BURNS MAENDEL
CONSULTING ENGINEERS LTD.

1331 Princess Ave.
Brandon, MB R7A 0R4
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Fax: 204.728.4418
www.bmce.ca

March 12, 2021

Director, Environmental Assessment and Licensing Branch
Manitoba Conservation
Suite 160, 123 Main Street
Winnipeg, MB R3C 1A5

Reference: Dangerous Goods Handling and Transportation Act
RM of Oakview, MB

Dear Director,

Burns Maendel Consulting Engineers Ltd. is pleased to submit an application for Dangerous Goods Handling and Transportation for the proposed Transfer Station conversion near Rapid City, Manitoba on behalf of Rural Municipality of Oakview. The transfer station will replace the existing Class 2 Waste Disposal Grounds in Rapid City, Manitoba located on SW 29-13-19 WPM.

All of the information relating to the application has been compiled in the attached document. Two (2) copies of our proposal have been included as required. If you have any questions or comments, please feel free to contact the undersigned.

Regards,

[redacted]

Daniel Burns, P.Eng.
Civil Engineer

Director, Environmental Assessment and Licensing Branch
Manitoba Conservation
Suite 160, 123 Main Street
Winnipeg, MB R3C 1A5

Transfer Station
RM of Oakview, MB

Submitted by:

Burns Maendel Consulting Engineers Ltd.
1331 Princess Ave.
Brandon, MB R7A 0R4
Tel: 204.728.7364
Fax: 204.728.4418

On behalf of:

RM of Oakview
Box 179
Oak River, MB R0K 1T0
Tel: 204.566.2146
Fax: 204.566.2126

March 12, 2021

Executive Summary

The Rural Municipality of Oakview is planning to convert the Rapid City Class 2 Waste Disposal Grounds to a Transfer Station. The disposal grounds are located approximately 1 km north of Rapid City, MB in the southwest quarter of 29-13-19 WPM. Surrounding the current waste disposal site is cultivated farmland to the north and unused pastureland owned by the RM of Oakview in all other directions. The RM of Oakview has retained Burns Maendel Consulting Engineers Ltd. (BMCE) for engineering services regarding the conversion and necessary upgrades to handle the hazardous wastes accepted by the transfer station.

The current waste disposal ground does not include a leachate management system for the hazardous waste collected at the site. The hazardous waste is placed throughout the site with no compacted liner below to prevent infiltration of the leachate. BMCE is proposing the new design for the Rapid City Transfer Station include a designated hazardous waste containment area to prevent leachate from entering the environment. The area will include a 1 m compacted clay liner, graded to collect runoff within a bermed area, and a 2.4 m page wire fence. The new containment area will hold all hazardous waste collected by the Rapid City Transfer Station until the waste is disposed of at a certified facility.

Standard Limitations

This report was prepared by Burns Maendel Consulting Engineers Ltd. (BMCE) for the account of the Rural Municipality of Oakview (the Client). The disclosure of any information contained in this report is the sole responsibility of the Client. The material in this report reflects BMCE's best judgment in light of the information available to it at the time of preparation. Should this report be used by a third party, any reliance or decisions made based on this report are the responsibility of such third party. BMCE accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions based on this report. BMCE makes no representation concerning the legal significance of the findings or the information contained within this report.

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List of Appendices

1. Introduction and Background

The Rural Municipality (RM) of Oakview has been operating a Class 2 Waste Disposal Ground (WDG) known as the Rapid City Waste Disposal Grounds (Licensing Permit No. 3011.113.5). The WDG is located on SW 29-13-19 WPM, approximately 1 km northwest of Rapid City, MB. The WDG services the residents from the Town of Rapid City and surrounding area which has an estimated population of 478.

The RM of Oakview is proposing to convert the current WDG into a Transfer Station. The RM of Oakview is proposing the new facility include a transfer station as well as accept burnable waste and various hazardous wastes. BMCE has been retained to complete the design and environmental approvals associated with the new hazardous waste containment area in addition to the transfer station conversion.

1.1. Existing Waste Disposal Ground

The Rural Municipality of Oakview is currently operating a Class 2 WDG approximately 1 km north of Rapid City, MB. The facility accepts an estimated volume of 400 tonnes/year of waste including the following waste streams:

- Household waste,
- Batteries,
- Waste oil, used oil filters and used oil containers,
- Antifreeze,
- Solvents/paints,
- Pesticide containers,
- Propane cylinders,
- Electronic Waste,
- Tires,
- Glass,
- Metals,
- Asphalt shingles, and
- Leaf and yard waste.

The current hazardous waste containment area is unlined and located throughout the waste disposal grounds. The pesticide container disposal site is fenced on three sides with 2.4 m page wire fencing and is located in the northeast corner of the facility. Used oil is currently centrally located within the facility in tanks and barrels. The burn pit located on the west side of the WDG is bermed. The Rapid City Landfill currently has no leachate pond or landfill gas management system in place.

2. Description of Proposed Development

Community consultation was not completed since this is a conversion of an existing waste disposal ground.

2.1. Certificate of Title

The legal land description where the hazardous waste containment area is situated is SW 29-13-19 WPM. The legal landowner of the existing landfill site is the RM of Oakview. Refer to Appendix A for a copy of the Certificate of Title. Additional property purchases are not required for the proposed transfer station.

2.2. Sealed Engineering Drawings

For sealed Engineering drawings detailing the proposed transfer station, refer to Appendix B.

2.3. Proposed Hazardous Waste Storage Design

The Rapid City Transfer Station will be accepting various hazardous wastes including the following:

- Batteries,
- Waste oil,
- Used oil filters and containers,
- Solvents/paints,
- Pesticide containers, and
- Propane cylinders.

The hazardous waste disposal site will consist of a bermed area that will be segregated from the rest of the transfer station. An 8 ft page wire fence will be place around the bermed area as required by MCC. To prevent any seepage of leachate into the groundwater a 1 m clay liner will be constructed below the hazardous waste containment area. The floor of the containment area is to be sloped at 1% away from the disposal area within the berm to allow leachate and runoff to be collected and pumped out if necessary.

The hazardous waste containment area has been sized to hold the leachate accumulation of a 1 in 25 year storm as per the Standards for Landfills in Manitoba. The hazardous waste area is to be monitored throughout the year to ensure the leachate does not overflow out of the confinement area. If the leachate is beginning to accumulate and there is a risk of the leachate leaving the containment area then the leachate is to be pumped out and disposed of at a registered facility.

3. Description of Pre-Development Environment

3.1. Land Use

The north half of the section is utilized by the Rapid City Landfill. The southern portion of the quarter section is unused land owned by the RM of Oakview.

3.2. Topography

The location of the transfer station will remain within the current WDG where the land is relatively flat, with a gradual slope to the south. Run off from the WDG is currently collected by a ditch south of the landfill which flows east along the access road away from the site.

3.3. Soil Conditions

The general soil stratigraphy from ground surface consists of organic topsoil overlying clay till. The clay till is silty, contains sand, trace gravel, is medium brown, moist, stiff, and medium plastic. Geotechnical information was provided by a Geotechnical Investigation Report prepared by ENG-TECH Consulting Ltd. and dated February 2020; see Appendix C.

3.4. Groundwater

Test holes completed in January 2020 were dry with no seepage or sloughing at the completion of drilling. Three monitoring wells were put in place, and checked by BMCE on February 26, 2020. Groundwater was encountered at depths of approximately 4.0 m in MW#3, 6.4m in MW#1 and 11.2m in MW#2. Groundwater impacts are anticipated to be negligible.

4. Description of Environmental and Health Effects of the Proposed Development

4.1. Impact on Biophysical Environment

The hazardous waste containment area will be constructed over the existing landfill site therefore the impact to the natural terrestrial environment is expected to be minimal. The site will be fenced in to reduce the ability for wildlife to enter the area.

No impact to the local groundwater is expected following construction of the hazardous waste containment area. A clay liner area will not allow leachate to infiltrate into the surrounding environment.

4.2. Type, Quantity and Concentration of Pollutants

4.2.1. Batteries

The RM of Oakview estimates that the Oakview transfer station will collect approximately 750 kg of battery waste each year. The batteries will be kept within the containment area on pallets.

4.2.2. Waste Oil

The RM of Oakview estimates the transfer station will receive approximately 2600 L of waste oil and 4 - 55 gal barrels of filters. Waste oil products will be stored within the containment area in storage tanks and barrels on pallets. The area will be lined with a clay liner greater than 152 mm thick in compliance with the Manitoba Hazardous Waste Legislation.

4.2.3. Solvents and Paints

The RM of Oakview estimates that the Oakview transfer station will collect approximately 500 kg of solvent and paint waste each year. The solvent and paint will be kept within the containment area on pallets to mitigate the effect of spills.

