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Memorandum

To	Marv McDonald, CET	Page	1
CC	Jeff Tallin, P.Eng.		
Subject	Logan Valve Chamber		
From	Jared Baldwin, EIT		
Date	January 20, 2010	Project Number	60114979-0300 D265 250 00 (4.4)

1. Introduction

This memorandum summarizes the results of the subsurface investigation conducted for a new valve chamber to be located near the intersection of Logan Avenue and Yeoman Street at the City of Winnipeg McPhillips Reservoir. This memorandum provides geotechnical recommendations concerning design of the proposed works.

2. Field Program

The investigation included drilling one 15.2 m deep test hole on the existing reservoir embankment at the location shown on Figure 01. The test hole was drilled on November 24, 2009 by Paddock Drilling Ltd. using a track mounted Ranger 24 drill rig equipped with 100 mm solid stem augers. The subsurface conditions were observed during drilling and the soil was visually classified by Jared Baldwin, EIT, of AECOM. Other pertinent information such as groundwater and drilling conditions were also recorded during the field investigation. Auger cutting samples and Shelby tube samples of soil were retrieved for testing at AECOM's Materials Testing Laboratory. Lab tests included: moisture content determinations, and unconfined compression tests. The attached test hole log describes the subsurface conditions encountered along with lab testing results, backfilling details and general observations. Test hole elevation was estimated from the topographical survey of the site.

3. Subsurface Conditions

The general soil profile in descending order is:

- Clay Fill
- Organic Clay
- Lacustrine Clay
- Silt Till

These soil units are described separately as follows:

Clay Fill

Clay embankment fill was encountered at surface and continued to a depth of 4.0 m below surface. The clay is intermediate to highly plastic and sandy with some silt. It is dry at surface but becomes moist and firm to stiff below 0.9 m depth. Moisture contents ranged from 16 to 30 percent. A Shelby tube sample was taken at 3.0 m; however, recovery was poor and an unconfined compression test could not be performed.

Organic Clay

Organic clay was encountered beneath the clay fill between 4.0 and 4.9 m below surface. The organic clay is medium to highly plastic, silty with some gravel and sand, grey and black, moist, and very soft to soft. Trace amounts of roots and wood fragments were also encountered in this layer. A single sample from this layer had a moisture content of 30 percent.

Lacustrine Clay

Highly plastic lacustrine clay extending to 14.6 m below ground surface was encountered beneath the organic clay. Above about 7.0 m depth it is brown and grey, firm to stiff, and laminated in layers up to 2 mm thick between about 4.9 to 7.0 m depth. Undrained shear strengths of 43 and 33 kPa, and unit weights of 16.5 and 19.3 kN/m^3 were measured on samples recovered from 4.6 m and 6.1 m, respectively. Below about 7.0 m depth the clay is grey and soft, with a moisture content between 46 and 60 percent.

Silt Till

Silt till was encountered beneath the lacustrine clay at 14.6 m. It extended to the maximum depth drilled of 15.2 m below grade. The till is sandy with some clay and some gravel, light brown, moist to wet, firm to stiff, and low plastic. A moisture content of 21 percent was determined on the one sample of till obtained. Groundwater from the till rose to 5.2 m below surface before the test hole was backfilled. No sloughing was observed during drilling.

4. Recommendations

4.1 Control of Groundwater

It is understood that the reservoir contains approximately 2.5 m of loose fills consisting of topsoil, construction rubble, and gravel that was placed above the concrete base of the reservoir when it was decommissioned. The groundwater in this fill is likely from precipitation that collects in the reservoir and is not hydraulically connected to the groundwater encountered in the till in the test hole. The groundwater in the till will not affect construction of the valve chamber, but it will be necessary to control inflows of groundwater in excavations made in the wet fills in the former reservoir by pumping and disposal during construction.

It is not expected that significant amounts of groundwater will be encountered in excavations made outside of the former reservoir, given that the maximum depth of excavation will be to about elevation 227 m. The implication of groundwater on construction should be reviewed for deeper excavations.

