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CITY OF THOMPSON

Environment Act Proposal for the Waste Disposal Ground

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: 16/6/2

PROVINCE OF MANITOBA
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Member 31648
REGISTERED PROFESSIONAL ENGINEER
16/6/2 T-727.01

Prepared by:

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Reviewed by:

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President

May 2016

JRCC ENGINEERING CONSULTANTS

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. JR Cousin Consultants Ltd. (JRCC) wishes to thank the City of Thompson who contributed to the data and content of this report.

REMARKS

JR Cousin Consultants Ltd. has conducted this environment act proposal in accordance with generally accepted professional engineering principles and practices for the purpose of identifying conditions that may have an environmental impact on the site. The findings and recommendations reached in this report are based on information made available to JRCC during the investigation and conditions at the time of the site investigation. Conclusions derived in this report are intended to reduce, but not wholly eliminate the uncertainty regarding potential environmental concerns on the site, and recognizes reasonable limitations with regards to time, accuracy, work scope and cost. It is possible that environmental conditions may change from the date of this report. If conditions appear different from those encountered and expressed in this report, JRCC should be informed so that mitigation recommendations can be reviewed and adjusted as required. Historical data and information obtained from personal communication used in this report, are assumed to be correct, however JRCC has not conducted further investigations into the accuracy of this data. JRCC has produced this report for the use of the client, and takes no responsibility for any third party decisions or actions based on information contained in this report.

TABLE OF CONTENTS

Appendix B

LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report, AECOM 2008

LGD of Mystery Lake Waste Geotechnical and Topographic Investigation for the Waste Disposal Ground, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes, JR Cousin Consultants Ltd., 2012

Phase I Construction Works – Hydraulic Conductivity Test Results NTL September 14, 2012

Phase II Construction Works – Hydraulic Conductivity Test Results NTL October 29, 2013

Phase III Construction Works – Hydraulic Conductivity Test Results Stantec October 23, 2014

Appendix C

Plan 1: Site Layout with Approximate Location of Property Line

Plan 2: Final Cover Grading Contours and Final Drainage Plan

Phase I Works – Record Drawing Plan Set

Phase II Works – Record Drawing Plan Set

Phase III Works – Record Drawing Plan Set

Phase IV Works – Design Drawing Plan Set

Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development: City of Thompson Waste Disposal Ground		
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88): Class 1		
Legal name of the applicant: City of Thompson		
Mailing address of the applicant: 226 Mystery Lake Road		
Contact Person: Ms. Carol Taylor		
City: Thompson	Province: Manitoba	Postal Code: R8N 1S6
Phone Number: 204-677-7923	Fax: 204-677-7936	email: ctaylor@thompson.ca
Location of the development: 4 km south of the City of Thompson		
Contact Person: Ms. Carol Taylor		
Street Address:		
Legal Description: Part NW ¼ 18, S ½ and NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM		
City/Town: Thompson	Province: Manitoba	Postal Code: R8N 1S6
Phone Number: 204-677-7923	Fax: 204-677-7936	email: ctaylor@thompson.ca
Name of proponent contact person for purposes of the environmental assessment: Brett McCormac, P.Eng., JR Cousin Consultants Ltd.		
Phone: 204-489-0474 Fax: 204-489-0487	Mailing address: 91 A Scurfield Blvd Winnipeg, Manitoba R3Y1G4	
Email address: bmccormac@jrcc.ca		
Webpage address: www.jrcc.ca		
Date: June 2, 2016	Signature of proponent, or corporate principal of corporate proponent: BMcC Printed name: Brett McCormac	

EXECUTIVE SUMMARY

General

The City of Thompson recently took ownership of the Thompson waste disposal ground (WDG) from the LGD of Mystery Lake. The WDG currently operates under Permit #42877, which expires on June 1, 2016. The Manitoba Conservation and Water Stewardship has directed that the City of Thompson must submit an Environment Act Licence proposal for the continued operation of a Class 1 waste disposal ground.

Project Background and Description

A four-phase construction project at the WDG for expansion and upgrade of the facility has been recently undertaken including construction of new WDG active cells, leachate collection piping and a leachate evaporation pond, a new contaminated soils remediation area and supply and set up of movable chain link fencing.

The City of Thompson plans to develop a 'One Stop Shop' which will include e-waste, household hazardous waste and used oil.

Population and Waste Generation

The Thompson WDG services the City of Thompson, the LGD of Mystery Lake, the Wuskawatim Generating Station, the Keeyask Generating Station and the Paint Lake Provincial Park. The City of Thompson contributes 94% of the total waste and the other populations contribute 6% of the total waste. The average per capita waste deposited at the WDG is 2.0 kg/person/day. Based on the WDG capacity and the projected incoming waste the WDG should have capacity until 2041.

Topography and Geotechnical Information

The past geotechnical investigations at the site showed there is a suitable in situ horizontal clay liner under the existing WDG area which can be used for the WDG expansion cells and the leachate pond. The test holes showed that sufficient clay does not exist further east of the existing WDG area and the perimeter dike with cut-off wall will have to be positioned close to the edge of the existing WDG area. The investigations also showed that the borrow pit contains suitable clay to use as a re-worked and re-compacted clay liner.

Environmental Effects

No negative residual effects are anticipated through the WDG expansion construction and continued operation, due to the mitigation measures and operating procedures described herein.

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for the continued operation of the existing waste disposal ground (WDG) near Thompson, Manitoba. The WDG receives more than 5,000 tonnes of solid waste per year and is therefore considered a Class 1 WDG under the Waste Management Facilities Regulation 37/2016 which comes into effect on July 1, 2016.

1.1 Introduction

The City of Thompson recently took ownership of the City of Thompson Waste Disposal Ground from the Local Government District (LGD) of Mystery Lake. The WDG currently operates under Permit #42877. This permit expires on June 1, 2016. The Manitoba Conservation and Water Stewardship has directed that the City of Thompson to submit an Environment Act Licence proposal for the continued operation of a Class 1 Waste Disposal Ground. JR Cousin Consultants Ltd. (JRCC) was retained for the engineering services to complete the EAP document.

1.2 Contact Information

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R3Y 1G4
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Ms. Carol Taylor
City of Thompson
226 Mystery Lake Road
Thompson, Manitoba
R8N 2B2
Phone (204) 677-7923, Fax (204) 677-7936

1.3 Background Information

The WDG is located on Part NW 1/4 18, S 1/2 and NW 1/4 19 in TWP 77-3 WPM and in Part SE 1/4 24-77-4 WPM, approximately 4 km south of the City of Thompson.

The WDG has a property of 55.2 ha (550 m x 1,005 m) of which, approximately 21 ha is used for the waste disposal ground and 34.2 ha is undeveloped. The WDG has been in operation since the late 1950s when the City of Thompson was developed. The WDG was owned and operated by the LGD of Mystery Lake until ownership was transferred to the City of Thompson on July 1, 2015.

The land is surrounded by forest and an established clay borrow pit to the north, forest to the south and west and a Manitoba Hydro transmission line and PTH 6, to the east. Access to site is via a gravel road running west off PTH 6.

A four-phase construction project at the WDG for expansion and upgrade of the facility has been recently undertaken. The four construction phases consisted of:

- Phase I – 2012: Construction of a new active cell area surrounded by a perimeter dike with clay cut-off wall, construction of a leachate evaporation pond with leachate collection piping in the new active cell area, drainage works and supply of portable litter control fencing.
- Phase II – 2013: Construction of a new active cell area surrounded by a perimeter dike with clay cut-off wall, extension of the leachate collection piping in the new active cell area, drainage works and construction of an upgraded contaminated soils remediation area.
- Phase III – 2014: Construction of a new active cell area surrounded by a perimeter dike with clay cut-off wall, extension of the leachate collection piping in the new active cell area and drainage works.
- Phase IV – Currently under construction to be completed in July/August 2016: Construction of a new active cell area surrounded by a perimeter dike with clay cut-off wall, extension of the leachate collection piping, drainage works, supply and set-up of 150 m of moveable chain link panel fencing to surround the active area.

The record drawings from the Phase I – 3 construction works and the design drawings from the Phase IV construction works are attached in Appendix C.

The site currently accepts household waste in a designated area at the north end of the site. The site also accepts metals, tires, white goods (if Freon has been removed by a licensed technician and a sticker is placed on the item), recyclables, burnable materials, batteries, used oil, concrete/ shingles and asbestos material in separate designated areas (permission from the City required prior to disposal). There is also a sludge-drying pit and a soil remediation area for contaminated soils (permission from the City required prior to disposal). The City of Thompson has recently moved the e-waste collection to the WDG and plans to develop a 'One Stop Shop', which will include e-waste, household hazardous waste and used oil. Currently the City collects household hazardous waste one weekend in September including paint, oil, cleaners, pesticides and chemicals.

The following materials are not accepted at the WDG: Oil based paint and varnish etc, hazardous waste (including paint thinner, aerosol cans, drain cleaner, pesticides, propane tanks and household cleaning supplies), fluorescent light ballasts, methyl hydrate, radiator coolant, antifreeze and items containing Freon.

Residential and commercial recycling service for the City is provided by the Thompson Recycling Center. Free curbside pickup is available throughout the city and the hours of operation are Monday to Friday 8:30 am to 4:30 pm. The Thompson Recycling Center recycles mixed paper, glass, aluminum, tin cans, plastics, cardboard, boxboard, and milk cartons.

Thompson operates a compost site at the Public Works Yard located at 120 Seal Road open from May to October 24 hours per day and 7 days per week to divert compostable materials from the WDG.

1.4 Existing Facility

The existing WDG currently operates with the following compounds/facilities:

- Active household waste disposal area – below and above grade storage with perimeter dikes constructed as part of the 4-phase construction project from 2012 – 2016
- 2 cell contaminated soils remediation area
- 2-cell burn area
- Separate designated areas for scrap metal, white goods, tires
- A used oil eco-centre for oil and filters
- A battery depot shed
- Asbestos material disposal area
- Sludge drying bed
- Operator building with attached storage garage
- Equipment storage building for site equipment and materials
- A certified weigh scale at the entrance to the site for recording incoming waste tonnage and issuing tipping fees.

The site also has the following features:

- six groundwater monitoring wells located around the perimeter of the property, installed in 2005
- internal access roads constructed with granular material
- a lockable entrance gate
- site signage (i.e. entrance sign and drop off location signs)
- above-ground fuel tank for equipment refueling.

1.5 Existing Site Operations

Waste material is collected from the City of Thompson daily and delivered to the WDG. Commercial and industrial wastes are also known to be received by the WDG. During daily operations, the site has a gate attendant who handles tipping fees and directs individuals to the appropriate drop off locations, while a site operator conducts general site cleanup and waste movement, compaction and intermittent covering.

Based on the current schedule, the hours of operation are from Monday to Friday 8:00 am to 5:45 pm in the winter season and access extended to include Saturday from 9:00 am to 5:00 pm in the summer season. The facility is locked during closure hours.

1.6 Existing Operating Permit

The WDG is operating under the Waste Disposal Ground Operating Permit #42877. A copy of the permit is attached in Appendix A.

1.7 Description of Previous Studies

- *LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report* (prepared by AECOM, March 2008) to develop a closure plan for the WDG. After the report was reviewed it was decided to develop a plan to extend the lifetime of the WDG rather than decommission it.
- *Local Government District of Mystery Lake Waste Disposal Area 2009 Master Plan* by AECOM, January 2010 describing the current WDG as well as the master plan for upgrading and expanding the entire site.
- *Existing Waste Disposal Facility Environmental Assessment Report* (prepared by AECOM, February 2010) to complete an environmental assessment of the existing WDG to address any potential environmental liabilities and assess future expansion potential.
- *LGD of Mystery Lake Waste Disposal Ground Overall Conceptual Layout and Phase I Design Works Environmental Assessment Submission* (prepared by JRCC in June 2011) to obtain a Permit for the Class 1 operating facility for the upgrades and expansion of the WDG.

2.0 DESCRIPTION OF THE DEVELOPMENT

For each heading there is an information request from the Environment Act Proposal Form. These requests are repeated herein in italics followed by the pertaining response.

2.1 Land Title/Location

Certificate of Title showing the owner(s) and legal description of the land upon which the development will be constructed; or, in the case of highways, rail lines, electrical transmission lines, or pipelines, a map or maps at a scale no less than 1:50,000 showing the location of the proposed development:

The WDG is located on Part NW $^1/_4$ 18, S $^1/_2$ and NW $^1/_4$ 19 in TWP 77-3 WPM and in Part SE $^1/_4$ 24-77-4 WPM in the Province of Manitoba.

The land is leased under the Crown Land Permit No. GP 50804 issued by Manitoba Conservation, dated February 22, 2005, and has been attached in Appendix A. The Permit was transferred from the LGD of Mystery to the City of Thompson on July 30, 2015. See correspondence from the Crown Lands and Property Agency on September 17, 2015 attached in Appendix A.

A sketch available on file at the Lands Branch shows the WDG property lines. The sketch is attached in Appendix A. A legal property plan was never registered at the Land Titles office for the site.

2.2 Owner of Land and Mineral Rights

Owner of land upon which the development is intended to be constructed, and of mineral rights beneath the land, if different from surface owner:

Based on information provided by the Crown Lands and Property Agency Branch the mines and minerals and sand and gravel in NW 18, S $^1/_2$ and NW 19 in 77-3 WPM and SE 24-77-4 WPM are owned by Her Majesty the Queen in Right of the Province of Manitoba (see e-mail correspondence from the Crown Lands and Property Agency dated March 9, 2011, attached in Appendix A).

2.3 Existing Land Use

Existing land use on the site and on land adjoining it, as well as changes that will be made in such land use for the purposes of the development:

Within the former and active waste disposal areas the site is generally flat with a gentle slope from east to west. A steeper grade to the west is present in the south end of the site where former waste disposal activity may have occurred. The former waste disposal area is approximately 4 – 6 m higher than the surrounding area. The average elevation changes from 225 m in the east to 210 m in the west. A bedrock outcrop protruding up to 8 m above the surrounding ground exists east of the site, parallel to PTH 6. The area surrounding the site is forested with an undulating slope to the west. North of the WDG is an established clay borrow site located on Crown Land.

2.4 Land Use Designation/Zoning Designation

Land use designation for the site and adjoining land as identified in a development plan adopted under the Planning Act or the City of Winnipeg Act, and the zoning designation as identified in a zoning by-law, if applicable:

Based on information provided by the City of Thompson, the WDG site is currently zoned under LGD Zoning by-law 541 LD as Limited Development which lists "Waste disposal grounds and landfill sites, as regulated by the Province" as an acceptable land use.

2.5 Description of Development

Description of proposed development and schedule for stages of the development, including proposed dates for planning, design, construction, commissioning, operation, and decommissioning and/or termination of operation (if known), identifying major components and activities of the development as applicable (e.g. access road, airstrip, processing facility, waste disposal area, etc.).

2.5.1 Project Schedule

The existing permit expires June 1, 2016 and Manitoba Conservation and Water Stewardship have directed that the City of Thompson submit an Environment Act Licence proposal for the continued operation of a Class 1 waste disposal ground prior to June 1, 2016.

Phase IV of the WDG upgrade are currently underway and are due to be completed in July/August of 2016. No other major construction works are scheduled for the WDG.

The WDG expected lifetime and closure date is discussed in Section 2.5.4.2 below.

2.5.2 Existing WDG Site Evaluation

The location of the WDG will not be altered from the existing footprint.

According to the *Guidelines for the Siting of a Class I Waste Disposal Ground in Manitoba* (1994) and the Waste Management Facilities Regulation 37/2016, Schedule B, the siting of the WDG expansion cells would require the following provincial guidelines and minimum setback requirements:

- Watersheds with surface water flow through the site.
- Sites underlain with sand, gravel, sandstone, limestone.
- Sites on the edge of steep slopes, subject to erosion and land sliding.
- Sites within 2 km of wetlands.
- Bedrock outcrops.
- Karst terrain.
- Fractured bedrock.

- Unstable terrain.
- Areas of unpredictable geology.
- Sites with shallow water tables or perched aquifers.
- Groundwater pollution hazard areas.
- Areas within 100 year flood plain.
- Areas with limited access to roads or utilities.
- Sites within 400 m of a residence.
- Sites within 400 m of a potable water well.
- Sites within 400 m of a cemetery.
- Sites within 400 m of a natural gas pipeline or an underground utility corridor.
- Sites within 2 km of a critical habitat area.
- Sites within 2 km of a designated park or historic site.
- Sites within 100 m from a public road or railway right of way.
- Sites within 1 km from a body of surface water.
- Sites within 8 km of an airport or setback as described in the local zoning plan.

The existing site complies with all the setback criteria with the exception of a surface water body (swamp) located southwest of the existing site which is within 1 km of the WDG. This requires design measures to prevent leachate migration and a variance by Manitoba Conservation to decrease the minimum separation distance. Given the location in northern Manitoba with numerous lakes, it is considered unlikely a WDG could be located such that the minimum setback distance is satisfied. Upon discussion with Manitoba Conservation and Manitoba Water Stewardship, the setback distance can be reduced if design measures are taken to ensure leachate is not able to reach the lake.

An important concern in evaluating Class I WDG sites is the protection of water quality, and human health and safety. The above setbacks also consider aesthetic qualities of the surrounding landscape and safety issues for nearby transportation routes.

The above siting requirements are established to ensure that if a WDG fails to adequately contain leachate, the site's natural conditions will protect groundwater and surface water resources, and control the migration of landfill gases. Preference should be given to sites located in areas where there is clay or till of low permeability (1×10^{-7} cm/sec or less) to ensure groundwater protection and minimal migration of landfill gases. If soils of sufficiently low permeability are not available, a geomembrane liner should be considered for containment.