4.2.4. Pesticide Containers

The RM of Oakview estimates that the transfer station will accept 500 kg of pesticide containers each year. Pesticide containers will be kept within the fenced area of the containment area.

4.2.5. Propane Cylinders

The RM of Oakview estimates that the Oakview transfer station will collect 50 propane cylinders each year. The propane cylinders will be kept within the containment area on pallets.

4.3. Socio-Economic, Climate Change Implications

The new hazardous waste containment facility will be adequately designed to ensure environmental effects are reduced. No impact to socio-economic factors or climate is expected.

4.4. Potential Impact on Human Health and Safety

The hazardous waste containment area is approximately 645 m from the nearest residence and will be contained within a bermed area. The facility is being converted to a transfer station therefore the wastes will be relocated to be properly disposed of.

Safety features will include a 2.4 m tall fence and signs to discourage unauthorized access and to make potential danger known. The area is also surrounded by a berm to prevent any hazardous waste from leaving the containment area.

Therefore, no impact on human health and safety is expected.

5. Mitigation Measures and Residual Environmental Effects

5.1. Protection

Practices to be used during construction of the transfer station are common to projects of a similar nature. As there is already an existing facility, and the conversion will be built on the current site, we anticipate that the proposed design will not adversely affect the environment. A clay-lined leachate pond will provide environmentally sound storage for any leachate leaving the hazardous waste disposal area.

5.2. Monitoring

On-going monitoring of the transfer station will be performed to ensure the proper functioning of the transfer station. Regular inspection will ensure that there is no leachate leaving the facility. The general condition of the transfer station will be observed on an ongoing basis.

Appendix A – Certificate of Title

STATUS OF TITLE

Title Number **2249824/5**
Title Status **Accepted**
Client File 19-103

Manitoba Land Titles Registry

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

TOWN OF RAPID CITY

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON IN THE FOLLOWING DESCRIBED LAND:

AT RAPID CITY AND BEING:
LOTS 1 AND 2 PLAN 216 NLTO
EXC: RIGHT-OF-WAY OF CANADIAN NORTHERN RAILWAY PLAN 406 NLTO
SUBJECT TO SPECIAL RESERVATIONS AS TO MINES MINERALS AND OTHER MATTERS AS PARTICULARLY DEFINED IN THE ORIGINAL GRANT FROM THE CROWN IN S 1/2 29-13-19 WPM

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act.*

2. ACTIVE INSTRUMENTS

No active instruments

3. ADDRESSES FOR SERVICE

TOWN OF RAPID CITY
BOX 146
RAPID CITY MB
R0K 1W0

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Neepawa

6. DUPLICATE TITLE INFORMATION

Duplicate Produced for: HOLD FOR PROD OF DUPL CT NO(S)
214420
SIMS & CO., MINNEDOSA
1988/08/17

7. FROM TITLE NUMBERS

214420/5 All

8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS

No real property application or grant information

9. ORIGINATING INSTRUMENTS

Instrument Type:	**Request Electronic Title Conversion**
Registration Number:	**1060202/5**
Registration Date:	2007-09-10
From/By:	NLTO - INTERNAL
To:	
Amount:	

10. LAND INDEX

Lot 1 Plan 216
IN S 1/2 29-13-19W EX RLY PLAN 406 EX RES

Lot 2 Plan 216
IN S 1/2 29-13-19W EX RLY PLAN 406 EX RES

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 2249824/5

Appendix B – Drawing Package

Appendix C – Geotechnical Investigation

Submitted to: **Burns Maendel Consulting Engineers Ltd.**

GEOTECHNICAL INVESTIGATION

RAPID CITY LANDFILL
SW-29-13-19W, RAPID CITY, MANITOBA

FEBRUARY 2020

FILE NO.: 19-398-07

ENG-TECH CONSULTING LIMITED

"Engineering and Testing Solutions That Work for You"

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Winnipeg, Manitoba
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YEARS OF EXCELLENCE

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1.0 INTRODUCTION

ENG-TECH Consulting Limited (ENG-TECH) was retained by Burns Maendel Consulting Engineers (BMCE) Ltd. to conduct a geotechnical investigation for a proposed transfer station located at the Rapid City Landfill located at SW-29-13-19W near the Town of Rapid City, Manitoba (in this report the property will subsequently be referred to as "the Site").

The purpose of the geotechnical investigation was to determine the soil profile and strata at selected borehole locations in the footprint of the proposed development and within the footprint of the old cell, install monitoring wells in the vicinity of the proposed station, comment on the soil permeability as outlined in the Standards for Landfills in Manitoba.

1.1 Scope of Work

ENG-TECH completed the following scope of work:

- Reviewed existing information about the site.
- Conducted a test hole drilling and soil sampling program consisting of drilling a total of seven (7) test holes with three (3) test holes to 12 m below grade (mbg), two (2) test hole to 9 mbg and two (2) test holes to 3 mbg.
- Installed three monitoring wells in the 12 m deep test holes.
- Conducted a laboratory testing program at ENG-TECH's Winnipeg laboratory consisting of moisture contents (44), Atterberg Limits (3), particle size analysis (3), and hydraulic conductivity (3).
- Surveyed the test hole UTM coordinates and all groundwater monitoring wells by means of GPS survey equipment.
- Prepared a report summarizing the findings of the field program and laboratory analyses, and assessment of the soils as outlined in the *Standards for Landfills in Manitoba* published by Manitoba Conservation and Climate (MCC, formerly Manitoba Sustainable Development) in 2016.

2.0 SITE ASSESSMENT

2.1 Groundwater Maps

A review of the *Groundwater Availability Map Series for the Winnipeg Area 62-H* (Manitoba Natural Resources, 1980) provided the following information:

Site Geology and Groundwater

Map Name	Details
Figure 3: Drift Thickness	<30.5 m (<100 feet)
Figure 4: Bedrock Geology	Riding Mountain Formation (Millwood Member): light to dark grey, green to grey green soft bentonitic shale and bentonite. Concretions are common.

Site Geology and Groundwater

Map Name	Details	
Figure 5: Bedrock Topography	442.0 m (1450 feet)	
Figure 6: Surface Deposits Map	Till	
Figure 7: Section A-A'	Till	0 to 22.9 m (0 to 75 feet)
	Sand	22.9 to 29.0 m (75 to 95 feet)
	Till	29.0 to 80.8 m (95 to 265 feet)
	Till & Gravel	80.8 to 103.0 m (265 to 338 feet)
	Bedrock	103.0 to 110.5 m (338 to 363 feet)
Figure 8: Section B-B'	Till	0 to 106.7 m (0 to 350 feet)
	Bedrock	106.7 to 109.7 m (350 to 360 feet)
Note: The cross section for Figure 7 was approximately 6.5 km south of the Site. The cross-section for Figure 8 was approximately 6.5 km north of the Site		

According to the Drift Thickness map, less than 30 m of till would be expected over the bedrock at the Site.

According to the cross-sections, the clay till soils would be expected to extend to a depth of 100 m with occasional sand layers and gravelly till at deeper intervals. Bedrock would be expected to be encountered at approximately 100 mbg. Since the cross-sections are approximately 6.5 km from the Site, they may not be representative of the Site conditions since the soils can vary considerably over that distance.

2.2 Test Hole Drilling and Field Program

2.2.1 Test Hole Rationale

Seven test holes were drilled at the Site. Five of the test holes (TH1 to TH5) were drilled based on the requirements of Section 3.1.1 of the Standards for Landfills in Manitoba since the size of the Site is less than 8.9 hectares (20 acres). Two of the test holes (TH6 and TH7) were drilled to determine the thickness of the refuse at an existing capped landfill cell.

Test hole locations are presented on Figure 1.

2.2.2 Test Hole Drilling

ENG-TECH supervised the drilling of seven (7) test holes (TH1 to TH7) on January 9 and 10, 2020. The test holes were drilled using a track-mounted Acker SX drill rig equipped with 125 mm diameter solid stem continuous flight augers owned and operated by Paddock Drilling Ltd. Three of the test holes (TH1, TH4 and TH5) were completed as groundwater monitoring wells at depths ranging from 12.1 to 12.2 mbg; the remaining test holes were backfilled using the auger cuttings and bentonite upon the completion of drilling.

The soil stratigraphy was visually classified at the time of drilling using the modified Unified Soil Classification System (USCS). Soil samples were collected off the auger flights in all test holes at regular depths. All soil samples were retained for testing in ENG-TECH's Winnipeg laboratory. Where possible, the consistency of the encountered cohesive soils was assessed in the field using a soil pocket penetrometer and/or pocket vane shear.

Photographs taken during the drilling program are attached in Appendix A. Test hole logs summarizing the soil conditions are attached in Appendix B.

