KGS GROUP
CONSULTING ENGINEERS

Winnipeg

COCKBURN AND CALROSSIE COMBINED SEWER RELIEF WORKS
C3 - PARKER SRB GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION

FINAL – REV 0
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1.0 INTRODUCTION

The City of Winnipeg is completing a combined sewer relief project for the Cockburn and Calrossie districts including the construction of the Parker Storm Retention Basin (SRB) located north of Heatherdale Avenue in Winnipeg, Manitoba. KGS Group was authorized by the City of Winnipeg to undertake a geotechnical and environmental investigation at the proposed SRB location. The purpose of the investigation was to determine the stratigraphy and representative material strength properties used for the slope stability analysis and determine whether any environmental impacts may be present within the soils in the vicinity of the CN Right-of-Way. The results of the geotechnical and environmental investigations are summarized in this report.

2.0 SITE INVESTIGATION

2.1 2015 TEST HOLE DRILLING AND SOIL SAMPLING

On June 11, 2015 KGS Group completed a geotechnical and environmental investigation at the proposed Parker SRB site. The approximate locations of the test holes are shown on the attached Figure 1.

The investigation program consisted of the following:

- Three (3) shallow (environmental) test holes advanced within the footprint of the proposed SRB. One (1) test hole was advanced to 9.2 m, and two (2) test holes were advanced to 6.1 m. Field environmental testing was completed on the samples collected from those test holes.
- Two (2) geotechnical test holes advanced to power auger refusal, ranging in depth from 14.2 to 15.3 m below existing grade.

All test holes were completed with solid stem augers using an ACKER MP-5 track mounted rig. The drill rig was provided and operated by Maple Leaf Drilling, under the guidance and direction of KGS Group personnel.

Environmental soil samples were collected directly off the auger flights at 0.8 m intervals. Soil samples were placed in heavy polyethylene bags, and tested for volatile hydrocarbon vapour concentrations using a Photovac Photo-Ionization Detector (PID), calibrated with an isobutylene standard at the start of the day. Select soil samples were placed in EPA approved sample containers, and transported to Maxxam Analytics in Winnipeg, Manitoba for analysis of the following: metals; polycyclic aromatic hydrocarbons (PAHs); petroleum hydrocarbons (PHCs) including benzene, toluene, ethylbenzene, xylenes (BTEX) and PHC fractions (F1 – F4); and flash point.

Representative geotechnical soil samples were collected directly off the auger flights at 1.5 m intervals or at changes in soil strata encountered during drilling. The soil samples were visually inspected for material type and classified according to Modified Unified Soil Classification System (USCS). All cohesive samples were tested with a field Torvane to evaluate consistency

and estimate undrained shear strength. Standard Penetration Tests (SPTs) were performed in the till at 1.5 m intervals to determine the relative insitu density.

Upon completion of drilling, the test holes were examined for indications of sloughing and seepage and then backfilled to grade.

Two (2) pneumatic piezometers were installed in the overburden clay and one (1) standpipe was installed at the clay/ silt till interface. The locations of the piezometers are shown on Figure 1. To date the piezometers have been monitored seven (7) times.

Detailed soil logs incorporating field observations, environmental field tests, geotechnical laboratory test results and instrumentation installation details are provided in Appendix A.

2.1.1 Laboratory Testing

Selected samples from the environmental test holes were submitted to Maxxam Analytics, a CALA accredited analytical laboratory for analysis. Samples for metals analysis were selected from the upper surface soils (<1.5 m) and samples for analysis of PAHs and PHCs were selected based on those samples which had the highest head space vapour readings. A total of three (3) samples were submitted for analysis of metals, PAHs, and PHCs. Tables summarizing the environmental laboratory testing results are included in Appendix B. Laboratory Certificates of Analysis are included in Appendix C.

A geotechnical diagnostic laboratory testing program was performed on representative geotechnical soil samples to determine the relevant engineering index properties of the subsurface soils relative to the preliminary stability assessment and excavation for the SRB. Diagnostic testing completed included twenty-seven (27) moisture content analysis, three (3) Atterberg Limit tests and three (3) grain size analysis.

2.2 2016 TEST HOLE DRILLING AND SOIL SAMPLING

In 2016, KGS Group completed a geotechnical investigation for the Land Drainage System (LDS) trunk sewer as part of Contract 4 (C4) of the Cockburn and Calrossie Sewer Relief

Project. The investigation was completed north of Parker SRB to Taylor Ave. along Wilton St.

The 2016 geotechnical drilling program was completed by KGS Group from April 18 to 22, 2016. The location of the 2016 test holes is shown on Figure 2.

The investigation program consisted of the following:

- Six (6) test holes advanced to power auger refusal ranging in depth from 13.3 to 16.4 m below existing grade.
- Three (3) test holes advanced approximately 1.5 m into the bedrock ranging in depth 14.9 to 16.2 m below existing grade.

Maple Leaf Drilling Enterprises of Winnipeg, Manitoba provided the drilling services using a track mounted drill rig equipped with 125 mm solid stem augers and NQ coring. The drilling was completed under the supervision and direction of KGS Group personnel. Soil samples were collected directly off the auger flights typically at 1.5 m (5 ft.) intervals or at changes in soil strata encountered during drilling. The soil samples were visually inspected for material type and classified according to the Modified Unified Soil Classification System (USCS).

A total of ten (10) pneumatic piezometers were installed in the clay, silt till and bedrock. Details of the instrumentation installation is shown on the test hole logs included in Appendix D.

3.0 INVESTIGATION RESULTS

3.1 2015 GEOTECHNICAL INVESTGATION RESULTS

3.1.1 Stratigraphy

In general, the soil stratigraphy at the site has been interpreted by KGS Group to consist of high plastic clay overlying silt till. The till was found at elevations ranging from 218.4 to 218.9 m± below existing grade.

Coal cinders ranging in thickness from 0.5 m to 1.2 m were observed below existing ground surface in test holes TH15-01, TH15-02 and TH15-05 along the north edge of the proposed SRB limits. The coal cinders were black in colour, wet, loose in consistency and contained fine to coarse grained sand. Clay fill was encountered in test hole TH15-03 extending to a depth of 0.9 m below ground surface, elevation 231.4 m±. The clay fill was brown in colour, moist, firm in consistency, of high plasticity and contained some fine to coarse grained sand and trace fine grained gravel.

Clayey Silt (ML) – A 0.6 m thick clayey silt layer was encountered in test holes TH15-03 and TH15-04, at an approximate elevation ranging from 231.1 to 231.4 m±. The clayey silt was brown in colour, moist to wet, firm, of intermediate plasticity and contained trace fine grained sand. The undrained shear strength of the clayey silt, estimated using a field Torvane, ranged from 5 to 10 kPa. The moisture content of the clayey silt varied between 23.1% and 23.9%.

Clay (CH) – Clay was observed in all of the test holes at depths ranging from ground surface to 1.5 m below ground surface. The clay extended to elevations ranging from 218.4 to 218.9 m±. The clay was damp to moist, stiff in consistency becoming firm to soft with increasing depth, of high plasticity, and contained trace fine grained sand and silt pockets. The clay was brown and oxidized to approximately 5 m depth and grey in colour below approximate El. 227.5m.

The undrained shear strength of the clay, estimated using a field Torvane, ranged from 18 to 97 kPa and typically decreased with depth. Three (3) Atterberg Limit tests were also completed to measure plasticity. The Liquid Limits ranged from 80% to 90%, Plastic Limits from 22% to 24%

and Plasticity Indices from 58% to 67% classifying the material as high plastic clay (CH). Moisture contents ranged from 27.7% to 58.1%.

Silt Till (ML) – Silt till was encountered at elevations ranging from 218.4 to 218.9m±. The silt till was typically brown in colour, compact to dense, of low plasticity and contained some fine to coarse grained sand and some fine to coarse grained gravel. Moisture contents within the silt till ranged from 16.4% to 17.9%.

3.1.2 Seepage, Sloughing, and Groundwater Conditions

After the completion of drilling, squeezing was observed within the clayey silt layer in test hole TH15-04 at approximately elevation 230.8m±.

At the completion of drilling the water level in the test holes varied from 0.92 m (El. 231.88 m) below existing ground surface in test hole TH15-01 to dry in the other test holes. Water infiltrating into TH15-01 from the coal cinders layer was also observed during drilling.

3.2 2016 GEOTECHNICAL INVESTIGATION RESULTS

3.2.1 Stratigraphy

In general the stratigraphy encountered during the 2016 geotechnical investigation consisted of a surficial layer of organic clay overlaying a layer of silt deposit. Beneath the silt deposit, an extensive layer of high plastic clay overlying dense silt till and limestone bedrock was observed. Varying thicknesses of fill was observed in five (5) of the test holes. Details of the 2016 geotechnical investigation are outlined in KGS Group's report "Cockburn and Calrossie Combined Sewer Relief Works C4 – 2700 Trunk Sewer Geotechnical Data Report – Final" dated October 2016. The test hole logs including piezometer installation and laboratory testing results are included in Appendix D.

3.2.2 Seepage, Sloughing, and Groundwater Conditions

Squeezing of the clay layer was observed in three (3) of the test holes during the drilling investigation. Water was observed infiltrating five (5) test holes with the water level ranging from elevation 224.47 and 232.09 m± upon completion of the test holes.

3.3 GROUNDWATER MONITORING

Two (2) pneumatic piezometers and a standpipe piezometer were installed during the 2015 geotechnical investigation. The piezometers have been read seven (7) times since installation. A total of ten (10) pneumatic piezometers were installed during the 2016 geotechnical investigation. Five (5) pneumatic piezometers were installed within the clay, two (2) pneumatic piezometers were installed within the till and three (3) pneumatic piezometers were installed within the bedrock. The groundwater monitoring data are presented on Table 1.

The groundwater level ranged from El. 224.32 to 231.50 m± within the high plastic clay, El. 225.08 to 227.39 m± within the silt till and El. 224.07 to 227.15 m± within the bedrock. It should be noted that groundwater levels fluctuate seasonally and following precipitation events. Higher groundwater levels should be conservatively assumed for design purposes.

The base of the required excavation for the Storm Retention Basin (SRB) will be at approximately El. 225.0 m within the saturated soft, high plastic grey clay. The Contractor should devise appropriate means to handle the challenges that will be posed by the wet/very soft condition and stickiness (high plasticity) of clays at this depth including trafficability of construction equipment and workability of the excavated material.

TABLE 1
PIEZOMETRIC MONITORING RESULTS

Test Hole:	TH15-04		TH15-05	TH16-05 (I9)		TH16-06 (SHAFT A)		TH16-07 (I3)		TH16-08 (SHAFT B)		TH16-09 (SHAFT C)	
Ground Elevation (m):	**232.00**	**232.00**	**232.80**	**233.15**	**233.15**	**233.27**	**233.27**	**233.99**	**233.99**	**233.30**	**233.30**	**232.73**	**232.73**
Piezometer No.:	**36650**	**36654**	**SP**	**36898**	**36890**	**36895**	**36891**	**36894**	**36892**	**36896**	**36893**	**36897**	**36889**
Tip Elevation (m):	**224.37**	**219.80**	**218.58**	**224.62**	**218.52**	**225.95**	**218.03**	**225.15**	**218.45**	**225.98**	**218.36**	**224.2**	**218.1**
Monitoring Zone:	**Clay**	**Clay**	**Silt till**	**Clay**	**Bedrock**	**Clay**	**Silt Till**	**Clay**	**Silt Till**	**Clay**	**Bedrock**	**Clay**	**Bedrock**
Date				**Piezometric Elevation (m)**									
24-Jun-15	224.37	228.03	224.48										
7-Jul-15	226.15	226.06	225.08		-	-	-	-	-	-	-	-	-
14-Oct-15	226.93	226.69	225.25		-	-	-	-	-	-	-	-	-
25-May-16				230.03	226.36	227.47	226.30	229.97	(Note 1)	230.57	225.22	226.42	225.72
17-Jun-16	227.07	226.83	225.60	229.60	227.07	227.47	226.68	230.05	(Note 1)	230.50	224.86	226.42	225.65
26-Aug-16	(Note2)	(Note 2)	225.17	229.52	225.14	227.47	227.39	229.90	(Note 1)	230.57	224.65	224.32	224.86
6-Oct-16			-	229.60	225.64	227.90	227.39	229.60	(Note 1)	230.36	224.07	225.62	225.36
19-May-17			226.37	229.31	227.15	destroyed	destroyed	Not accessible	Not accessible	231.50	(Note 1)	227.42	226.65
25-May-17	226.86	227.19	-	-	-	-	-	-	-	-	-	-	
12-July-17	230.34	225.92	225.94	229.16	226.57	destroyed	destroyed	Not accessible	Not accessible	230.36	(Note 1)	227.49	225.79

Notes:
1. Invalid reading obtained
2. Readings not taken for instrumentation on this date.

It should be noted that groundwater levels fluctuate seasonally and following precipitation events.

3.4 ENVIRONMENTAL FIELD OBSERVATIONS

No evidence of hydrocarbon impact (e.g. hydrocarbon odours, sheen or staining) was observed in test holes TH15-01, TH15-02 and TH15-03 located adjacent to the CNR Right-of-Way. Hydrocarbon soil vapour concentrations, as measured in the field with a PID, were all below 17.1 parts per million (ppm), which is considered low.

3.5 ENVIRONMENTAL SOIL SAMPLING RESULTS

The Province of Manitoba has adopted guidelines published by the Canadian Council of Ministers of the Environment (CCME) for the assessment of contaminated sites in Manitoba. For this project, federal criteria from the CCME *Canadian Environmental Quality Guidelines* (CEQG) for *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* (1999, Updated 2007) were used to assess metal, PAH and PHC concentrations in soil. The CCME document *Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil* from May, 2001 (revised January 2008; Updated July 2012) was also used to assess PHC concentrations. CCME guidelines were established to protect various receptors (human and environment) based on potential pathways and typical land uses that include agricultural, residential/parkland, commercial and industrial. These environment factors in conjunction with the appropriate risk management models, as detailed below, were used to establish appropriate generic remediation criteria.

Environmental samples were taken and analyzed to ensure materials excavated from the site could be disposed of in the appropriate manner. For application of criteria to this study, industrial land use Tier 1 site specific pathway criteria from the CCME guidelines were used to assess metals, PAHs and PHC parameter concentrations in soil. This criteria was applied because soil removed from the site for disposal at a landfill must meet the industrial property use guideline. The Tier 1 criteria are further divided based on the texture of the soil (fine and coarse-grained) and the depth at which soil samples were retrieved (surface and subsurface soil). The soils beneath the site are predominantly fine-grained soil (high plasticity clay of permeability 10^{-7} cm/sec or lower). Surface soil criteria are applied to those soil samples obtained at less than 1.5 m depth and subsurface soil criteria are applied to those soil samples obtained at a depth greater than 1.5 m.

The site is currently zoned by the city of Winnipeg as M2 for Manufacturing/ General. Should the land use designation at the site change in the future and if necessary, any soils remaining in-situ on the property should be compared to the applicable CCME land use guidelines.

Laboratory soil analysis results showed that all PHC and PAH concentrations were below the laboratory detection limits and, therefore, below the applicable guidelines. The results of the PHC and PAH soil analysis are summarized in Appendix B on Tables 1, 2a, and 2b. Laboratory analysis for metals showed that all concentrations of metals were detectable but below the applicable industrial guidelines. The results of the metals analysis are summarized in Table 3.

Although PHC, PAH, and metal soil concentrations were below applicable industrial guidelines for the soil samples submitted, it should be noted that the soil sampling program was limited to only three sampling locations across a large area.

During the drilling program, coal cinders were also observed in some of the test holes that were located along the north edge of the proposed SRB limits, directly adjacent to the CN Right-of-Way. This included test hole TH15-01 near the proposed drilling shaft. The layer of coal cinders ranged in thickness from 0.5 m to 1.2 m. Based on the existing laboratory results, while below applicable industrial land use guidelines, metal concentrations within the coal cinders and associated shallow fill are elevated above naturally occurring concentrations. As such, any future changes in land use or zoning should examine any remaining coal cinders/ shallow fill remaining at the site. A soil sample with coal cinders from near test hole TH15-01 was tested for flash point properties and was found to be within limits for disposal at conventional landfills. Flash point test results are included in Appendix E.

Note that soil samples from all three shallow test hole locations were found to be within acceptable PHC, PAH, metals and flash point limits for disposal at local conventional landfill sites in Southern Manitoba such as the Brady Landfill in Winnipeg, the Mid-Canada Environmental Landfill in Ile des Chenes, and the Miller Environmental Treatment & Processing Facility in St. Jean Baptiste. Correspondences from the Brady Landfill in Winnipeg confirm the acceptance of the sampled soils.

Laboratory Certificates of Analyses are included in Appendix C.

If evidence of soil contamination, such as odour, sheen or staining are observed during construction activities, additional soil sampling may be required. Any soil, confirmed by laboratory analysis, to be impacted and above the CCME industrial guidelines will require proper removal, transport, and disposal.

Furthermore, as the site was historically used as a rail yard there may be timber, metal objects, concrete rubble, etc. present near the surface and are considered general excavation. These materials were not observed during drilling.

4.0 STABILITY ASSESSMENT PARKER SRB SIDESLOPES

A slope stability analyses was completed for side slopes for the Parker SRB to determine the stability of the side slopes and the impact of rail loading 20 m from the edge of the SBR top of slope.

4.1 STABILITY MODEL

The stability analysis was completed using the two-dimensional computer model SLOPE/W developed by GeoSlope International Ltd. from Calgary, Alberta. The slope stability assessment for the side slopes was completed using the Morgenstern-Price method of analysis for limit equilibrium stability analysis. The method considers both shear and normal interslice forces and it satisfies both moment and force equilibrium. The model assumptions are outlined in the following sections

4.1.1 Geometry

The model geometry for the stability modeling was taken from Drawing LD-8221 “Stormwater Retention Basin Typical Sections & Details – Misc” shown on Figure 3. The slope of the SRB is 5H:1V from ground elevation to El. 231.37 m, 6H:1V from El. 231.37 m to 227.20 and 4H:1V from El. 227.2 m to the SRB bottom EL. 225.0 m.

