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KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

COPY

June 13, 2008 File No. 08-0107-07

City of Winnipeg
Water and Waste Department
110-1199 Pacific Avenue
Winnipeg, Manitoba
R3E 3S8

ATTENTION: Mr. Darcy Strandberg, C.E.T.
Project Manager

RE: Site Investigation – Somerset Avenue Outfall Gate Chamber
2008 Outfall Gate Chamber Upgrading Program

Dear Mr. Strandberg:

This letter report summarizes the results of KGS Group's geotechnical site investigation at the Somerset Avenue Outfall Gate Chamber including soil stratigraphy and groundwater monitoring. Information regarding lateral earth pressure coefficients, potential for blowout of the base of the excavation and suitable backfill soils are also included.

This information is submitted further to our letter of Proposal for Engineering Services dated May 13th, 2008.

1.0 BACKGROUND

It is our understanding that the new gate chamber at the Somerset Avenue Outfall will incorporate new flap gates, positive gates and pump chambers and will be constructed at a proposed depth of 9.0 m at this location, at the end of Somerset Avenue and the Red River.

2.0 SITE INVESTIGATION

On June 5th, 2008 KGS Group supervised the drilling of one test hole (TH08-01) at the site located approximately 4 m from the proposed gate chamber location. The UTM coordinates of the test hole are noted on the test hole log, as measured by a handheld GPS unit. The test hole was drilled with the truck mounted Acker MP5-T drill rig contracted from Paddock Drilling Ltd. of Brandon, MB. The test hole was advanced using 125 mm solid stem augers to 14.94 m± below existing ground surface. Representative soil samples were collected directly off auger flights at 1.5 m intervals or at changes in soil stratigraphy. All samples were visually inspected for material type and classified according to the Unified Soil Classification System. Clay samples were tested with a field Torvane to estimate undrained shear strength. Upon completion of the drilling, the test hole was examined for indications of squeezing and seepage.

STRUCTURAL▪GEOTECHNICAL▪ENVIRONMENTAL▪HYDRAULICS▪HYDROGEOLOGY▪MUNICIPAL▪MECHANICAL▪ELECTRICAL
3RD FLR. – 865 WAVERLEY ST., WINNIPEG, MANITOBA, R3T 5P4 PH: (204) 896-1209 FAX: (204) 896-0754
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A Casagrande tip standpipe piezometer was installed in the glacial till to measure piezometeric levels. Laboratory testing was performed on select soil samples and included moisture content analyses and Atterberg Limit testing.

A soil log incorporating all field observations and laboratory testing is attached to this letter.

3.0 STRATIGRAPHY

KGS Group's interpretation of the stratigraphy is based upon the test hole (TH08-01) drilled at the site. In general, the stratigraphy consists of granular fill over silty clay fill underlain by silty clay of lacustrine origin over glacial till.

Granular Fill

A layer of granular fill approximately 0.9 m± thick was found at the existing ground surface. The granular fill was an A-base granular material consisting of limestone gravel and sand.

Silty Clay Fill

Silty Clay fill extended 3.7 m± below the granular fill. The clay fill was dark grey to black in colour, moist, stiff, of intermediate to high plasticity, and contained trace amounts of coarse sand, fine gravel, organics and oxidation. Moisture contents within this layer ranged from 30% to 33%.

Lacustrine Clay

Underlying the fill was clay of lacustrine origin, which extended to a depth of 12.2 m± below ground surface. The clay was brown mottled grey in colour to a depth of 7.6 m±, becoming massive in structure and grey in colour below. The clay was moist, of high plasticity, firm and became soft, with undrained shear strengths ranging from 55 kPa at the top to 10 kPa at the bottom of the stratum (overall average 26 kPa). The clay contained trace amounts of silt, and oxidation. Trace silt nodules and no oxidation were noted below the 6.1 m± depth. Trace amounts of gravel were encountered below 10.6 m± depth. Moisture contents ranged from 45% to 58% with an overall average of 52%. Atterberg Limit testing at 10.5 m measured a Liquid Limit of 90% and a Plasticity Index of 62% with the material being classified as CH based upon the results.

Silt Till

The lacustrine clay was underlain by silt till which extended to a depth of 14.94 m±. The silt till was light grey to light brown in colour, moist, soft and dense below 13.4 m±, of low to no plasticity, and contained trace amounts of clay, coarse sand and gravel. Moisture contents ranged from 7% to 8% within the till.

Squeezing of the test hole was noted at a depth of 9.1 m± below ground surface. Upon completion of the test hole water infiltration was observed at the bottom of the test hole from within the underlying till material.

4.0 GROUNDWATER CONDITIONS

The groundwater level in the till was measured a total of two (2) times. The water level was first read immediately after the installation of the piezometer and the groundwater level was 14.92 m below ground surface. A subsequent groundwater reading in the till of 6.20 m below ground surface was observed on June 12, 2008.