2.2.3 Stratigraphy

The following summarizes the general soil profile at the Site:

Soil Stratigraphy

Depth (m)		Soil Description
0	0.1	TOPSOIL, dark grey
0.1	8.7	CLAY TILL, medium brown, medium plastic, moist, stiff.
8.7	12.2	CLAY TILL, medium grey, medium plastic, moist, stiff.

Underlying a thin layer of topsoil, the clay till layer was encountered to completion of all test holes. The clay till layer changed from brown to grey at depths ranging from 7.6 to 9.8 mbg.

At the time that the groundwater monitoring wells were installed, there was no water observed. Although free water was not observed during drilling (with the exception of TH3 where the garbage/debris was saturated), the change from brown to grey till may indicate the approximate water table. According to locals, groundwater may be deeper than the maximum depth drilled (i.e., 12.2 mbg). Groundwater monitoring was not included in the scope of work since this was to be completed by BMCE Ltd.

The GPS coordinates and elevations of the monitoring wells and test holes are summarized in the following table:

Test Hole Coordinates and Elevations

Test Hole	UTM Coordinates (WSG84)		Ground Elevation (m)	Top of Well Elevation (m)
	UTM	14U		
TH1	5553403.63	425276.82	500.02	501.20
TH2	5553543.40	425288.39	502.10	-
TH3	5553495.25	425193.25	501.71	-
TH4	5553554.53	425103.53	501.32	502.51
TH5	5553405.67	425123.14	500.16	501.16
TH6	5553568.88	425174.49	502.04	-
TH7	5553570.99	425207.47	502.55	-

2.3 Laboratory Analyses

Soil samples were submitted for the following analyses:

- Moisture contents for all soil samples collected (44);
- Three (3) Atterberg Limit tests;
- Three (3) particle size (hydrometer) tests; and
- Three (3) hydraulic conductivity tests.

The analytical results for the moisture contents and Atterberg Limits are presented on the test hole summary logs. The laboratory results are summarized in Table 1 (Particle Size Analyses) and Table 2 (Hydraulic Conductivity Test Data).

2.4 Findings

2.4.1 Analytical Results

ENG-TECH conducted hydraulic conductivity testing from three (3) Shelby tube samples. The Shelby tube samples were extracted on January 17, 2020 at the ENG-TECH laboratory. The soil samples were prepared for testing in accordance with ASTM D5084-16a, *Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*.

The following table summarizes the analytical results for the particle size analyses and final hydraulic conductivity values (k_{20}):

Particle Size Analysis and Hydraulic Conductivity

Test Hole	Depth (m)	Hydrometer				Hydraulic Conductivity (cm/sec)
		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	
TH1	3.3	6.5	35.3	34.1	24.0	1.37×10^{-7}
TH4	1.2	0.0	19.9	49.7	30.4	8.00×10^{-8}
TH5	1.8	1.1	38.6	35.6	24.7	1.51×10^{-8}

The following table summarizes the analytical results for Atterberg Limits:

Atterberg Limits

Test Hole	Depth (m)	Atterberg Limits		
		Plastic Limit (PL) (%)	Liquid Limit (LL) (%)	Plasticity Index (PI) (%)
TH1	1.5	18	44	26
TH4	0.8	20	52	32
TH5	0.8	19	50	31

Based on the soil testing, the primary soil type encountered at the site would be considered medium plastic clay. The hydraulic conductivities of the non-worked clay till ranged from 1.37×10^{-7} to 1.51×10^{-8} cm/sec.

The hydraulic conductivity test data is outlined in Table 2, while the graphical representations of the hydraulic conductivity versus elapsed time are presented in Charts 1 to 3. Photographs of the hydraulic conductivity samples are attached.

2.4.2 Waste Materials

Waste materials were encountered in two test holes at the Site (TH3 and TH7). At TH3, waste materials were encountered from approximately the surface to 2.9 mbg; at TH7, waste materials at TH7 were encountered from 0.8 to 1.5 mbg, beneath a 0.8 m thick cap constructed from clay till. The waste materials at TH3 did not appear to be capped.

The waste materials consisted of various refuse including clothes, household waste and organic matter (e.g., tree branches) (see photograph #4). The garbage/debris was saturated at TH3 since this location was not capped and precipitation likely collected in the less dense waste materials and perched above the underlying plastic clay till soil. The garbage/refuse at TH7 had a strong nuisance odour.

No waste materials were encountered at TH6 where the old landfill cell was originally suspected to be. An additional test hole (TH7) was drilled to the east of TH6 since the topography appeared to be "humped" and therefore suspected to be a landfill cap on an old cell. It was not possible to drill to the west of TH6 since this location had piles of soil and debris placed in this area (see photograph #3).

2.5 Discussion

According to the Standards for Landfills in Manitoba (2016), the soil used in the construction of a landfill must achieve a permeability of $1x10^{-7}$ cm/s or less. If the construction will consist of cut-and-fill clay cells (i.e., non-reworked soil) then the required permeability would be $1x10^{-8}$ cm/s or less.

In general the upper soil layer (represented by TH4 at 1.2 m and TH5 at 1.8) was more plastic when compared with the deeper soil layer (represented by TH1 at 3.4 m). The deeper soil sample also had a higher gravel content (6.5% vs 1%). As a result, the hydraulic conductivity for the deeper soil sample was higher than the other two samples.

None of the samples analyzed for hydraulic conductivity were able to achieve the guideline for non-reworked soil; however, the soil should be suitable for use as a reworked clay liner as the soil, on average, has hydraulic conductivity lower than $1x10^{-7}$ cm/s.

Although not directly applicable, MCC has the following requirements for soil to be used for clay liners for manure storages:

- Percent fines ≥ 50%;
- Clay content ≥ 15%;
- Sand content ≤ 45%;
- Plasticity index (PI) ≥ 16%
- Liquid limit (LL) ≥ 30%

All three soil samples met the above criteria.

3.0 RECOMMENDATIONS AND CONCLUSIONS

3.1 Soil Quality

ENG-TECH concludes that the soil types encountered at the Site would be suitable for use in construction of a clay liner. ENG-TECH recommends that the more shallow soil (i.e., less than 3.0 mbg) be used since it appears to have a lower hydraulic conductivity and higher plasticity that the deeper soil (i.e., greater than 3.0 mbg).

3.2 Inspection and Testing

The following inspection and testing by ENG-TECH will aid to ensure quality control during construction and that our recommendations are being met:

- Sub-grade Inspection

  The soil at the site can vary and there is a potential of encountering softer, wetter or siltier soil layers. Gravel content may also result in higher permeability of the soils used in the construction of the clay liners. Inspection will help to identify the soft soils and provide recommendations to deal with this potential concern on site as required.

- Hydraulic Conductivity Testing

  Testing of insitu soils is typically required by MCC to confirm that clay materials (including clay liners) have achieved the permeability of $1x10^{-7}$ cm/s or less. ENG-TECH can supervise the collection of the insitu samples and conduct the laboratory testing.

- Density Testing

  Density testing on the new clay liner construction will confirm the densities specified by MCC have been achieved.

- Annual Groundwater Monitoring

  Annual groundwater monitoring and sampling is typically required as a part of landfill and transfer station permits. Compliance with this requirement will ensure that any potential environmental concerns are identified and no enforcement action will be taken by the province due to a lack of compliance with the permit.

4.0 THIRD PARTY USE AND STATEMENT OF LIMITATIONS

This report has been prepared for Burns Maendel Consulting Engineers Ltd. 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 party. ENG-TECH Consulting Limited 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.

The findings and recommendations presented in this report were based on the scope of work outlined for the purpose of the geotechnical investigation and were prepared in accordance with generally accepted principles and practices. The findings and recommendations are based on the results of field and laboratory investigations, combined with the soil and groundwater conditions encountered. Other materials or compounds not investigated or addressed or beyond the scope of work could be present at the Site. If conditions encountered during construction appear to be different from that reported by ENG-TECH Consulting Limited 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.