4.1.2 Material Properties and Stratigraphy

The stability modeling was completed prior to the 2015 geotechnical drilling investigation and was based on test hole information from a test hole drilled for Contract 2 of the this project. The stratigraphy was confirmed with the 2015 geotechnical drilling program, outlined in Section 3.0.

The shear strength parameters used in the slope stability assessment are outlined on Table 2.

TABLE 2
SUMMARY OF ESTIMATED SHEAR STRENGTH PARAMETERS

Material	Unit Weight γsat (kN/m^3)	Effective Friction Angle Φ' (degrees)	Cohesion c' (kPa)
	Estimated Value	Estimated Value	Estimated Value
Silty Clay	18	14	5
Silt Till	21	35	10

4.1.3 Groundwater Conditions

Three (3) groundwater conditions were analyzed: normal operating conditions, rapid drawdown condition (RDD) and end of construction condition. A regional groundwater level of El. 228.7 m was used for the analysis, this level is approximately 0.8 m higher than the highest groundwater level observed within the Parker SRB site during the monitoring period. The piezometric conditions for Normal operating, rapid drawdown and end of construction are shown on Figure 4.

Normal operating conditions consisted of a regional groundwater level at Elev. 228.7 m to the edge of the design slope and a linear piezometric line down to the normal operating level of Elev. 227.7 m The RDD condition consisted of a groundwater level set at Elev. 230.5 m (equivalent to the 100 Year Water Level) at the edge of the design slope and a saturated slope down to 227.7 m. The end of construction condition consisted of a groundwater level at Elev. 227.2 m and no ponded water.

4.1.4 Rail Load

The potential of a rail load condition on the north slope was modelled as a 150 kPa strip load that was set back 20 m from the north edge of the SRB under normal loading conditions.

4.2 DESIGN CRITERIA

The following design criteria for slope stability factors of safety (FS) were used to assessment the results of the stability modelling:

- A minimum FS of 1.5 for Normal operating conditions,
- A minimum FS of 1.2 for RDD conditions, and
- A minimum FS of 1.2 for end of construction conditions.

4.3 STABILITY MODELLING RESULTS

The side slope geometry of the SRB was assessed under four (4) loading conditions including normal operating conditions, rail loading, rapid drawdown conditions and end of construction conditions. The results of the stability analysis are outlined on Table 3.

The estimated factors of safety are for global critical slip surfaces. Shallow slip surfaces that are not judged to be critical and that would not impact the overall stability of the slope were discarded. These shallow slips surfaces signifying potential surficial sloughing were excluded from the slope stability analysis results. The typical slip surface is shown on Figure 5.

TABLE 3
RESULTS OF SLOPE STABILITY ANALYSES

Case	Description	Minimum Factor of Safety	Factor of Safety
1	Normal Operating Conditions	1..5	1.61
2	Normal Operating Conditions with Rail loading	1.5	1.58
3	Rapid Drawdown Conditions	1.2	1.38
4	End of construction Conditions	1.2	1.20

Based on the stability modelling, Parker SRB geometry meets the minimum estimated factors of safety for the modelled loading conditions with either the 6H:1V or 7H:1V side slopes. The rail loading had minimal impact on the stability of the side slopes under normal conditions.

For the end of construction loading condition the factor of safety was sensitive to the assumed groundwater level. There is a risk of shallow sloughing and the formation of tension cracking if the groundwater level within the clay increases above elevation 227.2 m. In the case that tension cracking is observed, the cracks should be monitored and a toe berm should be constructed to mitigate progression of the cracking. It is recommended the groundwater level be carefully monitored with instrumentation during excavation.

5.0 FOUNDATION CONSIDERATIONS

KGS Group understands that foundations will be required for lightly loaded shade structures in the vicinity of the Parker SRB. Cast-in-place friction piles are a suitable foundation type for this development.

The foundation considerations described in this report follow the Limit States Design (LSD) guidelines. Limit States Design requires consideration of two (2) main group loading states: Ultimate Limit States and Serviceability Limit States. The Ultimate Limit States (ULS) are primarily concerned with collapse mechanisms of the structure and safety, and the Serviceability Limits States (SLS) present conditions of mechanisms that restrict or constrain the intended use, function or occupancy of the structure under expected service or working loads. For pile foundation design, each loading state prescribes Geotechnical Resistance Factors (Φ) that are based upon the method used to evaluate pile capacity to obtain the Factored Ultimate Limit State (ULS) pile capacity values.

5.1 CAST-IN-PLACE CONCRETE PILES

Cast-in-place concrete piles may be used to support the proposed structure loads. For design purposes, the upper 2.5 m of pile length below final ground elevation of piles potentially exposed to frost should be neglected when determining pile capacities.

Friction piles may be designed based upon the ULS and SLS skin friction values provided on Table 4. A geotechnical resistance factor (Φ) of 0.4 is recommended for the ULS values provided. Piles that are designed to be friction piles should be designed to resist the loads by shaft resistance only. The contribution from end bearing should be ignored in the pile capacity calculations. The tips of the CIPP friction piles should not extend below EL 221 m to avoid groundwater conditions encountered in the test holes drilled at the site.

TABLE 4
LIMIT STATE DESIGN –SKIN FRICTION VALUES FOR C.I.P. PILES UNDER COMPRESSIVE LOADING

Elevation (m)	SLS Values (kPa)	Ultimate Capacity (kPa)
230 – 232.5 m	0	0
226.5 – 230 m	15	40
221.0 – 226.5	12	30

Cast-in-place piles should be designed and constructed according to the following recommendations:

- The piles should be spaced a minimum three (3) pile diameters apart, measured centre to centre.
- In additional to pile acting individually, friction piles can act as a group when closely spaced, less than three (3) pile diameters apart. Group action occurs when the soil between adjacent piles is dragged down and shaft resistance develops around the perimeter of the group only. If it is necessary to space piles closer than three (3) pile diameters apart, the capacity of these piles acting as a group will need to be evaluated once final geometry and spacing of the piles is known.
- To minimize the potential for uplift due to frost action and/or swelling of the clay, piles that will be exposed to frost should have a minimum embedment length of 8 m with reinforcement over the full length of the cast-in-place pile.
- Concrete should be placed as soon as practical following the drilling of each pile.
- Temporary steel sleeves should be available for cast-in-place piles in the event that groundwater seepage or sloughing of the pile holes is encountered during pile installation.
- It is recommended that all concrete foundations in contact with native soils utilize sulfate resistance cement CSA Type HS.
- Full-time inspection by experience geotechnical personnel during construction of all foundations is recommended.

6.0 DESIGN CRITERIA

6.1 BASAL HEAVE

Excavation of the base of the SRB to El. 225.0 m will result in approximately 6 m± of clay remaining above the silt till, which was encountered at approximately El. 219 m±. As outlined on Table 1 the groundwater levels in the underlying silt till deposit varied from approximate elevation 225.08 to 227.39 m based on location and monitoring time. The factor of safety against basal heave with a groundwater level of El. 227.5 m would results in an estimated factor of safety of 1.2. The factor of safety against basal heave will be lower than 1.2 if the groundwater level exceeds El. 227.5 m at the time of construction and the need for dewatering should be evaluated. The Contractor must sequence the construction activities in a manner that would ensure that the work is completed prior to spring melt (March 10, 2018) when increased groundwater level may impact the stability of the excavations.

It should be noted that groundwater levels fluctuate seasonally and following precipitation events. Hence, groundwater levels should be monitored continuously (daily) throughout construction period to promptly identify and address any change in the piezometric levels.

7.0 CONCLUSIONS

Based on the field investigations completed at the proposed Parker SRB the following conclusions have been made:

- In general the stratigraphy at the Parker SRB site consists of clay overlying silt till. The till was found at elevations ranging from 218.4 m to 218.9 m below existing grade. Power auger refusal was encountered at depths ranging from 14.2 to 15.3 m.
- The groundwater level within the silt till ranged from El. 225.08 to 227.39 m during the monitoring period (July 2015 to October 2016).
- Squeezing was observed within the clayey silt layer during the 2015 geotechnical investigation.
- Three shallow test holes were advanced at the site (TH15-01, TH15-02, and TH15-03). Soil from the three test holes was submitted to the laboratory for analysis of PHC, PAH, and metal parameters. All soil results were below applicable industrial CCME guidelines. Non-contaminated soil can be disposed of at a local conventional landfill.
- Coal cinders were observed within test holes on-site. The results of the laboratory analysis indicated the flash point properties of the coal cinders were within the disposal limits for a conventional landfill.
- Based on the stability modeling completed the SBR meets the design criteria under all loading conditions including: normal operating conditions, normal operating conditions with rail loading, rapid drawdown and end of construction conditions.
- Cast-in-place piles can be used to support the lightly loaded structures to be constructed in the vicinity of the Parker SRB.
- The factor of safety for basal heave for an excavation with bottom elevation of 225 m is above FS = 1.2 for groundwater levels below El. 227.5 m. If groundwater levels increase above this elevation during the construction, the need for dewatering should be evaluated.

8.0 RECOMMENDATIONS

Based on our assessment the following recommendations are made:

- The groundwater level should be carefully monitored during construction to promptly identify and address any impact that the change in the piezometric levels may have on the stability of the excavation.
- The contractor must sequence the construction activities in a manner that would ensure that the excavation work is completed prior to spring melt when increased groundwater level may impact the stability of the excavations.
- Cast-in-place friction piles are recommended to support lightly loaded structures in the vicinity of the Parker SRB. Friction piles can be designed with ULS and SLS values outlined on Table 4.
- Friction piles should be designed to have a minimum embedment length of 8 m.
- Inspection by qualified geotechnical personnel should be performed throughout the excavation of the pond and construction of the foundations.
- It is recommended that all concrete foundations in contact with native soils utilize sulfate resistance cement CSA Type HS.
- If evidence of soil contamination, such as soil with an odour, sheen or staining, is observed during construction activities, additional soil sampling may be required. Any soil, confirmed by laboratory analysis to be impacted and above the CCME industrial guidelines will require proper removal, transport, and disposal.
- Should the land use designation at the site change in the future, soil left in-situ (in particular coal cinders and associated shallow fill) should be compared to the applicable CCME land use guidelines.

9.0 STATEMENT OF LIMITATIONS AND CONDITIONS

9.1 THIRD PARTY USE OF REPORT

This report has been prepared for the City of Winnipeg to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

9.2 GEO-ENVIRONMENTAL STATEMENT OF LIMITATIONS

KGS Group prepared the geo-environmental conclusions and recommendations for this report in a professional manner using the degree of skill and care exercised for similar projects under similar conditions by reputable and competent environmental consultants. The information contained in this report is based on the information that was made available to KGS Group during the investigation and upon the services described, which were performed within the time and budgetary requirements of the Client. As the report is based on the available information, some of its conclusions could be different if the information upon which it is based is determined to be false, inaccurate or contradicted by additional information. KGS Group makes no representation concerning the legal significance of its findings or the value of the property investigated.

9.3 GEOTECHNICAL INVESTIGATION STATEMENT OF LIMITATIONS

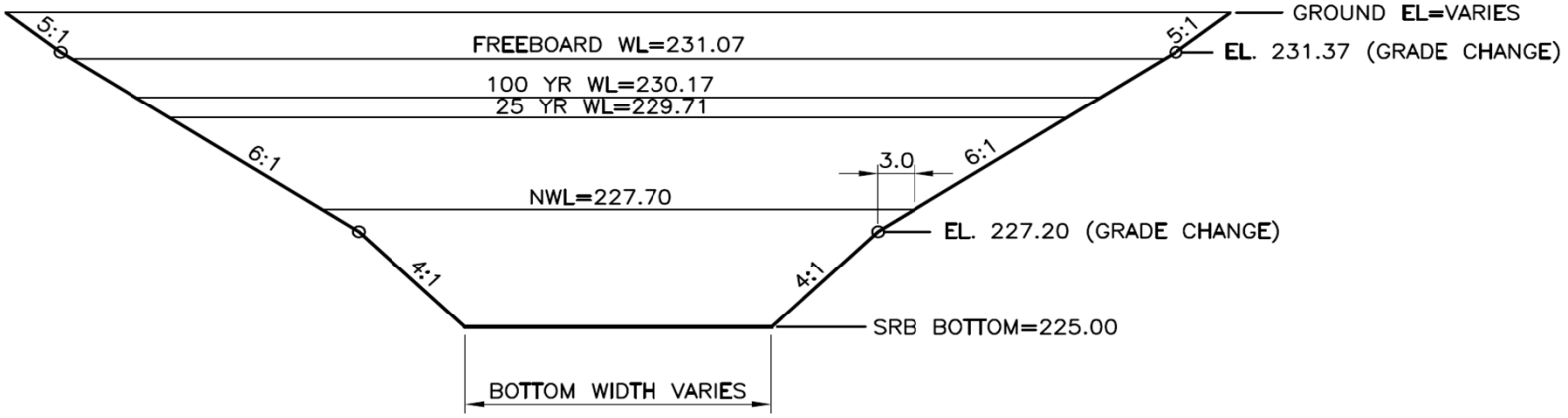
The geotechnical investigation findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions found at and within the depth of the test holes drilled by KGS at this site. If conditions encountered during construction appear to be different from those shown by the test holes drilled by KGS 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 modified if necessary.

FIGURES

FIGURE 1
APPROXIMATE LOCATION OF 2015 TEST HOLES

FIGURE 2
APPROXIMATE LOCATION OF 2016 TEST HOLES

N



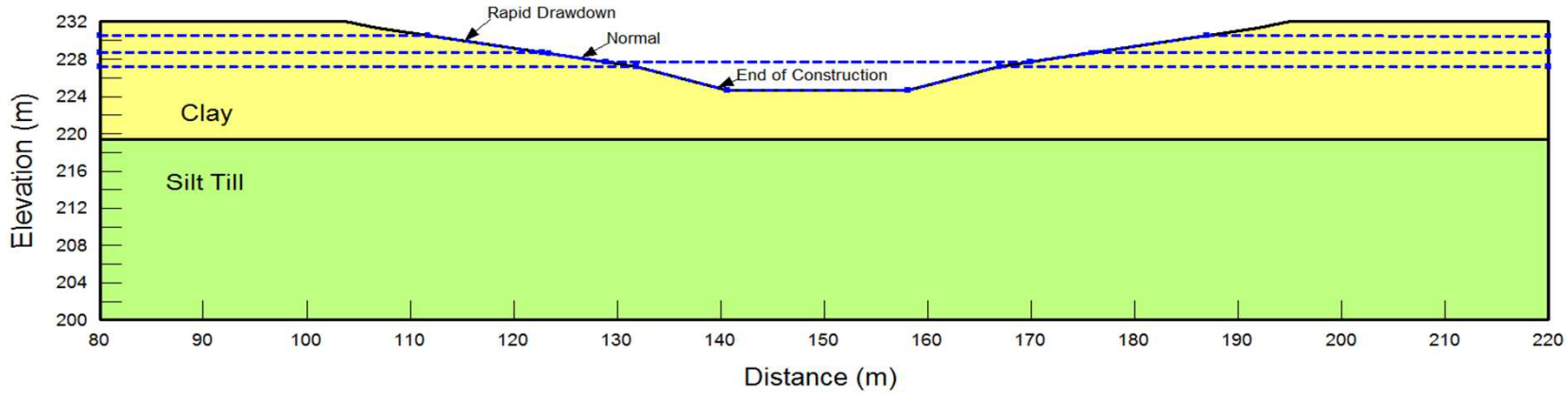
A1 LD-8214 TYPICAL SRB CROSS-SECTION

SCALE: H=1:500
V=1:125

NOTES:
Typical SRB Cross-Section from Drawing LD-8221 - Stormwater Retention Basin Typical Section & Details - Misc

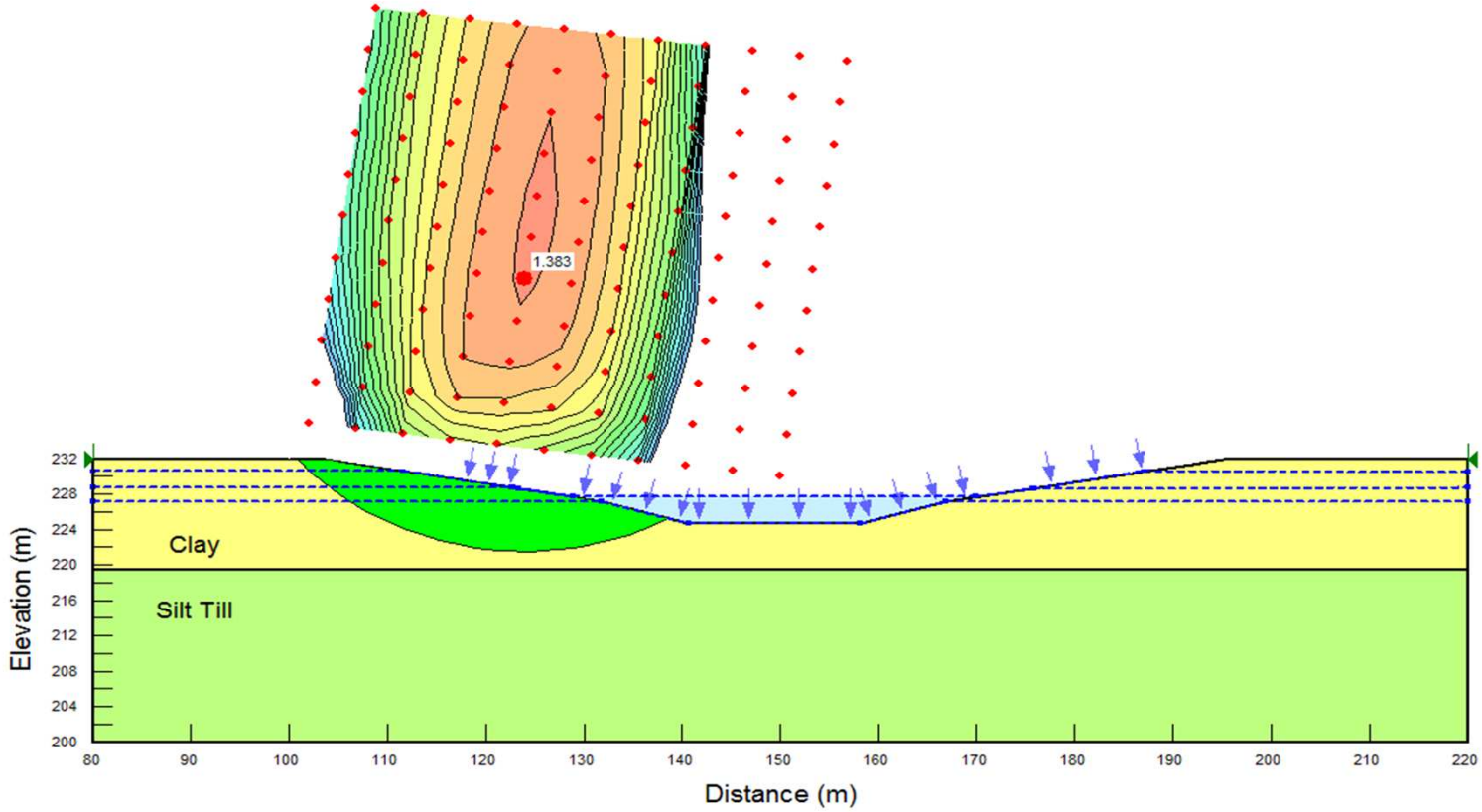
KGS GROUP	Winnipeg
Cockburn and Calrossie Sewer Relief Works	
Parker Pond - Slope Stability Analysis	
Parker Pond Configuration	