Groundwater pollution hazard areas occur where carbonate rock or sand and gravel deposits are at or near ground surface. In these areas seepage from leachate could readily percolate to the water bearing zone and cause groundwater pollution. Groundwater pollution hazard maps were not available for the WDG site, however, based on test holes taken at the site, the existing WDG is underlain by clay and silty clay in varying depths. Sand and gravel is not present at or near the ground surface in the active or former waste disposal areas. Sand was encountered beneath the clay and silty clay layer in MW401, MW402 and MW407 by AECOM, at depths of 2.1 m, 2.4 m and 5.2 m, respectively. As the WDG has a clay silt layer across the site and likely no direct routes to the groundwater aquifer through sand and gravel, the WDG is not likely located in a groundwater pollution hazard area.

2.5.3 Projected Service Population

2.5.3.1 City of Thompson

Census population information was obtained from Statistics Canada for the City of Thompson, from 1971 to 2011. The population decreased by 5,745 people from 1971 to 2001 but has remained relatively stable from 2001 - 2011. Details of the historic population data is shown in Table 21 below.

Table 2.1 – Historic population data for the City of Thompson

Year	Population	Average Annual Growth Rate
1971	19,001	
1976	17,291	-2.06%
1981	14,288	-4.61%
1991	14,977	0.45%
1996	14,385	-0.80%
2001	13,256	-1.62%
2006	13,446	0.29%
2011	13,123*	-0.49%

*The 2011 census population was adjusted from 12,829 to 13,123.

The future population projections for the City of Thompson will be based on a conservative growth rate of 0.52% as discussed in the *City of Thompson Wastewater Treatment Plant Upgrade/Expansion Functional Design Report* prepared by Stantec in January 2014 for sizing of the proposed wastewater treatment plant. Table 2.2 below shows the projected future population for the City of Thompson in 5 year increments.

Table2.2 – Projected future population data for the City of Thompson

Year	Population	Average Annual Growth Rate
2011	13,123	
2016	13,468	0.52%
2021	13,822	0.52%
2026	14,185	0.52%

Year	Population	Average Annual Growth Rate
2031	14,557	0.52%
2036	14,940	0.52%
2041	15,332	0.52%
2046	15,735	0.52%
2051	16,149	0.52%

2.5.3.2 LGD of Mystery Lake

The WDG also services the LGD of Mystery Lake. Population data for the LGD of Mystery Lake from the 2011 census was 10 people. The same future growth rate as Thompson of 0.52% is assumed to continue for the LGD population.

2.5.3.3 Other Populations

The Thompson WDG also accepts waste from the Wuskawatim Generating Station, the Keeyask Generating Station and the Paint Lake Provincial Park.

According to the City of Thompson, waste from the Wuskawatim Generating Station and the Paint Lake Provincial Park is expected to continue at the same rate in the future. Waste from the Keeyask Generating Station is expected to continue at the same rate for the next 3 - 4 years during construction and then drop off. For the purposes of WDG sizing the current rates are expected to continue in the future.

See Table 1 attached in Appendix A for a summary of the current and projected future populations.

2.5.4 Projected Waste Generation

A weigh scale was installed at the WDG in 2010 to monitor incoming waste. The total tonnage from 2010 – 2015 was provided to JRCC and summarized in the following table. The total quantity of recycled material by the Thompson Recycling Center from 2010 – 2015 was also provided and shown on the following table.

Table 2.3 – Total Recycled Material and Total Waste Received at the Thompson WDG

	2010	2011	2012	2013	2014	2015
Total Waste Generated (tonnes)	12,672	13,227	11,361	10,785	10,791	11,364
Total Recycled Material (tonnes)	664	838	836	912	991	944
Total Waste deposited at the WDG (tonnes)	12,008	12,389	10,525	9,873	9,800	10,420
Percentage of Waste Recycled	5.2%	6.3%	7.4%	8.5%	9.2%	8.3%

The average waste generation from 2012 - 2015 is 11,075 tonnes per year which is less than the waste generation from 2010 – 2011 of 12,950 tonnes per year. The average waste generation rate from 2012 – 2015 was used as a basis of calculation for future waste generation from the City of Thompson residents.

The total amount of recycled material has increased from 5.2% in 2010 to a peak of 9.2% in 2014. The future recycling rate of 8.7% of total waste is expected to continue in the future which is the average recycling rate from 2013 - 2015.

The City of Thompson also operates a composting site at the Public Works Yard which accepted 80 tonnes of material in 2015 which is expected to continue in the future.

The breakdown of waste received at the WDG for 2015 was provided to JRCC. The waste received was categorized by residential and commercial and by City of Thompson waste and waste from other sources. The other sources are the Wuskawatim and Keeyask Generating Stations and the Paint Lake Provincial Park. The following table shows the material breakdown for 2015.

Table 2.4 – Breakdown of Total Waste Received at the Thompson WDG in 2015

Source	Type	Waste Delivered to WDG (tonnes)	Percentage of Total Waste
City of Thompson	Residential	4,884	47%
	Commercial	4,923	47%
	Total	**9,807**	**94%**
Other Sources	Residential	491	5%
	Commercial	123	1%
	Total	**614**	**6%**

Based on the breakdown of material received at the WDG the 'Other Sources' represent approximately 6% of the total waste received at 614 tonnes which is expected to continue in the future. The waste generated from the City of Thompson is approximately 50% residential and 50% commercial which is expected to continue in the future.

The following table shows the per capita waste production from the City of Thompson residents (including residential and commercial waste) from 2010 – 2015.

Table 2.5 – City of Thompson Per Capita Waste Generation Rates

	2010	2011	2012	2013	2014	2015
Total Waste from City of Thompson Deposited at WDG (tonnes)	11,394	11,775	9,911	9,259	9,186	9,806

	2010	2011	2012	2013	2014	2015
Population of the City of Thompson	13,188	13,123	13,191	13,260	13,329	13,398
Per Capita Waste Deposited at WDG (kg/person/day)	2.4	2.5	2.1	1.9	1.9	2.0

To calculate the average per capita waste generation the estimated population per year was utilized. Note the population after 2011 was estimated based on a 0.52% growth rate from the 2011 census population. Based on the calculations the average per capita waste generation rate has ranged from 2.5 kg/person/day to 1.9 kg/person/day with an average from 2012 – 2015 of 2.0 kg/person/day.

Statistics Canada (2012) indicates that a waste generation rate of 1.1 kg/person/day, in Manitoba, is typical for residential waste only, and 2.3 kg/person/day is typical for residential and non-residential (i.e. commercial, industrial, institutional) waste combined. These values do not take into consideration waste diversion efforts through recycling, composting and burning. Including the actual recycling rate in Thompson of 0.2 kg/person/day and the waste sent to the WDG of 2.0 kg/person/day, the total waste generation from the City of Thompson is in line with the Statistics Canada report and the per capita waste sent to the WDG of 2.0 kg/person/day is reasonable to assume for the remaining lifetime of the WDG.

2.5.4.1 Burning at the WDG

According to the City of Thompson approximately 30% of the material received at the WDG is burned at the burn pit and this rate is expected to continue in the future or slightly decrease. The Manitoba Conservation and Water Stewardship released a guideline entitled *Burning Solid Waste at a Waste Disposal Ground or a Waste Transfer Station* effective November 24, 2014. The document outlines the requirements for burning of waste at a WDG, which must be followed including the types of materials suitable for burning which are: separated and readily combustible materials such as boughs, loose straw, leaves, paper products, cardboard non salvageable untreated wood and packing materials made from wood.

The guideline also states that CWS intends on phasing out most burning at waste disposal grounds and waste transfer stations, however, no timelines were provided.

For the purposes of remaining capacity of the WDG it will be assumed that no burning of material will be completed to act as a safety factor on the WDG capacity. If 30% of the incoming material is continued to be burned, the WDG capacity will increase by 30%.

2.5.4.2 Remaining Capacity

The remaining capacity of the WDG was calculated based on a previously conducted survey of the WDG taken on April 14, 2011 and compared to the designed final contours of the WDG. A maximum waste elevation of 235.75 m was assumed with 4:1 side slopes to the perimeter dikes and a top sloped 1.0% to the west. The proposed final contours are shown on Plan 2 attached in Appendix C. The total remaining capacity of the WDG in 2011 based on the assumptions stated is 906,853 m^3.

Of the total airspace available approximately 20% of the space will be comprised of cover soil and therefore 725,482 m^3 will be available for solid waste. The WDG utilizes a steel-wheeled waste compactor, which can typically compact waste to a density of 475 kg/m^3, if compaction occurs regularly. This density was utilized in estimating the volume of waste received in the waste disposal cells, as the operator indicated that compaction occurs regularly at the site. Therefore with the airspace available the WDG can accept an additional 344,604 tonnes of solid waste. The following is a summary of the calculations described above.

Total Remaining Capacity of WDG in 2011 (volume)	906,853 m^3
Remaining Capacity of WDG for Waste (volume)	725,482 m^3
Remaining Capacity of WDG for Waste (mass)	344,604 tonnes

Therefore based on the previously stated assumptions the WDG has the remaining capacity to allow operation to 2041, which is 25 years from the date of this report. See Table 1 attached in Appendix A for more information. The actual volume of incoming waste, actual compaction rates, the amount of material used for soil cover and the amount of material burned must be monitored to re-assess the remaining capacity on an ongoing basis.

2.5.5 Geotechnical, Topography and Groundwater Investigations

AECOM conducted a site investigation, topographic survey and completed test holes in October 2005. The full results are summarized in the *LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report* prepared by AECOM in March 2008. The report is attached in Appendix B.

On April 13 and 14, 2011, JR Cousin Consultants Ltd. (JRCC) conducted a geotechnical and topographic investigation. The site investigation was conducted over the existing WDG area and the proposed expansion area to supplement existing geotechnical information obtained in past reports and to identify changes in topography since the 2005 AECOM survey. The JRCC report entitled *LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground*, June 2011 is attached in Appendix B.

JRCC completed a subsequent report entitled *LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works*, September 2011 that investigates a potential WDG expansion east of the existing WDG and recommended additional testing be completed. The report is attached in Appendix B.

JRCC also completed a report entitled *LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes*, March 2012 which investigated the potential clay borrow area, the depth to clay liner through the existing waste and the boundary of the horizontal clay liner on the east side of the existing WDG area. The report is attached in Appendix B.

The following sections summarize the previously completed reports.

2.5.5.1 Geotechnical Information

From AECOM Report March 2008

A total of 11 test holes were completed by AECOM in 2005. Eight of the test holes were drilled along the perimeter of the WDG and three drilled within the former waste cells to determine the depth of waste. Test hole locations and test hole logs by AECOM are shown on the attached report in Appendix B.

The following is an excerpt describing the soil stratigraphy from the *LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report* prepared by AECOM in March 2008:

> *"The soil stratigraphy encountered in the test holes completed along the perimeter of the site generally consists of a 1.0 m to 2.1 m thick layer of high plastic clay overlying a layer of varved clay which ranges from 1.0 m to 4.0 m in thickness. Along the bedrock outcrop that runs along the east end of the site, the varved clay is underlain by sand to auger refusal. Beyond the bedrock outcrop, the varved clay is underlain by a layer of varved silt which ranged from 3.7 m to 7.6 m in thickness. In TH403A, the material encountered consisted of 2.1 m of clay fill and 0.6 m of waste underlain by varved clay. Auger refusal was encountered in MW401, TH401A, MW402 and MW407. The refusal depth ranged from 3.0 m to 7.3 m below the surface.*
>
> *Soils encountered in TH408 consisted of clay fill to the end of the test hole (4.6 m). The test hole was completed near a clay stockpile in the centre of the WDG. The depth of clay fill in this test hole indicates that this location may have been a former clay stockpile area. In TH409, the material encountered consisted of 0.3 m of clay fill underlain by a 2.7 m thick layer of waste, 1.5 m of clay fill, and another 1.5 m thick layer of waste followed by native soils composed of high plastic clay varved with clayey silt. Similarly, the material encountered in TH410 consisted of 0.3 m of clay fill underlain by a 2.4 m thick layer of waste followed by native varved clay soils."*

Shelby tube samples and laboratory analysis of soil samples taken in the expansion cell area were not completed as part of the report.

From JRCC Report June 2011

A total of 13 test hole were drilled at the WDG site. Three test holes were drilled in the leachate pond area (TH1 – TH3), seven test holes were drilled in the WDG expansion cell areas (TH4 – TH 10) and three test holes were drilled through the former waste disposal areas (TH11 – TH13). Bagged samples were sent for laboratory analysis and three Shelby tube samples for hydraulic conductivity analysis.

The general soil profile observed in TH1 – TH10 was an average of 0.4 m of peat followed by 3.1 m of brown high plastic clay, in some instances with trace silt, followed by grey low – high plastic clay, with trace silt to a depth of 6.0 m below ground. Laboratory analysis of the soil samples found a Plasticity Index from 18 to 43 and the percentage of clay from 85.5% - 96.4%. The test results show that all samples tested most likely meet the Manitoba Conservation guideline of a hydraulic conductivity of 1×10^{-7} cm/s, with the exception of a sample from TH8 (3.9 – 6.0 m) which had a Plasticity Index of 18 and a clay content of 85.5%. Three Shelby tube samples were analyzed from TH3, TH6 and TH8 and hydraulic conductivities of 8.9×10^{-9} cm/sec, 1.4×10^{-8} cm/sec and 9.9×10^{-9} cm/sec, respectively were obtained which are less than the required 1×10^{-7} cm/sec for a clay lined cell.

Laboratory analysis of the bagged samples from the clay liner beneath the existing waste (TH12 and TH13) found an average plasticity index of 41 and average clay content of 91.3% and a similar soil structure to the samples which did have an in situ hydraulic conductivity of less than 1×10^{-7} cm/sec. Based on these results, it is likely that the clay liner under the existing waste does meet the Manitoba Conservation guidelines for a WDG liner. Shelby tube samples could not be obtained in the layer and therefore in situ hydraulic conductivity testing could not be completed.

From JRCC Report September 2011

A total of 13 test holes were excavated, 11 at the proposed expansion area east of the existing WDG (TH14-24) and two test holes at the borrow pit area (TH25-26). The soil profile in the test holes taken east of the WDG area varied significantly with some holes consisting of sandy, silty low plastic clay and others with high plastic clay present, some beneath a layer of waste. See the test hole logs for more details. The test holes taken in the borrow pit area found high plastic clay.

Laboratory analysis was completed on eight bagged samples from the test holes. The analysis concluded that the soils from TH23 (0.4 – 3.2 m), TH24 (1.2 – 3.7 m), TH25 (0 – 1.6 m) and TH26 (0 – 2.2 m) were considered suitable for use as an in situ clay liner or when re-worked and recompacted. The soils from TH15 (0.6 – 1.9 m), TH21 (1.5 – 3.4 m), TH22 (2.4 – 4.5 m) and TH25 (1.6 – 4.1 m) had clay contents above 50% but had Plasticity Index less than 25 and therefore hydraulic conductivity testing of the soils would be required to determine if the soils could achieve a hydraulic conductivity of 1×10^{-7} cm/sec or less.

The report recommended that a perimeter dike with vertical cut-off walls extending a minimum 1.0 m into the horizontal clay liner be installed at the edge of the suitable horizontal clay liner. However, the location of the edge of the horizontal clay liner would require additional testing. The report also recommended additional test holes in the borrow pit and additional laboratory analysis of the borrow pit soil.

Based on the recommendations of this report a subsequent geotechnical investigation was completed by JRCC.

From JRCC Report March 2012

A total of 14 test holes were excavated during the investigation. Two test holes were excavated to determine the depth of waste near the vertical cut-off wall to be constructed as part of the Phase I Works (TH27 – TH28). Seven test holes were excavated along the east edge of the WDG to determine the edge of the in situ horizontal clay liner (TH29 – TH33 and TH 39 – TH40). Five test holes were excavated in the borrow pit area to determine the suitability of the clay soil for use as a re-worked and re-compacted clay liner (TH34 – TH38).

The soil profile at the borrow pit was found to be a combination of high and medium plastic clay. The soil profile east of the WDG varied considerably between test holes and included layers of existing waste, high plastic clay and some silty, sandy, low plastic clay. The test holes taken on top of the existing WDG area were waste from 0 – 5 m which was the capacity of the excavator.

Four representative bagged soil samples from the borrow pit area and four representative bagged samples from the area east of the WDG were submitted for laboratory testing. All samples except one from TH31 were deemed suitable for use as a clay liner. One Shelby tube sample from east of the WDG area was tested and found to have an in situ hydraulic conductivity of 2.1×10^{-8} cm/s. One sample from the borrow pit was re-worked and re-compacted and found to have a hydraulic conductivity of 2.1×10^{-8} cm/s.

Summary of Geotechnical Information

Overall the geotechnical investigations showed there is a suitable insitu horizontal clay liner under the existing WDG area which can be used for the WDG expansion cells and the leachate pond. The test holes showed that sufficient clay does not exist further east of the existing WDG area and the perimeter dike with cut-off wall will have to be positioned close to the edge of the existing WDG area. The investigations also showed that the borrow pit contains suitable clay to use as a re-worked and re-compacted clay liner.

2.5.5.2 Topographic Information

The topography of the WDG was surveyed and found that the top of the existing former and current waste disposal area slopes from east to west. The existing ground surrounding the WDG is approximately 4 m - 6 m lower than the top of waste and slopes to the southwest. The proposed leachate pond area slopes to the southeast with a maximum elevation of approximately 209.37 m at the northwest end and a minimum elevation of approximately 207.64 m at the southeast corner. There is a rock outcrop east of the former and current waste disposal area which slopes up to an elevation of 225.0 m towards PTH 6.