5.0 CLOSURE

This report was based on the scope of work outlined for the purpose of the investigation, and was prepared in accordance with acceptable professional engineering principles and practices. If you have any questions, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

[redacted]

Walter Holowka, C.E.T., N.C.S.O.
Senior Geoenvironmental Technologist

CDH/wgh

[redacted]

Reviewed By:

[redacted]

Clark Hryhoruk, M.Sc., P.Eng.
Principal

[redacted]

1999 20 2019
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LABORATORY REPORTS

ENG-TECH CONSULTING LIMITED
"Engineering and Testing Solutions That Work for You"

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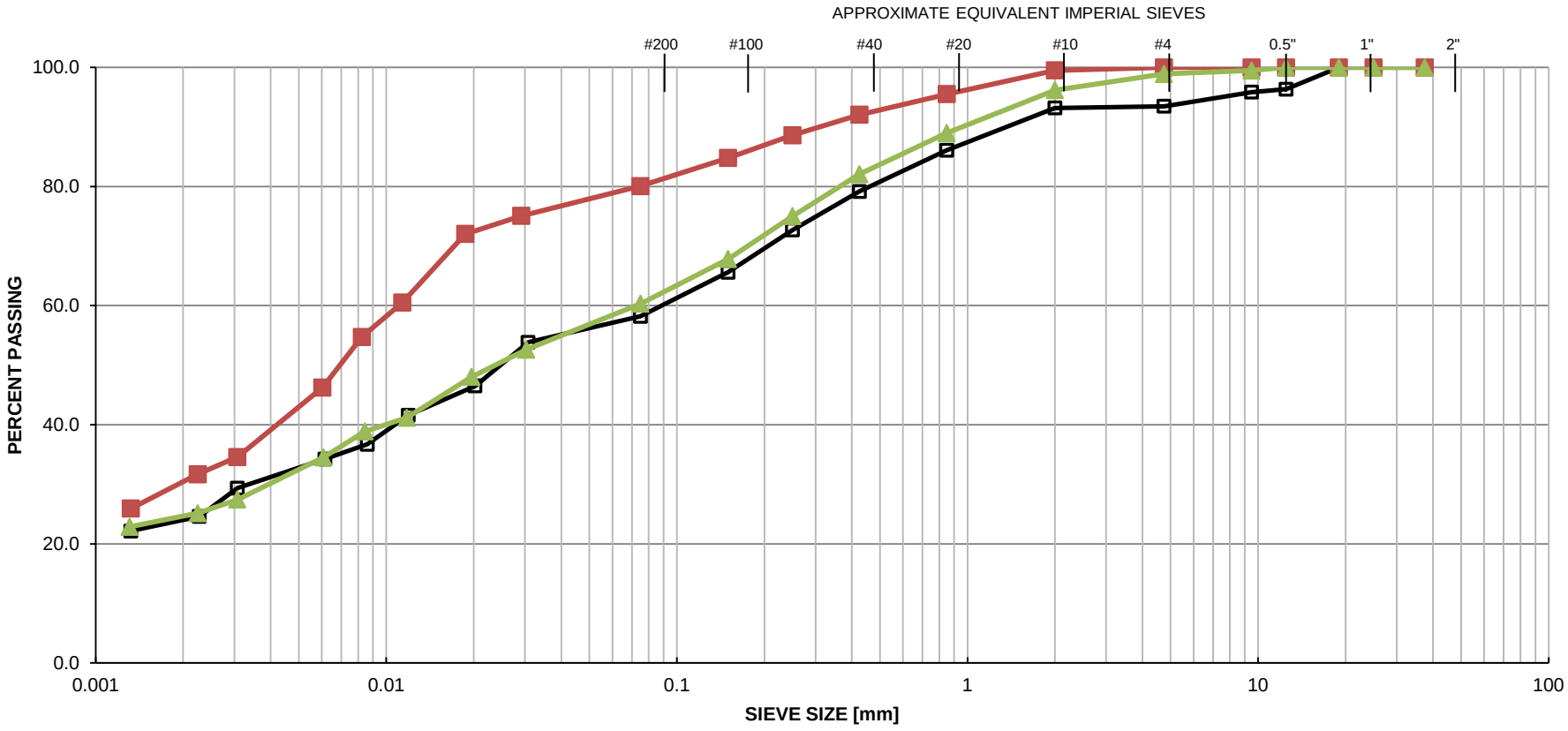
File No.: 19-398-07

TABLE 1 PARTICLE SIZE ANALYSIS

CLAY	SILT	SAND			GRAVEL	
		FINE	MEDIUM	COARSE	FINE	COARSE



Test Hole:	Sample:	Depth:	Reference No.:	Components:
1	S5	3.0 - 3.7 m	19-398-7-3	Gravel (6.5 %), Sand (35.3 %), Silt (34.1 %), Clay (24.0 %)
4	S2	0.9 - 1.5 m	19-398-7-6	Gravel (0.0 %), Sand (19.9 %), Silt (49.7 %), Clay (30.4 %)
5	S3	1.5 - 2.1 m	19-398-7-9	Gravel (1.1 %), Sand (38.6 %), Silt (35.6 %), Clay (24.7 %)

TABLE 2 HYDRAULIC CONDUCTIVITY TEST DATA RAPID CITY LANDFILL			
SAMPLE ID	**TH1 – S5**	**TH4 – S2**	**TH5 – S3**
INITIAL VALUES			
ENG-TECH Reference No.	19-398-7-4	19-398-7-7	19-398-7-10
Length of Sample in Tube (cm)	~60	~60	~60
Length (cm)	7.04	7.07	7.16
Diameter (cm)	7.15	7.13	7.10
Area (cm^2)	40.1	39.9	39.6
Volume (cm^3)	282.5	282.1	283.3
Water Content (%)	20.5	25.3	20.8
Bulk Dry Density (kg/m^3)	1714	1660	1738
Specific Gravity (G_s) (assumed)	2.66	2.70	2.70
Void Ratio	0.552	0.627	0.554
Degree of Saturation (%)	~100	~100	~100
FINAL VALUES			
Length (cm)	7.03	7.00	7.12
Diameter (cm)	7.15	7.16	7.10
Area (cm^2)	40.1	40.2	39.6
Volume (cm^3)	282.1	281.7	281.8
Water Content (%)	20.1	20.7	19.3
Bulk Dry Density (kg/m^3)	1733	1732	1776
Specific Gravity (G_s) (assumed)	2.66	2.70	2.70
Void Ratio	0.535	0.559	0.520
Degree of Saturation (%)	~100	~100	~100
CONSOLIDATION PHASE			
Confining Pressure (kPa)	103.4	103.4	103.4
Pore Water Pressure (kPa)	82.7	82.7	82.7
Effective Stress (kPa)	20.7	20.7	20.7
PERMEATION PHASE			
Confining Pressure (kPa)	103.4	103.4	103.4
Pore Water Pressure (kPa)	82.7	82.7	82.7
Effective Stress (kPa)	20.7	20.7	20.7
Hydraulic Gradient	15.4	15.4	15.4
Permeant Fluid	Potable Tap Water		
HYDRAULIC CONDUCTIVITY AT TEST TEMPERATURE: 20°C (cm/sec)	1.37×10^{-7}	8.00×10^{-8}	1.51×10^{-8}
HYDRAULIC CONDUCTIVITY TEMPERATURE CORRECTED TO 20°C (K_{20}) (cm/sec)	1.37×10^{-7}	8.00×10^{-8}	1.51×10^{-8}

Chart 1: Hydraulic Conductivity Versus Elapsed Time
Rapid City Landfill: Sample TH1-S5