July 2017	Figure 3	1 Rev



NOTES:
1. 6H:1V slope
2. Normal Loading Conditions

KGS GROUP	Winnipeg
Cockburn and Calrossie Sewer Relief Works	
Parker Pond - Slope Stability Analysis	
Stability Model - Piezometric Elevations	
July 2017	Figure 4	1 Rev



NOTES:
1. Rapid Drawdown Condition

KGS GROUP	Winnipeg	
Cockburn and Calrossie Sewer Relief Works		
Parker Pond - Slope Stability Analysis		
Stability Model - Typical Slip Surface		
July 2017	Figure 5	1 Rev

APPENDIX A

2015 TEST HOLE LOGS AND GEOTECHNICAL LABORATORY TEST RESULTS

KGS GROUP

SOIL DESCRIPTION CRITERIA

PRINCIPAL AND MINOR SOIL COMPONENTS

And	35 – 50%
With	20 – 35%
Some	10 – 20%
Trace	0 – 10%
Occasional	Trace of very local concentration

FIELD MOISTURE CONTENT

Dry	No moisture visible or to touch when fresh exposure is examined
Damp	Slightly wet to touch
Moist	Fresh exposure wet to touch
Wet	A film of water is readily visible around particles of granular soils, cohesive soils can readily be smeared or remolded; water can be squeezed out
Saturated	Water can easily be squeezed out
Free Water	Water completely separated from the soil particles

DEPOSITIONAL STRUCTURE

Massive	Structureless soil
Stratified (Layered)	Different soils or visible variations in soil constituents arranged in layers, generally but not necessarily parallel to one another, and not necessarily in horizontal position, at least 6 mm thick
Varved	Glaciolacustrine deposits with annual pairs of fine and coarser laminae (thin laminae of alternately deposited inorganic silt and clay)
Laminated	Closely spaced, regularly alternating layers of differing soils and/or colours, or shades of similar gradation, relatively consistent in thickness and consisting of sand, silt, or clay
Lens	Inclusions of a different soil within surrounding soils, which thins out horizontally and may not be continuous over any significant distance
Pocket	A different soil type of very limited thickness or lateral extent (a small lens)
Inclusions	Small pockets
Nuggety	A different soil type in the form of small lumps
Parting	Paper thin separation of one type by another

POST DEPOSITIONAL STRUCTURE

Fissured	A soil breaks along definite, pre-existing planes or fracture with little resistance to fracturing
Slickensided	Polished or glossy, sometimes striated surfaces resulting from movement of a material block relative to the adjacent blocks
Blocky/Friable/Platy	Cohesive soil that can be broken down into angular larger fragments (blocky), small fragments (friable), or thin plate-like fragments (platy) which resist further breakdown
Cemented	Soil particles or fragments held together by cemented materials, often chemical precipitants, or deposits within overall soil mass

GRAIN SIZE DISTRIBUTION IN COARSE GRAINED SOIL

Boulders	>200 mm ø
Cobbles	75 – 200 mm ø
Coarse Grained Gravel	19 – 75 mm ø
Fine Grained Gravel	4.75 – 19 mm ø
Coarse Grained Sand	2 – 4.75 mm ø
Medium Grained Sand	0.425 – 2 mm ø
Fine Grained Sand	0.075 – 0.425 mm ø

DENSITY OF GRANULAR SOIL

Description	Standard Penetration Test	Relative Density
Very Loose	0 – 4 Blows Per 0.3 m	<15%
Loose	4 – 10 Blows Per 0.3 m	15 – 35%
Compact	10 - 30 Blows Per 0.3 m	35 – 65%
Dense	30 - 50 Blows Per 0.3 m	65 – 85%
Very Dense	>50 Blows Per 0.3 m	>85%

CONSISITENCY OF COHESIVE SOILS

Description	Torvane	Standard Penetration Test
Very Soft	<12 kPa	<2
Soft	12 – 25 kPa	2 – 4
Firm	25 – 50 kPa	4 – 8
Stiff	50 – 100 kPa	8 – 15
Very Stiff	100 – 200 kPa	15 – 30
Hard	>200 kPa	>30

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-01**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Parker Pond Retention Basin Investigation
SITE Parker Pond
LOCATION Northeast corner
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.80
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 6/11/2015
UTM (m) N 5,523,789
E 632,421

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 %
232	1	5		**COAL CINDERS** - Black, wet, loose, with fine to coarse grained sand.		S1			
231.6				**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace organics.					
231	2	10		- No organics below 1.53 m. - Infiltration of water into the hole from the coal dust layer. - Trace silt pockets below 2.14 m.		S2			
230	3	10		- Trace oxidation below 3.05 m.					
229	4	15				S3			
228	5			- Firm below 4.88 m. - Grey below 5.19 m.		S4			
227	6	20		- Trace fine grained sand below 6.10 m.					
226	7					S5			
225	8	25				S6			
224	9	30							
223.7				**END OF HOLE AT 9.15 m**					
223	10	35		Notes: 1. Test hole open to 9.15 m upon completion of drilling. 2. Water level in test hole 0.92 m below grade immediately after drilling due to surface water infiltration. 3. Backfilled test hole with cuttings and bentonite.					
222	11								
221	12	40							
220									

SAMPLE TYPE Auger Grab

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-02**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Parker Pond Retention Basin Investigation
SITE Parker Pond
LOCATION Centre north
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.70
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 6/11/2015
UTM (m) N 5,523,757
E 632,240

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232.5				**TOPSOIL** - Black, moist, soft, trace rootlets.			
232.1				**COAL CINDERS** - Black, wet, loose, with fine to coarse grained sand.			
232				**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace fine grained sand.			
	1	5				S1	
231				- Trace oxidation below 1.53 m.			
	2					S2	
230				- 50 mm thick silt seam at 2.44 m.			
	3	10		- Water infiltration into the test hole from the coal dust.			
				- Firm below 3.36 m.			
229						S3	
	4						
		15					
228				- Silt pockets below 4.58 m.			
	5						
				- Grey below 5.19 m.		S4	
227							
226.6	6	20		**END OF HOLE AT 6.10 m**			
226				Notes: 1. Test hole open to 6.10 m upon completion of drilling. 2. Water level in test hole 6.10 m below grade immediately after drilling. 3. Backfilled test hole with cuttings and bentonite.			
	7	25					
225							
	8						
224							
	9	30					
223							
	10						
		35					
222							
	11						
221							
	12	40					
220							

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	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-03**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Parker Pond Retention Basin Investigation
SITE Parker Pond
LOCATION Northwest corner
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.30
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 6/11/2015
UTM (m) N 5,523,679
E 631,939

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
232				**CLAY Fill (CH)** - Brown, moist, firm, high plasticity, some fine to coarse grained sand, trace fine grained gravel.			
231.4							
	1			**CLAYEY SILT (ML)** - Brown, moist, firm, intermediate plasticity.		S1	
231							
230.8		5		**CLAY (CH)** - Brown, damp, firm, high plasticity, trace fine grained sand, trace silt pockets, trace oxidation.			
	2					S2	
230							
	3	10					
229							
						S3	
	4			- Firm below 3.97 m.			
228		15		- Grey below 4.56 m.			
	5						
227				- Grain Size Distribution: Gravel (0%), Sand (0.6%), Silt (23.2%), and Clay (76.2%) at 5.3 m.		S4	
226.2	6	20		**END OF HOLE AT 6.10 m**			
226							
	7			Notes: 1. Test hole open to 5.80 m upon completion drilling. 2. Trace water in the bottom of the test hole. 3. Backfilled test hole with cuttings and bentonite.			
225		25					
	8						
224							
	9	30					
223							
	10						
222		35					
	11						
221							
	12	40					
220							

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	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-04**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Parker Pond Retention Basin Investigation
SITE Parker Pond
LOCATION Centre south
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.00
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 6/11/2015
UTM (m) N 5,523,687
E 632,144

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 / %
231.1											
231	1			**CLAY (CH)** - Brown, damp, stiff, high plasticity.							
230.5		5		**CLAYEY SILT (ML)** - Brown, wet, firm, intermediate plasticity, trace fine grained sand.			S	1			
230	2			**CLAY (CH)** - Brown, moist, firm, high plasticity, trace fine to coarse grained sand, trace oxidation.			S	2			
229	3	10									
228	4			- Stiff between 3.66 and 4.58 m.			S	3			
		15									
227	5			- Grey, trace fine grained gravel, silt pockets below 4.58 m.			S	4			
226	6	20									
225	7						S	5			
		25				7.6					
224	8			- Trace fine grained sand below 7.63 m.							
				- Soft between 8.24 and 10.98 m. - Grain Size Distribution: Gravel (1.5%), Sand (7.2%), Silt (27.1%), and Clay (64.2%) at 8.4 m.			S	6			
223	9	30		- Increased silt pockets between 9.15 and 10.07 m.							
222	10						S	7			
		35									
221	11			- Soft below 11.29 m.			S	8			
220	12	40				12.2					

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH15-04

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 %
218.9				**SILT TILL (ML)** - Brown, moist, compact, low plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.				S9		▲8	●
218	14	45		- Split spoon dropped last 300 mm of SPT. Suspected gravel seam from 13.88 to 14.18 m.				S10	61		
217	15										
216.8		50		**END OF HOLE AT 15.27 m**		15.2		S11	2		
216	16			Notes: 1. Test hole open to 1.22 m upon completion of drilling. 2. Installed pneumatic piezometer #036650 at 7.63 m and pneumatic piezometer #036654 at 12.20 below grade. 3. Backfilled test hole with grout.							
215	17	55									
214	18	60									
213	19										
212	20	65									
211	21	70									
210	22										
209	23	75									
208	24	80									
207	25										
206	26	85									
205	27										
204	28	90									

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

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SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-05**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Parker Pond Retention Basin Investigation
SITE Parker Pond
LOCATION Southeast corner
DRILLING METHOD 125 mm ø Solid Stem Auger, ACKER MP5 Drill Rig

JOB NO. 11-0107-18
GROUND ELEV. 232.46
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 6/11/2015
UTM (m) N 5,523,764
E 632,435

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE / NUMBER
232				
231.9			**COAL CINDERS** - Black, wet, soft, with fine to coarse grained sand.	S1
	1	5	**CLAY (CH)** Brown, moist, stiff, high plasticity, trace fine grained sand.	S2
231				
	2			
230				S3
	3	10	- 50 mm thick silt seam at 2.90 m. - Silt pockets, trace oxidation below 3.05 m. - Firm between 3.05 and 4.58 m.	
229				S4
	4			
228		15		
	5			S5
227			- Firm below 5.49 m.	
	6	20		
226				S6
	7			
225		25	- Grey below 7.32 m.	
	8			S7
224				
	9	30		
223				
	10			S8
222		35	- Increased silt pockets below 10.68 m.	
	11			S9
221				
	12	40	- Trace fine to coarse grained sand below 12.20 m.	
220				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 ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

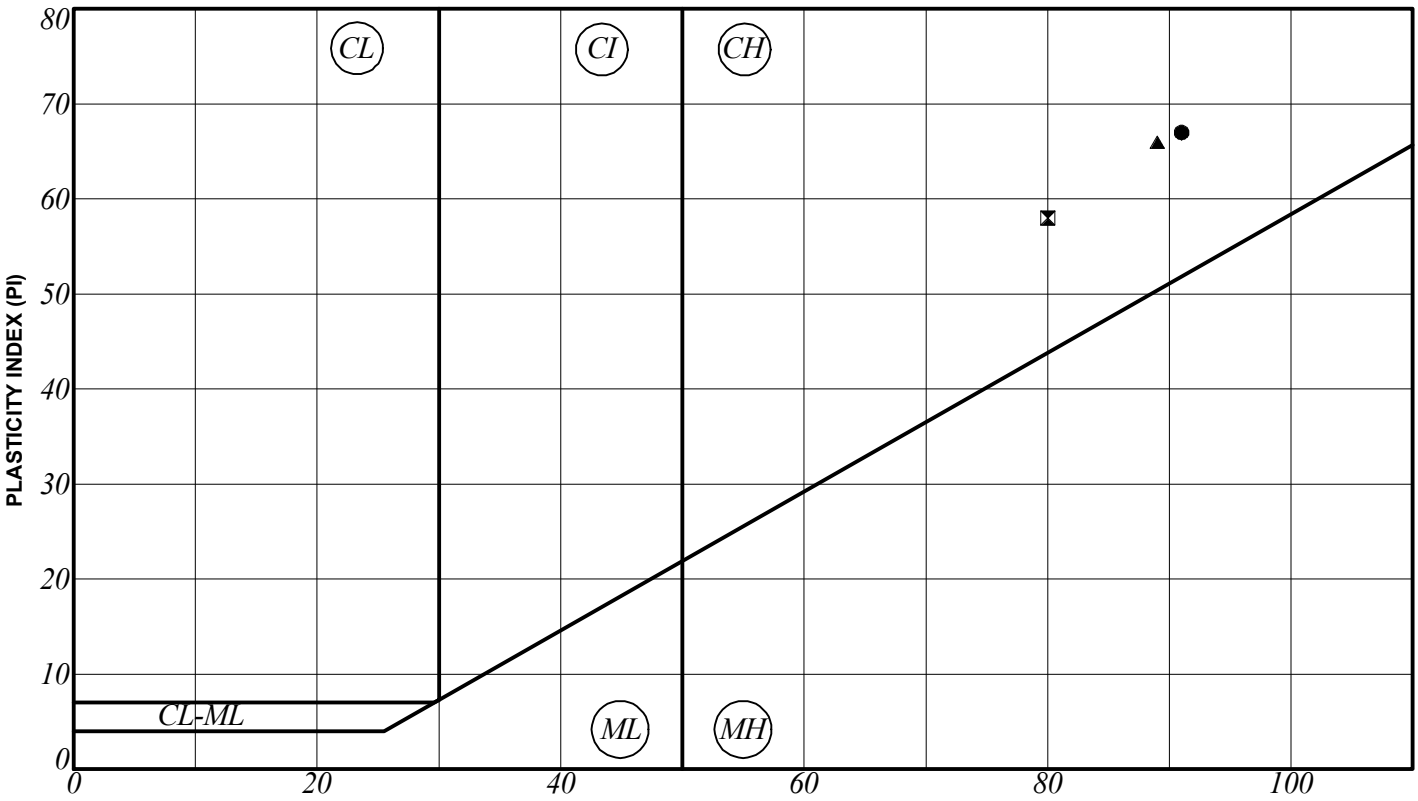
HOLE NO.
TH15-05

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
				- Grain Size Distribution: Gravel (0.1%), Sand (4.2%), Silt (24%), and Clay (71.7%) at 13.0 m		13.7					
218.4	14	45		**SILT TILL (ML)** - Brown, damp, dense, low plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.		13.9				▲50 50 blows for 12 mm	
218.3						14.2	S11 S12		3		
218				**END OF HOLE AT 14.19 m**							
	15	50		Notes: 1. Test hole open to 14.19 m upon completion of drilling. 2. Water level in test hole 2.44 m below grade immediately after drilling. 3. Installed a standpipe piezometer within the silt till. 2. Backfilled test hole with sand from 13.73 to 14.19 m, and bentonite from 13.73 m to ground surface.							
217											
	16										
216		55									
	17										
215											
	18	60									
214											
	19										
213											
	20	65									
212											
	21										
211		70									
	22										
210											
	23	75									
209											
	24										
208		80									
	25										
207											
	26	85									
206											
	27										
205		90									
	28										

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH15-03	5.3	S4	91	24	67	0.6	23.2	76.2	51.6	CH
⊠	TH15-04	8.4	S6	80	22	58	7.2	27.1	64.2	46.3	CH
▲	TH15-05	13.0	S10	89	23	66	4.2	24.0	71.7	49.8	CH

Notes:
ML - Low Plasticity Silt
MH - High Plasticity Silt
CL-ML - Silty Clay
CL - Low Plasticity Clay
CI - Intermediate Plasticity Clay
CH - High Plasticity Clay
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
MC - Moisture Content
NP - Non-Plastic