2.5.5.3 Groundwater Information

Groundwater Investigation from Past Report

Six monitoring wells were installed around the WDG site by AECOM in 2005. Two wells were installed up gradient of the groundwater flow (MW 401 and 407), two wells installed cross-gradient of the groundwater flow (MW 402 and 406) and two wells were installed down gradient from the groundwater flow (MW 403 and 405). Monitoring well locations by AECOM are shown on the attached report in Appendix B.

The following is the description of the groundwater table from the *LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report* prepared by AECOM in March 2008.

> "The groundwater levels recorded in the overburden monitoring wells on November 21, 2005 range from 0.87 m to 2.35 m below ground surface, with the exception of MW403, in which the water level was 0.19 m above ground. Based on these water levels, the direction of flow within the overburden is towards the west-southwest. This direction corresponds with the general slope of the topography in this area. The magnitude of the horizontal gradient within the overburden soils (change in water elevation with distance) is about 0.069 m/m."

Groundwater Investigation from JRCC Report June 2011

No standing water was observed in the test holes, with the exception of TH1 and TH2, taken in the proposed leachate pond area. The water in the test holes was caused by standing water on the ground surface around the test holes which flowed into the test holes.

TH6 was left open for four hours to allow for longer-term water infiltration to occur. After the elapsed time no standing water was observed in the hole, however, there was caving at approximately 3.6 m below the ground surface.

Groundwater Investigation from JRCC Report September 2011

Short-term groundwater conditions were assessed in each test hole by observing standing water in the test holes prior to backfilling the holes. No standing water was observed in the test holes with the exception of TH20, which had leachate water infiltration at the bottom of the waste layer and TH21, which had high rate water infiltration from the surface.

TH15 was left open for approximately two hours to allow longer-term water infiltration to occur. When the hole was re-visited caving of the test hole walls occurred and no standing water was observed.

Groundwater Investigation from JRCC Report March 2012

Short-term groundwater conditions were assessed in each test hole by observing standing water in the test holes prior to backfilling the holes. Water infiltration was observed in TH33 at a depth of 3.6 m with a cave-in observed at 1.0 m. Water infiltration was observed in TH29 at a depth of 1.3 m and leachate infiltration to the test hole was observed in TH40 at a depth of 2.2 m. No standing water or water infiltration was observed in the remainder of the test holes.

The JRCC report notes: "Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time as water levels will normally fluctuate seasonally."

2.5.6 WDG Cell Liner Requirements

The *Manitoba Siting Guidelines for Class I WDG Sites* require a clay liner of a waste disposal cell to have a minimum thickness of 1.0 m and have a hydraulic conductivity of 1×10^{-7} cm/sec or less. If suitable soils are not available for this construction, then a synthetic geomembrane liner can also be utilized. This low level of permeability in the active cell liner is required to ensure that leachate or wastewater does not impact surrounding groundwater resources.

2.5.6.1 Liner for the WDG

The existing former and active cell area will utilize the insitu soil beneath the existing waste as the cell liner. During the site investigation by JRCC on April 13, 2011, three test holes were drilled in the existing waste, and two of the holes, TH12 and TH13, were taken through the existing waste and into the soil beneath. The soil layer under the existing waste was described as brown/ grey high plastic clay, very stiff with some silt lenses. Laboratory analysis of the clay found the plasticity index to be 39 and 43, and a clay content of 87.0% and 95.5% which means the clay would most likely meet the Manitoba Conservation minimum hydraulic conductivity of 1×10^{-7} cm/s. Typically soils with a Plasticity Index above 25 and a clay content above 50% should have a hydraulic conductivity of 1×10^{-7} cm/s or less.

Shelby tubes could not be taken in the clay beneath the garbage due to caving in of the garbage layer that did not allow the Shelby tube to pass. Although the permeability test could not be performed, the plastic index above is an indicator that the clay soils would have a low permeability, and would meet the Manitoba Conservation requirements. The clay layer will continue to serve as the WDG liner of the existing and former waste disposal area.

AECOM drilled two test holes, TH409 and TH410, in the former waste disposal area through the waste. Both test holes found a layer of clay and silt beneath the waste described as "silty, brown, moist, firm, high plastic clay, varved with clayey silt lenses". Laboratory analysis was not completed on the soils, however, the description of the layer is consistent with the JRCC site investigation findings.

Based on test holes and laboratory analysis, a minimum 1.0 m thick insitu clay liner which meets the Manitoba Conservation guideline of hydraulic conductivity less than 1×10^{-7} cm/s also exists in the cell expansion areas and leachate pond area. The expansion cell perimeter dikes included a 3 m wide vertical clay cut-off wall constructed of clay excavated from the cell area or from the clay borrow pit located north of the WDG and tied into the horizontal clay liner.

The new WDG cells, contaminated soils area and leachate pond construction works included Shelby tube testing at the end of each construction phase to verify the as-constructed liner met the hydraulic conductivity requirements. All test results exceeded the Manitoba Conservation requirements. The following is a summary of the as-constructed test results from the construction works. Test results are included in Appendix B.

Phase I

- TH1 - 1.5-2.1 m — 1.6×10^{-8} cm/s
- TH2 - 0.2-0.8 — 9.7×10^{-9} cm/s
- TH4 - 4.5-5.1 — 3.1×10^{-8} cm/s

Phase II

- TH5 - 0.3-0.9 m — 3.6×10^{-8} cm/s
- TH7 – 0.3 – 0.9 m — 9.5×10^{-9} cm/s
- TH8 – 0.3 – 0.9 m — 1.9×10^{-8} cm/s

Phase III

- TH2 – 1.5 – 2.1 m — 7.5×10^{-9} cm/s
- TH5 – 0.3 – 0.9 m — 2.0×10^{-8} cm/s
- TH6 – 0.3 – 0.9 m — 1.2×10^{-8} cm/s

2.5.6.2 Contaminant Migration

The potential impact of leachate from the WDG on the underlying groundwater aquifer was evaluated to determine the geological sensitivity rating for the site. The following assumptions were made:

- leachate movement by advection
- no natural attenuation of leachate
- an average hydraulic conductivity of 1.61×10^{-8} cm/s for the clay layer determined by averaging the hydraulic conductivity of the Shelby tube samples from TH3, TH6 and TH8 and the 9 samples from the as-construction tests
- a downward vertical gradient of 0.67 m/m calculated by averaging the vertical gradients between the 6 monitoring wells based on November 21, 2005 water levels recorded by AECOM
- an average effective porosity of 0.35 calculated by averaging the porosity from the three Shelby tube samples and assuming effective porosity is 70% of total porosity.

The vertical rate of contaminant migration was calculated using Darcy's Law where:

$$q = \frac{Ki}{n_e}$$

where q = average linear velocity of the contaminant
K = average hydraulic conductivity of the soil
i = average hydraulic gradient
n_e = average effective porosity of the soil

Using the above parameters the average downward velocity of the contaminant is calculated as:

$$q = \frac{(1.61\ x\ 10^{-8})(0.67)}{(0.35)} = 3.09\ x\ 10^{-8}\frac{cm}{s} = 0.00973\ m/year$$

Using a minimum liner thickness of 1 m, the contaminant would reach the bottom of the clay liner in 103 years corresponding to a geological sensitivity rating of low – water moving vertically will reach the aquifer within several decades to a century.

From the test hole information the high plastic clay layer was observed to be between 3.1 and at least 5.6 m thick. Also, no infiltrating water was observed in any of the test holes taken to a depth of 6 m. This suggests that the ground water aquifer exists below 6 m from existing ground and contaminants must pass through at least 3.1 m of liner material, greatly increasing the time it would take for a contaminant to reach the groundwater aquifer.

2.5.7 Cover System

Based on the Waste Management Facilities Regulation 37/2016, which comes into effect on July 1, 2016, a Class 1 WDG must cover the waste with a layer of soil or another material approved by the director, compacted to a depth of at least 15 cm on a daily basis. The current permit specifies cover in accordance with M.R. 150/91 which indicates all solid waste must be covered once per month.

From discussion with Manitoba Conservation, based on the size of the City of Thompson WDG an alternate cover schedule may be approved. The City of Thompson WDG is considered a Class 1 WDG, however, the size is smaller than a 'typical' Class 1 WDG in Manitoba and daily covering of material would result in very low waste:soil ratios, reducing the lifetime of the WDG. The WDG accepts an average of 27.5 tonnes/day, which would occupy approximately 58 m^3 of space based on a compaction rate of 475 kg/m^3. The active portion of the active area is expected to have a surface area of approximately 1,700 m^2. Therefore the average daily waste accumulation will be approximately 0.035 m per day. If daily cover of 150 mm of soil was applied, the waste:soil ratio would be 0.2:1, which is much too low for efficient operation of the WDG. A typical waste:soil ratio at a WDG should be approximately 5:1. To achieve the ideal waste:soil ratio the waste would have to be covered once every 21 days. It is therefore requested that the licence indicate cover material is required once every three weeks.

Hydrocarbon contaminated soils delivered to the WDG for remediation are intended to be utilized as some of the cover material, after meeting criteria for daily cover. The remainder of the soils used for cover material will be borrowed from a clay borrow area identified near the WDG site.

The WDG operations plan, Plan 7 of the Phase I Works record drawings attached in Appendix C indicates that the depositing of waste and cover material will continue until the elevation is a maximum of 235.75 m, approximately 15 metres above the existing waste. The maximum waste height will be approximately 25 m above the leachate collection piping. As the land filling progresses above ground, temporary berms will be created around the active portion of the active cell as indicated on the plan. This will ensure precipitation in contact with the wastes is sent to the leachate evaporation pond and clean water is shed off the cell and directed to the perimeter ditches.

The proposed method of final WDG cover is discussed under the closure criteria Section 2.5.17 in this report.

2.5.8 Leachate Management System

The new active cell floors were graded in such a way that liquid or leachate from within the active portion of the active cell area is collected by 200 mm corrugated polyethylene piping at one end, and drained by gravity to the leachate evaporation pond. The pond is a one cell structure with a clay liner of permeability less than 1×10^{-7} cm/s to prevent groundwater contamination. The operator would be required to set up temporary berms in the active cell to divert clean run-off water away from the active portion of the cell and minimize leachate production.

Leachate Pond Sizing

Sizing of the leachate evaporation pond is based on the expected hydraulic loading created by precipitation in the active portion of the active cell of the WDG. Environment Canada precipitation data for the Thompson A data station listed an average annual precipitation of 509.2 mm for the years of 1981 - 2010. This average will be assumed for future precipitation quantities. The leachate pond will be sized to accommodate one year's worth of precipitation falling on the active portion of the active cell area, as well as the precipitation falling directly on the leachate pond. Based on the Phase I active cell area of 5,150 m^2, and an active portion of the active cell of 1/3 the surface area or 1,717 m^2 the volume of leachate produced by the active portion of the active cell is 874 m^3/year.

It is preferred to operate the evaporation pond with a liquid level of 0.5 m. The shallow liquid level will assist with evaporation by increasing the surface area exposed to the atmosphere and allowing more sunlight to be absorbed to increase the water temperature, to assist with evaporation. However, the yearly precipitation for Thompson is 509.2 mm, which is already over the 0.5 m liquid level in the cell (assuming 1 year of precipitation in the cell at one time). If the evaporation pond was larger, more precipitation would be stored, and the liquid level from precipitation would continue to be over the 0.5 m. Therefore, the cell was sized so that the expected leachate quantity resulted in a 0.5 m liquid level in the pond. The maximum liquid level in the pond would be 1.01 m which would occur if 1 year of leachate (0.5 m) and 1 year of precipitation (0.501 m) was present in the cell at once.

The leachate pond was constructed with a top of dike elevation of 209.2 m and a cell floor elevation of 207.7 m for a total depth of 1.5 m. The cell has a 40 m x 40 m flat bottom area, 4:1 inner side slopes, 3:1 outer side slopes and a 2 m wide top of dike. The pond can hold 885 m^3 of liquid with a liquid level of 0.5m and 1,964 m^3 with an operating level of 1.01 m.

Evaporation Rates and Alternative Disposal Options

The City of Thompson has a total of 142.9 degree days above 15°C compared to 421.5 for the City of Winnipeg according to Environment Canada Canadian Climate Normals data from 1981 - 2010. The average humidity in Thompson for the months of May – September is 67.4% and for Winnipeg is 68.9%. The City of Thompson annual precipitation is 509.2 mm compared to 521.1 mm for Winnipeg. Evaporation from the leachate pond will depend primarily on precipitation, temperature and humidity. With similar precipitation and humidity to Winnipeg and significantly lower temperatures it is expected that the evaporation rates at Thompson will also be significantly lower than Winnipeg. Also, during years of higher than average precipitation, net evaporation rates will be lower and successive years of high precipitation will result in increased liquid levels in the pond.

The *Leachate Management at Waste Disposal Grounds and at Waste Transfer Stations* produced by Manitoba Conservation and Water Stewardship dated June 9, 2015 was reviewed to determine alternative leachate disposal options permitted by Manitoba Conservation. The following are the four options described in the report with discussion related to the City of Thompson WDG:

- ***Leachate Evaporation:*** The document lists evaporation ponds as the preferred method to manage leachate and discusses the use of floating aerators to reduce odors and help increase evaporation rates. The WDG have experimented with mechanical evaporators at the site with some limited success. Even with mechanical evaporators, the evaporation rate is limited by the temperature and humidity of the air, as discussed above.

- ***Leachate Treatment:*** The document discusses pre-treatment and complete treatment methods consisting of both biological and physical/chemical treatments. Following complete treatment, surface discharge may be considered by Manitoba Conservation. Complete leachate treatment at the Thompson WDG would require an advanced treatment plant to be constructed which would require extensive design based on the expected leachate characteristics. A treatment plant would have high capital costs and high operating costs including power consumption and chemical costs and would require a highly trained operator to maintain. Even with complete treatment, surface discharge may not be approved. Overall, on-site leachate treatment would not be feasible for the Thompson WDG.

- ***Discharge to a Wastewater Treatment Plant:*** The document states leachate may be sent to a WWTP depending on the treatment type and capacity of the WWTP. Authorization would be required from the Director of Conservation and Water Stewardship. The City of Thompson is planning to construct a new WWTP to service the City. Tanker trucks could potentially collect liquid from the pond and haul it to the WWTP for co-treatment with municipal wastewater. Laboratory test results from the leachate would be required to ensure the WWTP could handle the loading and provide treatment of the parameters of concern. This option would likely require a road to be constructed to access the pond. Assuming a tanker truck volume of 9,092 L (2,000 gal) it would take 116 truck loads to lower the pond liquid level by 0.5 m. This option would potentially be feasible for the WDG if the new WWTP was able to accept the leachate and the option was approved by Manitoba Conservation, however the capital costs for road construction and on-going trucking costs would be very high.

- ***Leachate Collection and Recirculation:*** The document discusses leachate re-circulation to essentially create a bioreactor landfill. The document states that the option would only be considered in Manitoba for sites with a double liner system compatible with high strength leachate. From discussion with Manitoba Conservation, this option would not be approved for the Thompson WDG as the insitu clay liner would not be sufficient for this type of system.

Overall the only feasible option for the Thompson WDG, permitted by Manitoba Conservation is to operate the evaporation pond. The operator must minimize leachate production through the use of cover material, operating a small active cell and constructing temporary berms to divert clean surface water to the perimeter ditches. If liquid levels cannot be maintained at an acceptable level, hauling to the WWTP could be investigated.

2.5.9 Monitoring Wells

Manitoba Conservation guidelines suggest a groundwater monitoring system comprised of three monitoring wells (one upstream and two downstream of the WDG, on the basis of the assumed direction of the groundwater flow). Typically the installation of three monitoring wells is required for the construction of any new WDG. Six monitoring wells installed by AECOM in October 2005 exist on the current WDG site.

Three of the monitoring wells are within the proposed final berms around the former and active WDG cell. It was discussed with Manitoba Conservation and agreed that if these wells continue to be accessible and functional they will remain within the berms and continue to be used by extending the casing, as waste accumulates in the cells.

It is recommended that the City of Thompson perform sampling and testing from all monitoring wells on a regular basis as part of its operation and maintenance plan. Every sample should be tested for the baseline ground water chemistry parameters listed in the Guidelines for the Siting of a Class 1 Waste Disposal Ground in Manitoba. Test results should be compared to past samples to determine if any concerns exist.

2.5.10 Drainage

The WDG has a perimeter drainage ditch around the active cell to intercept surface water from outside of the WDG to prevent the surface water from entering the site. The entire WDG site, by design, will be graded to ensure any surface water will drain away from the site into the perimeter ditches.

Within the active cell area, small temporary berms are to be constructed around the active portion of the cell to ensure clean surface water does not enter the active portion of the cell. Only precipitation falling on the active portion of the active cell, in contact with waste will be directed to the leachate collection pond. Clean surface water falling in the active cell area, but not the active portion will be directed to the perimeter berms through grading of the cell cover. Clean surface water will then be pumped over the perimeter berms of the active cell into the perimeter ditches.

The perimeter ditch directs clean surface water to a discharge ditch which will send water to the surface water body located southwest of the WDG. The final drainage plan is shown on Plan 2 attached in Appendix C.

2.5.11 Contaminated Soils Remediation Area

The contaminated soil remediation area was upgraded as part of the Phase II construction works. The area was constructed with two cells using a 0.5 m thick re-worked clay horizontal liner, new 1 m high berms surrounding the area with 3:1 side slopes and leachate collection piping along the west side of the remediation area. Cell 1 has a surface area 1,531 m^2 and Cell 2 has a surface area of 1,019 m^2.

2.5.12 Burn Area

Separated and readily combustible materials such as boughs, loose straw, leaves, paper products, cardboard non salvageable untreated wood and packing materials made from wood will be burned in the designated burning area. Burning activities will only take place under the direct supervision of the facility operator, when weather conditions are favourable and only an amount of material that can be extinguished by the end of operating hours.