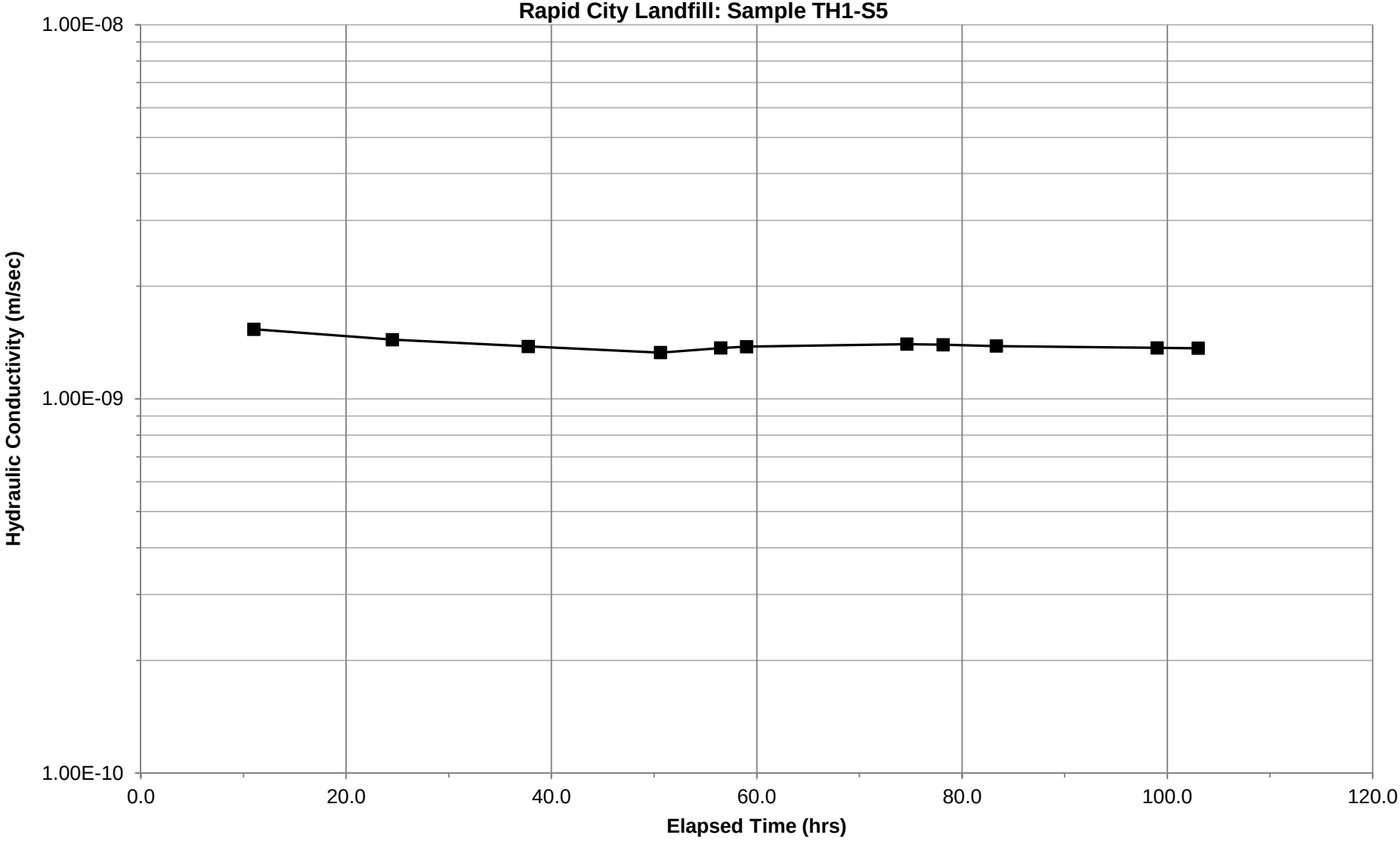


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Chart 2: Hydraulic Conductivity Versus Elapsed Time
Rapid City Landfill: Sample TH4-S2

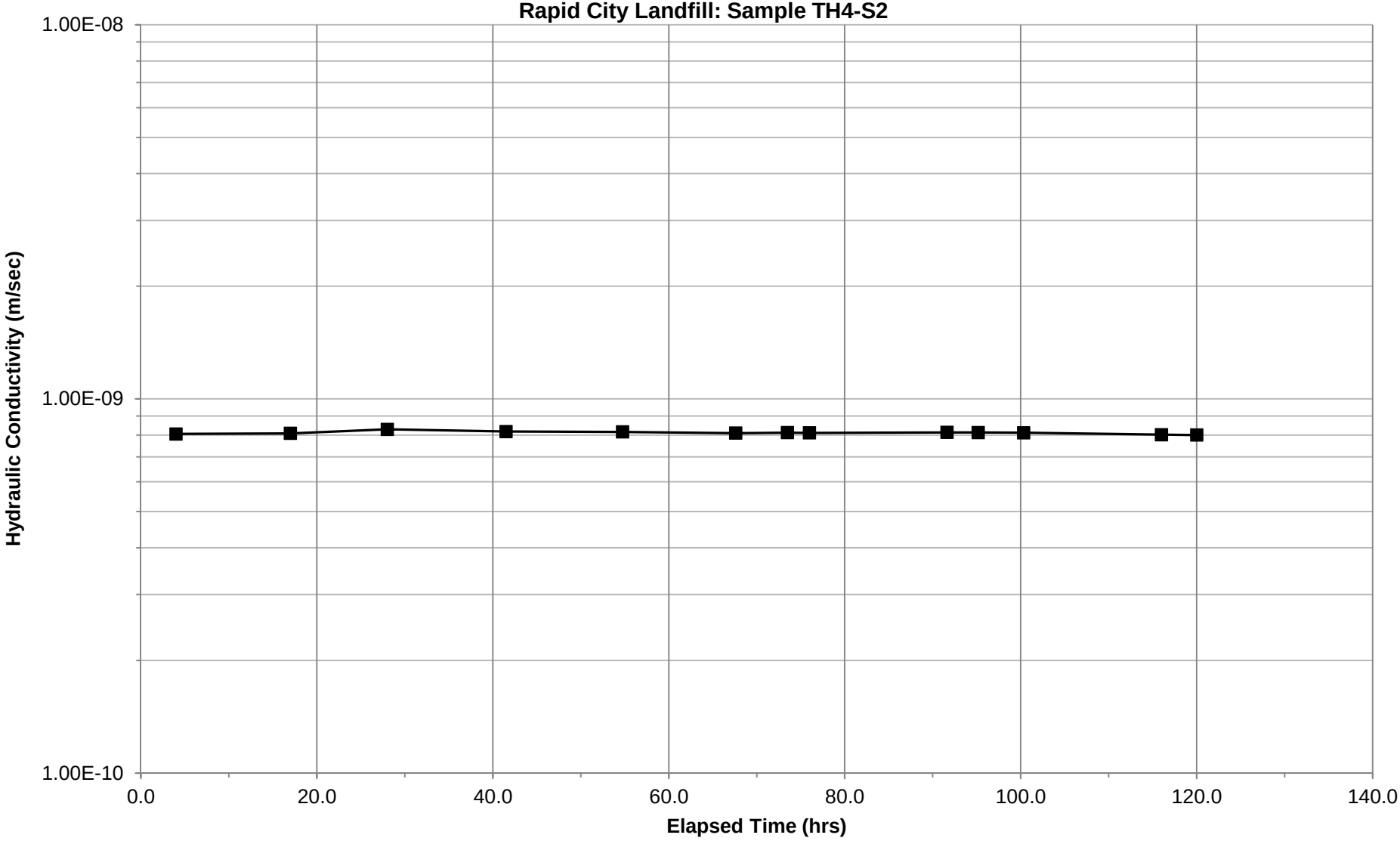

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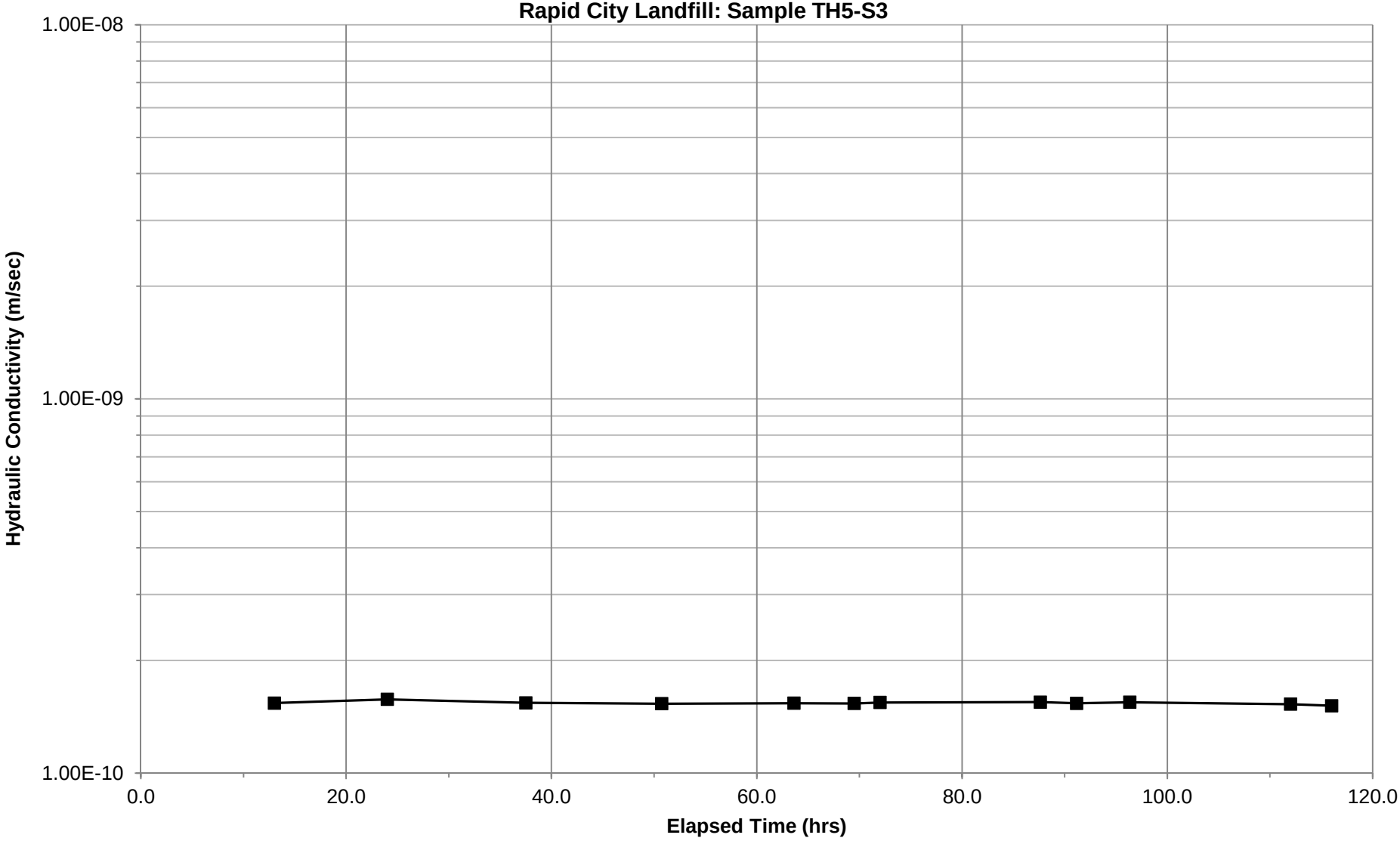
Chart 3: Hydraulic Conductivity Versus Elapsed Time
Rapid City Landfill: Sample TH5-S3



