GEOTECHNICAL INVESTIGATION AND FOUNDATION ENGINEERING REPORT FOR MARION PUMPING STATION WINNIPEG, MANITOBA

Prepared for
SNC-LAVALIN INC.
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June 3, 2010

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1.0 SUMMARY

The National Testing Laboratories Limited was retained to undertake a geotechnical investigation and provide foundation recommendations for a proposed pumphouse building. The project site is located at the existing Marion Pumping Station in Winnipeg, Manitoba. One testhole was drilled on the project site on May 11, 2010. The geotechnical investigation revealed a general soil profile of a thin layer of topsoil overlying clay fill, clay, and silt till to the depths explored. A thin silt layer was encountered at a depth of 3 m within the clay layer. Based upon the soil and groundwater conditions encountered in the testhole, cast-in-place concrete friction piles may be used to support the proposed pump house building.

2.0 TERMS OF REFERENCE

The National Testing Laboratories Limited was retained to undertake a geotechnical investigation and provide foundation recommendations for a proposed pumphouse building. The project site is located at the existing Marion Pumping Station in Winnipeg, Manitoba. The scope of work for geotechnical engineering services was outlined in our proposal dated April 13, 2010. Authorization to proceed with the geotechnical investigation was provided by Tony Deger on April 27, 2010.

3.0 GEOTECHNICAL INVESTIGATION

3.1 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted on May 11, 2010. Drilling services were provided by Subterranean (Manitoba) Ltd. under the supervision of our geotechnical field personnel. One testhole (TH1) was drilled using a truck-mounted drill rig equipped with 125 mm diameter solid stem augers. The testhole was drilled to auger refusal which was encountered on suspected boulders at a depth of 12.2 m. The testhole location is shown on the attached Testhole Location Plan.

Representative soil samples were obtained directly off the augers at depth intervals ranging from 0.5 to 1.5 m. Upon completion of drilling, the testhole was examined for evidence of sloughing and groundwater seepage. The soil samples were visually classified in the field and returned to our soils laboratory for additional examination and testing. The testhole was backfilled with the auger cuttings.

3.2 Laboratory Testing

Water content and torvane testing was conducted on soil samples recovered from the testholes and the test results 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 log, consisted of a thin layer of topsoil overlying clay fill, clay, and silt till to the depths explored. A thin silt layer was encountered at a depth of 3 m within the clay layer.

Topsoil

A thin layer of topsoil approximately 100 mm in thickness was encountered at the surface of the testhole.

Clay Fill
Clay fill was encountered beneath the topsoil. The clay fill was black, very stiff, moist, and of high plasticity. The clay fill extended to a depth of 0.6 m. Water content of a clay fill sample was determined to be 21%.

Clay
Clay was encountered beneath the clay fill. The clay varied in colour from brown to grey, and was of high plasticity. Based upon a review of the torvane test data, it is evident that the strength of the clay decreases with increasing depth. The clay extended to a depth of 10.7 m. Water contents of the clay ranged from 28 to 55%.

Silt
A silt layer was encountered at a depth of 3 m within the clay layer. The thickness of the silt layer was approximately 100 mm. The silt till was tan, soft, moist, and of low plasticity with some coarse gravel. The water content of the silt was 8%.

Silt Till
Silt till was encountered beneath the clay. The silt till was tan, compact, moist, and of low plasticity. Auger refusal was encountered in the silt till at a depth of 12.2 m on suspected boulders. Water content of a silt till sample was determined to be 10%.

4.2 Groundwater
Moderate to heavy groundwater seepage was observed from the silt till layer. The groundwater level was at a depth of 6.1 m upon completion of drilling. Soil sloughing was observed in the testhole below a depth of 10.8 m. 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 Foundations
It was reported that the footprint of the proposed pumphouse building will be approximately 5 m by 5 m, and the building will be constructed with a structural slab over grade beams and piles. The building will be heated. Based upon the soil and groundwater conditions encountered in the testhole, cast-in-place concrete friction piles may be used to support the proposed pumphouse building.

5.1.1 Cast-In-Place Concrete Friction Piles
Cast-in-place concrete friction piles are suitable for light to moderate foundation loads and 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	20
6 to 9.5	13

Due to the presence of clay and clay fill near the ground surface and the potential for soil drying and shrinkage, 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. The contribution from end bearing should be ignored in pile capacity calculations. Minimum pile spacing should be three pile diameters, measured center to center. Piles for heated structures should have a minimum pile length of 6 m measured from final grade.

Although no groundwater seepage was observed from the thin silt layer encountered at a depth of 3 m, groundwater seepage from the silt layer should be anticipated after periods of heavy rain. 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 not exceed 9.5 m to avoid penetration of the silt till and potential groundwater seepage and sloughing 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 A23.1-09 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 or HSb

5.3 Drainage

All roof downspouts should be directed away from the building and the ground surface around the building should be graded to promote drainage away from the foundation and therefore minimize soil swelling and frost action. Final site grading should ensure that all surface runoff is directed away from the building using a minimum gradient of 2%. To compensate for potential settlement of backfill materials adjacent to the building, the grade should be increased to 10% for the first 2 m from the building.

6.0 CLOSURE

Professional judgments 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 testhole 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 the 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.