KGS GROUP

CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

Parker Pond Retention Basin Investigation

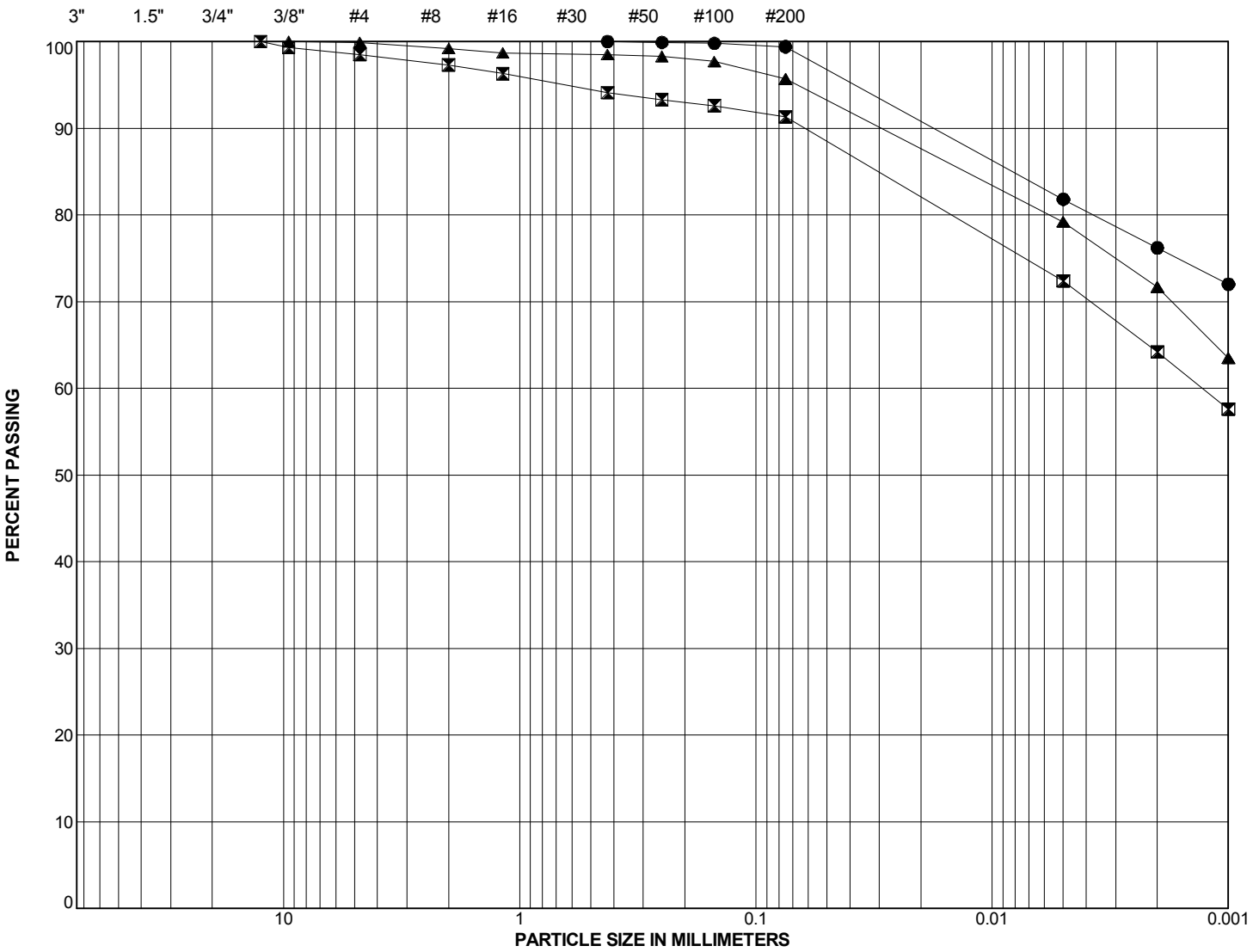
A-LINE PLOT

July 2017	Figure A01	Page 1 of 1

A-LINE PLOT P:\PROJECTS\2017\1117-0107-18\DESIGN\GEOLOGY\3-PARKER POND\PARKERPOND_LOGS.GPJ

SIEVE ANALYSIS

HYDROMETER ANALYSIS



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	*TH15-03*	*5.3*	*S4*	*0.0*	*0.6*	*23.2*	*76.2*	*99.4*			*CH*
⧓	*TH15-04*	*8.4*	*S6*	*1.5*	*7.2*	*27.1*	*64.2*	*91.3*			*CH*
▲	*TH15-05*	*13.0*	*S10*	*0.1*	*4.2*	*24.0*	*71.7*	*95.7*			*CH*

KGS GROUP

CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

Parker Pond Retention Basin Investigation

GRAIN SIZE ANALYSES

July 2017	Figure A02	Page 1 of 1

SIEVE ANALYSIS P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\LOGS\C3 -PARKER POND\PARKERPOND_LOGS.GPJ

APPENDIX B

ENVRIONMENTAL TABLES

APPENDIX B: TABLE 1
PETROLEUM HYDROCARBONS IN SOIL

Sample No.	Date	Depth (m)	Soil Type	Moisture Content (%)	Field Vapour Reading (ppm)	Parameter (mg/kg)							
						Benzene	Toluene	Ethylbenzene	Xylenes (o,-m,-p)	F1 (C_6 - C_{10})	F2 (C_{10} - C_{16})	F3 (C_{16} - C_{34})	F4 (C_{34} - C_{50})
TH15-01-04	11-Jun-15	3.0	silty clay	33	17	<0.0050	<0.020	<0.010	<0.040	<10	<20	<20	<20
TH15-02-01	11-Jun-15	0.8	silty clay	28	9.6	<0.0050	<0.020	<0.010	<0.040	<10	<20	<20	<20
TH15-03-01	11-Jun-15	0.8	silty clay	25	9.7	<0.0050	<0.020	<0.010	<0.040	<10	<20	<20	<20
Laboratory Detection Limits						*0.0050*	*0.020*	*0.010*	*0.040*	*10*	*20*	*20*	*20*

CCME Guidelines [1,2] - Industrial Land Use Criteria for Surface Soil (<1.5 m)																	
Soil Type	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**
TIER I GOVERNING OBJECTIVES GENERIC CRITERIA	**0.0068**	**0.03**	**0.08**	**0.37**	**0.018**	**0.082**	**2.4**	**11**	**170**	**240**	**230**	**260**	**2,500**	**1,700**	**6,600**	**3,300**
TIER I SITE SPECIFIC CRITERIA (For Pathways Applicable to Site)																
Soil Ingestion Guideline	11	11	NA	NA	620,000	620,000	NA	NA	-	-	-	-	-	-	-	-
Soil Dermal Contact Guideline	25	25	NA	NA	560,000	560,000	NA	NA	-	-	-	-	-	-	-	-
Inhalation of Indoor Air Check (slab on grade)	0.28	0.03	13,000	1,400	6,500	630	1,600	160	-	-	-	-	-	-	-	-
Groundwater Check (drinking water) [a]	0.0068	0.03	0.08	0.37	0.018	0.082	2.4	11	170	240	230	320	NA	NA	NA	NA
Soil Contact Guideline [b]	310	180	330	250	430	300	230	350	320	320	260	260	2,500	1,700	6,600	3,300
Groundwater Check (aquatic life) [c]	NC	1	NC	0.1	NC	50	NC	37	RES	970	RES	380	NA	NA	NA	NA
Direct Contact (Ingestion+Dermal Contact)	-	-	-	-	-	-	-	-	RES	RES	RES	RES	RES	RES	RES	RES
Vapour Inhalation (indoor)	-	-	-	-	-	-	-	-	4,600	320	23,000	1,700	NA	NA	NA	NA
Off-site migration Check	NC	NC	NC	NC	NC	NC	NC	NC	NA	NA	NA	NA	19,000	4,300	RES	RES
Management Limit [d]	-	-	-	-	-	-	-	-	800	700	1,000	1,000	5,000	3,500	10,000	10,000

CCME Guidelines [1,2] - Industrial Land Use Criteria, Subsurface Soil (>1.5 m)																
Soil Type	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**	**Fine**	**Coarse**
TIER I GOVERNING OBJECTIVES GENERIC CRITERIA	**0.0068**	**0.03**	**0.08**	**0.37**	**0.018**	**0.082**	**2.4**	**11**	**170**	**240**	**230**	**320**	**5,000**	**3,500**	**10,000**	**10,000**
TIER I SITE SPECIFIC CRITERIA (For Pathways Applicable to Site)																
Soil Ingestion Guideline	NC	NC	NC	NC	NC	NC	NC	NC								
Soil Dermal Contact Guideline	NC	NC	NC	NC	NC	NC	NC	NC								
Inhalation of Indoor Air Check (slab on grade)	0.29	0.032	13,000	1,500	6,700	670	1,600	170	-	-	-	-	-	-	-	-
Groundwater Check (drinking water) [a]	0.0068	0.03	0.08	0.37	0.018	0.082	2.4	11	170	240	230	320	NA	NA	NA	NA
Soil Contact Guideline [b]	620	360	660	500	860	600	460	700	NA	NA	NA	NA	NA	NA	NA	NA
Groundwater Check (aquatic life) [c]	NC	1.0	NC	0.1	NC	50	NC	37	RES	970	RES	380	NA	NA	NA	NA
Direct Contact (Ingestion+Dermal Contact)	-	-	-	-	-	-	-	-	NA	RES	NA	RES	NA	RES	NA	RES
Vapour Inhalation (indoor)	-	-	-	-	-	-	-	-	4,600	320	23,000	1,700	NA	NA	NA	NA
Off-site migration Check	NC	NC	NC	NC	NC	NC	NC	NC	NA	NA	NA	NA	19,000	4,300	NA	RES
Management Limit [d]	-	-	-	-	-	-	-	-	800	700	1,000	1,000	5,000	3,500	10,000	10,000

Notes:

"-" = No Data

NA = Not Applicable. Calculated value exceeds 1,000,000 kg/mg or pathway excluded.

NC = Not calculated. Insufficient data to allow derivation.

RES = Residual PHC formation. Calculated value exceeds 30,000 mg/kg and solubility limit for PHC fraction.

1. CCME - Canadian Council of Ministers of the Environment - Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007.
Chapter 7 - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health.

2. CCME - Canadian Council of Ministers of the Environment. Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil, May 2001 - revised January 2008. Updated July 2012.

a. Assumes site is underlain by groundwater of potable quality in sufficient yield (K of 10^{-4} cm/sec or greater).

b. For depths between 0 and 1.5 meters below ground level, the terrestrial ecological pathway must be applied.
A management limit has been developed for PHC that must be applied at all depths if the ecological pathway is removed.
CCME does not specify for depths between 1.5 and 3 meters bgl.

c. Assumes surface water body at 10 m from site.

d. Includes additional considerations such as free phase formation, explosive hazards, and buried infrastructure effects.

	- Exceedance of Tier I Generic Criteria
BOLD	- Exceedance of Tier I Site-Specific Criteria

APPENDIX B: TABLE 2A
POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - HUMAN HEALTH

Sample No.	Date	Depth (m)	Soil Type	Parameters (mg/kg)[5]								CCME[1] - Human Health Guidelines/Check Values		
				Benzo(a) anthracene	Benzo(a) pyrene	Benzo (b) fluoranthene[6]	Benzo(k) fluoranthene[6]	Chrysene	Benzo (g,h,i) perylene	Dibenzo (a,h) anthracene	Indeno (1,2,3-c,d) pyrene	Direct Contact[2] (SQG_{DH}) - ingestion, inhalation, and dermal exposures B[a]P TPE [3]		Protection of potable water (SQG_{PW}) IACR [4]
						Benzo (b+j+k) fluoranthene						$1x10^{-6}$ incremental lifetime cancer risk	$1X10^{-5}$ incremental lifetime cancer risk	
B[a]P Potency Equivalence Factors (PEFs)				0.1	1	0.1		0.01	0.01	1	0.1	0.6	5.3	-
Soil Quality Guideline for Protection of Potable Water Component Value				0.33	0.37	0.16		2.10	6.80	0.23	2.70	--	--	≤1.0
TH15-02-01	11-Jun-15	0.9 - 1.2	silty clay	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.04	0.04	0.31
TH15-03-01	11-Jun-15	0.9 - 1.2	silty clay	0.026	0.028	0.034	0.01	0.041	0.03	0.03	0.03	0.06	0.06	0.57
TH15-01-04	11-Jun-15	5.2 - 5.5	silty clay	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.04	0.04	0.31
Laboratory Detection Limits				*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.05*	*0.05*	*0.05*	-	-	-

Notes:

'--' = guideline/ check value that is not part of the exposure scenario for this land use and and therefore is not calculated.

IACR = Index of Additive Cancer Risk

B[a]P TPE = Benzo[a]pyrene Total Potency Equivalence

SQG_{DH} = human health-based soil quality guideline for direct contact

SQG_{PW} = soil quality guideline for the protection of potable water

1. CCME - Canadian Council of Ministers of the Environment - Canadian Environmental Quality Guidelines, 2008, revised 2010.
   Chapter 7 - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health for all Land Uses.
2. Guideline values for toddler pica soil ingestion have been calculated for benzo[a]pyrene, acenaphthene, fluorene, anthracene and fluoranthene, but are several orders of magnitude higher than the direct contact guidelines.
   For more details on the pica guidelines, refer to section 7.1.4 of the scientific supporting document (CCME, 2008a).
3. B[a]P TPE = Benzo[a]pyrene Total Potency Equivalents, which is the sum of estimated cancer potency relative to B[a]P for all potentially carcinogenic unsubstituted PAHs.
   The B[a]P TPE for a soil sample is calculated by multiplying the concentration of each PAH in the sample by its B[a]P Potency Equivalence Factor (PEF) and summing these products.
   B[a]P PEFs are order of magnitude estimates of carcinogenic potential and are based on the World Health Organization (WHO/IPCS 1998).
4. The Index of Additive Cancer Risk (IACR) assesses potential threats to potable groundwater water quality from leaching of carcinogenic PAH mixtures from soil.
   The IACR is calculated by dividing the soil concentration of each carcinogenic PAH by its soil quality guideline for protection of potable water component value to calculate a hazard index for each PAH, and then summing the hazards indices for the entire PAH mixture.
   The potable water component values were derived using a drinking water Maximum Allowable Concentration of 0.00001 mg/L for benzo[a]pyrene and the B[a]P PEFs, and the soil-to-groundwater model described in Appendix C of CCME (2006).
5. If analysis returns non-detects, then enter 1/2 the detection limit into the formulas.
6. If concentrations of benzo[b]fluoranthene, benzo[j]fluoranthene, and benzo[k]fluoranthene are reported separately, they shough be summed together and expressed as a single value for benzo[b+j+k]fluoranthene.

-Exceedance of CCME Criteria

APPENDIX B: TABLE 2B
POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - ENVIRONMENTAL HEALTH

Sample No.	Date	Depth (m)	Soil Type	Parameter (mg/kg)															
				Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo (b) fluoranthene	Benzo(k) fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenzo (a,h) anthracene	Fluoran-thene	Fluorene	Indeno (1,2,3-c,d) pyrene	Naphthalene	Phenanthrene	Pyrene
TH15-02-01	11-Jun-15	0.9 - 1.2	silty clay	<0.0050	<0.0050	<0.0040	<0.020	<0.020	<0.020	<0.020	<0.050	<0.020	<0.050	<0.020	<0.020	<0.050	0.019	0.025	<0.020
TH15-03-01	11-Jun-15	0.9 - 1.2	silty clay	<0.0050	0.0051	0.0050	0.026	0.028	0.034	<0.020	<0.050	0.041	<0.050	0.064	<0.020	<0.050	0.018	0.043	0.061
TH15-01-04	11-Jun-15	5.2 - 5.5	silty clay	<0.0050	<0.0050	<0.0040	<0.020	<0.020	<0.020	<0.020	<0.050	<0.020	<0.050	<0.020	<0.020	<0.050	<0.010	<0.020	<0.020
Laboratory Detection Limits				*0.0050*	*0.0050*	*0.0040*	*0.020*	*0.020*	*0.020*	*0.020*	*0.050*	*0.020*	*0.050*	*0.020*	*0.020*	*0.050*	*0.010*	*0.020*	*0.020*
CCME Guidelines [1] - Industrial Land Use																			
ENVIRONMENTAL HEALTH GUIDELINES																			
SQG_E [2]				NC	NC	32[6]	NC	72[9]	NC	NC	NC	NC	NC	180[6]	NC	NC	NC	NC	NC
Soil contact (SQG_{SC})				NC	NC	32	NC	72	NC	NC	NC	NC	NC	180	NC	NC	NC	NC	NC
Protection of freshwater life[3] (SQG_{FL})				0.28[4]	320[5]	NA[4,7]	NA[4,7]	8800[4]	NA[5,7]	NA[5,7]	NA[5,7]	NA[5,7]	NA[5,7]	NA[4,7]	0.25[4]	NA[5,7]	0.013[4,10]	0.046[4,10]	NA[4,7]
Interim Soil Quality Criteria (CCME 1991)				no value	no value	no value	10[8]	1.4	10[8]	10[8]	no value	no value	10[8]	no value	no value	10[8]	22[11]	50[12]	100[13]

Notes:

'-' = No data

SQG_E = Soil Quality Guideline for Environmental Health

SQG_{SC} = Soil Quality Guideline for soil contact by soil-dependent organisms (e.g. plants and invertebrates)

SQG_{FL} = Soil Quality Guideline for protection of freshwater life

NA = Not Applicable

NC = Not Calculated

1. CCME - Canadian Council of Ministers of the Environment - Canadian Environmental Quality Guidelines, 2008, revised 2010. Chapter 7 - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health.
2. The SQG_E is based on the lowest of the available environmental health guidelines (soil contact, soil and food ingestion, or protection of freshwater life). For PAHs where a soil contact guideline was not available, an overall SQG_E was not calculated.
3. Modeling assumptions include the absence of biodegradation of PAHs in the subsurface environment, a highly conservative assumption. for users to consider applying at their own discretion, but it has not be used to determine the overall SQG_E recommended here.
4. SQG_{FL} for freshwater life protection back-calculated based on CCME (2006) protocol, using pre-existing CCME Water Quality Guidelines (Freshwater Life) (CCME 1999).
5. SQG_{FL} for freshwater life protection guideline back-calculated from theoretically derived freshwater life thresholds based on baseline (narcosis-type) toxicity along with a Critical Body Residue (CBR) approach, assuming an internalized dose for aquatic life of 3.0 mmol PAH/kg lipid is a threshold for chronic, non-lethal toxicity.
6. The SQG_E is based on the soil contact guideline value.
7. A freshwater life protective guideline could not be calculated based on the assumed generic site/soil properties and the K_{OC} of the PAH, since the concentration in the groundwater at the point of leaching would need to far exceed the solubility limit to account for a concentration that approaches the toxicity threshold at a point 10 m down-gradient.
8. The interim soil quality criterion (CCME 1991) is retained as the environmental soil quality guideline for this land use because there was insufficient/inadequate data to calculate an SQG_E or provisional SQG_E. Consult the human health guidelines/check values to assess the human hazard of PAH mixtures containing this PAH.
9. The SQG_E is based on the soil contact guideline value. The 2008 benzo[a]pyrene SQG_E replaces the 1997 provisional benzo[a]pyrene SQG_E. Consult the human health guidelines/check values to assess the human hazard of PAH mixtures containing this PAH.
10. Users may wish to consider the application, on a site-specific basis, of the Soil Quality Guideline for the Protection of Freshwater Life where potential impacts on nearby surface water are a concern. This guideline value may be less than the common limit of detection in some jurisdictions. Consult appropriate jurisdiction for further guidance.
11. Data were insufficient/inadequate to update the 1997 provisional SQG_E and no attempt was made to calculate a SQG_{HH} or provisional SQG_{HH}, therefore the 1997 provisional SQG_E is retained as the soil quality guideline for the protection of environmental health for this land use. However, if there is concern for potential impacts to water bodies, the Soil Quality Guideline for the Protection of Freshwater Life (SQG_{FL}) should be applied. Consult other jurisdictions for the protection of human health from naphthalene.
12. Data were insufficient / inadequate to calculate an SQG_E or provisional SQGE and no attempt was made to calculate a SQG_{HH} or provisional SQG_{HH}, therefore the interim soil criterion (CCME 1991) is retained as the environmental soil quality guideline for this land use. However, if there is concern for potential impacts to water bodies, the Soil Quality Guideline for the Protection of Freshwater Life (SQGFL) should be applied. Consult other jurisdictions for the protection of human health from phenanthrene.
13. Data were insufficient / inadequate to calculate an SQG_E or provisional SQGE and no attempt was made to calculate a SQG_{HH} or provisional SQG_{HH}, therefore the interim soil criterion (CCME 1991) is retained as the environmental soil quality guideline for this land use. Consult other jurisdictions for the protection of human health from pyrene.