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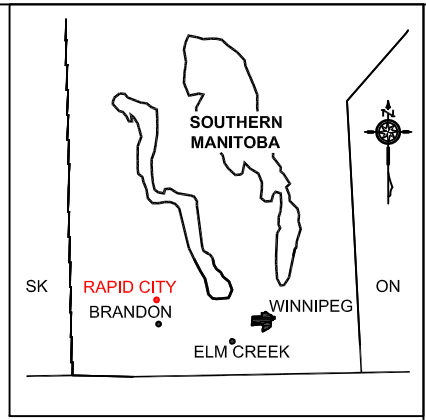
FIGURES

Figure 1 – Test Hole and Monitoring Well Locations

GPS COORDINATES OF TEST HOLES		
TEST HOLE	COORDINATE DATUM: WSG84	
	UTM	14U
TH1	5553404	425277
TH2	5553543	425288
TH3	5553495	425193
TH4	5553555	425104
TH5	5553406	425123
TH6	5553569	425174
TH7	5553571	425207

IMAGE © 2019 CNES / AIRBUS, GOOGLE EARTH (IMAGE DATE: JULY 5, 2019)

0 25m 50m 75m 100m 200m 300m
SCALE



KEYMAP - MB

LEGEND

TEST HOLE

MONITORING WELL (ENG-TECH)

NO.	DATE	ISSUE / REVISION
0	FEB 2020	REPORT

ENG-TECH CONSULTING LIMITED
420 Turenne Street
Winnipeg, MB
R2J 3W8
Phone: (204) 233-1694
Fax: (204) 235-1579

ENG. STAMP:

CLIENT:
BMCE LTD.

PROJECT:
GEOTECHNICAL INVESTIGATION
RAPID CITY LANDFILL, SW-29-13-19W
RAPID CITY, MANITOBA

DWG DESCRIPTION:
TEST HOLE AND MONITORING WELL LOCATIONS

SCALE:
1:2000

DRAWN BY: WGH
DATE: FEBRUARY 2020

FILE No.: 19-398-07
CLIENT DWG/FIG. No.:

ENG-TECH DWG/FIG. No.: 1
NO.: 0

P:\2019\398(Burns Maendel)\07(Geo_Rapid City Landfill)\Report\19-398-07 Figure 1 Site Plan.dwg

APPENDICES

Appendix A – Photographs
Appendix B – Test Hole Logs

APPENDIX A

Photographs (7)

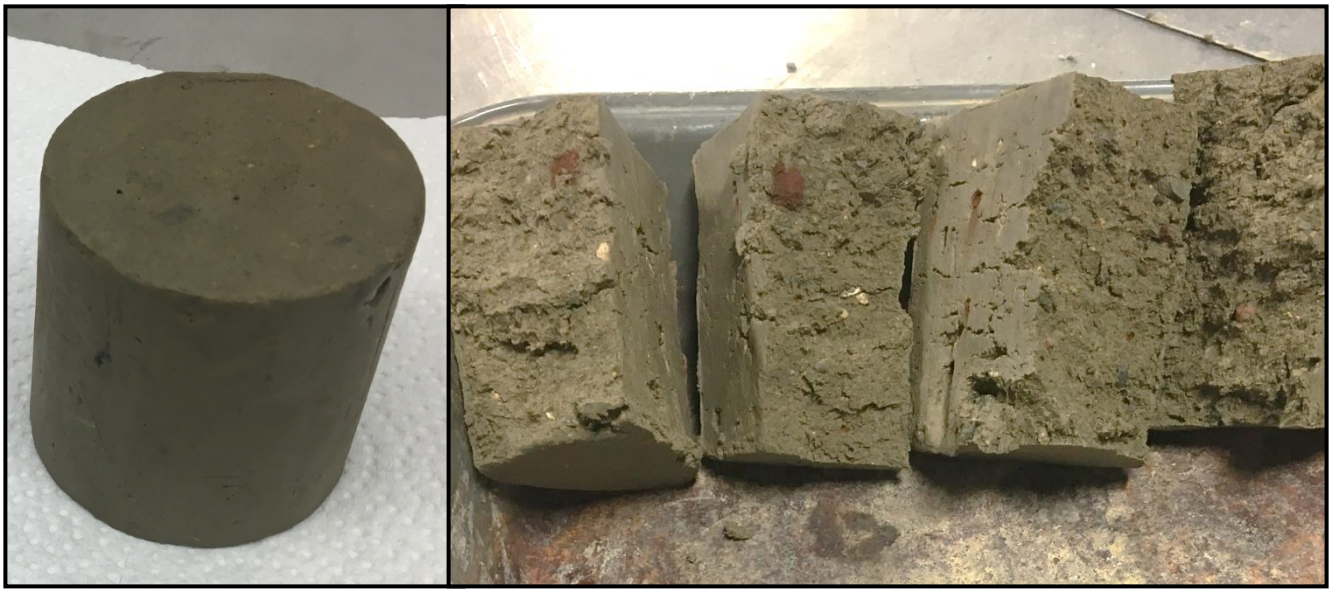
PHOTOGRAPH #1: Drilling at TH2 as seen facing southwest.

PHOTOGRAPH #2: View of TH4 as seen facing north.

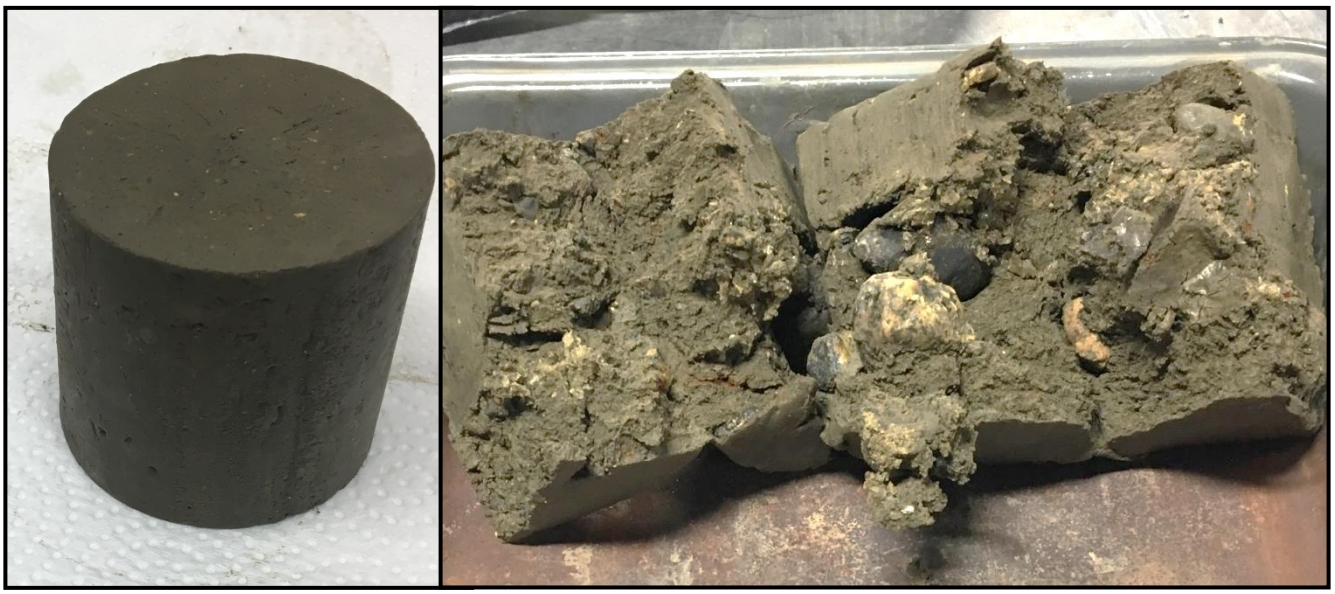
PHOTOGRAPH #3: Landfill cell at the northern portion of the Site.