4.2 Foundation

The proposed chamber valve is to be located within the former reservoir and have a foundation base slab at an elevation of 227.1 m (approximately 5.3 m below the existing ground surface inside the former reservoir). The base of the foundation will be in the lacustrine clay and an allowable bearing capacity of 140 kPa can be used for foundation design at this elevation. In addition, the following recommendations should be incorporated in the design and construction of the foundations:

1. The foundations should be designed to act as a rigid foundation.
2. The exposed bearing surface should consist of unfrozen and undisturbed lacustrine clay and free of deleterious material such as organics, debris, etc.
3. Care should be taken during construction to ensure that the clay is not allowed to dry out or become saturated or softened due to water inundation.
4. Once the bearing surface has been prepared, it should be inspected by qualified geotechnical personnel to verify that the bearing soil and foundation preparation are consistent with the conditions and recommendations in this memorandum.
5. As soon as possible following acceptance of the bearing surface by qualified geotechnical personnel, the steel reinforcement should be placed and concrete poured.
6. All excavations should be completed in accordance with Manitoba Workplace Health and Safety Regulations.
7. Backfill around the chamber should be compacted to 95% of Standard Proctor Maximum Dry Density (SPMDD).

4.3 Basement Walls

Where required, backfill around the valve chamber should consist of granular material. Backfill compaction should be conducted with hand operated plate compactors to minimize settlement of the backfill itself. Over-compacting the backfill should be avoided to ensure that the lateral earth pressures on the chamber do not exceed that used in design. A 1 m thick clay cap should be used at the ground surface to control the ingress of surface water around the structure.

The valve chamber should be designed to resist an at-rest triangular lateral earth pressure distribution using the following relationship:

$$P = K_o \gamma D$$

Where:

P = lateral earth pressure at depth D (kPa)
K_o = at-rest earth pressure coefficient = 0.70 (unitless)
γ = granular backfill unit weight = 19.0 (kN/m^3)
D = depth from ground surface to point of pressure calculation (m)

Because there is a potential for submerged conditions from the shallow groundwater in the former reservoir, the hydrostatic water pressure should be added and the submerged or buoyant weight of the backfill can be used. In this regard, long term groundwater table can be assumed to be at ground surface inside the reservoir (232.4 m).

4.4 Foundation Concrete

The degree of exposure of concrete in contact with soils to sulphate attack is classified in CSA-A23.1-M2004 (Concrete Materials and Methods of Concrete Construction) as moderate, severe or very severe. Based on significant data gathered through previous work in the Winnipeg area and in accordance with the Manitoba Building Code, the degree of exposure for soils in Winnipeg is commondly classified as severe. Accordingly, all concrete in contact with the soils should be made with sulphate resistance cement (CSA Type 50) in accordance with CSA-23.1-M2004.

5. Closure

These recommendations are based on the assumption that an adequate level of geotechnical monitoring will be provided during construction and that qualified contractors experienced in foundations and excavations will carry out the construction. An adequate level of geotechnical monitoring is considered to be regular monitoring of footing construction procedures and compaction testing for earthworks related to shallow foundations and excavations, as required.

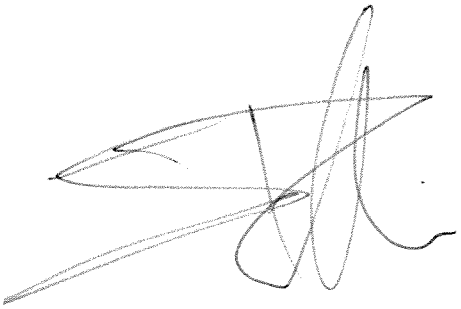
The findings and recommendations in this memorandum were based on the results of the field investigations combined with an extrapolation of soil and groundwater conditions. Soil conditions, by their nature, can be highly variable across a site. If conditions are encountered that appear to be different from those encountered during drilling at this site and described herein, or if the assumptions stated herein are not in keeping with the design, this office should be notified in order that the recommendations can be reviewed and adjusted, if necessary. A contingency should be

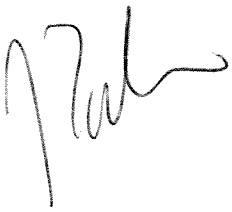
included in the construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

Please contact the undersigned if you have any questions regarding the subsurface investigation or recommendations found herein.