- Exceedance of CCME Criteria

APPENIDX B: TABLE 3
METALS IN SOIL

Sample No.	Date	Parameter (mg/kg)															
		Aluminum	Antimony[2]	Arsenic	Barium[2]	Beryllium[2]	Bismuth	Cadmium	Calcium	Chromium (Total)	Cobalt[2]	Copper	Iron	Lead	Lithium	Magnesium	Manganese
TH15-01-01	11-Jun-15	6590	3.72	7.96	337	0.59	<0.10	0.557	46800	23.4	4.65	78.7	33100	81.5	8.5	15100	305
TH15-02-01	11-Jun-15	26500	0.48	6.42	148	1.19	0.26	0.285	6640	41.9	11.0	33.4	29400	15.4	26.6	12300	286
TH15-03-01	11-Jun-15	19600	0.27	3.09	123	0.68	0.15	0.348	51400	30.5	9.88	18.9	21000	11.9	19.5	28900	577
Laboratory Detection Limits		*20*	*0.2*	*0.03*	*5*	*0.2*	*0.02*	*0.5*	*7*	*1*	*2*	*1*	*50*	*5*		*2*	*1*
CCME - Canadian Soil Quality Guidelines [1] - Industrial Land Use																	
TIER I GOVERNING OBJECTIVES GENERIC CRITERIA		-	40	12	2,000	8	-	22	-	87	300	91	-	600	-	-	-
Tier I Site Specific Criteria (For Pathways Applicable to Site)																	
Human Health Guidelines																	
SQG_{HH}		-	-	12	96,000	-	-	-	-	-	-	-	-	-	-	-	-
Direct contact guideline		-	-	-	130,000	-	-	-	-	-	-	-	-	-	-	-	-
Soil Ingestion Guideline [3]		-	-	12	NC	-	-	2,090	-	6,700	-	20,000	-	8,200	-	-	-
Off-site Migration Check		-	-	39	96,000	-	-	192	-	2,300	-	16,000	-	740	-	-	-
Environmental Health Guidelines																	
Soil Contact Guideline		-	-	26	NC	-	-	22	-	87	-	91	-	600	-	-	-
Nutrient and Energy Cycling Check		-	-	NC	NC	-	-	195	-	NC	-	350	-	834	-	-	-
Off-site Migration Check		-	-	140	NC	-	-	132	-	91	-	610	-	2,272		-	-

Sample No. [1]	Date	Parameter (mg/kg)															
		Mercury	Molybdenum[2]	Nickel	Phosphorus	Potassium	Selenium	Silver[2]	Sodium	Strontium	Thallium	Tin[2]	Titanium	Uranium	Vanadium	Zinc	Zirconium
TH15-01-01	11-Jun-15	<0.050	4.84	21.5	374	669	<0.50	0.070	1040	335	0.107	5.23	264	1.09	16.4	298	6.08
TH15-02-01	11-Jun-15	<0.050	0.23	39.8	432	5250	<0.50	0.138	570	57.1	0.327	1.06	142	0.891	65.6	79.9	9.87
TH15-03-01	11-Jun-15	<0.050	0.41	29.0	466	4330	<0.50	0.097	256	80.4	0.265	0.76	232	1.08	41.2	65.2	6.55
Laboratory Detection Limits		*0.01*	*3*	*2*	*20*	*7*	*0.1*	*1*	*2*	*0.02*	*0.2*	*4*	*5*	*0.006*	*1*	*5*	
CCME - Canadian Soil Quality Guidelines [1] - Industrial Land Use																	
TIER I GOVERNING OBJECTIVES GENERIC CRITERIA		50	40	89	-	-	2.9	40	-	-	1	300	-	300	130	360	-
Tier I Site Specific Criteria (For Pathways Applicable to Site)																	
Human Health Guidelines																	
SQC_{HH}		-	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct contact guideline		-	-	5,100	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil Ingestion Guideline [3]		690	-	5,100	-	-	4,050	-	-	-	NC	-	-	510	NC	NC	-
Off-site Migration Check		99	-	2,500	-	-	1,135	-	-	-	NC	-	-	300	NC	NC	-
Environmental Health Guidelines																	
Soil Contact Guideline		50	-	89	-	-	2.9	-	-	-	3.6	-	-	2000	130	360	-
Nutrient and Energy Cycling Check		52	-	235	-	-	NC	-	-	-	NC	-	-	NC	255	320	-
Off-site Migration Check		142	-	287	-	-	5	-	-	-	140	-	-	7,100	830	1,000	-

Notes:

"-" = No Data

NC = Not Calculated

1. CCME - Canadian Council of Ministers of the Environment - Canadian Environmental Quality Guidelines, 1999, Updated 7.0 - 2007. Updated July 2013
2. Interim remediation criteria for soil (mg/kg) that have not yet been replaced by Canadian Soil Quality Guidelines.
3. Selenium pathway names are from the new protocol (derived in 2006), however, some of the pathway names from the old guideline and the new guideline are interchangeable.
   Use old pathway names instead of the new ones because all of the inorganics
   with the exception of Selenium use the old guideline pathway names. The interchangeable pathway names are as follow:

Old Guideline	New Guideline
Soil Ingestion Guideline	Direct contact (SQG_{DH})
Inhalation of Indoor Air Check	Protection of Indoor Air Quality (Basement)
	Protection of Indoor Air Quality (Slab-on-Grade)
Groundwater Check (Drinking Water)	Protection of Potable Water
Groundwater Check (Aquatic Life)	Protection of Freshwater Life

	- Exceedance of Tier I Generic Criteria
BOLD	- Exceedance of Tier I Site Specific Criteria

APPENDIX C

LABORATORY CERTIFICATE OF ANALYSES

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your P.O. #: 11-0107-18.1004.05
Your Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your C.O.C. #: N005218

Attention:ANNE MARIE HAMILTON

KGS Group
3rd Floor
865 Waverly St
Winnipeg, MB
Canada R3T 5T4

Report Date: 2015/06/18
Report #: R1980149
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B549261
Received: 2015/06/11, 14:40

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
BTEX/F1 by HS GC-MS/FID (MeOH extract) (2)	3	2015/06/12	2015/06/18	WINSOP-00054 WINSOP-00055	EPA8260C/CCME PHCCWS
CCME Hydrocarbons (F2-F4 in soil) (3)	3	2015/06/16	2015/06/17	WINSOP-00056	CCME PHC-CWS
Elements by ICPMS (total) (1)	3	2015/06/13	2015/06/15	BBY7SOP-00001	EPA 6020a R1 m
Moisture	3	N/A	2015/06/15	WIN SOP-00060	Carter Method 51.2
PAH in Soil by GC/MS (SIM) - CCME (1)	3	2015/06/12	2015/06/17	BBY8SOP-00022	EPA 8270d R4 m
Benzo[a]pyrene Equivalency (1)	3	N/A	2015/06/18	BBY WI-00033	Auto Calc
Total LMW, HMW, Total PAH Calc (1)	3	N/A	2015/06/18	BBY WI-00033	Auto Calc
pH (2:1 DI Water Extract) (1)	3	2015/06/13	2015/06/15	BBY6SOP-00028	BCMOE BCLM Mar2005 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Vancouver
(2) This method complies with the reference method for the CWS PHC and is validated for use in the laboratory.
Applicable only to F1 and/or LH - nC6 and nC10 response factors are within 30% of the toluene response factor.
The hydrocarbon results are expressed as a dry weight basis.
(3) This method complies with the reference method for the CWS PHC and is validated for use in the laboratory.
The hydrocarbon results are expressed as a dry weight basis.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Janelle Kochan, B.Sc., Project Manager
Email: JKochan@maxxam.ca
Phone# (204)772-7276 Ext:2209

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Maxxam Job #: B549261
Report Date: 2015/06/18

KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your P.O. #: 11-0107-18.1004.05
Sampler Initials: ADS

BTEX/F1-F4 IN SOIL (SOIL)

Maxxam ID		MK9801	MK9801	MK9802	MK9803		
Sampling Date		2015/06/11 11:00	2015/06/11 11:00	2015/06/11 12:00	2015/06/11 10:15		
COC Number		N005218	N005218	N005218	N005218		
	Units	TH15-02-01	TH15-02-01 Lab-Dup	TH15-03-01	TH15-01-04	RDL	QC Batch
Physical Properties							
Moisture	%	28	27	25	33	0.3	7931871
Ext. Pet. Hydrocarbon							
Calculated F2 (C10-C16 Hydrocarbons)	mg/kg	<20	<20	<20	<20	20	7936302
Calculated F3 (C16-C34 Hydrocarbons)	mg/kg	<20	<20	<20	<20	20	7936302
Calculated F4 (C34-C50 Hydrocarbons)	mg/kg	<20	<20	<20	<20	20	7936302
Calculated Reached Baseline at C50	mg/kg	Yes	Yes	Yes	Yes	N/A	7936302
Volatiles							
Benzene	mg/kg	<0.0050		<0.0050	<0.0050	0.0050	7931869
Toluene	mg/kg	<0.020		<0.020	<0.020	0.020	7931869
Ethylbenzene	mg/kg	<0.010		<0.010	<0.010	0.010	7931869
Xylenes (Total)	mg/kg	<0.040		<0.040	<0.040	0.040	7931869
m & p-Xylene	mg/kg	<0.040		<0.040	<0.040	0.040	7931869
o-Xylene	mg/kg	<0.020		<0.020	<0.020	0.020	7931869
Methyl-tert-butylether (MTBE)	mg/kg	<0.10		<0.10	<0.10	0.10	7931869
F1 (C6-C10) - BTEX	mg/kg	<10		<10	<10	10	7931869
(C6-C10)	mg/kg	<10		<10	<10	10	7931869
Surrogate Recovery (%)							
4-Bromofluorobenzene (sur.)	%	102		103	101		7931869
D10-ETHYLBENZENE (sur.)	%	117		116	115		7931869
D4-1,2-Dichloroethane (sur.)	%	107		107	108		7931869
D8-TOLUENE (sur.)	%	97		98	97		7931869
Calculated O-TERPHENYL (sur.)	%	82	91	90	89		7936302

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Maxxam Job #: B549261
Report Date: 2015/06/18

KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your P.O. #: 11-0107-18.1004.05
Sampler Initials: ADS

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		MK9800	MK9801	MK9802		
Sampling Date		2015/06/11 10:00	2015/06/11 11:00	2015/06/11 12:00		
COC Number		N005218	N005218	N005218		
	Units	TH15-01-01	TH15-02-01	TH15-03-01	RDL	QC Batch
Physical Properties						
Soluble (2:1) pH	pH	8.53	7.76	8.76	N/A	7933203
Total Metals by ICPMS						
Total Aluminum (Al)	mg/kg	6590	26500	19600	100	7933167
Total Antimony (Sb)	mg/kg	3.72	0.48	0.27	0.10	7933167
Total Arsenic (As)	mg/kg	7.96	6.42	3.09	0.50	7933167
Total Barium (Ba)	mg/kg	337	148	123	0.10	7933167
Total Beryllium (Be)	mg/kg	0.59	1.19	0.68	0.40	7933167
Total Bismuth (Bi)	mg/kg	<0.10	0.26	0.15	0.10	7933167
Total Cadmium (Cd)	mg/kg	0.557	0.285	0.348	0.050	7933167
Total Calcium (Ca)	mg/kg	46800	6640	51400	100	7933167
Total Chromium (Cr)	mg/kg	23.4	41.9	30.5	1.0	7933167
Total Cobalt (Co)	mg/kg	4.65	11.0	9.88	0.30	7933167
Total Copper (Cu)	mg/kg	78.7	33.4	18.9	0.50	7933167
Total Iron (Fe)	mg/kg	33100	29400	21000	100	7933167
Total Lead (Pb)	mg/kg	81.5	15.4	11.9	0.10	7933167
Total Lithium (Li)	mg/kg	8.5	26.6	19.5	5.0	7933167
Total Magnesium (Mg)	mg/kg	15100	12300	28900	100	7933167
Total Manganese (Mn)	mg/kg	305	286	577	0.20	7933167
Total Mercury (Hg)	mg/kg	<0.050	<0.050	<0.050	0.050	7933167
Total Molybdenum (Mo)	mg/kg	4.84	0.23	0.41	0.10	7933167
Total Nickel (Ni)	mg/kg	21.5	39.8	29.0	0.80	7933167
Total Phosphorus (P)	mg/kg	374	432	466	10	7933167
Total Potassium (K)	mg/kg	669	5250	4330	100	7933167
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	0.50	7933167
Total Silver (Ag)	mg/kg	0.070	0.138	0.097	0.050	7933167
Total Sodium (Na)	mg/kg	1040	570	256	100	7933167
Total Strontium (Sr)	mg/kg	335	57.1	80.4	0.10	7933167
Total Thallium (Tl)	mg/kg	0.107	0.327	0.265	0.050	7933167
Total Tin (Sn)	mg/kg	5.23	1.06	0.76	0.10	7933167
Total Titanium (Ti)	mg/kg	264	142	232	1.0	7933167
Total Uranium (U)	mg/kg	1.09	0.891	1.08	0.050	7933167
Total Vanadium (V)	mg/kg	16.4	65.6	41.2	2.0	7933167
Total Zinc (Zn)	mg/kg	298	79.9	65.2	1.0	7933167

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B549261
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KGS Group
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Sampler Initials: ADS

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		MK9800	MK9801	MK9802		
Sampling Date		2015/06/11 10:00	2015/06/11 11:00	2015/06/11 12:00		
COC Number		N005218	N005218	N005218		
	Units	**TH15-01-01**	**TH15-02-01**	**TH15-03-01**	**RDL**	**QC Batch**
Total Zirconium (Zr)	mg/kg	6.08	9.87	6.55	0.50	7933167
RDL = Reportable Detection Limit						

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CCME PAH IN SOIL BY GC-MS (SOIL)

Maxxam ID		MK9801	MK9802	MK9802	MK9803		
Sampling Date		2015/06/11 11:00	2015/06/11 12:00	2015/06/11 12:00	2015/06/11 10:15		
COC Number		N005218	N005218	N005218	N005218		
	Units	TH15-02-01	TH15-03-01	TH15-03-01 Lab-Dup	TH15-01-04	RDL	QC Batch
Calculated Parameters							
Index of Additive Cancer Risk(IARC)	N/A	0.31	0.69		0.31	0.10	7931088
Benzo[a]pyrene equivalency	N/A	<0.10	<0.10		<0.10	0.10	7931088
Polycyclic Aromatics							
Naphthalene	mg/kg	0.019	0.018	0.015	<0.010	0.010	7937004
2-Methylnaphthalene	mg/kg	0.041	0.025	0.021	<0.020	0.020	7937004
Acenaphthylene	mg/kg	<0.0050	0.0051	<0.0050	<0.0050	0.0050	7937004
Acenaphthene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7937004
Fluorene	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	7937004
Phenanthrene	mg/kg	0.025	0.043	0.027	<0.020	0.020	7937004
Anthracene	mg/kg	<0.0040	0.0050	<0.0040	<0.0040	0.0040	7937004
Fluoranthene	mg/kg	<0.020	0.064	0.027	<0.020	0.020	7937004
Pyrene	mg/kg	<0.020	0.061	0.023	<0.020	0.020	7937004
Benzo(a)anthracene	mg/kg	<0.020	0.026	<0.020	<0.020	0.020	7937004
Chrysene	mg/kg	<0.020	0.041	<0.020	<0.020	0.020	7937004
Benzo(b&j)fluoranthene	mg/kg	<0.020	0.053	0.025	<0.020	0.020	7937004
Benzo(b)fluoranthene	mg/kg	<0.020	0.034	<0.020	<0.020	0.020	7937004
Benzo(k)fluoranthene	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	7937004
Benzo(a)pyrene	mg/kg	<0.020	0.028	<0.020	<0.020	0.020	7937004
Indeno(1,2,3-cd)pyrene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	7937004
Dibenz(a,h)anthracene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	7937004
Benzo(g,h,i)perylene	mg/kg	<0.050	<0.050	<0.050	<0.050	0.050	7937004
Low Molecular Weight PAH`s	mg/kg	0.085	0.097		<0.050	0.050	7930624
High Molecular Weight PAH`s	mg/kg	<0.050	0.27		<0.050	0.050	7930624
Total PAH	mg/kg	0.085	0.37		<0.050	0.050	7930624
Surrogate Recovery (%)							
D10-ANTHRACENE (sur.)	%	91	84	84	93		7937004
D8-ACENAPHTHYLENE (sur.)	%	87	81	81	91		7937004
D8-NAPHTHALENE (sur.)	%	89	85	84	92		7937004
TERPHENYL-D14 (sur.)	%	99	92	93	103		7937004