As per Regulation 37/2016 the burn pit must be located 400 m from a building not located on the facility site, 50 m from an active area and 50 m from a compost area or an area used to collect flammable materials. The burn pit location with 50 m setback is shown on Plan 1 attached in Appendix C. The WDG active area cannot be within the setback area shown.

2.5.13 Asbestos Disposal Area

It was originally intended to construct the new perimeter dikes of the WDG on the east side to surround the existing asbestos disposal area. However, during the geotechnical site investigations east of the existing WDG area it was discovered that a suitable insitu clay horizontal liner does not exist at all areas. From discussion with Manitoba Conservation at the time, it was decided to leave the existing asbestos area undisturbed and construct the perimeter dikes closer to the existing WDG cell area, rather than excavating and re-compacting a horizontal liner beneath the asbestos area.

A new asbestos disposal area will have to be established within the perimeter dike area, once the Phase IV construction works are complete. Asbestos will be deposited at the WDG only if asbestos is packaged in accordance with the current edition -of *Guidelines for an Asbestos Operations and Maintenance Program* from Workplace Safety and Health Division. All asbestos shall, be covered immediately with a minimum of metre of material and the location for disposal shall be documented and recorded in the Facility operation and maintenance plan accessible to all operators.

2.5.14 Sludge Drying Area

The existing WDG site includes a sludge drying bed which accepts dewatered biosolids (stabilized sludge) from the City of Thompson WWTP. Sludge is also accepted from the Keeyask Generating Station.

2.5.15 Access Road

The existing access road is an all weather road in good condition. The main access highway is PTH 6 located approximately 150 m east of the site. The interior roads appear to be in good condition and are maintained by the WDG operator on an ongoing basis.

2.5.16 Fencing and Signage

The existing locking gate will be utilized at the entrance to the site. The gate will be locked except during hours of operation. Three sections of litter control fencing are currently being utilized at the active face of the active cell to help control wind-blown litter.

The Phase IV construction works currently under contract includes the supply and set-up of 150 m of 1.8 m high moveable chain link fencing. The fencing will be installed surrounding the active portion of the active cell to contain wind-blown litter. The fencing can be re-located as the active cell moves.

The leachate pond is surrounded by a 1.2 m high 4-stranded barbed wire fence.

Currently signs are located at the entrance to the site and at various locations within the site to direct the public to the correct waste disposal areas, and to ensure public safety on site. Signage will continue to be used on the site.

According to the Waste Management Facilities Regulation 37/2016 the signage at the entrance to the WDG facility must contain the following information:

- the name of the facility
- the operating hours of the facility
- the types of materials that may be deposited at the facility
- the types of materials that are not accepted at the facility
- a 24-hour emergency contact telephone number.

The existing sign at the entrance to the facility contains the name of the facility and the hours of operation but does not contain information about the types of waste accepted at the site and does not contain an emergency telephone number.

2.5.17 Proposed 'One Stop Shop'

The City of Thompson is planning to create a 'One Stop Shop' at the WDG site to accept household hazardous waste, e-waste, used oil, and fridges. The project is currently in the early stages of planning. The current plan is to hold the e-waste in an existing building on-site and collect household hazardous waste in a steel storage container (sea can). The used oil building will be re-located at the 'One Stop Shop'. Thompson is working with Product Care Manitoba (household hazardous waste) and the Manitoba Association for Resource Recovery Corp. (MARRC) for oil recovery and e-waste.

The 'One Stop Shop' will be open part time year round (Tuesday and Thursday in the winter and Tuesday, Thursday and Saturdays in the summer).

2.5.18 Decommissioning and Closure

The waste disposal cells, when at maximum height above ground, will be decommissioned in accordance with the Waste Management Facilities Regulation 37/2016 Part 4 - Closure Requirements and the Manitoba Conservation and Water Stewardship Supporting Document for Waste Disposal Ground or Waste Transfer Station Site Closures April 2014 guideline.

A preliminary closure plan will be submitted to the director within 12 months of the licence being issued. A final closure plan will be submitted to the director at least six months before the permanent closure of the facility.

Upon closure, the WDG household waste are will be covered with a minimum of 0.5 m compacted clay soil and topsoil for seeding. The surface of the capped cells will be graded to allow positive drainage away from the cell towards the perimeter ditching. The decommissioned cells will be seeded with grass to provide an aesthetically pleasing environment, and regular monitoring of the site will continue to occur to determine if there are any impacts to groundwater at the site.

2.5.19 WDG Maintenance and Operation

The intended method of land filling is to compact (a typical municipal compaction rate of 475 kg/m^3 has been assumed) and cover the active area of the active cell with 0.15 m thickness of clean soil cover material once every three weeks, or as stipulated in the Environment Act Licence. The cover material in each instance will serve to eliminate the wind-blown wastes, rodents, birds, moisture and fires. Active areas in the cell will propagate in an upward direction as waste collects and is compacted.

As the active portion of the active cell is re-located, temporary berms are to be constructed at the edge of the active portion to prevent clean surface water from entering the new active portion of the cell. Clean surface water will either be directed to the perimeter ditching by surface grading or pumped into the perimeter ditches, if grading is not possible. The general operation/filling of the active cells is shown on Plan 7 of the Phase I Works record drawings attached in Appendix C.

By way of this document and plans the operator is instructed that the solid waste disposal ground cells, when at their maximum height above existing waste level, as previously described must be decommissioned by covering with clay soil and topsoil as per Manitoba Conservation guidelines. Positive drainage away from the site must be provided and maintained.

In accordance with Regulation 37/2016 the City of Thompson must employ at least one person certified with the Manager of Landfill Operation certificate provided by the Solid Waste Association of North America (SWANA) by July 1, 2019. This person does not have to be at the WDG at all times. However, at all times when the WDG is open to the public, at least one operator at the facility must have their Landfill Operations Basics certification or equivalent.

The active cell area will be restricted to employees only, with the public having access to the dumping area of the active portion of the active cell. The operator is to limit the waste type to those previously discussed. The operator is to provide onsite signage to direct public to the dumping areas of acceptable wastes.

The life expectancy of the WDG is based upon the application of the above operation and management practices. The usable life of the WDG will be reduced if these practices are not followed.

The WDG operators will also handle the following various tasks:

- collecting tipping fees at the gate entrance
- recording waste tonnage dropped off at the site
- directing the public to the appropriate drop off locations
- moving, covering and compacting waste material in the active waste disposal cells
- moving ash from the burn cells into the active cells after material is completely extinguished
- inspecting and maintaining the fencing, gate and lock
- ensuring the entrance gate is locked at all times when the operators are not present
- ensuring burning activities are continuously monitored and recorded
- ensuring the liquid level in the leachate pond is maintained at an acceptable height
- ensuring only leachate from the active cell is drained to pond
- ensuring recyclable materials and tires are hauled off site regularly
- ensuring that unacceptable waste products are not dumped at the site
- ensuring internal access roads are cleared and maintained regularly
- ensuring the movable chain link fencing is properly positioned around the active cell area to prevent blown litter
- ensuring windblown waste material is cleaned up regularly
- controlling insects, rodents and other vectors onsite.

3.0 POTENTIAL ENVIRONMENTAL IMPACTS

The biophysical and socioeconomic environment as related to the development, and potential impacts of the development on the environment.

3.1 Releases to Air, Water, Land

3.1.1 Air

Prevailing winds in the area can carry odours if the waste disposal areas are exposed and there is unobstructed wind sweep across the site. These odours have the potential to be a nuisance to nearby residents.

While there is potential for odours at the WDG site during operation, the active waste disposal activities are located well beyond the minimum distance of 400 m from the nearest resident. In addition, with waste cover material being utilized, odours are not likely to become a nuisance. The site is also bordered by forest which acts as a windbreak to reduce the spread of odours. Due to the evaporation of liquid leachate, odours from the leachate pond are not expected to be significant.

There is also a potential for greenhouse gas emissions during operation works from heavy equipment and transport vehicles.

3.1.2 Water

Pollutants that have the potential to be released into surface water and groundwater during the operation of WDG would be from leachate production. Pollutants potentially produced in waste disposal cells would generally include nutrients, coliforms, volatile organics, suspended solids, heavy metals, inorganic compounds and organic carbons that are typical for leachate produced from residential and commercial wastes.

Pollutants that have a potential to be released into the surface water or groundwater during the WDG expansion construction activities, would include petroleum hydrocarbons (PHCs) from heavy equipment spills/leaks and sediments from soil erosion.

3.1.3 Land

The footprint of the WDG will not be altered from the current layout with the exception of the Phase IV construction works to be completed in the summer of 2016 on the east side of the WDG area. Leachate and windblown litter can impact surrounding lands if not contained. Ground areas disturbed by construction activities can be impacted through soil erosion if not covered or re-vegetated shortly after works are completed.

Pollutants that may be released to the land are predominantly PHCs, which could be released during construction activities from equipment leaks, and/or re-fuelling incidences and could result in impacts to the soils/land.

3.2 Wildlife

The typical concern on any construction project is that wildlife species would be displaced through the construction works. However, the footprint of the WDG will not be altered.

3.3 Fisheries

The typical concerns with impacts to fish and fish habitat are from sediments released during construction and the leachate discharges into a body of surface water utilized by fish species. These impacts could include the reduction of water quality or physical disturbances that would create an unfavorable environment for fish or fish eggs. As leachate will be contained on site and silt fencing will be maintained during construction works, significant impacts on fisheries are not expected.

3.4 Vegetation and Forestry

The typical concern on any construction project is the removal of vegetative species through the construction works, however the footprint of the WDG will not be altered.

3.5 Noise Impacts

There is a potential for noise impacts in the immediate area of expansion due to the heavy equipment utilized during construction, however these impacts are not expected to be significant, as heavy equipment is already being used at the site during daily maintenance. No additional noise impacts are expected during the continued operation of the WDG as no additional maintenance equipment will be utilized.

3.6 Health and Safety

There is a potential for impacts to the health and safety of workers and the public during the construction works and operating of the WDG, as heavy equipment is utilized on site while the public has access to other areas of the WDG.

3.7 Socio-Economic Implications

The final phase of the WDG expansion is not expected to have adverse socio-economic impacts. In fact, construction related economic activity is likely to have a positive economic impact on the City of Thompson.

3.8 Aesthetics

The WDG will have an impact on the general aesthetics of the area, as the active cell area is currently several metres above the original ground elevation and is planned be extended several more metres prior to WDG closure. The site is surrounded by forest on the north, west and east side and a tree line existing on the east side between the WDG and PTH 6. Windblown litter is also a concern at WDG sites as it creates a site which can be aesthetically unpleasing.

4.0 MANAGEMENT PRACTICE

Proposed environmental management practices to be employed to prevent or mitigate adverse implications from the impacts identified above.

4.1 Mitigation of Impacts to Air

The WDG is located well beyond the minimum setback distances to nearby residents which reduces the potential for nuisance odours. Regular covering of the waste disposal cells will reduce the odours generated from the site.

Emissions from construction equipment and WDG equipment will be controlled through regular maintenance, and should meet all provincial and local emission standards. Dust suppression methods (i.e. water spraying) can be utilized at the construction site if dry conditions create excessive dust through construction activities and transport, and becomes a nuisance to nearby residents.

4.2 Mitigation of Impacts to Water

Impacts to surrounding surface waters and groundwater from leachate production in the waste disposal cells will be reduced by the WDG clay liner, which meets the permeability requirements of Manitoba Conservation.

Leachate produced will be collected and contained in a leachate evaporation pond as per Manitoba Conservation requirements. Leachate production will be minimized by covering all waste except for the active portion of the active cell and diverting clean surface water to perimeter ditches. Leachate management is discussed in detail in Section 2.5.8.

Siltation in the drainage ditch from disturbed soil areas during the construction works will be mitigated through the installation of silt fencing. Dike and ditch slopes would also be seeded with grass to control erosion.

4.3 Mitigation of Impacts to Land

To minimize impacts to the surrounding land, perimeter dikes around the WDG cells will act to contain leachate and movable fencing installed around the active area will act to contain windblown litter to the designated areas. Intermittent cover will also act to prevent windblown litter and the production of leachate in the waste disposal cells. Disturbed ground surface areas will be seeded upon completion of construction works to minimize soil erosion.

4.4 Mitigation of Impacts to Vegetation

Tree removal will not be required, as the footprint of the WDG will not be expanded. Vegetation outside of this construction area will not be damaged and the tree line surrounding the site will remain intact.

4.5 Mitigation of Noise Impacts

To minimize the potential for noise impacts, construction equipment and WDG maintenance equipment should have mufflers working properly, and construction activities should be limited to daylight hours only.

4.6 Mitigation of Impacts to Health and Safety

To minimize impacts to health and safety of workers and the public, the construction contractor should have a safety program in place, in accordance with all federal and provincial health and safety regulations. During construction, access to the construction areas will be limited to the construction crew only. Personal protective equipment will be worn by all personnel while in the construction area, in accordance with the contractor's safety program.

The WDG will develop an operations manual that includes an emergency response plan, waste acceptance procedures and policies and drawings and descriptions necessary for the safe and efficient operation of the facility.

4.7 Aesthetics

Impacts to aesthetics at the WDG site would be mitigated by maintaining the tree line along the east border of the site to reduce the visual impacts of the WDG from PTH 6. Windblown litter would be reduced by cover material placement in the waste disposal cells and would be cleaned up regularly as part of the WDG operations, which would increase aesthetics of the site.

5.0 RESIDUAL AND CUMULATIVE EFFECTS

Residual environmental effects remaining after the application of mitigation measures, to the extent possible expressed in quantitative terms relative to baseline conditions

No negative residual effects are anticipated through the WDG expansion construction and continued operation, due to the mitigation measures described above. Positive residual effects to the service area are expected from the increased waste disposal capacity, which will allow for continued growth of the service population without immediate concern for waste disposal availability. In addition, the construction of a containment liner around the existing and proposed waste disposal cells, would minimize the potential for contaminants leaving the WDG site.

6.0 MONITORING AND FOLLOW-UP

Proposed follow-up activities that will be required at any stage of development (eg. Monitoring, inspection, surveillance, audit, etc.)

The clay liner around the WDG cells will be inspected and tested in the presence of Manitoba Conservation after the Phase IV construction works are complete. The liner would be tested for hydraulic conductivity to ensure that the requirements of the Environment Act Licence are met. The WDG liner and leachate pond liner was tested after construction phases 1 – 3 and met the Manitoba Conservation requirements.

Long-term monitoring on the WDG site would include regular testing of the groundwater monitoring wells for water quality parameters described in the Environment Act Licence. The operator is to monitor and record the liquid level in the leachate pond to establish long-term evaporation rates and determine the need for alternative leachate management options as discussed in Section 2.5.8. The operator is to maintain records of type and quantity of waste received at the site, a record of all burning activities. If there are any concerns with the operation of the WDG or with possible groundwater contamination, the City of Thompson is to contact the local environment officer and the Environmental Approvals Branch of Manitoba Conservation to discuss options.

7.0 FUNDING AND APPROVALS

Name and address of any Government Agency or program (federal, provincial or otherwise) from which a grant or loan of capital funds have been requested (where applicable). Other federal, provincial or municipal approvals, licences, permits, authorizations, etc. known to be required for the proposed development, and the status of the project's application or approval.

Funding for preparation of the EAP document will be undertaken by the City of Thompson. Funding for WDG equipment and maintenance including any minor projects at the WDG such as development of the 'One Stop Shop' will be undertaken by the City of Thompson. No other approvals, licences or permits are expected for continued use of the Waste Disposal Ground.

8.0 PUBLIC CONSULTATION

Results of any public consultations undertaken or to be undertaken in conjunction with project planning.

Public consultation by the City of Thompson through a designated public forum has not been conducted. Public comments received by Manitoba Conservation through the public registry during the Environmental Act Proposal review period will be reviewed and addressed.

9.0 CONCLUSION

Based on the construction works that have been completed at the WDG and the implementation of the mitigation measures identified in Section 4.0 above, no significant negative environmental impacts are anticipated.

The proponent would like to complete the requirements of the Environment Act Proposal as soon as possible so that the WDG will be in compliance with Provincial regulations.

JR Cousin Consultants Ltd. requests that a draft copy of the Environment Act Licence be forwarded for review prior to the issue of the final licence.

APPENDIX

Appendix A

Letter from Crown Lands and Property Agency September 17, 2015

Crown Lands Permit

Schedule A1 Sketch of WDG Property from file at Lands Branch

Waste Disposal Ground Operating Permit #42877

Crown Lands & Property Agency - Lands Branch, March 9, 2011 Email Correspondence

Table 1: Population and Waste Generation Projections – City of Thompson Waste Disposal Ground

Appendix B

LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report, AECOM 2008

LGD of Mystery Lake Waste Geotechnical and Topographic Investigation for the Waste Disposal Ground, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes, JR Cousin Consultants Ltd., 2012

Phase I Construction Works – Hydraulic Conductivity Test Results, NTL, September 14, 2012

Phase II Construction Works – Hydraulic Conductivity Test Results, NTL, October 29, 2013

Phase III Construction Works – Hydraulic Conductivity Test Results, Stantec, October 23, 2014

Appendix C

Plan 1: Site Layout with Approximate Location of Property Line

Plan 2: Final Cover Grading Contours and Final Drainage Plan

Phase I Works – Record Drawing Plan Set

Phase II Works – Record Drawing Plan Set

Phase III Works – Record Drawing Plan Set

Phase IV Works – Design Drawing Plan Set

Appendix A

Letter from Crown Lands and Property Agency September 17, 2015

Crown Lands Permit

Schedule A1 Sketch of WDG Property from file at Lands Branch

Waste Disposal Ground Operating Permit #42877

Crown Lands & Property Agency - Lands Branch, March 9, 2011 Email Correspondence

Table 1: Population and Waste Generation Projections – City of Thompson Waste Disposal Ground

Letter from Crown Lands and Property Agency September 17, 2015

CLPA
Crown Lands and Property Agency

308-25 Tupper Street North
Portage la Prairie, MB R1N 3K1
P. (204) 239-3510 F. (204) 239-3560
Toll Free 1-866-210-9589

Writer's direct line – (204) 239-3810
Email: kelsey.little@gov.mb.ca

September 17, 2015

The City of Thompson
Attention: Gary Ceppetelli
226 Mystery Lake Road
Thompson MB R8N 1S6

Dear Mr. Ceppetelli:

Re: Site in Part NW ¼ 18, S ½ & NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM
Assignment of Crown Land Permit No. 50804
Specific Use: Waste Disposal Site

The application to assign Crown Land Permit No. GP 50804 from LGD of Mystery Lake to the City of Thompson has been approved and registered in the office of Crown Lands and Property Agency, Portage la Prairie, on the **30th** day of **July**, **2015** as No. **4612**-Electronic.