Groundwater levels vary seasonally and in response to precipitation such that future groundwater conditions at the site may vary from those reported herein.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 BASAL HEAVE AND BLOWOUT

Based upon a proposed depth of excavation of 9.0 m for the proposed gate chamber and the measured groundwater conditions at this location, the estimated factor of safety against blowout of the base of the excavation is 0.92. In order to achieve a factor of safety of 1.5 against blowout of the base of the excavation the groundwater level in the till needs to be 8.51 m below ground surface.

Squeezing of the test hole was also noted below a depth of 9.1 m±. Difficult conditions should be anticipated during excavation as squeezing of the excavation walls and significant softening and the potential for blowout of the base of the excavation may occur. Sheet piling should control potential for squeezing.

5.2 LATERAL EARTH PRESSURE CO-EFFICIENTS

Estimated lateral earth pressure coefficients of the soil are summarized in the table below for soils within the depth of the excavation of approximately 9.0 m.

Table 1 – Active, Passive and At-Rest Lateral Earth Pressure Coefficients

Soil Type	Estimated Friction Angle (Φ')	Ka	Kp	Ko
Clay Fill	18°	0.53	1.89	0.69
Clay	14°	0.61	1.64	0.76

Note : Ka = Active Earth Pressure
Kp = Passive Earth Pressure
Ko = Earth Pressure At-Rest

5.3 BACKFILL

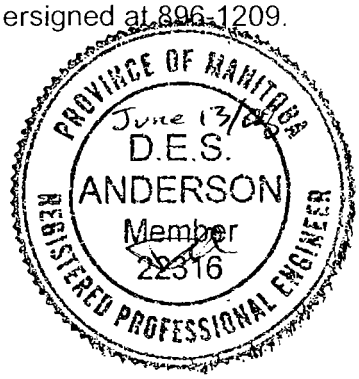
Free draining granular backfill should be placed around the chamber walls for a minimum width of 0.6 m and covered with a low permeability clay cap at ground surface. All backfill should be placed in maximum 150 mm thick lifts and compacted to a minimum of 95% Standard Proctor maximum dry density (SPMDD).

6.0 SUMMARY

We have completed a geotechnical site investigation for the proposed gate chamber expansion at the Somerset Avenue Gate Chamber. The stratigraphy at the site generally consisted of granular fill over silty clay fill underlain by silty clay of lacustrine origin over glacial till. Construction Design considerations for basal heave and blowout, lateral earth pressure coefficients and backfill are included.

KGS Group thanks you for the opportunity to provide engineering services on this project. If you have any questions please contact the undersigned at 896-1209.

Yours truly,



David Anderson, M. Sc., P. Eng.
Geotechnical Engineer

DA/

TEST HOLE LOG

KGS GROUP

SUMMARY LOG

HOLE NO. **TH08-01**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT 2008 GATE CHAMBER INVESTIGATIONS
SITE SOMERSET GATE CHAMBER
LOCATION END OF SOMERSET DRIVE
DRILLING METHOD 150 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. 08-107-07
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5-Jun-08
UTM (m) N 5,523,522
E 633,387

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL / %
	0			**GRANULAR FILL** - Light grey to white, moist, loose to compact, A-base limestone gravel and sand.							
	1	5		**SILTY CLAY FILL** - Dark grey to black, moist, stiff, intermediate to high plasticity, trace coarse grained sand, trace fine grained gravel, trace organics, trace oxidation.				S1			
	2										
	3	10						S2			
	4	15		**SILTY CLAY** - Brown mottled grey, moist, firm, massive, high plasticity, trace silt, trace oxidation. (Lacustrine clay)				S3			
	5										
	6	20		- Mottled grey-brown, trace silt nodules below 6.10 m.				S4			
	7	25		- Grey below 7.62 m.				S5			
	8										
	9	30						S6			

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.
INSPECTOR D. ANDERSON
APPROVED Da DATE 12/6/08

SPT & TORVANE 2 P:\PROJECTS\2008\08-0107-07\DESIGN\GEO\LOGS\2008 GATE CHAMBER INVESTIGATIONS 5-JUN-08.GPJ

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SUMMARY LOG

HOLE NO.
TH08-01

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION
	11	35		- Grey, soft, trace gravel below 10.67 m.
	12	40		**SILT TILL** - Light grey to light brown, moist, soft, non-plastic to low plasticity, trace gravel, trace coarse grained sand, trace clay.
	13	45		- Dense below 13.41 m.
	14			
	15	50		**AUGER REFUSAL AT 14.94 m.**
	16			Notes: 1. Hole squeezing below 9.14 m. 2. Installed till standpipe with Casagrande tip at 14.94 m, with stickup of 1.03 m. 3. Water level observed at 14.92 m below ground surface on June 5, 2008.
	17	55		
	18	60		
	19			
	20	65		
	21	70		

PIEZ. LOG: 14.0 – 14.9

SAMPLE TYPE / NUMBER / RECOVERY %: S7, S8, S9, S10

SPT (N) blows/0.15 m ▲
DYNAMIC CONE (N) blows/ft △
20 40 60

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80
PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.
INSPECTOR D. ANDERSON
APPROVED
DATE 12/6/08