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Maxxam Job #: B549261
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KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	16.8°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your P.O. #: 11-0107-18.1004.05
Sampler Initials: ADS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7931869	4-Bromofluorobenzene (sur.)	2015/06/17	103	60 - 140	101	60 - 140	102	%				
7931869	D10-ETHYLBENZENE (sur.)	2015/06/17	105	50 - 130	108	50 - 130	111	%				
7931869	D4-1,2-Dichloroethane (sur.)	2015/06/17	105	60 - 140	99	60 - 140	102	%				
7931869	D8-TOLUENE (sur.)	2015/06/17	100	60 - 140	97	60 - 140	98	%				
7936302	Calculated O-TERPHENYL (sur.)	2015/06/17	78	50 - 130	83	50 - 130	93	%				
7937004	D10-ANTHRACENE (sur.)	2015/06/17	89	60 - 130	96	60 - 130	98	%				
7937004	D8-ACENAPHTHYLENE (sur.)	2015/06/17	87	50 - 130	92	50 - 130	95	%				
7937004	D8-NAPHTHALENE (sur.)	2015/06/17	89	50 - 130	93	50 - 130	97	%				
7937004	TERPHENYL-D14 (sur.)	2015/06/17	96	60 - 130	102	60 - 130	103	%				
7931869	(C6-C10)	2015/06/18	82	60 - 140	123	60 - 140	<10	mg/kg	NC	50		
7931869	Benzene	2015/06/18	90	60 - 140	94	60 - 140	<0.0050	mg/kg	NC	50		
7931869	Ethylbenzene	2015/06/18	97	60 - 140	103	60 - 140	<0.010	mg/kg	NC	50		
7931869	F1 (C6-C10) - BTEX	2015/06/18					<10	mg/kg	NC	50		
7931869	m & p-Xylene	2015/06/18	97	60 - 140	101	60 - 140	<0.040	mg/kg	NC	50		
7931869	Methyl-tert-butylether (MTBE)	2015/06/17	97	60 - 140	96	60 - 140	<0.10	mg/kg				
7931869	o-Xylene	2015/06/18	96	60 - 140	101	60 - 140	<0.020	mg/kg	NC	50		
7931869	Toluene	2015/06/18	89	60 - 140	92	60 - 140	<0.020	mg/kg	NC	50		
7931869	Xylenes (Total)	2015/06/18					<0.040	mg/kg	NC	50		
7931871	Moisture	2015/06/15					<0.3	%	2.2	20		
7933167	Total Aluminum (Al)	2015/06/15					<100	mg/kg	1.6	35	106	70 - 130
7933167	Total Antimony (Sb)	2015/06/15	100	75 - 125	95	75 - 125	<0.10	mg/kg	NC	30	97	70 - 130
7933167	Total Arsenic (As)	2015/06/15	98	75 - 125	94	75 - 125	<0.50	mg/kg	NC	30	98	70 - 130
7933167	Total Barium (Ba)	2015/06/15	NC	75 - 125	97	75 - 125	<0.10	mg/kg	11	35	103	70 - 130
7933167	Total Beryllium (Be)	2015/06/15	104	75 - 125	99	75 - 125	<0.40	mg/kg	NC	30		
7933167	Total Bismuth (Bi)	2015/06/15					<0.10	mg/kg	NC	30		
7933167	Total Cadmium (Cd)	2015/06/15	102	75 - 125	99	75 - 125	<0.050	mg/kg	NC	30	103	70 - 130
7933167	Total Calcium (Ca)	2015/06/15					<100	mg/kg	6.2	30	100	70 - 130
7933167	Total Chromium (Cr)	2015/06/15	97	75 - 125	95	75 - 125	<1.0	mg/kg	1.0	30	102	70 - 130
7933167	Total Cobalt (Co)	2015/06/15	97	75 - 125	95	75 - 125	<0.30	mg/kg	4.7	30	92	70 - 130
7933167	Total Copper (Cu)	2015/06/15	102	75 - 125	100	75 - 125	<0.50	mg/kg	3.6	30	94	70 - 130

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Maxxam Job #: B549261
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QUALITY ASSURANCE REPORT(CONT'D)

KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your P.O. #: 11-0107-18.1004.05
Sampler Initials: ADS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7933167	Total Iron (Fe)	2015/06/15					<100	mg/kg	0.76	30	96	70 - 130
7933167	Total Lead (Pb)	2015/06/15	105	75 - 125	100	75 - 125	<0.10	mg/kg	11	35	98	70 - 130
7933167	Total Lithium (Li)	2015/06/15	100	75 - 125	95	75 - 125	<5.0	mg/kg	NC	30		
7933167	Total Magnesium (Mg)	2015/06/15					<100	mg/kg	0.44	30	107	70 - 130
7933167	Total Manganese (Mn)	2015/06/15	NC	75 - 125	96	75 - 125	<0.20	mg/kg	2.1	30	97	70 - 130
7933167	Total Mercury (Hg)	2015/06/15	102	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	95	70 - 130
7933167	Total Molybdenum (Mo)	2015/06/15	103	75 - 125	96	75 - 125	<0.10	mg/kg	NC	35	113	70 - 130
7933167	Total Nickel (Ni)	2015/06/15	102	75 - 125	97	75 - 125	<0.80	mg/kg	2.2	30	97	70 - 130
7933167	Total Phosphorus (P)	2015/06/15					<10	mg/kg	7.2	30	89	70 - 130
7933167	Total Potassium (K)	2015/06/15					<100	mg/kg	9.4	35		
7933167	Total Selenium (Se)	2015/06/15	103	75 - 125	100	75 - 125	<0.50	mg/kg	NC	30		
7933167	Total Silver (Ag)	2015/06/15	103	75 - 125	101	75 - 125	<0.050	mg/kg	NC	35	99	60 - 140
7933167	Total Sodium (Na)	2015/06/15					<100	mg/kg	NC	35		
7933167	Total Strontium (Sr)	2015/06/15	100	75 - 125	96	75 - 125	<0.10	mg/kg	11	35	105	70 - 130
7933167	Total Thallium (Tl)	2015/06/15	101	75 - 125	99	75 - 125	<0.050	mg/kg	NC	30	90	70 - 130
7933167	Total Tin (Sn)	2015/06/15	97	75 - 125	92	75 - 125	<0.10	mg/kg	NC	35		
7933167	Total Titanium (Ti)	2015/06/15	NC	75 - 125	92	75 - 125	<1.0	mg/kg	2.9	35	104	70 - 130
7933167	Total Uranium (U)	2015/06/15	100	75 - 125	96	75 - 125	<0.050	mg/kg	NC	30	106	70 - 130
7933167	Total Vanadium (V)	2015/06/15	NC	75 - 125	91	75 - 125	<2.0	mg/kg	2.3	30	98	70 - 130
7933167	Total Zinc (Zn)	2015/06/15	NC	75 - 125	99	75 - 125	<1.0	mg/kg	0.53	30	90	70 - 130
7933167	Total Zirconium (Zr)	2015/06/15					<0.50	mg/kg	NC	30		
7933203	Soluble (2:1) pH	2015/06/15			100	97 - 103			1.9	N/A		
7936302	Calculated F2 (C10-C16 Hydrocarbons)	2015/06/17	96	50 - 130	91	70 - 130	<20	mg/kg	NC	50		
7936302	Calculated F3 (C16-C34 Hydrocarbons)	2015/06/17	99	50 - 130	92	70 - 130	<20	mg/kg	NC	50		
7936302	Calculated F4 (C34-C50 Hydrocarbons)	2015/06/17	97	50 - 130	90	70 - 130	<20	mg/kg	NC	50		
7936302	Calculated Reached Baseline at C50	2015/06/17					YES	mg/kg	NC	50		
7937004	2-Methylnaphthalene	2015/06/17	85	50 - 130	88	50 - 130	<0.020	mg/kg	NC	50		
7937004	Acenaphthene	2015/06/17	84	50 - 130	87	50 - 130	<0.0050	mg/kg	NC	50		
7937004	Acenaphthylene	2015/06/17	83	50 - 130	87	50 - 130	<0.0050	mg/kg	NC	50		
7937004	Anthracene	2015/06/17	87	60 - 130	91	60 - 130	<0.0040	mg/kg	NC	50		

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QUALITY ASSURANCE REPORT(CONT'D)

KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
Your P.O. #: 11-0107-18.1004.05
Sampler Initials: ADS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7937004	Benzo(a)anthracene	2015/06/17	78	60 - 130	84	60 - 130	<0.020	mg/kg	NC	50		
7937004	Benzo(a)pyrene	2015/06/17	75	60 - 130	84	60 - 130	<0.020	mg/kg	NC	50		
7937004	Benzo(b&j)fluoranthene	2015/06/17	77	60 - 130	84	60 - 130	<0.020	mg/kg	NC	50		
7937004	Benzo(b)fluoranthene	2015/06/17	77	60 - 130	84	60 - 130	<0.020	mg/kg	NC	20		
7937004	Benzo(g,h,i)perylene	2015/06/17	71	60 - 130	80	60 - 130	<0.050	mg/kg	NC	50		
7937004	Benzo(k)fluoranthene	2015/06/17	81	60 - 130	91	60 - 130	<0.020	mg/kg	NC	50		
7937004	Chrysene	2015/06/17	80	60 - 130	88	60 - 130	<0.020	mg/kg	NC	50		
7937004	Dibenz(a,h)anthracene	2015/06/17	77	60 - 130	81	60 - 130	<0.050	mg/kg	NC	50		
7937004	Fluoranthene	2015/06/17	87	60 - 130	90	60 - 130	<0.020	mg/kg	NC	50		
7937004	Fluorene	2015/06/17	84	50 - 130	87	50 - 130	<0.020	mg/kg	NC	50		
7937004	Indeno(1,2,3-cd)pyrene	2015/06/17	76	60 - 130	81	60 - 130	<0.050	mg/kg	NC	50		
7937004	Naphthalene	2015/06/17	84	50 - 130	88	50 - 130	<0.010	mg/kg	NC	50		
7937004	Phenanthrene	2015/06/17	85	60 - 130	90	60 - 130	<0.020	mg/kg	NC	50		
7937004	Pyrene	2015/06/17	82	60 - 130	86	60 - 130	<0.020	mg/kg	NC	50		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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KGS Group
Client Project #: 11-0107-18.1004.05
Site Location: WINNIPEG, MB
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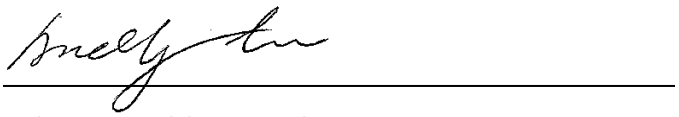
Sampler Initials: ADS

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Andy Lu, Data Validation Coordinator

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

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A Bureau Veritas Group Company

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Phone: 204-772-7276 Fax: 204-772-2386 Toll Free: (866) 800-6208

CHAIN OF CUSTODY RECORD

Page 1 of 1

INVOICE INFORMATION	REPORT INFORMATION (if different from invoice)	PROJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: KGS Group Bill MacQuarrie	Company Name: KGS Group	Quotation #:	B549261
Contact Name: ~~Anne Marie Hamilton~~	Contact Name: Anne Marie Hamilton	P.O. #: 11-0107-18, 1000.05	CHAIN OF CUSTODY #
Address: 865 Waverley St 3rd Flwr R3T 5P4 Winnipeg MB	Address: 865 Waverley St 3rd Floor R3T 5P4 Winnipeg MB	Project #: 11-0107-18, 1000.05	N 005218
Phone: 896 1209 Fax: 896 0754	Phone: 896-1209 Fax:	Project Name:	
Email: ~~AHamilton@KGSGroup.com~~	Email: AHamilton@KGSGroup.com / ASinclair@KGSGroup.com	Location: Winnipeg, MB	
		Sampled By: APS	

REGULATORY REQUIREMENTS SERVICE REQUESTED:

- ☐ CCME — BMACQUARRIE@KGSGroup.com
- ☐ DRINKING WATER
- ☐ Other:

Special Instructions:

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT:
☒ 5 to 7 Working Days

Rush TAT:
☐ 1 day ☐ 2 days ☐ 3 days

DATE Required:

TIME Required:

TATs for certain tests are > 5 days. Please contact your Project Manager for details

	Lab Use	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil etc)	Drinking Water? (Y / N)	Coliforms: Total / Fecal / E. coli / MF / MPN / QT	Dissolved Metals: Field Filtered?	Field Acidified?	Total Metal: Field Acidified?	BTEX	BTEX / F1	F2 - F4	PCB	Biochemical Oxygen Demand	METALS	pH	HOLD - DO NOT ANALYZE	# of Cont.	COMMENTS / TAT COMMENTS
1	MK9800	TH15-01-01	June 11	10:00	Soil											X			1	BAG
2	MK9801	TH15-02-01		11:00								X	X			X	X		4	BAG + 3 JARS
3	MK9802	TH15-03-01		12:00								X	X			X	X		4	BAG + 3 JARS
4	MK9803	TH-15-01-04		10:15								X	X				X		3	3 JARS
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

RELINQUISHED BY (Signature/Print)	RECEIVED BY (Signature/Print)	Date	Time	#JARS USED AND NOT SUBMITTED	Laboratory Use Only
Andrew Sinclair	Sena Shuly,	19/06/11	14:40		Temperature (°C) on Receipt: 15.4, 16.8, 18.7 ice present

***MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.**

APPENDIX D

2016 TEST HOLE LOGS AND GEOTECHNICAL LABORATORY TEST RESULTS

KGS GROUP

SOIL DESCRIPTION CRITERIA

PRINCIPAL AND MINOR SOIL COMPONENTS

And	35 – 50%
With	20 – 35%
Some	10 – 20%
Trace	0 – 10%
Occasional	Trace of very local concentration

FIELD MOISTURE CONTENT

Dry	No moisture visible or to touch when fresh exposure is examined
Damp	Slightly wet to touch
Moist	Fresh exposure wet to touch
Wet	A film of water is readily visible around particles of granular soils, cohesive soils can readily be smeared or remolded; water can be squeezed out
Saturated	Water can easily be squeezed out
Free Water	Water completely separated from the soil particles

DEPOSITIONAL STRUCTURE

Massive	Structureless soil
Stratified (Layered)	Different soils or visible variations in soil constituents arranged in layers, generally but not necessarily parallel to one another, and not necessarily in horizontal position, at least 6 mm thick
Varved	Glaciolacustrine deposits with annual pairs of fine and coarser laminae (thin laminae of alternately deposited inorganic silt and clay)
Laminated	Closely spaced, regularly alternating layers of differing soils and/or colours, or shades of similar gradation, relatively consistent in thickness and consisting of sand, silt, or clay
Lens	Inclusions of a different soil within surrounding soils, which thins out horizontally and may not be continuous over any significant distance
Pocket	A different soil type of very limited thickness or lateral extent (a small lens)
Inclusions	Small pockets
Nuggety	A different soil type in the form of small lumps
Parting	Paper thin separation of one type by another

POST DEPOSITIONAL STRUCTURE

Fissured	A soil breaks along definite, pre-existing planes or fracture with little resistance to fracturing
Slickensided	Polished or glossy, sometimes striated surfaces resulting from movement of a material block relative to the adjacent blocks
Blocky/Friable/Platy	Cohesive soil that can be broken down into angular larger fragments (blocky), small fragments (friable), or thin plate-like fragments (platy) which resist further breakdown
Cemented	Soil particles or fragments held together by cemented materials, often chemical precipitants, or deposits within overall soil mass

GRAIN SIZE DISTRIBUTION IN COARSE GRAINED SOIL

Boulders	>200 mm ø
Cobbles	75 – 200 mm ø
Coarse Grained Gravel	19 – 75 mm ø
Fine Grained Gravel	4.75 – 19 mm ø
Coarse Grained Sand	2 – 4.75 mm ø
Medium Grained Sand	0.425 – 2 mm ø
Fine Grained Sand	0.075 – 0.425 mm ø

DENSITY OF GRANULAR SOIL

Description	Standard Penetration Test	Relative Density
Very Loose	0 – 4 Blows Per 0.3 m	<15%
Loose	4 – 10 Blows Per 0.3 m	15 – 35%
Compact	10 - 30 Blows Per 0.3 m	35 – 65%
Dense	30 - 50 Blows Per 0.3 m	65 – 85%
Very Dense	>50 Blows Per 0.3 m	>85%

CONSISITENCY OF COHESIVE SOILS

Description	Torvane	Standard Penetration Test
Very Soft	<12 kPa	<2
Soft	12 – 25 kPa	2 – 4
Firm	25 – 50 kPa	4 – 8
Stiff	50 – 100 kPa	8 – 15
Very Stiff	100 – 200 kPa	15 – 30
Hard	>200 kPa	>30

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH15-05**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Parker Pond
LOCATION Southeast corner
DRILLING METHOD

JOB NO. **11-0107-18**
GROUND ELEV. **232.46**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **6/11/2015**
UTM (m) N **5,523,764**
E **632,435**

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 %
232				**COAL CINDERS** - Black, wet, soft, with fine to coarse grained sand.						20 40 60	20 40 60 80
231.9				**CLAY (CH)** Brown, moist, stiff, high plasticity, trace fine grained sand.							
231	1	5									
230	2										
229	3	10		- 50 mm thick silt seam at 2.90 m. - Silt pockets, trace oxidation below 3.05 m. - Firm between 3.05 and 4.58 m.							
228	4	15									
227	5			- Firm below 5.49 m.							
226	6	20									
225	7	25		- Grey below 7.32 m.							
224	8										
223	9	30									

SAMPLE TYPE

CONTRACTOR | INSPECTOR | APPROVED | DATE 7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH15-05

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 %
222	11	35		- Increased silt pockets below 10.68 m.						20 40 60	20 40 60 80
221	12	40		- Trace fine to coarse grained sand below 12.20 m.							
220	13			- Grain Size Distribution: Gravel (0.1%), Sand (4.2%), Silt (24%), and Clay (71.7%) at 13.0 m							
219		45				13.7					
218.4	14					13.9					
218.3				**SILT TILL (ML)** - Brown, damp, dense, low plasticity, some fine to coarse grained sand, some fine to coarse grained gravel.		14.2					
218				**END OF HOLE AT 14.19 m**							
217	15	50		Notes: 1. Test hole open to 14.19 m upon completion of drilling. 2. Water level in test hole 2.44 m below grade immediately after drilling. 3. Installed a standpipe piezometer within the silt till. 2. Back							
216	16										
215	17	55									
214	18	60									
213	19	65									
212	20										
211	21	70									