Prepared by

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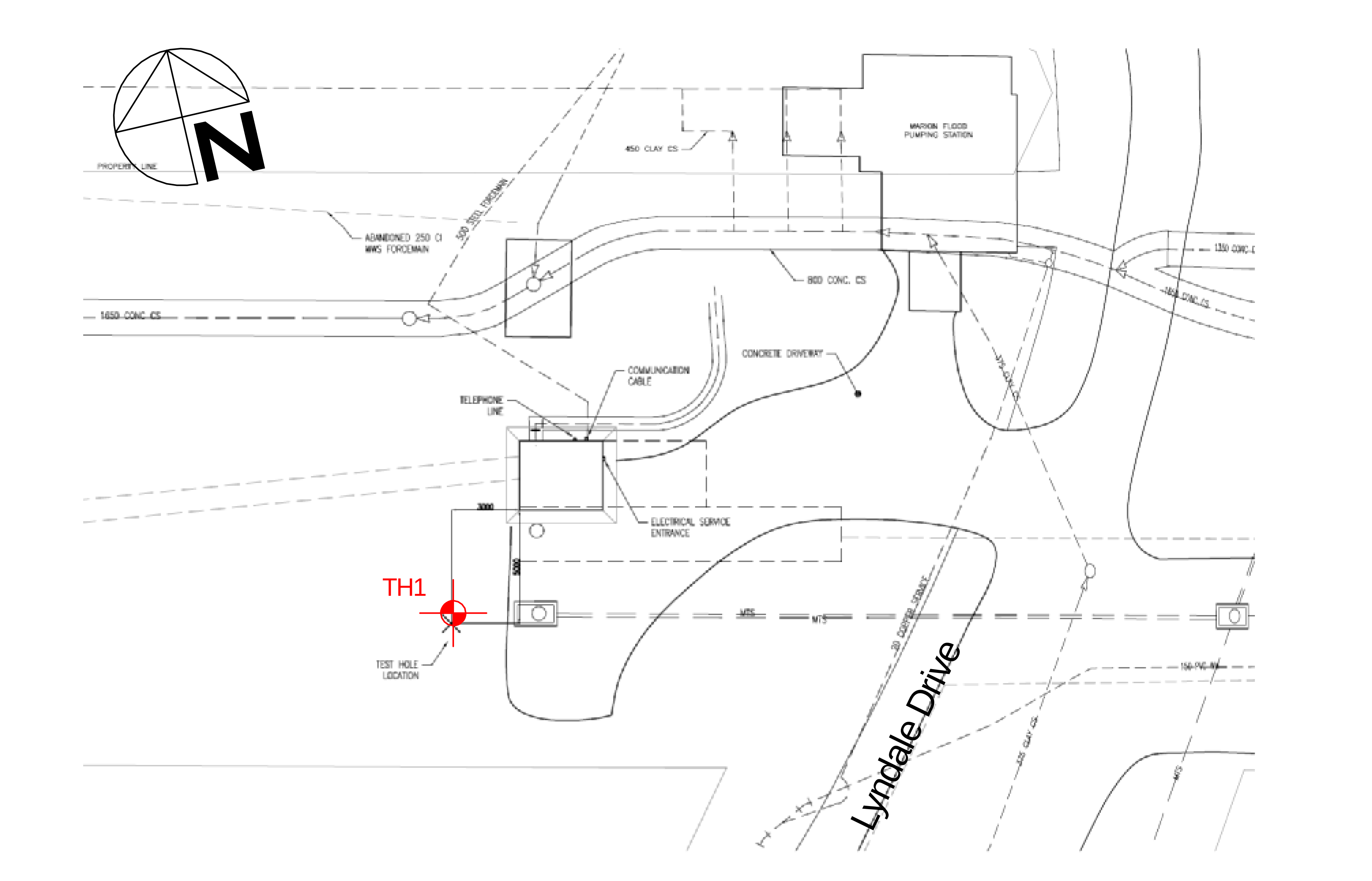
Geotechnical Engineering

Reviewed by

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

APEGM
Certificate of Authorization
The National Testing Laboratories Limited
No. 690 Date: JUNE 3/10

PROVINCE OF MANITOBA
D.G. FLATT
Member
5062
REGISTERED PROFESSIONAL ENGINEER



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Project No. SNC-1001	Drawn by: AP	Figure: 1	Testhole Location Plan Marion Pumping Station Winnipeg, Manitoba
Date: June 2, 2010	Reviewed by: DF	Scale: NTS	

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TESTHOLE TH1

Project Name: Marion Pumping Station
Client: SNC-Lavalin Inc.
Drilling Contractor: Subterranean (Manitoba) Ltd.
Drilling Method: 125 mm Auger

Date Drilled: May 11, 2010
Depth of Testhole: 12.2 m
Logged by: Solomon Olumola-Davies
Reviewed by: Aron Piamsalee

Subsurface Profile

Depth (m)	Symbol	Description
0		Ground Surface
0 – 0.6		**Topsoil**
0.6 – 1.8		**Clay Fill** - black, very stiff, moist, high plasticity - some sand and fine to coarse gravel
1.8 – 3.3		**Clay** - brown, very stiff, moist, high plasticity - some coarse gravel between 2.9 m and 3.0 m
3.3 – 4.5		**Silt** - tan, soft, moist, low plasticity - some coarse gravel
4.5 – 10.7		**Clay** - brown, stiff, moist, high plasticity - stiff below 5.0 m - grey below 7.6 m - firm below 8.0 m
10.7 – 12.2		**Silt Till** - tan, compact, moist, low plasticity - some sand and fine to coarse gravel

- Moderate to heavy groundwater seepage observed from the silt till layer.
- Groundwater level at 6.1 m upon completion of drilling.
- Soil sloughing observed below a depth of 10.8 m.
- Auger refusal at 12.2 m on suspected boulders.

Laboratory Testing