Enclosed is your copy of the registered assignment for your records and a copy of Crown Land Permit No. GP 50804.

In addition to payment of the rent, you may be responsible for the payment of taxes to the LGD of Mystery Lake.

Tax issues are to be dealt with directly with the taxing authority. Both taxes and rent must be kept current to constitute a valid permit. Failure to do so may result in cancellation of the permit. As well, it is imperative that all conditions of the Crown Land Permit are adhered to.

If you have any questions or require further information please contact me at the above noted number.

Yours truly,

Kelsey Little

Kelsey Little
Land Administrator
General Leases & Permits

KAL/kal

cc: Dave Hastman, Regional Land Manager (copy of signed Schedule A)
Lori Stevenson, Manitoba Conservation and Water Stewardship
Tannis Bohn, Department of Local Government – Assessment Branch
Rico Penamante, Department of Local Government – Assessment Branch

LGD of Mystery Lake
P.O. Box 189
Thompson MB R8N 1N1

Crown Lands Permit

Manitoba

Conservation

Lands Branch

Box 20000, 123 Main Street W
Neepawa Mb. R0J 1H0 CANADA
Tel: (204)-476-7060 Fax: (204)-476-7539

DRAFT

February 22, 2005

Local Government District of Mystery Lake
Attention: Louise Hodder
Box 730
Thompson, Mb. R8N 1N5

Dear Madam:

Re: Site in Part NW¼ 18, S½ & NW¼ 19 in Twp 77-3 WPM and in Part SE¼ 24-77-4 WPM as shown on a sketch on file at Lands Branch.
waste disposal site
Crown Land Permit No. GP 50804

I am pleased to advise that your Crown Land Permit application for the above noted land has been conditionally approved under the terms and conditions outlined in the enclosed Schedule A.

Please review Schedule A. If the terms and conditions are acceptable to you, please sign and date both copies where indicated and have your Witness sign and date both copies where indicated.

Return one copy of the signed Schedule A to this office.

If we have not received a signed copy of Schedule A by April 22, 2005, we will assume that you are no longer interested in this property and your application will be cancelled. Any new application received after that date will be dealt with in accordance with the policies and regulations in effect at that time.

Your permit will be issued upon receipt of the signed copy of Schedule A.

If you have any questions concerning Permit No. GP 50804, please contact Larry Krakowka, Land Administrator at (204) 476-7515.

Yours truly,

Harley Jonasson
Director

/km
Copy: Brian Barton, Regional Land Manager

PROVINCE OF MANITOBA
MANITOBA CONSERVATION

DRAFT

SCHEDULE "A" TO CROWN LAND PERMIT NO. GP 50804 ("the Permit")

ISSUED BY:

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA
represented herein by the Honourable Minister of Conservation

("Manitoba")

ISSUED TO:

Local Government District of Mystery Lake

(the "Permittee")

pursuant to *The Crown Lands Act* as amended from time to time.

WHEREAS:

A) The Permittee has made an application to Manitoba for a Crown Land Permit for the Land (as described further in this Schedule);

B) The Permittee is eligible for a Crown Land Permit for the Land and the Land has been determined by Manitoba to be suitable for the use and purpose as described in this Schedule; and

C) Manitoba agrees to issue a Crown Land Permit to the Permittee, subject to the terms and conditions set out in this Schedule, which is Schedule "A" to the Permit, and the Standard Conditions attached to the Permit, for the land described as follows and as substantially similar to that set out on the map attached as Schedule A1:

Site in Part NW¼ 18, S½ & NW¼ 19 in Twp 77-3 WPM and in Part SE¼ 24-77-4 WPM as shown on a sketch on file at Lands Branch.

Area: 136.38 acres (1,800 ft. x 3,300 ft.)

(the "Land")

THE PERMIT IS SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

1.00 TERM AND RIGHT TO USE AND OCCUPY THE LAND

1.01 The Permit shall be effective from the date it is issued by Manitoba until December 31, 2005, subject to termination or extension under section 7.

1.02 Subject to the terms and conditions of the Permit, Manitoba grants to the Permittee the right to use and occupy the Land.

2.00 PAYMENT OF FEES AND TAXES

2.01 The Permittee shall pay to Manitoba rent equal to the annual fee prescribed from time to time by the Regulations under *The Crown Lands Act*, in accordance with such Regulations and the Permit, within 30 days of receipt of an invoice from Manitoba. The Permittee acknowledges that the current annual fee is $0.00, as per Item No. 4 of an Agreement dated December 16, 1966 and signed by Manitoba, the International Nickel Company of Canada Limited, the Local Governmet District of Mystery Lake, the School District of Mystery Lake No. 2355, the Town of Thompson and the Resident Administrator of the Local Government District of Mystery Lake.

2.02 The Permittee acknowledges that an application for renewal and administration fee in relation to the Permit shall be paid by the Permittee, as prescribed by the Land Administration Fees Regulation (M.R. 216/89) and as amended from time to time.

2.03 Payments of the annual fee and the administration fees shall be made in accordance with the directions contained in the invoice from Manitoba.

2.04 Manitoba may establish a new annual fee rate where there is a change in one or more of the following factors in order to reflect these changes:
a) the appraised value of the Land as determined by Manitoba;
b) the appraised value of the buildings and improvements owned by Manitoba;
c) the policy of Manitoba as set out in an Act of the Legislature or a Regulation relating to the determination of annual fee; or
d) the use of the buildings, infrastructure or Land.

2.05 Manitoba shall give notice to the Permittee 30 days prior to the effective date of an increase in the annual fee.

2.06 The Permittee shall pay all taxes, rates, duties and assessments whatsoever, whether municipal or otherwise, now or hereafter charged on the Land or in respect of the Permittee's use and occupation thereof.

2.07 The Permittee shall pay interest to Manitoba on any arrears of annual fee or administration fees at rate equal to the rate fixed from time to time by the Minister of Finance of Manitoba under section 25(1) of *The Financial Administration Act*. Failing such rate being fixed, interest shall be payable thereon at a rate equal to the rate fixed from time to time by Manitoba.

2.08 The Permittee shall pay to Manitoba an amount equal to any and all goods and services taxes now or hereafter imposed on, or collectible by Manitoba with respect to any amounts payable by the Permittee to Manitoba hereunder, whether characterized as a goods and services tax, sales tax, value added tax or otherwise ("Sales Taxes"). The intention of the parties is that Manitoba shall be fully reimbursed by the Permittee with respect to any and all Sales Taxes payable or collectible by Manitoba now or in the future.

2.09 The Permittee is responsible for and shall pay any and all costs, charges, impositions and expenses related to the Land, including, without limitation, all water, sewer, gas, telephone, or electric power charges.

2.10 If the Permittee fails to pay any and all taxes or water, sewer, gas, telephone, or electric power charges as required, Manitoba may pay them or any of them and charge those payments to the Permittee who shall reimburse Manitoba forthwith and Manitoba may take the same steps for the recovery of those payments as it would be for the recovery of rent arrears.

2.11 The Permittee shall pay all amounts payable to Manitoba hereunder without any deduction or set-off whatsoever.

3.00 USE OF THE LAND

3.01 The Permittee shall use the Land for a waste disposal site and for no other purpose, including non-use, without prior permission in writing from Manitoba.

3.02 The Permittee agrees that the following structures and improvements on the Land are authorized under the Permit: 1 office building (35 ft. x 20 ft.).

3.03 Other than those developments and uses permitted under paragraphs 3.01 and 3.02 of this Schedule, the Permittee shall not construct, erect or alter any other buildings or structures on the Land or effect any change in use of the Land without prior permission in writing from Manitoba.

3.04 The Permittee agrees to notify Manitoba of any building destroyed, demolished, or removed from the Land within 30 days of that occurrence; and to rebuild, replace or reinstate the building within 24 months of that occurrence.

3.05 It is the responsibility of the Permittee to place and maintain all buildings within the boundaries of the Land, and to obtain any Surveyor's Certificates necessary to effect or verify this condition.

3.06 Manitoba has no obligation to survey or resurvey the Land, and the Permit shall create no such obligation on Manitoba to survey or resurvey the Land.

3.07 The Permittee agrees that removal or relocation of any existing Manitoba Hydro facilities shall be at his/her expense.

3.08 The Permittee and its officers, directors, agents, invitees and employees, as applicable, shall be bound by the rules, regulations and guidelines made by Manitoba from time to time. All such rules, regulations and guidelines will be deemed to be incorporated into and form part of the Permit. Some form of advance public notice shall be provided for changes in these rules, regulations and guidelines.

3.09 The Permittee shall comply with all federal, provincial and municipal laws and regulations, and obtain all licences and permits necessary for the lawful use of the Land, which, without restricting the generality of the foregoing, includes obtaining a work permit from the local District Resource Officer before cutting any trees or commencing any work on the Land, obtaining a building permit from the Department of Labour before constructing any structures, as may be authorized by Manitoba, in accordance with the Manitoba Building Code and applicable Municipal By-laws and regulations. The Permittee shall provide Manitoba with a copy of work permits or building permits obtained at the request of Manitoba.

3.10 The Permittee understands and agrees that the issuance of this Permit in no way implies that either Manitoba or the local government authority shall provide any services.

3.11 The Land is contained in the "Burntwood River Water Power Reserve" and this Permit is issued subject to *The Water Power Act* and Regulations thereunder.

3.12 The Permittee acknowledges that the Land is affected by Mineral Lease Nos. M4795, M4796, M4798, M4801, M4802, M4804 and M4805 and the leases are in good standing under *The Mines and Minerals Act*. These leases are held in the name of Inco Ltd, and this company retains the right to travel across the Land and to mine thereunder.

3.13 The Permittee acknowledges that the operation of the waste disposal site on the Land is governed by Operating Permit #N-02. Any expansion of the Land would require an Environment Act Licence which would require the filing of a proposal for a Class 2 development.

3.14 The Permittee acknowledges that a Manitoba Telephone System fibre optic cable is situated within the Hydro Right-of-Way paralleling Provincial Trunk Highway #6 or immediately adjacent to that Hydro faciltiy. The Permittee understands and agrees to contact the Manitoba Telephone System before any excavation occurs near this area.

4.00 MAINTENANCE OF LAND

4.01 The Permittee agrees:

a) to keep the Land, and all buildings and structures thereon, in a clean and sanitary condition free from inflammable materials, other than those contained in containers approved by the Canadian Standards Association;

b) to comply with all federal, provincial and municipal by-laws, Acts and regulations relating to the Permittee and/or the Land including, but not limited to, *The Crown Lands Act* and Regulations, *The Dangerous Goods Handling and Transportation Act* and Regulations and *The Environment Act* and Regulations, all as amended, replaced or substituted from time to time;

c) not to commit waste or damage the Land;

d) to keep the Land, and all buildings and structures thereon, in good and safe repair; and in a proper and neat condition and to repair in accordance with any notice from Manitoba;

e) to allow a person or persons on behalf of Manitoba to enter the Land, including all buildings and structures, at all reasonable times to examine the state of repair;

f) not to cut or remove any trees without prior written consent of Manitoba

g) any shoreline development to be minimal on Crown land adjacent to lakes or rivers and limited only to facilities or uses approved in writing by Manitoba. Natural vegetation and features should have minimal disturbance, and a vegetative riparian zone should be maintained or encouraged.

4.02 The Permittee shall not release upon the Land or any part thereof any Pollutants (as defined in paragraph 4.05), but if Permittee does release any Pollutants, the Permittee shall

a) at his/her expense, immediately give Manitoba notice of the release; remove the Pollutants from the Land in a manner which conforms with all laws and regulations covering the handling, removal and management of the Pollutants and as may be directed or ordered by an Environment Officer or Director of the Environmental Approvals Branch, or such successor as appropriate, as soon as reasonably practicable; and

b) obtain from an independent Qualified Environmental Consultant, a report verifying the complete and proper removal thereof from the Land, if requested by Manitoba, otherwise the Permittee shall report as to the extent and nature of any failure to comply with this Section.

4.03 Any Pollutants noted in paragraph 4.02 shall not become the property of Manitoba notwithstanding any rule of the law to the contrary (save and except where such Pollutants are brought or created upon the Land by Manitoba or its servants, employees or agents, and provided such person is not the Permittee or an officer, director, agent or employee of the Permittee). At the option of Manitoba, any substance contaminated by such Pollutants shall become the property of the Permittee and at the Permittee's expense, the Permittee or, at Manitoba's option, Manitoba, shall remove the contaminated substance from the Land and make good any damage done in so doing.

4.04 The Permittee shall indemnify and save harmless Manitoba from all costs or expenses, liabilities, losses, claims, damages (including consequential damages, interest, penalties, fines or monetary sanctions), legal costs or fees on a solicitor and own client basis, and fees or expenses of professional consultants incurred by Manitoba by reason of Pollutants being present on the Land and resulting from the Permittee's use or occupation of the Land or the breach of any warranty or covenant of the Permittee in this Section.

4.05 In this Section, "Pollutants" means any product, solid, liquid, gas, smoke, odour, waste, radiation or organism, or any combination of these, that is foreign to or in excess of the natural constituents of the environment on the Land and that:

a) has affected, is affecting or may affect the natural, physical, chemical or biological quality of the air, land and water; or
b) is, or is likely to be, injurious or damaging to the health or safety of a person(s), or injurious or damaging to property or to plant or animal life.

5.00 NO ASSIGNMENT OF PERMIT WITHOUT CONSENT

5.01 The Permittee shall not assign the Permit without the prior written consent of Manitoba, that consent not be unreasonably withheld. If the Permittee is a corporation, any change in ownership or control of the Permittee is deemed to be a proposed assignment.

5.02 Manitoba shall not unreasonably withhold consent to the assignment of the Permit for collateral (financing and security) purposes.

5.03 The Permittee shall submit an application on a form specified by Manitoba for approval to assign the Permit or any interest in the Permit.

5.04 Notwithstanding paragraphs 5.01 or 5.02, Manitoba may, in its sole discretion, refuse to assign the Permit if:

a) the Permittee has not paid any and all outstanding rent and taxes in respect of the Land and improvements, or
b) the proposed assignee is not eligible to hold a Permit in accordance with then current laws, regulations and policies of Manitoba.

5.05 The Permittee shall not sublet or rent out the Land.

5.06 The Permit shall be binding upon the executors, administrators, heirs, successors and any permitted assigns of the Permittee.

6.00 RESPONSIBILITY AND INSURANCE

6.01 Nothing contained in the Permit shall create any liability on the part of Manitoba or Manitoba Hydro for any damages caused or purported to be caused in respect to the Land by raising or lowering waters bordering upon or adjacent to the Land.

6.02 The Permittee shall use due care in the occupation of the Land to ensure that no person is injured, no property is damaged or lost and no rights are infringed.

6.03 The Permittee shall be solely responsible for and indemnify and save harmless Manitoba, its officers, employees and agents from and against all claims, liabilities and demands with respect to:

a) any injury to persons (including death), damage or loss to property caused by, or related to the occupation of the Land or the performance of the Permit or the breach of any term or condition of the Permit by the Permittee, any agent, invitee, officer, director or employee of the Permittee or any other person authorized by the Permittee to occupy the Land, and
b) any omission or wrongful or negligent act of the Permittee, any agent, invitee, officer, director or employee of the Permittee or of any other person authorized by the Permittee to occupy the Land;

unless such claims, liabilities, and demands arise out of the acts or omissions of Manitoba, its officers, employees or agents, and provided such person is not the Permittee or an officer, director, agent or employee of the Permittee.

6.04 It is the responsibility of the Permittee to discuss his/her insurance requirements with his/her insurance adviser/broker and to arrange for his/her own insurance coverage(s). However, at a minimum, the Permittee shall purchase and maintain comprehensive general liability insurance with a minimum limit of $1,000,000 per occurrence or claim. Manitoba reserves the right to require the Permittee to purchase and maintain a different minimum amount of liability insurance as specified by Manitoba from time to time by providing at least 180 days notice in writing of the change in the minimum amount to the Permittee. Evidence of insurance in the form of a Certificate of Insurance shall be provided by the Permittee upon request.

6.05 Notwithstanding paragraph 6.03, the Permittee agrees that any buildings, including any buildings existing at the issuance of the Permit, on the Land shall be maintained entirely at the Permittee's own risk, and the Permittee agrees to assume full responsibility for any damage or injury to persons or property situated on the Land resulting from flooding, erosion, ice damage, or temporary or permanent loss of Land accessibility. The Permittee agrees not to institute any action or make any claim against Manitoba or any employee or agent of Manitoba, including Manitoba Hydro, in respect to any personal injury caused by or related to flooding, whether or not the damage was occasioned by flooding resulting from the regulation or control of the adjacent waterway by Manitoba or Manitoba Hydro.

