THE NATIONAL TESTING LABORATORIES LIMITED

GEOTECHNICAL INVESTIGATION AND FOUNDATION ENGINEERING REPORT FOR TRANSCONA CEMETERY COLUMBARIA

Prepared for

CITY OF WINNIPEG CEMETERIES
PLANNING, PROPERTY AND DEVELOPMENT DEPARTMENT
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1.0 SUMMARY

The National Testing Laboratories Limited were retained to undertake a geotechnical investigation to establish the soil conditions and provide foundation recommendations for the proposed columbaria at the Transcona Cemetery in Winnipeg, Manitoba. Three testholes were drilled to depths of 16 to 19 m on August 5, 2009. The investigation revealed a soil profile of topsoil, silt, and clay underlain by silt till. Based upon the soil and groundwater conditions encountered at the site and the anticipated foundation loads, the proposed structure may be supported on cast-in-place concrete friction piles.

2.0 TERMS OF REFERENCE

The National Testing Laboratories Limited were retained to undertake a geotechnical investigation to establish general soil conditions and provide foundation recommendations for the proposed columbaria at the Transcona Cemetery in Winnipeg, Manitoba. The scope of work for this project was outlined in our proposal dated July 16, 2009. Authorization to proceed with the geotechnical investigation was received from Jane Saxby on July 23, 2009.

3.0 GEOTECHNICAL INVESTIGATION

3.1 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted on August 5, 2009 with drilling services provided by Paddock Drilling Ltd. under the supervision of our geotechnical field personnel. The testholes were drilled using a track-mounted drill rig equipped with 125 mm diameter solid stem augers. The testhole locations were identified on a site plan provided to us from the City of Winnipeg Cemeteries Branch. One testhole was drilled at the location of the proposed columbaria and the remaining two testholes were drilled in the south portion of the cemetery. Testholes TH1, TH2 and TH3 were drilled to auger refusal at a depth of 16.6, 17.1 and 18.6 m respectively. The testhole locations are shown on the attached Testhole Location Plan.

Representative soil samples were obtained directly off the augers at depth intervals ranging from 0.8 to 1.5 m. Upon completion of the drilling, the testholes were examined for evidence of sloughing and groundwater seepage. The soil samples were returned to our soils laboratory for additional examination and testing.

3.2 Laboratory Testing

Strength index testing using a torvane device was performed on soil samples obtained from the clay layer. Water contents were determined for all soil samples. The torvane readings and water contents are shown on the attached testhole log.

4.0 SUBSURFACE CONDITIONS

4.1 Soil Profile

The general soil stratigraphy at the site, as interpreted from the testhole logs, consisted of topsoil, silt and clay underlain by silt till.

Topsoil

Topsoil with a thickness of approximately 50 mm was encountered at the surface of the testholes.

Silt

Silt was encountered at a shallow depth in the testholes. The silt extended to up a depth of 2.4m below grade. The silt was tan, soft, moist, and of medium plasticity. Water contents of the clay ranged from 26 to 29%.

Clay

Clay was encountered beneath the topsoil in the testholes. The clay extended to a depth of 16.6, 17.1 and 18.6 m in Testholes TH1, TH2 and TH3 respectively. The clay was black to grey, stiff, moist, and of high plasticity with trace organic material. With increasing depth, the consistency of the clay was firm to soft. Coarse sand and fine gravel were found at a depth of 10.7, 8.5 and 14.3 m in Testholes TH1, TH2 and TH3 respectively. Water contents of the clay ranged from 24 to 60%.

Silt Till

Silt till was encountered beneath the clay in the testholes. The till was composed predominantly of silt with some fine sand and gravel. The till was tan, firm, moist, and of low plasticity. The water content of the glacial till ranged from 8 to 23%.

4.2 Groundwater

Moderate groundwater seepage was observed from the silt between a depth of 1.4 and 2.4 m in Testhole TH3. The groundwater level in Testhole TH3 was measured as 9.8 m upon completion of drilling. No soil sloughing was observed during or upon completion of drilling. It should be noted that only short-term seepage and sloughing conditions were observed and groundwater levels will normally fluctuate during the year and will be dependent upon precipitation and surface drainage.