Sincerely,

Reviewed By:





Jared Baldwin, M.Sc., EIT
Geotechnical Engineer-In-Training

Jeff Tallin, M.Sc., P.Eng.
Senior Geotechnical Engineer

JB:dh
Encl.

PROJECT: Logan Aqueduct II Valve Chamber	CLIENT: City of Winnipeg	TESTHOLE NO: **09-01**
LOCATION: E - 631127, N - 5530760		PROJECT NO.: 6011-4979.0300
CONTRACTOR: Paddock Drilling Ltd.	METHOD: Ranger 24, 100 mm SSA	ELEVATION (m): 234.00

SAMPLE TYPE ■ GRAB ▯ SHELBY TUBE ☒ SPLIT SPOON ▬ BULK ▨ NO RECOVERY ◧ CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS: ✳ Becker ✳, ◇ Dynamic Cone ◇, ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100; ■ Total Unit Wt ■ (kN/m³) 16 17 18 19 20 21; Plastic MC Liquid 20 40 60 80 100	UNDRAINED SHEAR STRENGTH: + Torvane +, × QU ×, □ Lab Vane □, △ Pocket Pen. △, ⬟ Field Vane ⬟ (kPa) 50 100 150 200	COMMENTS	ELEVATION
0		CLAY (Fill) - sandy, some silt, light brown, dry, firm to stiff, intermediate to high plasticity		G1					
1		- brown, moist below 0.9 m							233
2		- silty, some sand, soft, high plasticity below 1.8 m		G2					232
3		- brown and grey, sandy below 3.4 m		T3					231
4		CLAY (Organic) - silty, some sand, some gravel (<12 mm dia.), trace organics (roots, wood fragments), grey and black, moist, very soft to soft, intermediate to high plasticity		G4					230
5		CLAY - silty, some sand, brown, firm to stiff, moist, high plasticity, laminated (<2 mm thick), trace oxidation		T5					229
		- trace silt inclusions (<5 mm dia., grey), mottled grey and brown below 5.3 m		G6					
6		- grey below 6.1 m		T7					228
7		- mottled grey and brown, soft to firm below 7.0 m		G8				227.1 m - proposed location of base of valve chamber foundation slab	227
8		- grey below 7.6 m							226
9				G9					225
10									

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LOGGED BY: Jared Baldwin	COMPLETION DEPTH: 15.24 m
REVIEWED BY: Jared Baldwin	COMPLETION DATE: 24/11/09
PROJECT ENGINEER: Jeff Tallin	Page 1 of 2

LOG OF TEST HOLE D265-250-00 - TEST HOLE LOGS.GPJ UMA WINN.GDT 19/1/10

PROJECT: Logan Aqueduct II Valve Chamber	CLIENT: City of Winnipeg	TESTHOLE NO: **09-01**
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10			■	G10					
11		- sandy below 10.7 m							223
			■	G11					
12		- trace gravel (<12 mm dia., subrounded) below 11.9 m							222
13									221
			■	G12					
14		- mottled grey and brown, firm below 13.4 m							220
		- trace gravel (<25 mm dia., subrounded) below 14.3 m							
15		SILT (Till) - sandy, some clay, some gravel (<25 mm dia., subrounded), light brown, moist to wet, firm to stiff, low plasticity	■	G13					219
		END OF TEST HOLE AT 15.2 m IN SILT (TILL) Notes: 1) Seepage observed in SILT (Till). 2) Water level observed at 5.2 m below grade after drilling. 3) No sloughing observed. 4) Test hole backfilled with auger cuttings to 0.6 m below grade and bentonite chips to grade.							
16									218
17									217
18									216
19									215
20									