SAMPLE TYPE

CONTRACTOR | INSPECTOR | APPROVED | DATE 7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-01 (I1)

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION 18 m North of CN Tracks
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. **11-0107-18**
GROUND ELEV. **233.00**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **4/18/2016**
UTM (m) N **5,523,861**
E **632,463**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE / NUMBER
232.1				**SAND & GRAVEL FILL** - Brown, wet, loose, some silt.	
232	1			**CLAY (CH)** - Grey, damp, stiff, high plasticity, some silt.	
					S1
231.5		5		**SILT (ML)** - Tan, moist, soft, low plasticity, some clay.	
231	2				S2
230.6				**CLAY (CH)** - Brown, moist, stiff, high plasticity, some silt.	
230	3	10			S3
				- Water infiltrating test hole below 3.05 m.	
				- Firm to stiff below 3.36 m.	
				- Some silt nodules, oxidation below 3.66 m.	S4
229	4				
		15		- Firm below 4.57 m.	
228	5				
				- Grey below 5.18 m.	S5
				- No silt nodules from 5.18 to 6.10 m.	
227	6	20		- Mottled grey and brown from 5.80 to 6.10 m.	
					S6
226	7				
		25			
225	8				S7
224	9	30		- Trace to some fine to coarse grained sand below 9.14 m.	
					S8

RECOVERY %

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 ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-01 (I1)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 %
								20 40 60	20 40 60 80
		35		- Increased fine to coarse grained sand content below 10.67 m.					
222	11								
						S9			
221	12	40							
						S10			
220	13			- Soft to firm below 13.12 m.					
		45							
219.0	14			**SILT TILL (ML)** - Tan, moist, loose, low plasticity, some fine to coarse grained sand, trace fine grained gravel.					
						S11			
218	15			- Increased density, with fine to coarse grained sand content below 14.6 m.					
		50		- Non-plastic from 14.95 to 15.56 m.				4	
				- Damp, compact below 15.20 m.		S12	56	20	
						S13		9	
217	16								
216.7				**AUGER REFUSAL AT 16.31 m.**					
		55		Notes:					
216	17			1. Test hole open to 3.05 m below grade after drilling. 2. Water level in test hole at 0.91 m below grade after drilling. 3. Test hole backfilled to grade with bentonite chips and auger cuttings.					
215	18	60							
214	19								
		65							
213	20								
212	21	70							

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH16-02 (I4/5)**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 45 m Southeast of Shaft B - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. **11-0107-18**
GROUND ELEV. **233.92**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **4/18/2016**
UTM (m) N **5,523,978** E **632,433**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 / %
233	1	5		**SANDY SILT (ML)** - Mottled black and brown, damp, loose to compact, non-plastic, with fine to coarse grained sand, trace fine to coarse grained gravel.	S1			
				- Low plasticity, some clay below 1.07 m.				
232.4				**CLAY (CH)** - Mottled grey and black, damp, stiff, high plasticity, some fine to coarse grained sand.				
232	2	10			S2			
231.8				**SILT (ML)** - Tan, damp to moist, low plasticity, soft, some clay, trace coarse grained sand.				
231	3				S3			
230.4				**CLAY (CH)** - Brown, moist, stiff, high plasticity, some silt, trace silt nodules.				
230	4	15			S4			
				- Mottled grey and brown, trace oxidation below 4.57 m.				
229	5				S5			105
228	6	20		- Firm below 6.10 m.				
227	7	25			S6			
				- Grey, trace coarse grained sand below 7.62 m.				
226	8				S7			
				- Soft to firm below 8.54 m.				
225	9	30						
224								

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-02 (I4/5)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %
223	11	35			S8		
				- Soft below 11.59 m.	S9		
222	12	40					
221	13	45			S10		
220	14			- Some fine to coarse grained sand, trace fine grained angular gravel below 14.02 m.			
219.3				**SILT TILL (ML)** - Tan, moist, loose, low plasticity, some fine to coarse grained sand, trace fine grained gravel.			
219	15	50			S11		
				- Compact, trace to some fine to coarse grained gravel below 15.24 m.	S12		89
				- Spoon contained angular rock pieces (~30 mm diameter) below 15.25 m.	S13		
218.1							
218	16			**AUGER REFUSAL AT 15.85 m.**			
217	17	55					
216	18	60					
215	19						
214	20	65					
213	21	70					

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

▲6
▲50
SPT refusal at 75 mm into 2nd set

Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80

PL MC LL
%
20 40 60 80

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-03 (I7)

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 65 m Northwest of Shaft B - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.39
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/19/2016
UTM (m) N 5,524,081
E 632,378

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 / %
233	0			**CLAY FILL (CI)** - Black, damp, stiff, intermediate plasticity, some organics, some fine to coarse grained sand, some fine to coarse grained gravel.		S1			
232	1	5							
231.3	2			**SILT (ML)** - Brown, moist, soft, low plasticity, some clay.		S2			
231									
230.8				**CLAY (CH)** - Brown, moist, stiff, high plasticity, some silt.		S3			
230	3	10		- Trace silt pockets below 3.35 m.		S4			
229	4	15		- Mottled grey and brown below 4.12 m.					
228	5			- Firm below 5.18 m.		S5			
227	6	20				S6			
226	7	25							
225	8			- Grey, increased silt pockets below 8.23 m. - Trace fine to coarse grained sand below 8.54 m.		S7			
224	9	30				S8			

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-03 (I7)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 %
223	11	35		- Soft below 10.37 m.					
222	12	40			S	S9			
221									
220.4	13			**SILT TILL (ML)** - Tan, moist, firm, low plasticity, some fine to coarse grained sand, trace fine grained gravel.	S	S10			
220		45			S	S11	100	▲50 SPT refusal at 75 mm into 1st set	
219.4	14			**AUGER REFUSAL AT 15.85 m.**	S	S12			
219	15	50		Notes: 1. Test hole open to 9.45 m below grade after drilling. 2. Water level in test hole at 8.53 m below grade after drilling. 3. Test hole backfilled to grade with bentonite chips and auger cuttings.					
218									
217	16	55							
216	17								
215	18	60							
214	19								
213	20	65							
212	21	70							

SAMPLE TYPE S Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH16-04 (I11)**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 50 m Southeast of Shaft C - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. **11-0107-18**
GROUND ELEV. **233.02**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **4/19/2016**
UTM (m) N **5,524,189**
E **632,313**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 / %
232.1				**CLAY FILL (CI)** - Black, moist, firm, intermediate plasticity, some organics, trace fine grained gravel, trace fine to coarse grained sand.		S1			
232	1			**CLAY (CH)** - Brown, damp, stiff, high plasticity, trace fine to coarse grained sand.					
		5				S2			
231	2								
230.7				**SILT (ML)** - Brown, moist, soft, low plasticity, some clay.		S3			
230.4				**CLAY (CH)** - Brown, damp, stiff, high plasticity, some silt, trace fine to coarse grained sand.					
230.0	3	10		**SILT (ML)** - Brown, moist, soft, low plasticity, some clay.					
229.2				**CLAY (CH)** - Brown, moist, stiff, high plasticity, some silt, trace silt pockets.					
229	4					S4			
		15		- Firm from 4.57 to 5.19 m.					
228	5					S5			
				- Grey below 5.79 m.					
227	6	20		- Firm below 6.10 m. - Mottled brown and grey from 6.10 to 6.86 m.					
						S6			
226	7								
		25							
225	8					S7			
				- Increased silt pockets from 8.54 m to 9.14 m.					
224	9	30		- Soft from 9.15 to 10.07 m.					

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-04 (I11)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	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 %
								20 40 60	20 40 60 80
222	11	35				S8			◆
221	12	40				S9			◆
220.8				**SILT TILL (ML)** - Tan, moist, loose, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel.					
				- Augers wet below 12.19 m.					
220	13	45		- Compact below 12.81 m.		S10			
219.7						S11	100	▲50 SPT refusal at 25 mm into 1st set	
				AUGER REFUSAL AT 13.29 m.					
219	14	50		Notes:					
				1. Test hole open to 2.74 m below grade after drilling.					
218	15	55		2. Water level in test hole at 2.74 m below grade after drilling.					
				3. Test hole backfilled to grade with bentonite chips and auger cuttings.					
217	16	60							
216	17	65							
215	18	70							
214	19								
213	20								
212	21								

SAMPLE TYPE ⊠ Auger Grab ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH16-05 (I9)**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. 100 m Southeast of Shaft C - East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.15
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/19/2016
UTM (m) N 5,524,144
E 632,333

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 %
233				**CLAY FILL (CI)** - Mottled brown and black, moist, stiff, intermediate plasticity, with fine to coarse grained sand, some organics, some rootlets. - No rootlets below 0.30 m.								
232.1	1			**CLAY (CH)** - Brown, damp, stiff, high plasticity.			S	1				
231.6		5		**SILT (ML)** - Tan, moist, soft, low plasticity, some clay.								
231	2						S	2				
230.6				**CLAY (CH)** - Brown, damp, stiff, high plasticity, some silt.								
230.1	3	10		**SILT (ML)** - Tan, moist, soft, low plasticity, some clay.								
229.6				**CLAY (CH)** - Brown, moist, stiff, high plasticity, some silt, trace silt pockets.								
229	4						S	3				
		15		- Silt seam from 4.57 to 4.88 m.								
	5			- Firm below 4.88 m.								
228				- Grey below 5.18 m.			S	4				
227	6	20										
							S	5				
226	7											
		25										
	8			- Soft to firm, silt pockets below 7.92 m.								
225					P	8.4 8.5	S	6				
224	9	30										

SAMPLE TYPE: Auger Grab ▨ | Split Spoon ☒ | Core Barrel ▮

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-05 (I9)

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 %
223	11	35					S7			20 40 60	20 40 60 80
222											
	12	40		- Auger flights coming up wet below 12.19 m.			S8				
221											
220.0	13										
220				**SILT TILL (ML)** - Grey, damp, loose to compact, low plasticity, some fine to coarse grained snad, trace to some fine to coarse grained gravel.			S9				
219.4		45		- Auger refusal, switch to coring at 13.11 m.			S10			▲50 SPT refusal at 25 mm into 1st set.	
	14			**LIMESTONE BEDROCK** - Light beige, lightly fractured, strong, RQD = 49%.							
219				- Decreased fractures below 14.42 m.		14.5	R1		81		
						14.6					
218.2	15					14.9					
218		50		**END TEST HOLE AT 14.93 m.**							
				Notes:							
	16			1. Installed RST flow - through piezometer PN36898 at 8.53 m below grade and PN36890 at 14.63 m.							
217				2. Backfilled test hole with bentonite - cement grout mixture from 14.93 m to grade.							
		55		3. Minor sloughing in test hole from 12.80 m to 13.72 m.							
	17										
216											
	18	60									
215											
	19										
214		65									
	20										
213											
	21	70									
212											

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon ▮ Core Barrel

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-06 (Shaft A)

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft A
DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.27
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/20/2016
UTM (m) N 5,523,883
E 632,477

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %
233				**CLAY FILL (CH)** - Mottled brown and black, damp, stiff, high plasticity, some fine to coarse grained sand, trace organics.					
				- Increased sand content between 0.61 and 0.91 m.					
				- Trace silt lenses below 0.76 m.					
232.2	1						S1		
232		5		**CLAY (CH)** - Black, damp, stiff, high plasticity, some organics, trace fine to coarse grained sand.			S2		
231.3	2			**SILT (ML)** - Tan, moist, soft, low plasticity, trace clay.			S3		
231				- Increased clay content below 2.29 m.					
	3	10		- Auger flights coming up wet below 3.05 m.					
230.1				**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, some silt, trace silt pockets.			S4		100
230							S5		
	4			- 12 mm diameter silt inclusion at 4.11 m.					
229		15							
	5						S6		
228									
	6	20		- Firm below 6.10 m.			S7		100
227				- Test hole sloughing at 6.10 m.					
				- Unconfined Compressive Strength measured to be 45 kPa at 6.10 m.			S8		
	7			- Grain Size Distribution: Gravel (0.0%), Sand (0.5%), Silt (19.4%) and Clay (80.1%) at 6.10 m.		7.2			
226		25				7.3			
	8								
225							S9		
				- Grey below 8.53 m.					
	9	30							
224				- Soft below 9.14 m.			S10		100
				- Unconfined conmpressive strength was measured to be 53 kPa at 9.14 m.					
				- No recovery from 9.14 to 9.75 m.			S11		

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 ☐ Shelby Tube ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-06 (Shaft A)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
223	11	35		- Firm, some silt pockets below 10.67 m.							
222							S	12			
221	12	40					S	13	100		
220	13										
219.7		45		**SILT TILL (ML)** - Tan, moist, loose, low plasticity, some to with fine to coarse grained sand, trace fine to coarse grained gravel. - Encountered coarse grained gravel and cobbles while drilling below 13.72 m.			S	14			
219	14										
218	15	50		- Increased coarse grained gravel with depth below 15.24 m. - Compact below 15.25 m.		15.1	S	15			
						15.2	S	16	83	▲9 ▲9 ▲13	
217	16						S	17			
216.9		55		- Spoon contained angular rock pieces (~30 mm diameter) below 16.32 m. **AUGER REFUSAL AT 16.38 m.**		16.4	S	18	100	▲32 ▲60 *SPT refusal at 75 mm into 2nd se	
216	17										
215	18	60									
214	19										
213	20	65									
212	21	70									

Notes:

1. Installed RST flow - through piezometer PN36891 at 15.24 m below grade and PN36895 at 7.32 m.
2. Backfilled test hole with bentonite - cement grout mixture from 16.38 m to grade.

SAMPLE TYPE: Auger Grab | Shelby Tube | Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO. **TH16-07 (I3)**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

PROJECT Cockburn and Calrossie Combined Sewer Relief

SITE Wilton St from Taylor Ave to CN Tracks

LOCATION Approx. 45 m Northwest of Shaft A - East of Wilton

DRILLING METHOD 100 mm ø Solid Stem Auger, B37X Mobile Drill

JOB NO. **11-0107-18**
GROUND ELEV. **233.99**
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED **4/20/2016**
UTM (m) N **5,523,934**
E **632,451**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %
233	0			**SAND FILL (SW)** - Brown, dry to damp, loose to compact, well graded, fine to coarse grained, some fine to coarse grained gravel.				S1	
232.5	1	5		**SAND (SW)** - Black, damp, loose, non plastic, some organics, some gravel.					
232	2			**CLAY (CH)** - Black, damp, stiff, high plasticity, some organics, some fine to coarse grained sand.				S2	
231.7				**SILT(ML)** - Brown, moist, soft, low plasticity, some clay.					
231	3	10						S3	
230.2				**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, some silt, trace silt pockets.					
230	4							S4	
229	5	15							
228	6	20		- Firm below 6.10 m.				S5	
227	7							S6	
226	8	25		- Grey below 7.62 m.					
225	9	30				8.7 8.8		S7	
224									

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 ⊠ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

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KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-07 (I3)

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 %
223	11	35					S8				
222	12	40		- Soft to firm below 12.19 m.			S9				
221	13	45					S10				
220	14										
219.4				**SILT TILL (ML)** - Tan, moist, compact to dense, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel.			S11				
219	15	50				15.4	S12	100		▲22 ▲49 ▲53	
				- 180 mm sand seam at 15.45 mm.		15.5	S13				
218	16			- Auger refusal at 15.85 m.						▲12 ▲16 ▲9	
217.7				- Spoon contained angular rock pieces (~30 mm diameter) below 16.08 m.		16.3	S14	100			
		55		**END TEST HOLE AT 16.31 m.**							
217	17			Notes:							
216	18	60		1. Installed RST flow - through piezometer PN36892 at 15.54 m below grade and PN36894 at 8.84 m. 2. Backfilled test hole with bentonite - cement grout mixture from 16.31 m to grade. 3. Water level in test hole at 5.18 m below grade after drilling.							
215	19										
214	20	65									
213	21	70									

SAMPLE TYPE ▨ Auger Grab ☒ Split Spoon

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-08 (Shaft B)

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft B
DRILLING METHOD 100 mm ø Solid Stem Auger and NQ coring , B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 233.30
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/21/2016
UTM (m) N 5,524,036
E 632,399

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %
233				**TOPSOIL** - Black, damp, firm, non plastic, some fine to coarse grained sand, some rootlets.					
232.7				- No rootlets below 0.30 m.					
	1			**CLAY (CH)** - Black, damp, stiff, high plasticity, some organics, trace oxidation, trace fine grained sand.				S1	
232									
231.8		5		**SILT (ML)** - Tan, moist, soft, low plasticity, some clay.				S2	
	2			- Augers wet below 1.52 m.				S3	100
231									
230.9				**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, some silt, trace silt pockets.				S4	
	3	10						S5	92
230								S6	
	4								
229		15		- Decreased silt pockets below 4.57 m.					
	5			- Firm below 4.88 m.					
228								S7	
	6	20		- Unconfined compressive strength was measured to be 45 kPa at 6.10 m.				S8	100
227				- Grain Size Distribution: Gravel (0.0%), Sand (0.4%), Silt (18.2%) and Clay (81.4%) at 6.10 m.				S9	
	7					7.2			
226						7.3			
	8	25		- Trace to some silt pockets below 7.62 m.					
225				- Grey below 8.23 m.				S10	
	9	30							
224				- Unconfined compressive strength was measured to be 79 kPa at 9.14 m.				S11	100
								S12	

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 | Shelby Tube | Split Spoon | Core Barrel