6.06 Notwithstanding paragraph 6.03, the Permittee agrees to indemnify and save harmless Manitoba and all employees and agents of Manitoba, including Manitoba Hydro, from and against all claims, liabilities and demands in respect of any damage to property or injury to persons located on the Land, which has been caused by flooding, erosion, ice damage, or temporary or permanent loss to Land accessibility.

6.07 The Permittee agrees not to institute any action or make any claim against the local government authority with respect to damage to any building or personal property or any injury to persons located on the Land that may be caused by flooding, erosion, ice damage, or temporary or permanent loss of land accessibility, as described herein and the Permittee agrees to enter into a written Agreement with the local government authority if the local government authority deems it necessary.

7.00 TERMINATION AND EXTENSION

7.01 The Permittee acknowledges that the Permit does not operate to prevent the sale or lease of the Land at any time during its term and is subject to the condition that Manitoba may give the Permittee notice of the cancellation thereof; and at the expiration of 30 days from the service of the notice, the Permit shall be cancelled.

7.02 Subject to 7.01 and provided that there has been no uncured default by the Permittee, including payment of rent, Manitoba may, in its discretion automatically renew the Permit for a 1 year term on an annual basis and in accordance with then current laws, regulations or policies respecting rental rates and rental property of this type, unless otherwise notified by the Permittee.

7.03 Without restricting any other remedies available, Manitoba may, at its sole option, immediately terminate the Permit in writing if:

a) the Permittee has failed to make any payment due hereunder, has misrepresented any fact on the application for the Crown Land Permit, or has failed to comply with anyterm or condition of the Permit and has not remedied that failure to comply within 30 days of receipt of notice in writing from Manitoba;

b) the Permittee makes an assignment for the benefit of creditors, becomes bankrupt or insolvent, takes the benefit of, or becomes subject to, any statutes that may be in force relating to bankrupt or insolvent debtors (the appointment of a receiver or receiver and manager of the assets of the Permittee being conclusive evidence of insolvency), or if any certificate or order is made or granted for the winding-up or dissolution of the Permittee, voluntarily or otherwise;

c) the Permittee suffers a lien under *The Builders' Lien Act* (Manitoba) or any similar or successor legislation registered against the Land or Manitoba's interest therein and does not contest the validity or the amount of the lien and do all things necessary to obtain and register a discharge forthwith after the lien has come to the notice of the Permittee.

7.04 Where the Permittee terminates the Permit under paragraph 7.02 or Manitoba terminates the Permit in accordance with paragraph 7.01 or 7.03, or upon the expiration of the term or any renewal term of the Permit:

a) the Permittee shall deliver up possession of the Land to Manitoba and shall not remain in possession of the Land following the date of expiration or termination of the Permit; and

b) at the option of Manitoba:

(i) the Permittee and Manitoba may agree on the fair market value of the buildings or structures added to the Land by the Permittee and Manitoba may purchase such buildings or structures by paying to the Permittee that fair market value. If they fail to reach an agreement regarding the fair market value within 180 days of notice of termination being given by Manitoba, such value shall be determined by reference to the Land Value Appraisal Commission, or such other body as may hereafter be substituted therefor from time to time, or

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(ii) the Permittee shall remove all buildings and structures added to the Land by the Permittee within six months of such expiry or termination, or such other term as agreed to by Manitoba, and where those buildings and structures are not removed within six months or the term agreed to by Manitoba, they shall become the property of Manitoba. At the end of such six months or term agreed to by Manitoba, any assets left on the property as at such date shall vest in Manitoba, and the Permittee shall be deemed to have released and quit-claimed any interest therein to and in favour of Manitoba. No compensation or payment whatsoever shall be payable therefor by Manitoba to the Permittee in such event.

7.05 Where Manitoba terminates the Permit in accordance with paragraph 7.01 in instances where the Permittee is entering into a purchase or lease Agreement in respect of the Landwith Manitoba, all buildings and structures added to the Land by the Permittee shall be dealt with in accordance with the terms of that Agreement.

7.06 Where Manitoba terminates the Permit in accordance with paragraph 7.01 and 7.03 in instances where collateral assignments are recorded, it shall provide notice in writing of such termination to the holder of such collateral assignments (the "Security Holder"). The Security Holder:

a) shall then be allowed a reasonable time frame of not less than 30 days as stipulated in the notice, to cure defaults of the Permittee, and upon doing so the Permit shall be deemed not to have terminated;
b) shall not be obligated to go into possession; and
c) shall be allowed to assign the Permittee's interest in the Permit to a third party purchaser, subject to the prior written consent of Manitoba being required, but which shall not be unreasonably withheld; provided that as a condition of any such assignment, such subsequent assignee shall execute such documentation as Manitoba considers reasonable to bind the assignee directly to Manitoba on the terms and conditions as contained in the Permit, and all defaults of the Permittee shall be cured and brought to good standing. In the event of such permitted assignment, the Permit shall be deemed not to have terminated.

8.00 ENTIRE PERMIT

8.01 The Permit, including this Schedule and any Standard Conditions attached to the Permit, constitutes the entire Permit. There are no undertakings, representations, warranties, covenants, guarantees, agreements or promises, express or implied, verbal or otherwise, other than those contained in the Permit.

8.02 No amendment or change to, or modification of, the Permit shall be valid unless it is in writing.

9.00 APPLICABLE LAW

9.01 The Permit shall be governed by, interpreted, performed and enforced in accordance with the laws of Manitoba.

10.00 NOTICES

10.01 Any notice or other communication to Manitoba under the Permit shall be in writing and shall be delivered or sent by mail, postage prepaid to: Manitoba Conservation, Lands Branch, Attention: Director, Box 20,000, 123 Main Street West, Neepawa, Mb., R0J 1H0.

10.02 Any notice or other communication to the Permittee under the Permit shall be in writing and shall be delivered personally to the Permittee or an officer, director or employee of the Permittee or sent by mail, postage prepaid, to: Box 730, Thompson, Mb., R8N 1N5.

10.03 Any notice or communication sent by mail shall be deemed to have been received on the third business day following the date of mailing. If mail service is disrupted by labour controversy, notice shall be delivered personally.

10.04 Either party may provide notice of change of address to the other in writing and thereafter all notices or communications shall be provided to the new address.

10.05 Any notice or other communication signed by any employee, officer or minister of Manitoba acting in that capacity shall be deemed for the purposes of the Permit to be a notice or other communication executed by Manitoba.

10.06 Notwithstanding paragraphs 10.02 and 10.03 any written notice to be served or given by Manitoba to the Permittee under the Permit shall be effectively given or served by posting the same in a conspicuous place on the Land.

11.00 ADDITIONAL PROVISIONS

11.01 Time shall be of the essence of the Permit.

11.02 If any provision of the Permit is illegal or invalid or unenforceable at law it shall be deemed to be severed from the Permit and the remaining provisions shall nevertheless continue to be in full force and effect.

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11.03 No waiver of any default under the Permit shall be binding unless acknowledged in writing by Manitoba. Any condoning, excusing or overlooking by Manitoba of any default shall not operate as a waiver of Manitoba's rights hereunder in respect of any subsequent default.

11.04 All headings in this Schedule are inserted for convenience of reference only and will not affect the construction and interpretation of the Permit.

11.05 If this Permit is issued to two or more persons as Permittee, the liability of each to pay rent and taxes and to perform all other obligations hereunder shall be joint and several. If the Permittee is a corporation, each person acknowledging the terms of the Permit on behalf of the Permittee by so signing hereby agrees to guarantee to Manitoba the performance by the Permittee of all obligations of the Permittee hereunder, and each such person shall be jointly and severally liable with the Permittee as Permittee hereunder.

11.06 If the Permittee remains in possession of the Land after the termination of the Permit and Manitoba accepts rent, the tenancy, in the absence of written Agreement, will be from month to month only and shall be subject to all terms of the Permit, including rent, except that the tenancy shall be from month to month.

11.07 The Permittee shall not be entitled to file a caveat against title to the Land respecting the Permit under *The Real Property Act* (Manitoba) as it may be amended, replaced or substituted from time to time.

11.08 Sections 4 and 6 shall survive the termination or expiration of the Permit

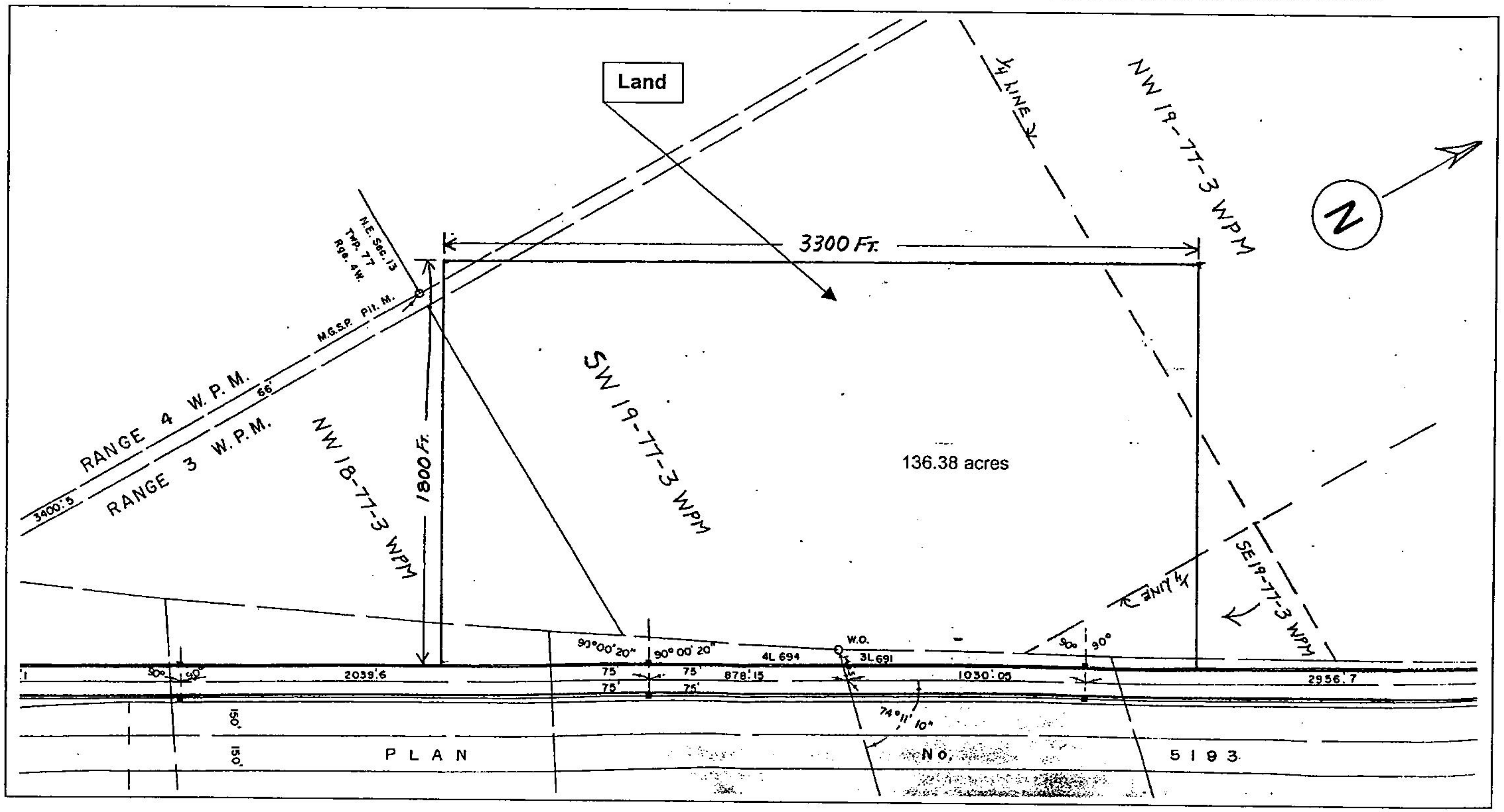
THE PERMITTEE or the Permittee's duly authorized representative, on the dates noted below, acknowledges that he/she has read and understands all the terms and conditions of the Permit and agrees to be bound by same.

WITNESS SIGNED IN THE PRESENCE OF	**PERMITTEE** Local Government District of Mystery Lake
Print Name of Witness	**Name of Permittee**
Signature of Witness	**Signature of Permittee**
DATE:	DATE:

Schedule A1 Sketch of WDG Property from file at Lands Branch

SCHEDULE A1

Site in Part NW¼ 18, S½ & NW¼ 19 in Twp 77-3 WPM and in Part SE¼ 24-77-4 WPM as shown on a sketch on file at Lands Branch.



Waste Disposal Ground Operating Permit #42877

Conservation and Water Stewardship
Environmental Stewardship Division
Environmental Approvals Branch
123 Main Street, Suite 160, Winnipeg, Manitoba R3C 1A5
T 204 945-8321 F 204 945-5229
www.gov.mb.ca/conservation/eal

September 22, 2015

Mr. Gary Ceppetelli
City Manager
City of Thompson
226 Mystery Lake Road
Thompson, MB R8N 1S6

Dear Mr. Ceppetelli:

Re: Thompson Waste Disposal Grounds, Permit 42877

Enclosed please find the permit for your waste disposal ground.

Please note that failure to comply with any condition of the permit may result in prosecution pursuant to the *Waste Disposal Grounds Regulation*.

Pursuant to Section 27 of *The Environment Act*, this permit may be appealed to the Minister of Conservation and Water Stewardship by any person who is affected by the issuance of this permit within 30 days of the date of issue.

In addition to the enclosed Permit requirements, please be informed that all other applicable federal, provincial and municipal regulations and by-laws must be complied with.

If you have any questions concerning the permit or procedures, please call Jeff Fountain in Thompson at (204) 677-6703 or via electronic mail at jeff.fountain@gov.mb.ca.

Yours sincerely,

Tracey Braun

Tracey Braun, M.Sc.
Director
Environmental Approvals Branch

c: D. Labossiere/T.Prawdzik/D.Smiley, Environmental Compliance and Enforcement Branch

NOTE: Confirmation of Receipt of this Permit No. 42877 *(by the Permitee only)* is required by the Director of Environmental Approvals. Please acknowledge receipt by signing in the space provided below and faxing a copy (letter only) to the Department by October 5, 2015.

____________________________ ____________________
On behalf of the City of Thompson Date

Waste Disposal Ground Operating Permit

Manitoba
Conservation and Water Stewardship

Permit No: 42877 **Client File: 11587**

In accordance with the *Waste Disposal Grounds Regulation*, made under *The Environment Act*, the **City of Thompson** is hereby permitted to operate a **Waste Disposal Ground**, to be known as the **Thompson Waste Disposal Ground** situated at **Pt NW ¼ 18, S ½ & NW ¼ 19 Twp 77-3 WPM and Pt SE ¼ 24-77-4 WPM** in the Province of Manitoba.

THIS OPERATING PERMIT is subject to being AMENDED, SUSPENDED or REVOKED under section 6 of the *Waste Disposal Grounds Regulation*.

THIS OPERATING PERMIT is issued subject to the following TERMS AND CONDITIONS:

General Terms and Operating Conditions

1. This permit expires on **June 1, 2016**.
2. The Operator shall, prior to **June 1, 2016** submit to the Director an Environmental Act Licence proposal for continued operation of a Class 1 Waste Disposal Ground.
3. The Operator shall construct, maintain and operate the **Thompson Waste Disposal Ground** (the Facility) in accordance with the most current version of the *Waste Disposal Grounds Regulation*, (M.R. 150/91), the engineering submission prepared by J.R. Cousin Consultants Ltd dated June 30, 2011 inclusive of supporting documentation from AECOM (2009 Master Plan) dated January 2010 and AECOM Environmental Assessment Report dated February 2010 hereafter referred to as The Plan, and this Operating Permit.
4. In accordance with section 8 of the *Waste Disposal Grounds Regulation*, this permit is issued to the Facility with a variance to the distance from a body of surface water requirements. Based upon the proximity of the surface water body to the waste disposal ground, the Operator shall sample the surface water body for the baseline parameters stipulated in Appendix B once annually starting in Summer 2015.
5. The Operator shall operate the Facility as per the operation and maintenance parameters included in The Plan.
6. The Operator shall provide site supervision when the Facility is open to the public.
7. The Operator shall restrict access to the Facility with a locked gate or barrier when site supervision is not provided.

Materials Acceptance and Handling

8. The Operator shall maintain a sign at the entrance of the Facility indicating the type of waste accepted, days and hours of operation, and the location for disposal of wastes not accepted on site.

9. Recyclable materials such as, but not limited to, bulky metallic waste, E-Waste, and rubber tires must be segregated in an area of the Facility other than the waste disposal cells (active area) and those areas must be appropriately signed.

10. The Operator shall remove any litter accumulated along the access road and around the perimeter of the site at minimum twice annually or as required by an Environment Officer.

11. The Operator shall only accept asbestos that is packaged in accordance with the current edition of Guidelines for an Asbestos Operations and Maintenance Program from Workplace Safety and Health Division. All asbestos shall be covered immediately with a minimum of 1 metre of material and the location for disposal shall be documented and recorded in the Facility operation and maintenance plan, accessible to all operators.

Liquids and Dangerous Goods

12. The disposal of liquid wastes or liquid industrial wastes shall not be allowed at the Facility.

13. The Operator shall collect and dispose of hazardous waste in accordance with *The Dangerous Goods Handling and Transportation Act*, and other Provincial and Federal Regulations.

Placement and Cover

14. Any animal mortality disposed of at the Facility must be covered within 24 hours of deposit with a minimum one (1) metre of soil, or within such time as is approved by an environment officer.