5.0 DESIGN RECOMMENDATIONS AND COMMENTS

5.1 Foundation

Based upon the soil and groundwater conditions encountered at the site and the anticipated foundation loads, the proposed structure may be supported on cast-in-place concrete friction piles. Cast-in-place concrete friction piles may be designed based upon the allowable skin friction values shown in the following table:

Depth Interval below Existing Grade (m)	Allowable Skin Friction (kPa)
0 to 2.5	0
2.5 to 6	13
6 to 13	7

Due to the presence of silt and clay and the potential for soil drying and shrinkage near the ground surface, the frictional support should be excluded in the calculation of the pile capacity for a depth of 2.5 m measured from existing grade. The allowable skin friction value is applied to the pile circumference within the clay stratum over the depth intervals indicated in the above table. For example, the capacity of a 13 m pile would be based upon an allowable skin friction value of 13 kPa from 2.5 to 6 m and an allowable skin friction value of 7 kPa from 6 to 13 m. The contribution from end bearing should be ignored in pile capacity calculations. Minimum pile spacing should be three pile diameters, measured center to center.

To prevent frost jacking of the piles due to adfreeze forces, the piles should have a minimum pile length of 8 m measured from final grade and should be provided with steel reinforcement to at least 8 m below grade. It should be noted that moderate groundwater seepage was observed from a silt layer in Testhole TH3. Pile holes should be poured with concrete as soon as they are drilled to minimize any potential problems of soil sloughing and groundwater seepage. Temporary steel sleeves should be available in the event that groundwater seepage or sloughing of the pile holes is encountered during pile installation. Groundwater, if encountered in the pile holes, should be removed prior to concrete placement.

It is recommended that the pile length below existing grade not exceed 13 m for the site to avoid penetration of the silt till and potential groundwater seepage below this depth. A minimum void space of 200 mm should be provided beneath all structural elements to accommodate potential heave of the high plasticity clay. Pile settlements are expected to be negligible with the use of cast-in-place concrete friction piles.

5.2 Foundation Concrete

The clay soils in the Winnipeg area contain sulphates that will cause deterioration of concrete. The class of exposure for concrete in contact with clay soil in the Winnipeg area is considered to be severe (S-2 in CSA A23.1 Table 3). The requirements for concrete exposed to severe sulphate attack are provided in the following table.

Parameter	Design Requirement
class of exposure	S-2
compressive strength	32 MPa at 56 days
air content	4 to 7%
water-to-cementing materials ratio	0.45 max.
cement	type HS

6.0 CLOSURE

Professional judgements and recommendations are presented in this report. They are based partly on evaluation of the technical information gathered during our site investigation and partly on our general experience with subsurface conditions in the area. We do not guarantee the performance of the project in any respect other than that our engineering work and judgment rendered meet the standards and care of our profession. It should be noted that the testholes may not represent potentially unfavourable subsurface conditions on the project site. If during construction soil conditions are encountered that vary from those discussed in this report, we should be notified immediately in order that we may evaluate effects, if any, on foundation performance. The recommendations presented in this report are applicable only to this specific site. These data should not be used for other purposes.