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LOGGED BY: Jared Baldwin	COMPLETION DEPTH: 15.24 m
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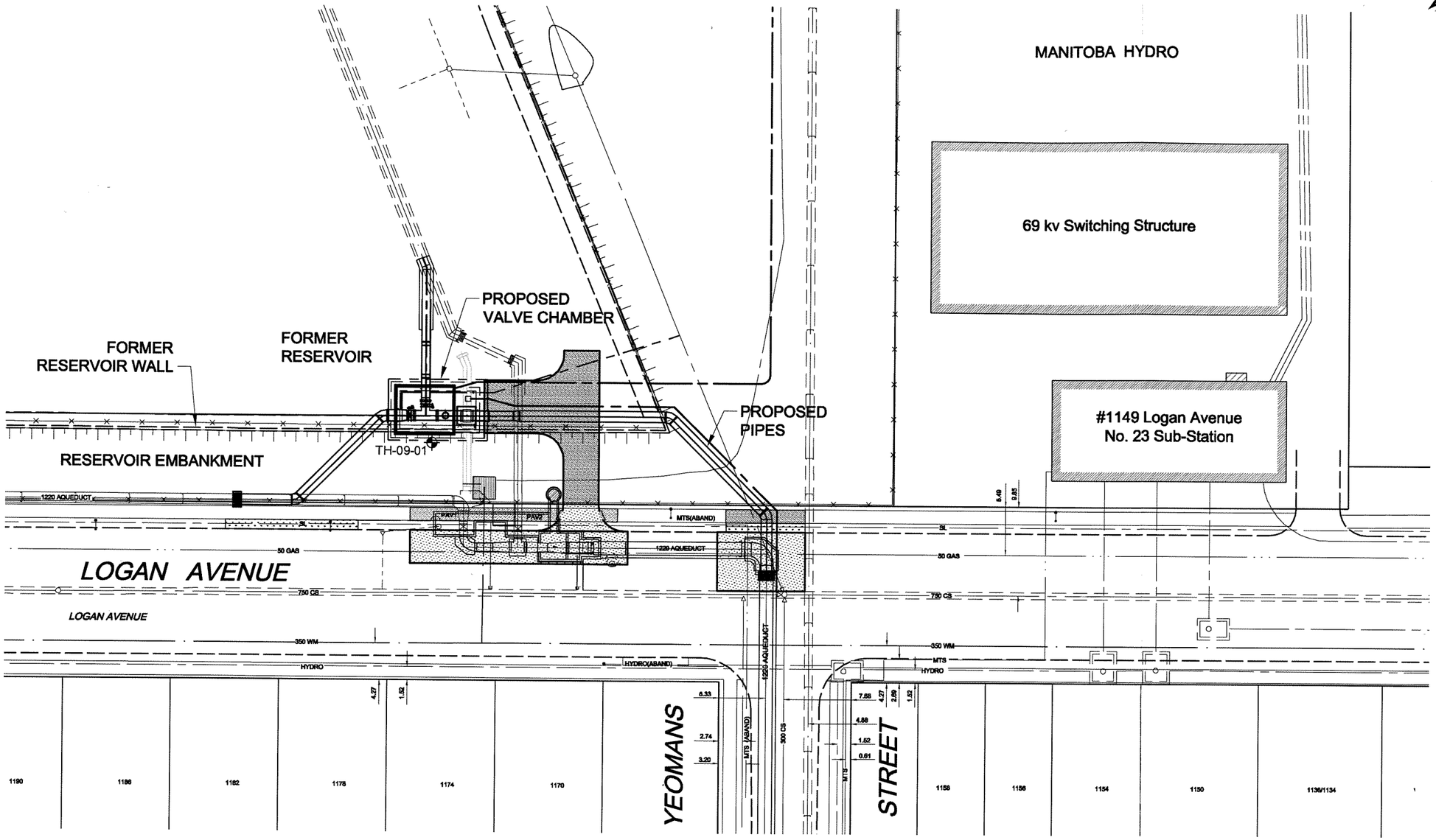
LOG OF TEST HOLE D265-250-00 - TEST HOLE LOGS.GPJ UMA WINN.GDT 19/1/10



PLAN

0 5 10 m SCALE 1:500

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City of Winnipeg
Branch I Aqueduct Valve Chamber at McPhillips
Figure 01