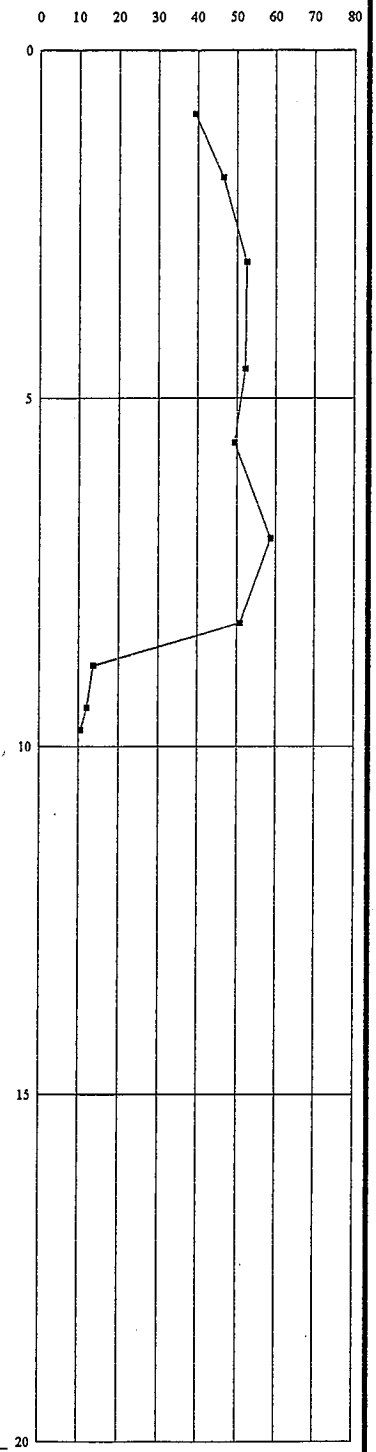

FIGURE 3