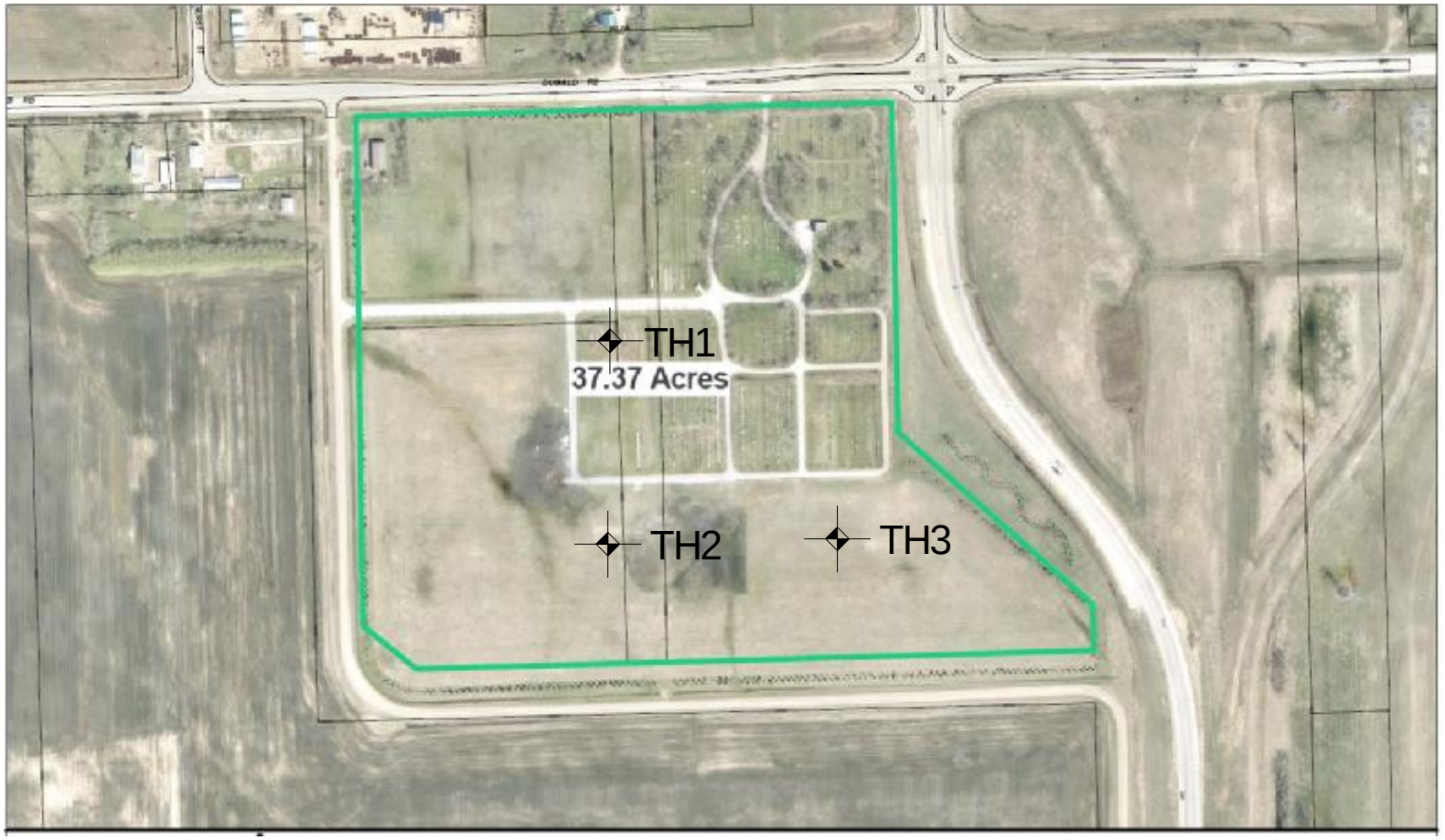
We appreciate the opportunity to assist you in this project. Please call me if you have any questions regarding this report.

Don Flatt

Don Flatt, M. Eng., P. Eng.
Senior Geotechnical Engineer

PROVINCE OF MANITOBA
D. G. FLATT
Aug 19/09
REGISTERED ENGINEER

APEGM
Certificate of Authorization
The National Testing Laboratories Limited
No. 666 Date: Aug 19/09



THE NATIONAL TESTING LABORATORIES LIMITED *Established in 1923*	Project No.COW-918	Drawn by: L.P	Figure: 1
	Date:August 14, 2009	Reviewed by: DF	Scale: NTS