15. Cover of waste shall occur in accordance with M.R. 150/91 or as required by an environment officer. The use of cover materials other than those specified in M.R. 150/91 may be permitted with written approval of the Director.

16. The Operator shall implement control measures to prevent attraction and sustenance of rodents and scavenging vectors.

Surface Water Management

17. The Operator shall grade and maintain the site so that all uncontaminated surface water flows to the perimeter ditch or away from the Facility and impacted water from all material storage and disposal areas shall be directed to a leachate evaporation pond or contained within the site.

Site Construction and Upgrading

18. The Operator shall have all new waste disposal cells designed by and construction overseen by a Professional Engineer in accordance with Condition 19 of this Operating Permit.

19. Individual waste disposal cell (active cell) construction shall be subject to the following conditions:

a) the Operator must notify the assigned Environment Officer within five (5) days of commencement of construction of all waste cells and within five (5) days of installing any additional groundwater monitoring wells;
b) the Operator must provide for testing of all clay liners by a qualified consultant to confirm compaction is 95% Standard Proctor Density on maximum lifts of 150 mm;
c) all active areas or leachate containment developed from or with clay must be constructed to achieve a hydraulic conductivity of not more than $1x10^{-7}$ cm/s with a minimum thickness of 1 metre perpendicular to the surface. If appropriate or sufficient clay is not available an alternative proposal must be submitted to the Director for written approval prior to construction; and
d) the active area (cell) shall be constructed to retain any flyaway loose garbage or the Operator shall install a 1.8 metre fence constructed in such a manner as to contain the solid waste around the active area upon the request of an Environment Officer.

20. The Operator shall arrange with the designated Environment Officer a mutually acceptable time and date for any required soil sampling between the 15th day of May and the 15th day of October of any year, unless otherwise approved by the Environment Officer.

21. The Operator shall, within 90 days of the completion of the construction of any component of the waste disposal ground, submit "record drawings" along with a construction report to the Director.

Composting

22. Prior to establishing any composting area, the Operator shall provide a detailed operation and maintenance manual focused on the compost area including, but not limited to: the design and construction of the composting, curing and storage areas, the proposed volume and type of material for compost, the type of bulking materials used, the proposed frequency and method of turning, methods of vector and odour control, and the end use of the compost. For fish carcass composting areas this manual must be provided to the Director, and a written acceptance of the proposed operations must be received prior to the construction of the composting site.

Closure of Active Cells

23. The closure of each cell shall be performed as indicated in The Plan.

Environmental Emergency Reporting

24. The Operator shall, in the event of a fire which continues in excess of thirty (30) minutes, report the fire to the Environmental Emergency Response line by calling 1-855-944-4888 and identify the type of material involved and the location of the fire, excluding any fire in accordance with Condition 25.

Burning of Combustible Waste

25. All burning shall be carried out in accordance with the attached Appendix A: Terms and Conditions for Burning at Waste Disposal Grounds.

Monitoring and Reporting Requirements

26. Groundwater monitoring well samples shall be collected, stored and analyzed using approved field and laboratory techniques for dissolved analysis. The analytical results shall be retained in a format acceptable to Manitoba Conservation and Water Stewardship and must show previous results and analytical trends.

27. The Operator shall sample the groundwater monitoring wells once per year in late summer for those parameters identified in Appendix B or selected parameters and frequency, as approved by the Director.

28. The Operator shall submit an annual report, in a format acceptable to the Director, detailing the results of groundwater and surface water sampling analyses, complete with previous results and trends. The report shall be submitted to the designated Environment Officer no later than December 31 annually.

September 22 2015
Date

Tracey Braun
Tracey Braun, M.Sc.
Director, Environmental Approvals

APPENDIX A

TERMS and CONDITIONS for BURNING at WASTE DISPOSAL GROUNDS

Burning of certain waste materials is allowed at waste disposal grounds **only** if a condition in the permit specifically allows for the activity and all terms and conditions of this appendix have been satisfied. Timing of burning is conducted at the **operator's** discretion and subject to authorization under *The Wildfires Act*.

Siting Criteria

1. A burn area is allowed only at a waste disposal ground which can meet the siting and design criteria below.
2. There shall be no dwellings or commercial establishments within **400** metres of the burn area.
3. The burn area shall be located a minimum of **50** metres from the active waste cell or any area utilized for the collection of flammable materials.

Design Criteria

4. The burning area shall be constructed of 2 or more separate cells or an enclosed metal burn containment vessel. These cells shall have containment on 3 sides and each side shall be not less than 1.8 metres in height.
5. A chain link fence, not less than 1.5 metres in height and with mesh size no greater than 5.5 cm, shall be constructed on top of the berms to contain windblown scatter at the written request of the designated Environment Officer.
6. The base of the burn area shall be graded to prevent the collection of water inside the burn area. In areas where groundwater contamination is a concern the base of the burn area shall be constructed of 1 metre of compacted clay with hydraulic conductivity less than of 10^{-7} cm/s or equivalent upon the written approval of the Environment Officer.

Operating Criteria

7. Burning shall take place within the confines of a trench, in a berm-confined area or within a burn vessel and not on or above the prevailing grade.
8. Only separated and readily combustible materials such as boughs, leaves, loose straw, paper products, cardboard, non-salvageable untreated wood, and packing materials derived from wood may be burned, and only when there is an appropriate volume of this material to burn. Plywood, composite board or other materials constructed with glues, finishes or preservatives must not be burned.
9. Burning of any other product or material is prohibited, including but not limited to plastics, composites, rubber, manures, chemically treated fabrics, mattresses, finished furniture, or man-made synthetics.
10. Burning is to occur only when weather conditions are favourable, taking into consideration wind direction and velocity, so that nuisance to any neighbouring resident and / or highway does not occur.
11. Burning shall be under constant supervision.
12. Burning is restricted to daylight hours only.
13. If burning is started as a result of vandalism or natural cause, the fire is to be extinguished as quickly as possible by the most appropriate means; and the regional Environment Officer must be notified of the occurrence and actions taken.
14. Ashes, when completely extinguished, shall be removed from the burn area regularly and deposited at the active cell.
15. The site supervisor shall keep a record of all controlled burns indicating the date of each burn; volume of waste burned and types of wastes burned on each occasion. Upon request by the Director or an Environment Officer, the records must be provided.

Appendix B
Ground Water Chemistry Parameters

Chemical Parameters		
Inorganics		
Alkalinity – Total		Magnesium – Dissolved
Ammonia – Total		Manganese – Dissolved
Arsenic – Total		Mercury – Dissolved
Barium – Dissolved		Nitrate - Reported as N
Boron – Dissolved		Nitrite - Reported as N
Cadmium – Dissolved		Total Kjeldahl Nitrogen – Reported as N
Calcium – Dissolved		pH
Calcium Carbonate		Total Phosphorous
Chloride		Potassium – Dissolved
Chromium – Dissolved		Silicon – Dissolved
Conductivity		Sodium – Dissolved
Copper – Dissolved		Total Dissolved Solids (TDS)
Iron – Dissolved		Sulphate
Lead – Dissolved		Uranium – Dissolved
		Zinc – Dissolved
Volatile Organic Compounds (VOC's)		
BTEX		
Other Organics		
Biological Oxygen Demand (BOD)		Chemical Oxygen Demand (COD)
Dissolved Organic Carbon (DOC)		
Field Parameters		
pH		Groundwater Elevation
Conductivity		Dissolved Oxygen
Temperature		

Note: All metals (except Arsenic) are to be sampled for dissolved analysis.
Dissolved samples should be filtered in the field and preserved in the field at time of sampling. If dissolved samples are not to be filtered and preserved in the field then Conservation and Water Stewardship and the Laboratory must be notified prior to sampling.

Crown Lands & Property Agency - Lands Branch, March 9, 2011 Email Correspondence

From: "Little, Karen (CLP)" <Karen.Little@gov.mb.ca>
Subject: RE: LGD of Mystery Lake WDF - Mineral Rights
Sent date: 03/09/2011 09:21:07 AM
To: '"Brett McCormac'"<bmccormac@jrcc.ca>
Cc: "Armitt, Ernest (IEM)" <Ernest.Armitt@gov.mb.ca>

Good Morning Brett, according to our records this date, Her Majesty the Queen in Right of the Province of Manitoba owns the Mines & Minerals and Sand & Gravel in NW 18, S 1/2 & NW 19 in 77-3 WPM and in SE 24-77-4 WPM.

You may want to contact Mr. Ernie Armitt of Mines Branch to determine if any mineral dispositions are affected.

Karen Little
Supervisor of Crown Lands Registry
Crown Lands and Property Agency
308 - 25 Tupper Street North
Portage la Prairie MB R1N 3K1
P (204) 239-3805 F (204) 239-3560
Toll Free 1-866-210-9589
karen.little@gov.mb.ca
An Agency of MB Infrastructure and Transportation

-----Original Message-----
From: Brett McCormac [mailto:bmccormac@jrcc.ca]
Sent: Tuesday, March 08, 2011 9:53 AM
To: Little, Karen (CLP)
Subject: LGD of Mystery Lake WDF - Mineral Rights

Hello Karen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Submission on behalf of the LGD of Mystery Lake, for a proposed solid waste disposal facility upgrade and expansion. The WDF site is located approximately 4 km south of the City of Thompson located on Part NW ¼ 18, S ½ and NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM. The site can be seen in the attached plan.

The land is Crown Land leased to the LGD of Mystery Lake under Crown Land Permit No. GP 50804.

Would you please provide information regarding who owns the Mineral Rights underneath the WDF site?

Thank you,

Brett McCormac, E.I.T.
Environmental Engineer-in-Training

J.R. Cousin Consultants Ltd.
Phone: (204) 489-0474
Fax: (204) 489-0487
http://www.jrcc.ca

Table 1: Population and Waste Generation Projections – City of Thompson Waste Disposal Ground

F:\700\727 Thompson, City\727.01 Landfill EAP Submission\03 Design\[Table 1 - Population and Waste Generation.xlsx]Table 1

TABLE 1

POPULATION AND WASTE GENERATION PROJECTIONS

City of Thompson Waste Disposal Ground

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11
CALENDAR YEAR	PROJECT YEAR	CITY OF THOMPSON (people) 0.52% annual growth	LGD OF MYSTERY LAKE (people) 0.52% annual growth	TOTAL WASTE FROM CITY OF THOMPSON AND LGD OF MYSTERY LAKE 2.0 kg/person/day (tonnes / year)	TOTAL WASTE FROM WUSKWATIM, KEEYASK AND PAINT LAKE (tonnes / year) 0.0% annual growth	TOTAL WASTE TO DISPOSAL SITE (tonnes / year)	ACTUAL WASTE TO DISPOSAL SITE from weigh scale (tonnes / year)	TOTAL WASTE TO DISPOSAL SITE (m^3 / year)	CAPACITY REMAINING AT END OF YEAR (tonnes)	CAPACITY REMAINING AT END OF YEAR (m^3)
2010	0	13,188	10	9,634	614	10,248	12,008	25,280	344,604	725,482
2011	0	13,123	10	9,587	614	10,201	12,389	26,082	332,215	699,400
2012	0	13,191	10	9,637	614	10,251	10,525	22,158	321,690	677,242
2013	0	13,260	10	9,687	614	10,301	9,873	20,785	311,817	656,457
2014	0	13,329	10	9,737	614	10,351	9,800	20,632	302,017	635,825
2015	0	13,398	10	9,788	614	10,402	10,420	21,937	291,597	613,888
2016	0	13,468	10	9,839	614	10,453		22,006	281,144	591,882
2017	1	13,538	10	9,890	614	10,504		22,114	270,640	569,768
2018	2	13,608	10	9,942	614	10,556		22,222	260,084	547,546
2019	3	13,679	10	9,993	614	10,607		22,331	249,477	525,215
2020	4	13,750	10	10,045	614	10,659		22,440	238,818	502,774
2021	5	13,822	11	10,097	614	10,711		22,550	228,106	480,224
2022	6	13,893	11	10,150	614	10,764		22,661	217,342	457,563
2023	7	13,966	11	10,203	614	10,817		22,772	206,526	434,791
2024	8	14,038	11	10,256	614	10,870		22,884	195,656	411,907
2025	9	14,111	11	10,309	614	10,923		22,996	184,733	388,911
2026	10	14,185	11	10,363	614	10,977		23,109	173,756	365,802
2027	11	14,258	11	10,417	614	11,031		23,222	162,725	342,580
2028	12	14,333	11	10,471	614	11,085		23,336	151,641	319,244
2029	13	14,407	11	10,525	614	11,139		23,451	140,501	295,793
2030	14	14,482	11	10,580	614	11,194		23,566	129,308	272,226
2031	15	14,557	11	10,635	614	11,249		23,682	118,059	248,544
2032	16	14,633	11	10,690	614	11,304		23,798	106,754	224,746
2033	17	14,709	11	10,746	614	11,360		23,916	95,394	200,830
2034	18	14,786	11	10,802	614	11,416		24,033	83,979	176,797
2035	19	14,863	11	10,858	614	11,472		24,151	72,507	152,646
2036	20	14,940	11	10,914	614	11,528		24,270	60,978	128,376
2037	21	15,017	11	10,971	614	11,585		24,390	49,393	103,986
2038	22	15,096	12	11,028	614	11,642		24,510	37,751	79,476
2039	23	15,174	12	11,086	614	11,700		24,631	26,052	54,845
2040	24	15,253	12	11,143	614	11,757		24,752	14,294	30,093
2041	25	15,332	12	11,201	614	11,815		24,874	2,479	5,219

Appendix B

LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report, AECOM 2008

LGD of Mystery Lake Waste Geotechnical and Topographic Investigation for the Waste Disposal Ground, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works, JR Cousin Consultants Ltd., 2011

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes, JR Cousin Consultants Ltd., 2012

Phase I Construction Works – Hydraulic Conductivity Test Results, NTL, September 14, 2012

Phase II Construction Works – Hydraulic Conductivity Test Results, NTL, October 29, 2013

Phase III Construction Works – Hydraulic Conductivity Test Results, Stantec, October 23, 2014

LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report, AECOM 2008

The Manitoba Water Services Board

Local Government District of Mystery Lake

Existing Waste Disposal Facility

Assessment and Closure Report

Prepared by:
UMA Engineering Ltd.
1479 Buffalo Place
Winnipeg, MB, R3T 1L7

UMA Project No.: 0326 060 00 03 (4.6.1)

March 2008

March 11, 2008 UMA Project No.: 41 01 0326 060 00 (4.6.1)

Mr. David Shwaluk, P.Eng.
The Manitoba Water Services Board
2022 Currie Boulevard
Box 22080
Brandon, Manitoba
R7A 6Y9

Dear Mr. Shwaluk:

Re: LGD of Mystery Lake Existing Waste Disposal Facility Assessment and Closure Report

UMA Engineering Ltd. (UMA) is pleased to submit our report summarizing the engineering assessment for the closure of the existing waste disposal facility on behalf of the Local Government District of Mystery Lake and the City of Thompson.

Should you have any questions or require additional information, please contact Mr. Clifton Samoiloff, B.Sc. directly at (204) 284-0580.

Yours truly,

UMA Engineering Ltd.

Ron Typliski, P.Eng.
Regional Manager
Earth and Environmental
/dh

cc: Ken Allard, City of Thompson
Carol Taylor, LGD of Mystery Lake

Disclaimer

The attached Report (the "Report") has been prepared by UMA Engineering Ltd. ("UMA") for the benefit of the Manitoba Water Services Board ("Client") in accordance with the agreement between UMA and Client (the "Agreement") for the services described therein, and is subject to the budgetary, time and other constraints and limitations set forth therein.

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This Disclaimer is attached to and forms part of the Report.

Table of Contents

List of Appendices

1.0 Introduction

The Local Government District (LGD) of Mystery Lake currently operates a Class I Waste Disposal Facility (WDF) servicing the LGD and the City of Thompson, under Manitoba Conservation Permit N-02 (issued March 26, 1992). The existing WDF is located on Part NW ¼ 18, S ½ & NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM, approximately 4 km south of the City of Thompson (Figure 01).

UMA Engineering Ltd. (UMA) was retained by The Manitoba Water Services Board to complete an engineering assessment and to develop a Closure Plan for the existing WDF. According to the Request for Proposal dated April 7, 2005, local officials estimate that the WDF will reach the end of its useful life within five years. As such the municipalities are anxious to develop a new Class I facility to replace the existing WDF before it reaches its capacity. Closure of the existing facility would occur once the new facility is operational. To prepare for landfill closure, a Closure Plan is required in accordance with Manitoba Regulation 150/91, Waste Disposal Ground Regulation.

The existing WDF is owned and operated by the LGD of Mystery Lake under Crown Land Permit No. GP 50804 issued by Manitoba Conservation, dated February 22, 2005. A copy of the Permit is provided in Appendix A. Waste sources include commercial and residential waste from the LGD and the City of Thompson. Operations include compaction of the wastes, placement of cover soils and preparation of new cells.

Access to the site is via a gravel road west off of PTH 6. The WDF is approximately 24 ha in size. The site is generally covered in grasses and the surrounding area consists primarily of forested land, with the exception of a Manitoba Hydro transmission line and PTH 6, which border the site to the east.

The following report provides documentation on the existing WDF in support of a submission to Manitoba Conservation as per Manitoba Regulation 150/91. The study was completed based on the work program outlined in our initial proposal submission dated April 27, 2005. The work program involved: an assessment of the landfill, including site surveys, geotechnical and hydrogeological investigations; an assessment of remaining capacity; and recommendations for closure, including cost estimates.