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-08 (Shaft B)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
223	11	35		- Soft below 10.07 m.							
222											
221	12	40									
220	13							S13	100		
219.9		45		**SILT TILL (ML)** - Tan, damp, loose to compact, low plasticity, some to with fine to coarse grained sand, trace fine grained gravel.							
219	14			- Compact below 14.02 m.				S14			
218.9				- Auger refusal, switch to coring at 14.33 m.							
218	15	50		**LIMESTONE BEDROCK** - Light beige, lightly fractured, RQD = 83%. - Recovery from 14.33 to 16.17 m consisted of limestone gravel, with a maximum diameter of 600 mm.	P	14.8 14.9		S15	56	▲ 13 ▲ 17 ▲ 7	
				- Loss of return water below 15.25 m.				R1	72		
217.1	16			- 50 mm thick silt seam at 16.00 m.		16.2					
217				**END TEST HOLE AT 16.15 m.**							
	17	55		Notes:							
216				1. Installed RST flow - through piezometer PN36896 at 7.32 m below grade and PN36893 at 14.94 m.							
	18	60		2. Backfilled test hole with bentonite - cement grout mixture from 16.15 m to grade.							
215				3. Water level in test hole at 12.19 m below grade after drilling to 14.33 m.							
	19	65									
214											
	20										
213											
	21	70									
212											

SAMPLE TYPE: Auger Grab | Shelby Tube | Split Spoon | Core Barrel

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-09 (Shaft C)

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT Cockburn and Calrossie Combined Sewer Relief
SITE Wilton St from Taylor Ave to CN Tracks
LOCATION Approx. Shaft C - Taylor Ave. Boulevard East of Wilton
DRILLING METHOD 100 mm ø Solid Stem Auger and NQ coring , B37X Mobile Drill

JOB NO. 11-0107-18
GROUND ELEV. 232.73
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 4/22/2016
UTM (m) N 5,524,243
E 632,294

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %
232.1				**CLAY (CH)** - Mottled brown and black, damp, stiff, high plasticity, some organics, trace silt pockets.					
232				**SILT (ML)** - Tan, damp to moist, soft, low plasticity, some clay.				S1	
	1			- Clay seam from 1.07 to 1.22 m.					
231.4				**CLAY (CH)** - Mottled brown and grey, moist, stiff, high plasticity, some silt, some silt pockets.					
231		5							
	2							S2	
230									
	3	10		- Shelby tube pushed at 3.05 m, 0% recovery.					
229								S3	
	4							S4	100
		15		- Firm to stiff below 4.58 m.					
228	5							S5	
227									
	6	20		- Unconfined compressive strength was measured to be 117 kPa at 6.1 m. - Grain Size Distribution: Gravel (0.0%), Sand (0.9%), Silt (18.2%) and Clay (80.9%) at 6.10 m.				S6	100
226								S7	
	7			- Grey below 6.71 m. - Sulphate pieces (~30 mm diameter) at 6.86 m. - Firm below 7.01 m.					
		25							
225	8					8.4 8.5		S8	
224									
	9	30		- Unconfined compressive strength was measured to be 43 kPa at 9.14 m.				S9	100
223				- Soft below 9.75 m.				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 | Shelby Tube | Split Spoon | Core Barrel

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

KGS GROUP

SUMMARY LOG

REFERENCE NO.

HOLE NO.
TH16-09 (Shaft C)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY %
222	11	35					S11		
221	12	40							
220.4				**SILT TILL (ML)** - Tan, damp, loose, low plasticity, some to with fine to coarse grained sand.			S13		100
220				- Red below 12.80 m.			S12		
	13						S14		
219.5				**CLAY TILL (CL)** - Mottled grey, red and green, moist, compact, low plasticity, some fine to coarse grained sand.			S15		
219		45		- Increased density below 13.41 m.			S16		100
218.7	14			- Some fine to coarse grained sand, trace fine grained gravel below 13.72 m.			S17		
				- Auger refusal, switch to coring at 14.02 m.					
218				**LIMESTONE BEDROCK** - Light beige, lightly weathered, strong, RQD = 78%.		14.5 14.6	R1		78
217.7	15	50		**END TEST HOLE AT 15.04 m.**		15.0			
217				Notes:					
	16			1. Installed RST flow - through piezometer PN36897 at 8.53 m below grade and PN36889 at 14.63 m.					
216		55		2. Backfilled test hole with bentonite - cement grout mixture from 15.04 m to grade.					
	17								
215									
	18	60							
214									
	19								
213		65							
	20								
212									
	21	70							
211									

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

▲12
▲50
*SPT refusal at 75 mm into 2nd set

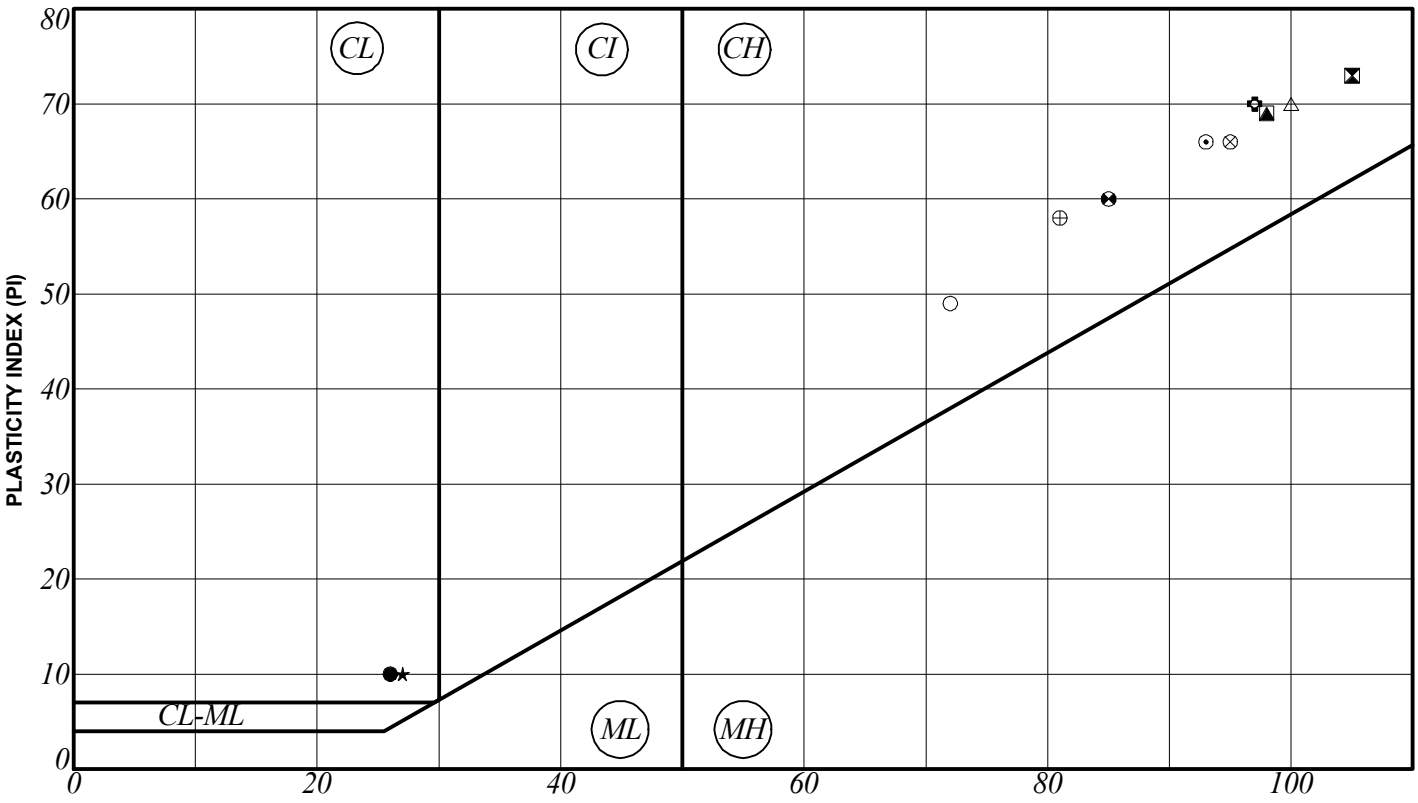
Cu POCKET PEN (kPa) ★
Cu TORVANE (kPa) ◆
20 40 60 80

PL MC LL
%
20 40 60 80

SAMPLE TYPE: Auger Grab | Shelby Tube | Split Spoon | Core Barrel

CONTRACTOR	INSPECTOR	APPROVED	DATE
Maple Leaf Enterprises	J. MACLENNAN	DAA	7/12/17

GEOTECHNICAL-SOIL LOG P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH16-02 (I4/5)	2.9	S3	26	16	10				22.9	CL
⊠	TH16-02 (I4/5)	5.6	S5	105	32	73				56.3	CH
▲	TH16-03 (I7)	5.3	S5	98	29	69				53.4	CH
★	TH16-05 (I9)	2.0	S2	27	17	10				25.0	CL
⊙	TH16-05 (I9)	5.6	S4	93	27	66				53.1	CH
✿	TH16-06 (Shaft A)	6.1	S7	97	27	70	0.5	19.4	80.1	51.8	CH
○	TH16-06 (Shaft A)	9.1	S10	72	23	49				51.5	CH
△	TH16-08 (Shaft B)	5.3	S7	100	30	70				57.5	CH
⊗	TH16-08 (Shaft B)	6.1	S8	95	29	66	0.4	18.2	81.4	52.9	CH
⊕	TH16-08 (Shaft B)	9.1	S11	81	23	58				58.1	CH
□	TH16-09 (Shaft C)	6.1	S6	98	29	69	0.9	18.2	80.9	57.4	CH
⊛	TH16-09 (Shaft C)	9.1	S9	85	25	60				46.5	CH

Notes:
ML - Low Plasticity Silt
MH - High Plasticity Silt
CL-ML - Silty Clay
CL - Low Plasticity Clay
CI - Intermediate Plasticity Clay
CH - High Plasticity Clay
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
MC - Moisture Content
NP - Non-Plastic

KGS GROUP

CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

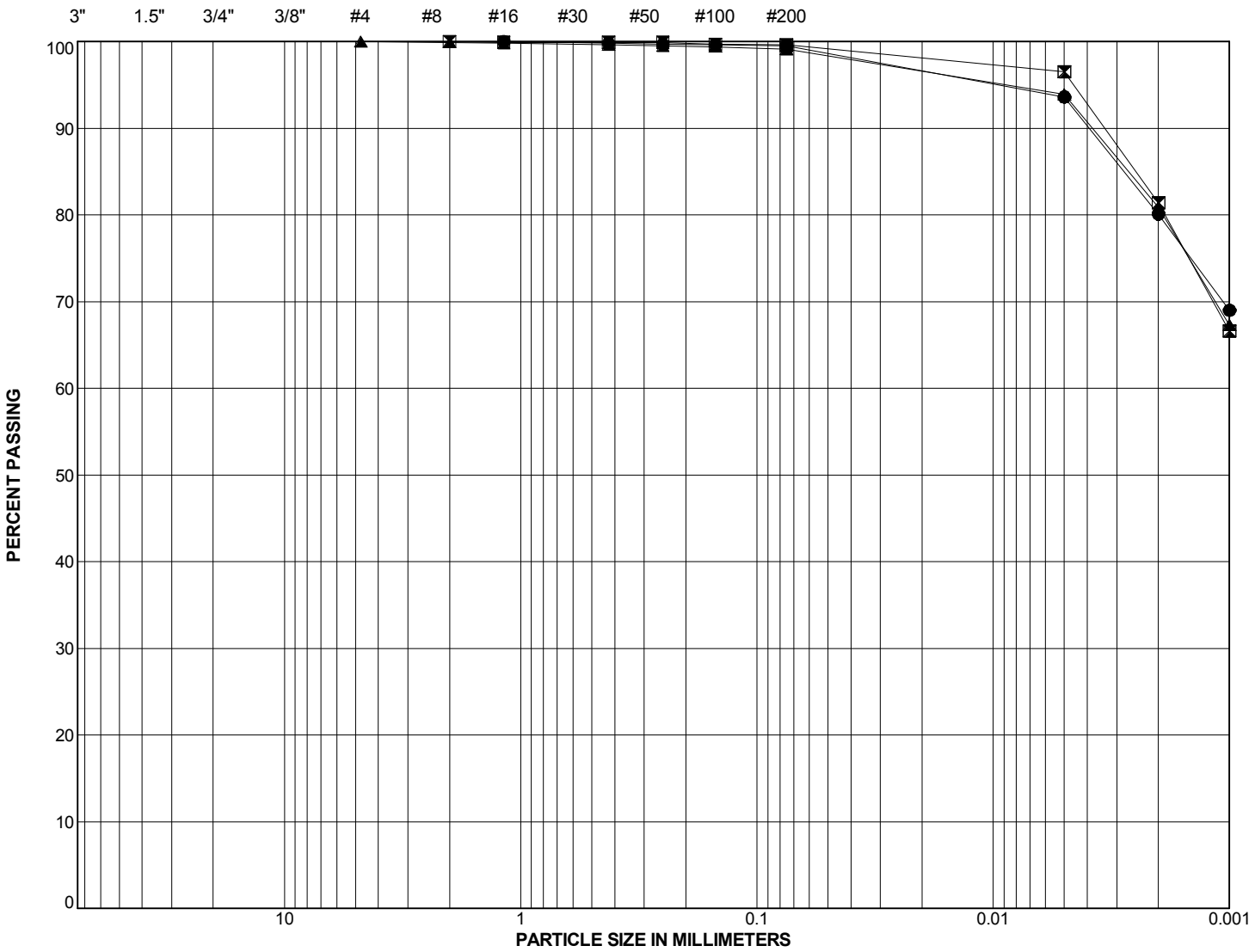
Cockburn and Calrossie Combined Sewer Relief

A-LINE PLOT

July 2017	Figure D01	Page 1 of 1

SIEVE ANALYSIS

HYDROMETER ANALYSIS



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	*TH16-06 (Shaft A)*	*6.1*	*S7*	*0.0*	*0.5*	*19.4*	*80.1*	*99.5*			*CH*
⊠	*TH16-08 (Shaft B)*	*6.1*	*S8*	*0.0*	*0.4*	*18.2*	*81.4*	*99.6*			*CH*
▲	*TH16-09 (Shaft C)*	*6.1*	*S6*	*0.0*	*0.9*	*18.2*	*80.9*	*99.1*			*CH*

KGS GROUP

CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

Cockburn and Calrossie Combined Sewer Relief

GRAIN SIZE ANALYSES

July 2017	Figure D02	Page 1 of 1

SIEVE ANALYSIS P:\PROJECTS\2011\11-0107-18\DESIGN\GEO\C5 - TAYLOR AVE (PEMBINA TO WEST OF WILTON)\LOGS\TRENCHLESSLDS_LOGS.GPJ

APPENDIX E

FLASH POINT TEST RESULTS

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 11.0107-018
Site#: PARKER SANDS
Your C.O.C. #: 00475289

Attention:Loni Andres

KGS Group
3rd Floor
865 Waverly St
Winnipeg, MB
Canada R3T 5T4

Report Date: 2016/08/17
Report #: R2239479
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B668447
Received: 2016/08/15, 15:05

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Flash Point (1)	1	N/A	2016/08/17	AB SOP-00062	ASTM D3828-12A/A m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Calgary Environmental

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Amanda Hung, B.Sc., Project Manager
Email: AHung@maxxam.ca
Phone# (204)772-7276 Ext:2215
==========
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Maxxam Job #: B668447
Report Date: 2016/08/17

KGS Group
Client Project #: 11.0107-018

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		PG5372	
Sampling Date		2016/08/15 13:30	
COC Number		00475289	
	UNITS	S1	QC Batch
Physical Properties			
Closed Cup Flash Point	deg. C	>61	8366589

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Maxxam Job #: B668447
Report Date: 2016/08/17

KGS Group
Client Project #: 11.0107-018

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	15.8°C

Results relate only to the items tested.

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Maxxam Job #: B668447
Report Date: 2016/08/17

QUALITY ASSURANCE REPORT

KGS Group
Client Project #: 11.0107-018

			RPD	
QC Batch	**Parameter**	**Date**	**Value (%)**	**QC Limits**
8366589	Closed Cup Flash Point	2016/08/17	NC	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

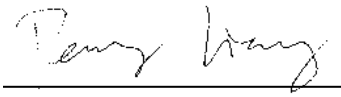
Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

Maxxam Job #: B668447
Report Date: 2016/08/17

KGS Group
Client Project #: 11.0107-018

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Harry (Peng) Liang, Senior Analyst

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Winnipeg: Unit D, 675 Berry Street R3H 1A7 Telephone (204) 772-7276 Fax (204) 772-2386

CHAIN OF CUSTODY RECORD

Maxxam Analytics Inc
6740 Campobello Road, Mississauga, ON L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5778 Toll Free: (800) 563-6266

INVOICE INFORMATION	REPORT INFORMATION (if differs from invoice)	PROJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: KGS Group	Company Name:	Quotation #:	B668447
Contact Name: Loni Andres	Contact Name:	P.O. #:	CHAIN OF CUSTODY #
Address: 3rd Floor - 865 Waverley WPG MB R3T 5P4	Address:	Project #: 11-0107-018	OO 475289
Phone: 204-896-1209 Fax:	Phone: Fax:	Project Name: Parker Lands.	
Email: landres@kgsgroup.com	Email:	Location:	
		Sampled By:	

REGULATORY CRITERIA

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form.

☐ MISA Reg. 153 Sewer Use ☐ Other
☐ Table 1 ☐ Sanitary
☐ PWQO ☐ Table 2 ☐ Storm specify
☐ Table 3 Region:
☐ Reg. 558
Report Criteria on C of A? ☐

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT:
☒ 5 to 7 Working Days

Rush TAT: Rush Confirmation #: (call Lab for #)
☐ 1 day ☐ 2 days ☐ 3 days

DATE Required:
TIME Required:

Please note that TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	Flashpoint	# of Cont.	COMMENTS / TAT COMMENTS
1	S1 PO5312	15/08/16	13:30	SOIL	N	N	X	1	
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

RELINQUISHED BY (Signature/Print)	RECEIVED BY (Signature/Print)	Date	Time
Ariel Mallory	LAURA COUPLAND	2016/08/15	15:05

Laboratory Use Only

Temperature (°C) on Receipt: 15.8, 15.8, 15.8 ice present.

Condition of Sample on Receipt: ☐ OK ☐ SIF

***MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.**

ENVCOC-ONT-05/06

White: Maxxam Yellow: Mail Pink: Client

KGS
GROUP
CONSULTING
ENGINEERS