Testhole Location Plan
Transcona Cemetery Columbaria
Winnipeg, Manitoba

TESTHOLE TH1

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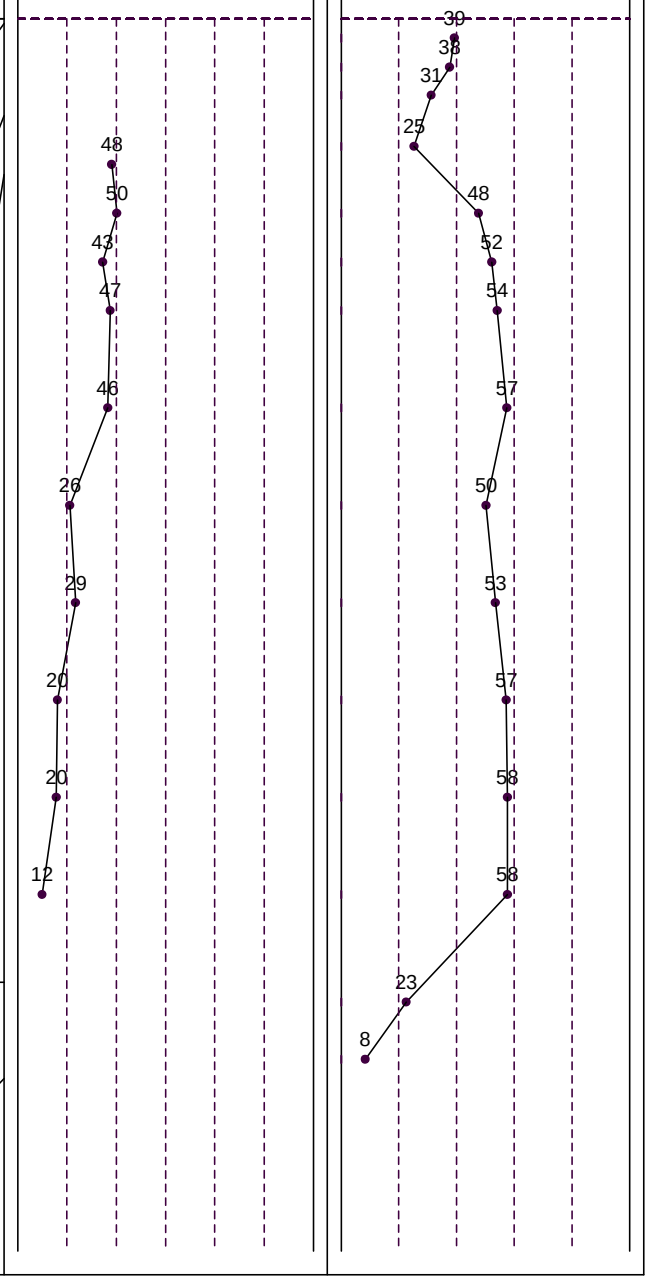
Project Name: Transcona Cemetery Columbaria
Client: City of Winnipeg Cemeteries Branch
Drilling Contractor: Paddock Drilling
Drilling Method: 125 mm Auger

Date Drilled: August 5, 2009
Depth of Testhole: 16.6 m
Logged by: Larry Presado
Reviewed by: Don Flatt

Subsurface Profile			Laboratory Testing	
Depth (m)	Symbol	Description	Torvane Readings (kPa)	Water Content (%)
		Ground Surface		
0		**Topsoil**		
1		**Clay** - black, stiff, moist, high plasticity - trace organic material - brown below 0.7 m		
2				
3		**Silt** - tan, firm, moist, medium plasticity with some clay - trace fine sand to coarse gravel below 2.1 m		
4				
5		**Clay** - brown, firm, moist, high plasticity, trace silt inclusions - trace coarse grained sand below 10.7 m - soft below 11 m		
6				
7				
8				
9				
10				
11				
12				
13				
14				
15		**Silt Till** - tan, very soft, saturated, low plasticity, trace fine sand to coarse gravel - dense, moist below 16 m		
16				
17		• No groundwater seepage or soil sloughing observed during or upon completion of drilling • Auger refusal at 16.6 m on suspected boulder		
18				
19				



