KGS GROUP

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

July 20, 2005 File No. 05-0107-07

City of Winnipeg
Water and Waste Department
1500 Plessis Road
Winnipeg, Manitoba
R3C 5G6

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

RE: Geotechnical Investigation
Proposed Gate Chamber – Falconer Avenue

Dear Mr. Strandberg:

KGS Group was authorized by the City of Winnipeg Water and Waste Department to undertake a geotechnical site investigation for the proposed gate chamber construction at the existing Falconer Bay Outfall on the Red River. This letter report details the results of our investigation including a summary of soil and groundwater conditions at the site plus geotechnical design considerations for temporary shoring, lateral earth pressure, foundations and backfill. Comments received from the City with respect to our draft letter report are included with this letter.

1.0 BACKGROUND

It is our understanding the proposed gate chamber will consist of cast-in-place concrete and be located on the riverbank approximately 5 m north of the existing sewer manhole. The base of the chamber will be situated approximately 5.0 m below ground surface and a braced or strutted excavation will be used for construction.

2.0 SITE INVESTIGATION

On June 17, 2005 KGS Group supervised the drilling of one (1) test hole to 6.1 m depth below existing ground surface in the vicinity of the proposed gate chamber. The test hole was advanced using 125 mm diameter solid stem augers with representative soil samples collected directly off the auger flights at 1.5 m intervals or at changes in stratigraphy. Drilling services were provided by Paddock Drilling Ltd. of Brandon, MB. with continuous KGS Group supervision. Laboratory testing was performed on select soil samples and included moisture content analysis and Atterberg limit testing.

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
560 SQUIER PLACE, THUNDER BAY, ONTARIO, P7B 6M2 PH: (807) 345-2233 FAX: (807) 345-3433

3.0 SITE CONDITIONS

3.1 Stratigraphy

In general, the stratigraphy at the site consisted of clay fill overlying native silty clay. The clay fill extended to a depth of 2.5 m below ground surface. The material was of low to intermediate plasticity, firm in consistency and contained silt nodules, pockets and seams, trace coarse grained sand and trace organic matter. Underlying the fill was a strata of native clay extending to the bottom of the test hole at a depth of 6.1 m. The clay was mottled grey and brown in colour. The clay was of high plasticity, stiff to firm in consistency, and contained a trace of fine grained sand, gravel, silt seams, and gypsum pockets throughout the deposit. The natural moisture content of the silty clay ranged from 44.7% to 51.7%, with an overall average of 48.1%. The undrained shear strength of the clay ranged from 38 to 60 kPa, with an overall average of 46 kPa as measured from the field Torvane. A summary soil log for the site is attached.

3.2 Groundwater Conditions

No groundwater infiltration or caving of the test hole side walls was observed during the test hole drilling. KGS Group is in the process of completing an additional test hole at the site, which will include installation of a standpipe piezometer in the underlying glacial till. The measured groundwater level from the piezometer will be reported to the City in a supplemental letter when available.

Groundwater levels vary seasonally and in response to precipitation such that future groundwater conditions at the site may vary from those observed at the time of this site investigation.

4.0 GEOTECHNICAL CONSIDERATIONS

4.1 Temporary Shoring

It is our understanding that temporary shoring will be used to support the side walls of the gate chamber excavation. Due to the depth of the excavation, space limitations, and close vicinity of the existing manhole strutted or braced walls are considered a suitable type of shoring for the proposed construction. The detailed design of the temporary shoring depends upon the final geometry of the excavation, the type of shoring utilized, and construction details. Design considerations should include the following:

- The shoring should be designed to resist the lateral earth pressure of the clay fill and silty clay soils, groundwater pressures, and the surcharge load from construction equipment.

- An assessment of the potential for basal heave and blowout at the base of the excavation. Groundwater monitoring information from the standpipe piezometer that will be installed at the site shortly will be provided when available. Depending on the actual groundwater levels at the time of construction measures may be to counteract the risk of blowout, such as by temporary construction dewatering below the base of the proposed excavation.

- The design of any required temporary construction dewatering measures should include an evaluation of the potential settlement implications below the adjacent structures which are likely supported by shallow foundations. This includes the adjacent manhole and underground piping.

- The vertical spacing of the internal struts should be designed and installed to minimize the potential for lateral and vertical soil movement, which could be detrimental to the existing infrastructure at the site.

- The removal of the temporary shoring and backfilling between the existing ground and the new gate chamber should be completed to minimize the potential for lateral and vertical ground movements.

- No stockpiling of excavated materials should be permitted adjacent to the excavation.

A registered professional engineer who is experienced with the design of braced excavations and the related soil and groundwater considerations should complete the shoring design.

4.2 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).