PHOTOGRAPH #4: Waste materials encountered during drilling at TH3.

PHOTOGRAPH #5: Sample TH1-S5 after hydraulic conductivity testing.



PHOTOGRAPH #6: Sample TH4-S2 after hydraulic conductivity testing.



PHOTOGRAPH #7: Sample TH5-S3 after hydraulic conductivity testing.

APPENDIX B

Test Hole Logs (7)

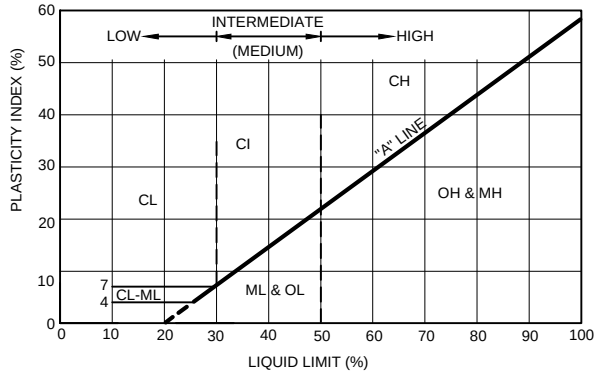
MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75 mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ TO 3
			GP		POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND P.I. MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75 mm	CLEAN SANDS (TRACE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ TO 3
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND P.I. MORE THAN 7
FINE GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	LL ≤ 50%	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHTY PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		LL > 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	LL ≤ 30%	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < LL ≤ 50%	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		LL > 50%	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	LL < 50%	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		LL > 50%	OH		ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

ADDITIONAL SYMBOLS

TILL		SANDSTONE	
		GRANITE	
FILL			
TOPSOIL			
CONCRETE			
SHALE			
LIMESTONE			

PLASTICITY CHART FOR SOILS PASSING 425 µm SIEVE



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PLASTIC SOILS

MOISTURE	PLASTICITY	INTRUSIONS	CONSISTENCY	POCKET PEN (TSF)	(N)
DRY	LOW	ROOTLETS	VERY SOFT		< 2
DAMP	MEDIUM	OXIDES	SOFT	0 - 0.5	2 - 4
MOIST	HIGH	MICA	FIRM	0.5 - 1.0	4 - 8
WET		GYPSUM	STIFF	1.0 - 2.0	8 - 15
		ETC.	VERY STIFF	2.0 - 4.0	15 - 30
			HARD	> 4.0	> 30

TSF x 95.8 = kPa (q_U) $S_U = \frac{1}{2} \times q_U$

SOIL DESCRIPTIONS

TRACE:	0 - 10%	BOULDERS:	> 200 mm	COARSE SAND:	2 - 4.75 mm
SOME:	10 - 20%	COBBLES:	75 - 200 mm	MEDIUM SAND:	0.425 - 2 mm
WITH:	20 - 35%	COURSE GRAVEL:	19 - 75 mm	FINE SAND:	0.075 - 0.425 mm
AND:	35 - 50%	FINE GRAVEL	4.75 - 19 mm	FINES:	< 0.075 mm

GRANULAR SOILS

MOISTURE	DENSITY	GRADATION	INTRUSIONS	SPT (N)
DRY	VERY LOOSE	POORLY	ROOTLETS	0 - 4
DAMP	LOOSE	WELL	OXIDES	4 - 10
MOIST	MED. DENSE		MICA	10 - 30
WET	DENSE		FINES	30 - 50
	VERY DENSE		ETC.	> 50

DEFINITIONS

LL = LIQUID LIMIT
P.I. = PLASTICITY INDEX
C_U = COEFFICIENT OF UNIFORMITY
q_U = UNCONFINED COMPRESSIVE STRENGTH
S_U = UNDRAINED SHEAR STRENGTH
C_C = COMPRESSION INDEX
PL = PLASTIC LIMIT

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ENG-TECH CONSULTING LIMITED

Engineering And Testing Solutions That Work For You

Monitoring Well #: TH1 (MW1)

Client: BMCE Ltd.
Site: See Figure 1
Location: Rapid City Landfill, Manitoba
Project: Geotechnical Investigation

File No.: 19-398-07
Date Drilled: January 9, 2020
Grade Elevation: 500.0 m
Water Elevation: --

Depth (m)	Description	Elevation (m)	Sample No.	Sample Type	Moisture Content (%)
0.0	Ground Surface	500.0			
	Topsoil (OH) (75 mm) - dark grey, with clay, some silt.		S1		21.3
1.0	*Clay Till (Cl)* - medium brown, moist, stiff, medium plastic, with silt, with sand, trace gravel, oxidation.	499.0	S2		20.1
2.0		498.0	S3		20.2
3.0		497.0	S4		20.0
			S5		20.5
4.0		496.0	S6		19.4
5.0		495.0			
6.0		494.0	S7		19.6
7.0		493.0	S8		19.2
8.0		492.0			
9.0	- below 9.1 m medium grey.	491.0	S9		18.7
10.0		490.0			
11.0		489.0	S10		18.7
12.0		488.0	S11		19.1
	End of Test Hole - end of test hole at 12.2 m. - no seepage or sloughing observed immedately after completion of drilling. - 50 mm PVC monitoring well installed at 12.2 m below grade.				
13.0		487.0			
14.0		486.0			
15.0		485.0			
16.0		484.0			

Moisture Content (%): PL I----------X----------I LL; 20 40 60 80

Below Grade Well Completion Details:
- top of pipe at 1.2 m above grade
- bentonite seal from surface to 7.0 m
- solid 50 mm PVC to 7.6 m
- filter sand from 7.0 m to 12.2 m
- slotted 50 mm PVC to 12.2 m
- ▼ - no water on Jan 9, 2020

ENG-TECH Consulting Limited

Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.
Drill Rig: Acker SX
Auger Size: 125 mm

Completion Depth: 12.2 m
Completion Elevation: 487.8 m
Sheet: 1 of 1

Sample Type — Split Barrel | Shelby Tube | Auger Cuttings | Split Spoon

ENG-TECH CONSULTING LIMITED

Engineering And Testing Solutions That Work For You

Test Hole #: TH2

Client: BMCE Ltd.

Site: See Figure 1

Location: Rapid City Landfill, Manitoba

Project: Geotechnical Investigation

File No.: 19-398-07

Date Drilled: January 9, 2020

Grade Elevation: 502.1 m

Water Elevation: --

Depth (m)	Description	Elevation (m)	Sample No.	Sample Type	Moisture Content (%)	Blows/300 mm	P. Pen	Torvane	UC
0.0	Ground Surface	502.1							
	Topsoil (OH) (100 mm) - dark grey, with clay, some silt.		S1		23.0		144		
1.0	*Clay Till (CI)* - medium brown, frozen, medium plastic, with silt, with sand, trace gravel, oxidation. - below 0.5 m moist, stiff.	501.0	S2		19.3		108		
2.0		500.0	S3		19.7		96		
3.0			S4		19.6		96		
4.0		499.0							
		498.0	S5		18.3		96		
5.0		497.0							
6.0		496.0	S6		17.9		96		
7.0	- below 7.6 m medium grey, no oxidation.	495.0	S7		18.7		96		
8.0		494.0							
9.0		493.0	S8		19.3		96		
	End of Test Hole - test hole completed at 9.1 m below grade - no sloughing or seepage observed immediately after completion of drilling. - test hole backfilled with auger cuttings and bentonite.								
10.0		492.0							
11.0		491.0							
12.0									

Moisture Content (%): PL I----------X----------I LL (20, 40, 60, 80)

SHEAR STRENGTH (kPa)

ENG- TECH Consulting Limited

Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.