TESTHOLE TH2

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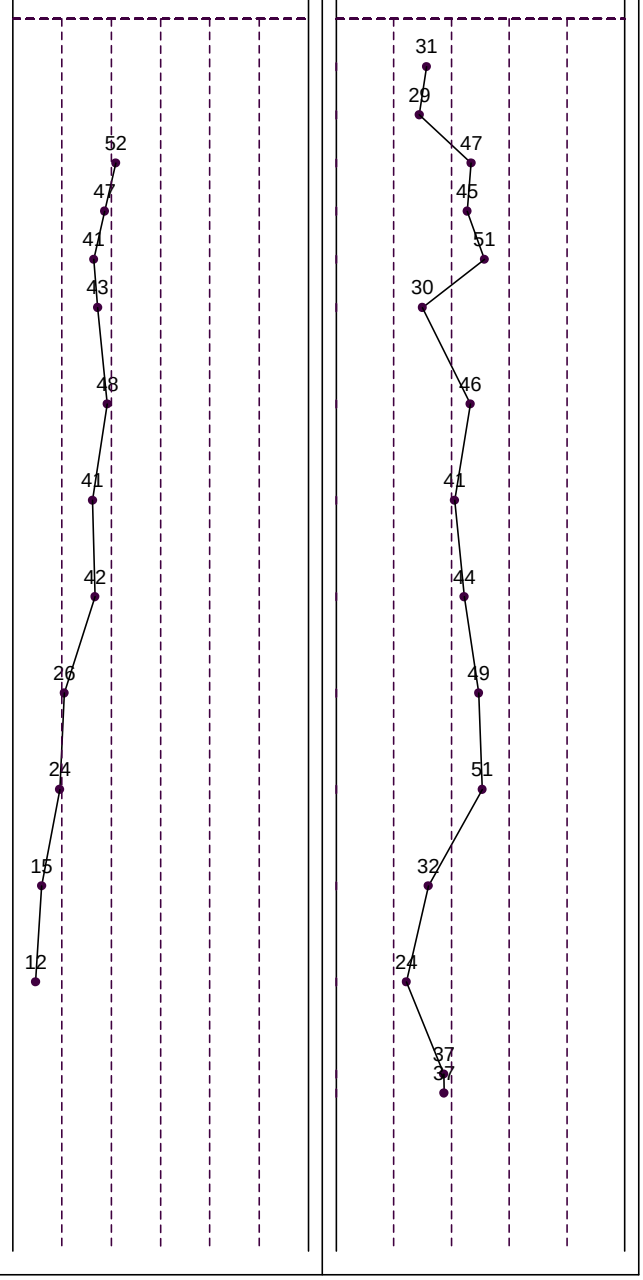
Project Name: Transcona Cemetery Columbaria
Client: City of Winnipeg Cemeteries Branch
Drilling Contractor: Paddock Drilling
Drilling Method: 125 mm Auger

Date Drilled: August 5, 2009
Depth of Testhole: 17.1 m
Logged by: Larry Presado
Reviewed by: Don Flatt

Subsurface Profile			Laboratory Testing	
Depth (m)	Symbol	Description	Torvane Readings (kPa)	Water Content (%)
0		Ground Surface	0 25 50 75 125 150	0 20 40 60 80 100
0		**Topsoil**		
1		**Clay** - black, soft, moist, high plasticity, trace organic material		
2		**Silt** - tan, soft, moist, medium plasticity		
3		**Clay** - brown, firm, moist, high plasticity, trace silt inclusions - trace oxidation below 1.8 m - grey below 6.7 m - trace medium to coarse grained sand below 8.5 m - very soft below 12.5 m		
17		• No groundwater seepage soil sloughing was observed during or upon completion of drilling • Auger refusal at 17.1 m on suspected boulder		



TESTHOLE TH3

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Project Name: Transcona Cemetery Columbaria
Client: City of Winnipeg Cemeteries Branch
Drilling Contractor: Paddock Drilling
Drilling Method: 125 mm Auger

Date Drilled: August 5, 2009
Depth of Testhole: 18.6 m
Logged by: Larry Presado
Reviewed by: Don Flatt

Subsurface Profile			Laboratory Testing	
Depth (m)	Symbol	Description	Torvane Readings (kPa)	Water Content (%)
0		Ground Surface	0 25 50 75 125 150	0 20 40 60 80 100
0		**Topsoil**		
1		**Clay** - black, firm, moist, high plasticity - trace organic material		
2		**Silt** - tan, firm, moist, medium plasticity		
3		**Clay** - brown, firm, moist, high plasticity, trace silt inclusions - soft below 9.2 m - trace fine gravel below 14.3 m		
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15		**Silt Till** - tan, loose, moist, low plasticity, trace fine sand to coarse gravel - dense, moist below 18 m		
16				
17				
18				
19		• Moderate groundwater seepage from the silt layer at 2.3 m • Groundwater level at 9.8 m upon completion of drilling • No soil sloughing observed during or upon completion of drilling. • Auger refusal at 18.6 m on suspected boulder		
20				
21				
22