4.3 Lateral Earth Pressure

Providing the gate chamber is constructed using the backfill recommendations outlined above the permanent walls of the chamber may be designed using an at-rest earth pressure coefficient of 0.7 and the following expression, which assumes a triangular pressure distribution:

$$P_o = K_o (\gamma' H + q) + u$$

where:

P_o = Lateral earth pressure at-rest condition for restrained wall at a given depth (kPa)

K_o = Coefficient of earth pressure at-rest (assume 0.7)

γ' = Effective unit weight of retained soil (below water table $\gamma' = \gamma_{bulk} - \gamma_{water}$, above water table $\gamma' = \gamma_{bulk}$)

γ_{bulk} = Bulk unit weight of soil (for silts and clays assume γ_{bulk} = 19 KN/m^3, for sands and gravels assume γ_{bulk} = 21 KN/m^3)

γ_{water} = Unit weight of water (9.81 KN/m^3)

H = Depth of wall below final grade (m)

q = Any surcharge pressure at ground surface (kPa)

u = net porewater pressure acting on wall (kPa)

4.4 Mat Slab

A mat slab foundation bearing on the native clay is suitable to support the proposed gate chamber. A design net allowable bearing capacity of 85 kPa may be used for a mat slab located at approximately 5.0 m below ground surface. Excessive wetting or drying of the clay subgrade in the base of the excavation should be avoided during construction to reduce the potential for swelling and shrinkage of the soil. In this regard placement of a lean mix concrete slab (mud slab) over the exposed bearing surface should be considered immediately following excavation.

4.5 Uplift

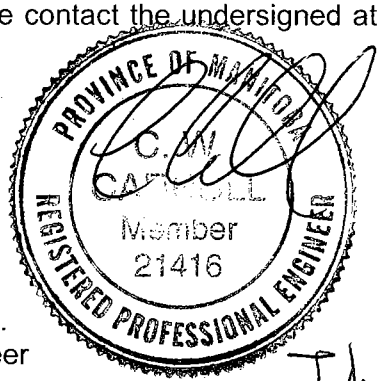
Taking into account the proposed embedment depth of the gate chamber and anticipated weight of the structure we do not anticipate there will be any special requirements to resist potential hydraulic uplift forces acting on the base slab. However we are currently in the process of verifying groundwater levels at the site by installing a standpipe piezometer. The additional groundwater monitoring information may be used to verify potential uplift pressures will be forwarded in a supplemental letter report when available.

5.0 SUMMARY

We have completed a geotechnical site investigation for the proposed gate chamber expansion at the Falconer Bay Outfall. The stratigraphy at the site consisted of clay fill overlying silty clay. Geotechnical design considerations for temporary shoring, backfill, lateral earth pressure, and foundations are included.

We thank you for the opportunity to provide engineering services on this project. If you have any questions please contact the undersigned at 896-1209 or Dr. Rob Kenyon, P. Eng. of our office.

Yours truly,



Chris Carroll, P. Eng.
Geotechnical Engineer

July 20/05

CC/jr
cc: Mr. Kas Zurek, P. Eng., Design and Construction Engineer

KGS GROUP

SUMMARY LOG

HOLE NO.
TH-10 Falconer Bay

CLIENT CITY OF WINNIPEG

PROJECT 2005 OUTFALL GATE CHAMBER UPGRADES - GEOTECHNICAL INVESTIGATIONS

SITE FALCONER BAY

LOCATION ±1 m west and 2 m north of manhole adjacent to sidewalk at City of Wpg R.O.W.

DRILLING METHOD 125 mm ø Solid Stem Auger (Truck Mounted)

JOB NO. 05-107-07
GROUND ELEV.
WATER ELEV.
DATE DRILLED 17-Jun-05
UTM N 5521426
E 634388

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.30 m ▲	Cu TORVANE (kPa) ◆
	1	5		**CLAY FILL** - Brownish-grey, damp, firm, low to intermediate plasticity, trace coarse grained sand, trace silt nodules, pockets and seams, trace rootlets.		1			
	2			- Light brown below 1.22 m.		2			
				- Tan below 1.98 m.		3			
	3	10		**SILTY CLAY (CH)** - Mottled grey and brown (mostly grey), damp, stiff, high plasticity, trace gypsum pockets, trace silt pockets and seams, trace rootlets.		4			
				- Increased silt and fine grained gravel between 3.05 and 3.35 m.					
	4			- Brownish-grey, damp to moist, firm, trace gypsum pockets, trace fine grained sand, trace silt pockets below 3.35 m.		5			
	5	15							
	6	20		**END OF HOLE AT 6.10 m**		6			
	7	25		Notes: 1. No water in test hole at completion of drilling. 2. Test hole backfilled with cuttings and bentonite to surface.					
	8								
	9	30							

SPT (N) blows/0.30 m ▲: 40 80 120

Cu TORVANE (kPa) ◆: 20 40 60 80

PL MC LL

%: 20 40 60 80

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR B. P. ARPIN

APPROVED

DATE 20-07-05

SPT & TORVANE P:\PROJECTS\2005\05-0107-07\GEOLOGS\05-107-07 LOGS.GPJ

2.0 GROUNDWATER CONDITONS

A summary of the groundwater levels measured at each site is shown in Table 1 below. This information is submitted to supplement the groundwater information included in our original July 20, 2005 letter reports.