Drill Rig: Acker SX

Auger Size: 125 mm

Completion Depth: 9.1 m

Completion Elevation: 493.0 m

Sheet: 1 of 1

SAMPLE TYPE — SPLIT BARREL — SHELBY TUBE — AUGER CUTTINGS — SPLIT SPOON

ENG-TECH CONSULTING LIMITED

Engineering And Testing Solutions That Work For You

Test Hole #: TH3

Client: BMCE Ltd.
Site: See Figure 1
Location: Rapid City Landfill, Manitoba
Project: Geotechnical Investigation

File No.: 19-398-07
Date Drilled: January 9, 2020
Grade Elevation: 501.7 m
Water Elevation: --

Depth (m)	Description	Elevation (m)	Sample No.	Sample Type	Moisture Content (%)	Blows/300 mm	P. Pen	Torvane	UC
0.0	Ground Surface	501.7							
	Debris/Garbage - moist to wet, various garbage including clothing, branches and paper products.								
1.0		501.0							
	- below 1.2 m black, wet to saturated.								
2.0		500.0							
		499.0							
3.0	***Clay Till (Cl)*** - medium brown, moist, stiff, medium plastic, with silt, with sand, trace gravel, oxidation.		S1		21.8		96		
4.0		498.0							
			S2		20.7		96		
5.0		497.0							
6.0		496.0	S3		21.1		96		
	- below 6.1 m dark brown.	495.0							
7.0			S4		19.8		96		
8.0	- below 7.6 m medium grey, no oxidation.	494.0							
		493.0							
9.0			S5		19.4		96		
	End of Test Hole - test hole completed at 9.1 m below grade. - no sloughing observed immediately after completion of drilling. - water level at 1.5 m immediately after drilling. - test hole backfilled with auger cuttings and bentonite.	492.0							
10.0									
		491.0							
11.0									
		490.0							
12.0									

Moisture Content (%): PL I---------X---------I LL (20, 40, 60, 80)

SHEAR STRENGTH (kPa)

ENG- TECH Consulting Limited

Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.
Drill Rig: Acker SX
Auger Size: 125 mm

Completion Depth: 9.1 m
Completion Elevation: 492.6 m
Sheet: 1 of 1

SAMPLE TYPE — SPLIT BARREL | SHELBY TUBE | AUGER CUTTINGS | SPLIT SPOON

ENG-TECH CONSULTING LIMITED

Engineering And Testing Solutions That Work For You

Monitoring Well #: TH4

Client: BMCE Ltd.
Site: See Figure 1
Location: Rapid City Landfill, Manitoba
Project: Geotechnical Investigation

File No.: 19-398-07
Date Drilled: January 10, 2020
Grade Elevation: 501.3 m
Water Elevation: --

Depth (m)	Description	Elevation (m)	Sample No.	Sample Type	Moisture Content (%)
0.0	Ground Surface	501.3			
	Topsoil (OH) (100 mm) - dark grey, with clay, some silt.		S1		28.7
1.0	*Clay Till (CI)* - medium brown, frozen, medium plastic, and silt, some sand, trace gravel, oxidation.	500.0	S2		25.3
2.0	- below 0.6 m moist, stiff to very stiff.		S3		21.0
3.0	- below 2.0 m with silt, with sand.	499.0	S4		20.7
4.0		498.0			
		497.0	S5		19.8
5.0		496.0			
6.0			S6		18.6
7.0		495.0			
		494.0	S7		17.4
8.0		493.0			
9.0			S8		15.9
	- below 9.8 m medium grey.	492.0			
10.0		491.0			
11.0		490.0			
12.0			S10		18.3
	End of Test Hole - end of test hole at 12.2 m. - no seepage or sloughing observed immedately after completion of drilling. - 50 mm PVC monitoring well installed at 12.2 m below grade.	489.0			
13.0		488.0			
14.0		487.0			
15.0		486.0			
16.0					

Moisture Content (%): PL I----------X----------I LL; 20 40 60 80

Below Grade Well Completion Details: ▼ - no water on Jan 10, 2020

Comments:
- top of pipe at 1.2 m above grade
- bentonite seal from surface to 7.0 m
- solid 50 mm PVC to 7.6 m
- filter sand from 7.0 m to 12.2 m
- slotted 50 mm PVC to 12.2 m

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Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.
Drill Rig: Acker SX
Auger Size: 125 mm

Completion Depth: 12.2 m
Completion Elevation: 489.1 m
Sheet: 1 of 1

Sample Type — Split Barrel; Shelby Tube; Auger Cuttings; Split Spoon

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Engineering And Testing Solutions That Work For You

Monitoring Well #: TH5

Client: BMCE Ltd.
Site: See Figure 1
Location: Rapid City Landfill, Manitoba
Project: Geotechnical Investigation

File No.: 19-398-07
Date Drilled: January 10, 2020
Grade Elevation: 500.2 m
Water Elevation: --

Depth (m)	Description	Elevation (m)	Sample No.	Moisture Content (%)	Comments
0.0	Ground Surface	500.2			
	Topsoil (OH) (100 mm) - dark grey, with clay, some silt.		S1	24.8	- top of pipe at 1.0 m above grade
1.0	*Clay Till (CI)* - medium brown, frozen, medium plastic, with silt, with sand, trace gravel, oxidation.	499.0	S2	21.2	
2.0			S3	20.8	
		498.0	S4	19.7	
3.0	- below 0.6 m moist, stiff to very stiff.		S5	20.7	- bentonite seal from surface to 7.0 m
		497.0			
4.0	- below 4.6 m very stiff, dark brown.	496.0	S6	19.6	- solid 50 mm PVC to 7.6 m
5.0		495.0			
6.0		494.0	S7	18.5	
7.0		493.0	S8	19.2	
8.0		492.0			- filter sand from 7.0 m to 12.2 m
9.0	- below 8.8 m medium grey.	491.0	S9	18.6	
10.0		490.0			
11.0		489.0	S10	20.9	- slotted 50 mm PVC to 12.1 m
12.0		488.0	S11	17.9	
	End of Test Hole - end of test hole at 12.1 m. - no seepage or sloughing observed immedately after completion of drilling. - 50 mm PVC monitoring well installed at 12.1 m below grade.				
13.0		487.0			
14.0		486.0			
15.0		485.0			
16.0					

Moisture Content (%): PL I----------X----------I LL; 20 40 60 80

Below Grade Well Completion Details: ▼ - no water on Jan 10, 2020

ENG-TECH Consulting Limited

Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.
Drill Rig: Acker SX
Auger Size: 125 mm

Completion Depth: 12.1 m
Completion Elevation: 488.1 m
Sheet: 1 of 1

Sample Type — Split Barrel; Shelby Tube; Auger Cuttings; Split Spoon

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Test Hole #: TH6

Client: BMCE Ltd.
Site: See Figure 1
Location: Rapid City Landfill, Manitoba
Project: Geotechnical Investigation

File No.: 19-398-07
Date Drilled: January 10, 2020
Grade Elevation: 502.0 m
Water Elevation: --

Depth (m)	Description	Elevation (m)
0.0	Ground Surface	502.0
	Clay Till (Fill) - medium brown, frozen, medium plastic, some silt, some sand, tracel gravel, oxidation.	
	Topsoil (OH) - dark grey, medium plastic, with clay, some silt.	
1.0	*Clay Till (Cl)* - medium brown, moist, stiff, medium plastic, with silt, with sand, trace gravel, oxidation.	501.0
2.0		500.0
3.0	*End of Test Hole* - test hole completed at 3.0 m below grade - no sloughing or seepage observed immediately after completion of drilling. - test hole backfilled with auger cuttings and bentonite.	499.0
4.0		498.0

SUBSURFACE PROFILE | SAMPLE DATA | Moisture Content (%) (PL I----------X----------I LL, 20 40 60 80) | SHEAR STRENGTH (kPa): P. Pen, Torvane, UC

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Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.
Drill Rig: Acker SX
Auger Size: 125 mm

Completion Depth: 3.0 m
Completion Elevation: 499.0 m
Sheet: 1 of 1

SAMPLE TYPE: SPLIT BARREL | SHELBY TUBE | AUGER CUTTINGS | SPLIT SPOON

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Engineering And Testing Solutions That Work For You

Test Hole #: TH7

Client: BCME Ltd.

Site: See Figure 1

Location: Rapid City Landfill, Manitoba

Project: Geotechnical Investigation

File No.: 19-398-07

Date Drilled: January 10, 2020

Grade Elevation: 502.6 m

Water Elevation: --

Depth (m)	Soil Symbol	Description	Elevation (m)
0.0		Ground Surface	502.6
		Clay Till (Fill) - medium brown, frozen, medium plastic, with silt, with sand, tracel gravel, oxidation.	
			502.0
1.0		*Debris/Garbage* - black, wet, strong odour.	
		Clay Till (Cl) - medium brown, moist, stiff, medium plastic, with silt, with sand, trace gravel, oxidation.	501.0
2.0			
			500.0
3.0		*End of Test Hole* - test hole completed at 3.0 m below grade - no sloughing or seepage observed immediately after completion of drilling. - test hole backfilled with auger cuttings and bentonite.	
			499.0
4.0			

SUBSURFACE PROFILE

SAMPLE DATA

Sample No.	Sample Type	Moisture Content (%)	Blows/300 mm

Moisture Content (%)

PL I----------X----------I LL

20 40 60 80

SHEAR STRENGTH (kPa)

P. Pen	Torvane	UC

ENG- TECH Consulting Limited

Logged by: WGH

Reviewed by: [redacted]

Drilled By: Paddock Drilling Ltd.

Drill Rig: Acker SX

Auger Size: 125 mm

Completion Depth: 3.0 m

Completion Elevation: 499.6 m

Sheet: 1 of 1

SAMPLE TYPE — SPLIT BARREL — SHELBY TUBE — AUGER CUTTINGS — SPLIT SPOON