TABLE 1
SUMMARY OF MEASURED GROUNDWATER LEVELS
2005 OUTFALL GATE CHAMBER UPGRADING PROGRAM

SITE	Rowandale Crescent	LeMaire Street	Rue Notre Dame	Kavanagh Street	Evans Street	Falconer Bay	Blackmore Avenue
TEST HOLE	TH-01A	TH-02A	TH-04A	TH-06A	TH-09A	TH-10A	TH-11A
STRATUM	Till	Till	Till	Till	Till	Till	Till
DATE	Measured Groundwater Level (m) [1]						
26-Jul-05	-	-	10.67	-	-	-	-
2-Aug-05	4.88	6.72	11.55	5.44	Dry	7.31	4.67

Notes:
"-" = No Data
1. All measured groundwater levels are below existing grade at test hole locations.

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

3.0 SUMMARY

Standpipe piezometer installations and groundwater level monitoring has been performed at seven (7) sites for the 2005 Gate Chamber Upgrading Program. Measured groundwater levels are reported herein and supplement our original geotechnical letter reports dated July 20, 2005.

We thank you for the opportunity to provide engineering services on this project. If you have any questions please contact the undersigned at 896-1209 or Dr. Rob Kenyon, P. Eng. of our office.

Yours truly,

Chris Carroll, P. Eng.
Geotechnical Engineer

CC/jr
Attachment

cc: Mr. Kas Zurek, P. Eng., Design and Construction Engineer

KGS GROUP

SUMMARY LOG

HOLE NO.
TH-10A Falconer Bay

CLIENT CITY OF WINNIPEG

PROJECT 2005 OUTFALL GATE CHAMBER UPGRADES - GEOTECHNICAL INVESTIGATIONS

SITE FALCONER BAY

LOCATION ±3 m from centreline of existing manhole

DRILLING METHOD 125 mm ø Solid Stem Auger (Truck Mounted)

JOB NO. **05-107-07.02.1000**
GROUND ELEV.
WATER ELEV.
DATE DRILLED **29-Jul-05**
UTM N **5521437**
E **634368**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.30 m (40 80 120)	Cu TORVANE (kPa) (20 40 60 80) PL MC LL % (20 40 60 80)
	0			**CLAY FILL** - Brownish-grey, damp, firm, low to intermediate plasticity, trace coarse grained sand, trace silt nodules, pockets and seams, trace rootlets.		0.3		1			
	1	5		- Light brown below 1.22 m.				2			
	2			- Tan below 1.98 m.				3			
	3	10		**SILTY CLAY (CH)** - Mottled grey and brown (mostly grey), damp, stiff, high plasticity, trace gypsum pockets, trace silt pockets and seams, trace rootlets. - Increased silt and fine grained gravel between 3.05 and 3.35 m. - Brownish-grey, damp to moist, firm, trace gypsum pockets, trace fine grained sand, trace silt pockets below 3.35 m.				4			
	4							5			
	5	15									
	6	20		- Damp, soft to firm, trace silt pockets below 6.10 m.				6			
	7	25						7			
	8										
	9	30		- Grey, with silt pockets below 8.84 m.				8			

SAMPLE TYPE Auger Grab

CONTRACTOR **Paddock Drilling Ltd.**

INSPECTOR **B. P. ARPIN**

APPROVED

DATE 09-08-05

SPT & TORVANE P:\PROJECTS\2005\05-0107-07\GEO\LOGS\05-107-07 LOGS (EXPANDED).GPJ

KGS GROUP

SUMMARY LOG

HOLE NO.
TH-10A Falconer Bay

ELEVATION (m)	DEPTH (m)	(ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.30 m ▲	Cu TORVANE (kPa) ◆
	11	35		- Increased larger silt pockets (~15 mm in size) below 10.36 m.			9		40 80 120	20 40 60 80
	12	40		- Decreased larger silt pockets (~15 mm in size) below 11.89 m.			10			PL MC LL % 20 40 60 80
	13	45					11			
	14									
	15	50		TILL - Mixture of silt, clay, and fine to coarse grained sand and gravel. Tan, saturated, very soft, low plasticity.			12			
	16					16.0 16.2 16.3	13			
		55		- Wet, increased coarse grained gravel below 16.38 m.		16.6 16.8	14			
	17			**AUGER REFUSAL AT 16.76 m**						
	18	60		Notes: 1. Soil stratigraphy from 0 to 6.10 m depth based on previous TH-10 completed on June 17, 2005. 2. Installed Casagrande standpipe to a depth of 16.46 m. Top of pipe is 0.16 m below ground surface elevation. 3. Water level measured at 7.15 m below top of pipe when monitored on August 2, 2005.						
	19									
	20	65								
	21	70								

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR B. P. ARPIN

APPROVED

DATE 09-08-05