2.0 Site Development and Remaining Capacity

2.1 Site Layout

In general, the site is composed of a reception/operations area, former and active waste areas, a used oil filter/container Eco-Centre, a recycling depot, and designated areas for burning, asbestos material, clay stockpile, metals, tires, white goods, and automobiles. The facility also includes a sewage treatment plant sludge drying pit and soil remediation area. The site is unfenced, however, the entrance to the facility is gated. The general layout of the WDF is depicted on Figure 02. Photographs of the overall site are provided in Appendix B. Individual photographs relating to specific site features are referenced below.

The hours of operation for the WDF are 8 am to 6 pm Monday to Saturday. The entrance to the waste and stockpile areas is manned at all times when the facility is open. The site access gate is locked when the facility is closed.

The following are observations noted during the site investigation:

- The surfaces of the WDF are fairly well drained other than in the vicinity of the soil remediation area (Photo 1). There are no defined drainage ditches along the perimeter of the WDF other than on the north side. At the time of the site investigation, ponded water was observed in the north ditch and along the western border of the facility (Photos 2, 3 and 4). The south and east perimeter of the facility is well drained due to the slope of the land.

- In the active area, refuse is not confined with berms (Photos 5 and 6). Refuse from the active area is in contact with water in the north ditch. Blown refuse litters the trees on the north, east and west borders of the site (Photos 7, 8 and 9). The former waste cells have been covered with clay and vegetation has been established in these areas (Photo 10).

- Two above ground petroleum storage tanks were observed in the reception/operations area (Photo 11).

- Unburied plastic bags containing asbestos material were observed within the asbestos material area (Photo 12).

- A pile of sludge, approximately 20 m^3 in volume, was observed within the asbestos material area (Photo 13). According to municipal officials, the sludge is from the City of Thompson sewage treatment plant. A small pond of water was observed adjacent to the pile of sludge (Photo 14).

2.2 Above and Below Grade Development

The existing limits of above grade development are shown on Figure 02. The height of the former and active waste disposal areas is an average of approximately 5 m above the existing grade elevation. The maximum elevation of the waste mound is 7 m from grade.

According to the current operator at the WDF, the past and present waste cells were developed below grade. This was confirmed by the absence of the surficial layer of native high plastic soil (that was observed in the test holes surrounding the site) in the test holes completed within the former waste cells (refer to Section 4.3).

2.3 Remaining Capacity

An assessment of the remaining capacity at the existing WDF was conducted to determine whether the facility can accommodate wastes from the LGD and the City until a new WDF can be constructed.

The existing WDF property is approximately 58 ha in size. Of this land, approximately 34 ha remain undeveloped. However, the land located to the west of the developed area is not ideal for expansion of the facility as a good portion of it is low-lying and wet. Therefore, for the purposes of this study, the remaining capacity of the WDF is considered to be limited to the available area within the previously developed and current active areas. If development of the low lying area to the west is considered in the future, detailed geotechnical and hydrogeological investigations would be required to confirm its suitability.

The remaining capacity of the existing WDF is dependant on the available area, fill height, waste generation rate and compaction density. As a general guideline, waste generation rates are in the order of 1.5 to 3.0 kg/person/day. This rate is dependent on the level of industrial development in the region. More industry typically relates to higher generation rates. Waste generation estimates provided by the City of Thompson and the LGD of Mystery Lake indicate that the current waste generation rate is estimated at 5.5 kg/person/day. This includes both the residential and commercial waste streams. As this value is significantly greater than typical waste generation rates, there is a concern as to the accuracy of the figure reported. Therefore, the upper end of the range of typical waste generation rates, 3.0 kg/person/day, is assumed for this study.

Based on Canada Census information, the population of the City of Thompson was 13,256 in 2001. Assuming an annual growth rate of 1.0% since 2001, based on the current economic development within the region, the 2006 population of the City would be approximately 13,932. According to the LGD of Mystery Lake, the 2006 population of the LGD is only 5 people. The current combined population is therefore estimated to be 13,937 people. Based on a waste generation rate of 3.0 kg/person/day and assuming a compacted density of 350 kg/m^3 of waste, this equates to an estimated volume of approximately 44,000 m^3 of waste being deposited in the WDF in 2006.

Currently, the active area is approximately 22,500 m^2 in size. The height of this area is an average of approximately 3 m below the final elevations of the older portions of the facility. If the active area is only built up to the elevation of the former waste disposal areas, the WDF would only have sufficient capacity for approximately one more year. To provide sufficient time to design, obtain an environmental licence and construct the new WDF, the existing WDF must remain in operation for approximately 2 to 3 years. To accommodate 2 to 3 years of wastes from the LGD of Mystery Lake and the City of Thompson, the WDF would have to be built up to an elevation above that of the former waste disposal areas.

An area of approximately 100,000 m^2 is available within the active and the former waste disposal areas for further above grade development. Based on this area and a waste generation rate of 44,000 m^3/year over three years, the waste would have to be built up approximately 1.3 m, not including monthly and final cover material. Assuming a requirement of approximately 65,000 m^3 for monthly and final cover material (refer to Section 5.2), the final elevation of this area would be approximately 2.0 m above the existing grades. Further above grade development would result in sections of the waste disposal areas being above the elevation of PTH 6.

3.0 Geological and Hydrogeological Setting

3.1 Physiography

The physiography of the Thompson area is a reflection of the underlying bedrock terrain and the various glacial deposits formed during the last Ice Age. The terrain is undulating and is characterized by bedrock ridges and knolls interspaced with till plains and poorly drained areas of organics.

3.2 Bedrock Geology

The regional bedrock geology is consists of bedrock outcrops consisting of Precambrian felsic migmatite, gneiss, granofels, and mafic granulite.

3.3 Surficial Geology

The surficial soils in the area typically consist of clay with thicknesses ranging from a thin veneer to up to 30 m forming extensive former lake plains. Where the drift thickness is thin the overlying topography generally mirrors the underlying bedrock surface. Water well driller's records in the area indicated that the general soil profile consists of clay underlain by till with silt and sand overtop of bedrock.

3.4 Hydrogeology

Water Resources Branch water well records indicate little groundwater development in the Thompson area other than within the City itself. There are no domestic groundwater wells in use within a distance of at least 2.0 km of the existing WDF site.

There is no information available on the regional groundwater flow system. Based on conditions in similar environments, the regional groundwater flow is likely towards the surrounding lakes with localized discharge in topographic lows.

4.0 Site Investigation

4.1 General

A topographic survey, geotechnical investigation, hydrogeological investigation, and groundwater quality analysis were conducted at the existing WDF to determine the extent of leachate contamination at the facility and provide technical data for closure of the site.

4.2 Topography

Within the former and active waste disposal areas, the WDF site is generally flat with a gentle slope to the west. A bedrock outcrop rises to an elevation of approximately 8 m along the eastern border of the site, parallel to PTH 6. The area surrounding the WDF is an undulating downward slope toward the west.

Level surveys were performed to establish ground elevations within and surrounding the WDF. Ground elevations based on the survey are depicted on Figure 03. A level survey of the ground surface and top of the PVC pipe at each of the monitoring well locations was also completed. The results of the monitoring well survey are summarized on Table 3.1 below.

4.3 Geotechnical Investigation

A total of eleven (11) 127 mm diameter test holes were completed at the existing WDF on October 5, 2005. Eight (8) of the test holes (TH401, TH401A, TH402, TH403, TH403A and TH405 to TH407) were drilled along the perimeter of the facility to determine the soil conditions underlying the site and three (3) test holes (TH408 to TH410) were drilled within former waste cells to determine the depth of the waste. The locations of the test holes are shown on Figure 03. Several test holes were completed as monitoring wells. These holes are labelled as MW rather than TH (for example, TH401 is labelled as MW401 on Figure 03).

The depth of the test holes ranged from 3.0 m to 10.7 m. All test holes were visually logged in the field for soil type, moisture content, consistency, density and visual evidence of impact (i.e. staining discolouration, odour). Test hole logs are provided in Appendix C.

Soil Stratigraphy

The soil stratigraphy encountered in the test holes completed along the perimeter of the site generally consists of a 1.0 m to 2.1 m thick layer of high plastic clay overlying a layer of varved clay which ranges from 1.0 m to 4.0 m in thickness. Along the bedrock outcrop that runs along the east end of the site, the varved clay is underlain by sand to auger refusal. Beyond the bedrock outcrop, the varved clay is underlain by a layer of varved silt which ranged from 3.7 m to 7.6 m in thickness. In TH403A, the material encountered consisted of 2.1 m of clay fill and 0.6 m of waste underlain by varved clay. Auger refusal was encountered in MW401, TH401A, MW402 and MW407. The refusal depth ranged from 3.0 m to 7.3 m below the surface.

Soils encountered in TH408 consisted of clay fill to the end of the test hole (4.6 m). The test hole was completed near a clay stockpile in the centre of the WDF. The depth of clay fill in this test hole indicates that this location may have been a former clay stockpile area. In TH409, the material encountered consisted of 0.3 m of clay fill underlain by a 2.7 m thick layer of waste, 1.5 m of clay fill, and another 1.5 m thick layer of waste followed by native soils composed of high plastic clay varved with clayey silt.

Similarly, the material encountered in TH410 consisted of 0.3 m of clay fill underlain by a 2.4 m thick layer of waste followed by native varved clay soils.

4.4 Hydrogeological Investigation

Monitoring wells were installed around the perimeter of the WDF to determine the depth of the water table, the horizontal gradient and flow direction within the overburden.

Overburden Monitoring Wells

Monitoring wells were installed in the overburden soils at six (6) test hole locations, MW401, MW402, MW403, MW405, MW406 and MW407. Wells MW401 and MW407 were installed upgradient of the site. Wells MW402 and MW406 were installed cross-gradient to the site. Wells MW403 and MW405 were installed down-gradient from the site. The piezometers were completed as 50 mm diameter PVC wells complete with a 1.5 metre slotted screen. The annular space around the intake was backfilled with silica sand followed by bentonite pellets to surface. Construction details for the monitoring wells are shown on the corresponding test hole logs presented in Appendix C. The intake screens for MW401, MW402 and MW407 were installed within a layer of sand. The remainder of the monitoring well screens were installed in a varved silt layer.

Following installation of the overburden monitoring wells, groundwater level measurements were recorded at each well to determine equilibrium water levels. All water level measurements were made using an electric sounding line referenced to the top of the well casing. The results are summarized on Table 3.1.

Table 3.1 – Summary of Monitoring Details

	MW401	MW402	MW403	MW405	MW406	MW407
Installation Details						
Top of PVC Pipe	227.859	218.559	208.623	212.411	214.583	219.088
Ground Elevation	226.763	217.952	207.884	211.471	213.685	218.285
Top of Screen	225.263	215.662	201.784	205.371	207.585	212.495
Bottom of Screen	223.763	214.142	200.264	203.851	206.065	210.965
Static Water Level						
November 21, 2005	225.119	217.079	208.073	210.511	211.333	Dry

Groundwater Table

The groundwater levels recorded in the overburden monitoring wells on November 21, 2005 range from 0.87 m to 2.35 m below ground surface, with the exception of MW403, in which the water level was 0.19 m above ground. Based on these water levels, the direction of flow within the overburden is towards the west-southwest. This direction corresponds with the general slope of the topography in this area. The magnitude of the horizontal gradient within the overburden soils (change in water elevation with distance) is about 0.069 m/m. The groundwater level measurements and inferred flow direction are illustrated on Figure 04.

Hydraulic Conductivity Testing

On November 21, 2005, single well hydraulic conductivity tests (bail tests) were conducted on the five (5) monitoring wells at the site that contained water. The data was analyzed with AqtesolveTM software, using the Bouwer and Rice (1976) method. The results are included in Appendix D. The measured hydraulic conductivity values ranged from 1.2×10^{-4} cm/s to 4.5×10^{-5} cm/s in the monitoring wells installed within the sand (MW401 and MW402), and from 1.3×10^{-6} cm/s to 2.8×10^{-7} cm/s in the monitoring wells installed within the varved silt (MW403, MW405 and MW406).

Contaminant Migration

To evaluate the potential impact of leachate from the WDF on the underlying groundwater, an assessment of the vertical and lateral migration of contaminants from the proposed landfill site was conducted based on the following:

- leachate movement by advection,
- no natural attenuation of leachate,
- an average hydraulic conductivity of 2.0×10^{-6} cm/sec for the varved clay soils, and 8.3×10^{-5} cm/sec for the sand soils,
- a downward (vertical) gradient of 0.3 m/m,
- an average effective porosity of 0.10,
- the vertical and horizontal rate of migration (average linear velocity) calculated using Darcy's Law:

$q = Ki/n_e$, where:

q = average linear velocity

K = average hydraulic conductivity

i = average hydraulic gradient

n_e = average effective porosity of the clay

Using the above parameters, a vertical rate of migration of about 0.19 m/year is estimated for the varved clay layer, and 78.5 m/year for the sand layer. Based on the siting guidelines, a continuous layer of varved clay, ranging from 1 m to 4 m in thickness, with a vertical rate of migration rate of 0.19 m/year corresponds to a high geological sensitivity rating for the site. Based on the rate of vertical migration through the sand layer, it would not have a significant effect on the geological sensitivity rating of the site given the influence of the varved clay layer.

4.5 Groundwater Quality Assessment

Water samples were recovered from the monitoring wells to determine whether leachate from the site may be impacting the local groundwater.

<u>Groundwater Sampling and Discussion of Water Quality Results</u>

Monitoring wells MW401, MW402, MW403, MW405 and MW406 were sampled on November 4, 2005. MW407 was reported dry. The samples were submitted to Enviro-Test Laboratories in Winnipeg, Manitoba for chemical analysis.

The samples were analyzed for a range of parameters including; trace organics (benzene, toluene, ethylbenzene, and xylenes (BTEX)), total volatile hydrocarbons (TVH) and total extractable hydrocarbons (TEH), inorganics and total metals. As a result of limited recovery, MW-401 was only sampled for select inorganics and total metals. The test parameters included in the laboratory analyses were stipulated in the Siting Guidelines for Class II and Class III Waste Disposal Grounds. Although these analyses were originally intended for new waste disposal sites, they are also appropriate for use in monitoring existing and closed waste disposal sites. The laboratory analytical results are presented in Table 1, in Appendix E along with a copy of the laboratory report.

Analytical results have been compared with the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) for Community Water, (updated December 2004). The appropriate Community Water quality guidelines are noted on Table 1.

Concentrations of all trace organic parameters were non-detect and below the applicable CCME guidelines. All metal and inorganic parameters analysed were below the selected CEQG, with the exception of aluminium in all wells, iron in one gradient and two down-gradient wells, manganese, selenium and sodium in down-gradient wells, and turbidity and total dissolved solids in almost all of the wells. The aluminum concentrations exceeded the CEQG by magnitudes ranging from 1.4 to 4.0. Iron concentrations exceeded the CEQG by magnitudes ranging from 1.4 to 2.0. Manganese concentrations exceeded the CEQG by magnitudes of 2.8 to 7.7. Selenium and sodium values exceeded the CEQG by factors of 1.2 and 1.3, respectively. Turbidity values well exceeded the CEQG and the measured total dissolved solids values were generally twice the CEQG.

Although there is insufficient data to define specific trends, results of the analysis indicate that the greatest impact on water quality appears to be in monitoring wells MW403 and MW405, located down-gradient of the existing active area. The least amount of impact appears to be in well MW406 to the north and cross gradient from the existing active area. Further groundwater sampling is required to ascertain whether leachate from the WDF is impacting the underlying groundwater.

In most cases, values that exceeded the CCME limit will affect the aesthetic water quality and do not pose a risk to human health or the environment. On this basis, there is currently no risk to local groundwater users. The following is a brief interpretation on those parameters which exceeded the CEQG.

<u>Turbidity</u>

Turbidity in drinking water should not exceed 1 unit. Levels exceeding this value may make water unpleasing or may protect micro-organisms against the effects of a disinfection agent. Elevated levels were noted at all sampled locations. Turbid samples are common from newly installed wells and typically diminishes after periodic development and resampling of the wells.

Total Dissolved Solids

This is a measure of the dissolved minerals in the water. As a general rule, greater than 500 mg/L (aesthetic objective) is considered unsatisfactory. Levels higher than this are not necessarily a problem as it depends on the specific minerals present. Elevated levels were noted in the cross-gradient wells (MW402 and MW406). Levels were approximately twice as high in the down-gradient wells (MW403 and MW405).

Aluminum -Total

Aluminum is the third most common element in the earth's crust and is naturally present in soils and water. The total aluminum concentrations noted in all wells exceeded the CEQG. These values may, however be a result of suspended sediment in the water from drilling activities or may be indicative of natural groundwater concentrations in the area.

Iron – Total

If the concentration of iron is above 0.3 mg/L, it will cause staining of laundry and fixtures. Higher concentrations will produce a metallic taste and may produce a yellow precipitate. If the concentration of iron is above 0.5 mg/L, it may interfere with zeolite water softening. As illustrated in Table 1, elevated levels of iron were noted at three of the five points sampled including one upgradient well (MW401) and the two down-gradient wells (MW403 and MW405). Elevated iron is common in groundwater in Manitoba and the results may indicate natural background conditions

Manganese – Total

Manganese is undesirable in domestic water supplies because it causes unpleasant tastes, deposits on food during cooking, stains or discolours laundry and plumbing fixtures and fosters the growth of some micro-organisms in reservoirs, filters, and distribution systems. The guideline limit for these aesthetic considerations is 0.5 mg/L. Elevated levels were noted at downstream wells in comparison to the upgradient point MW401. This may be indicative of impacts to the underlying groundwater from the WDF.

Selenuim - Total

The concentration of selenium exceeded the CEQG in one of the downgradient sampling points. The reported concentration at MW405 was however only slightly above the guideline value. Although the CEQG are based on health risk, most toxic effects of selenium appear to be associated with the consumption at high concentrations in food rather then water.

Sodium –Total

Most soils contain sodium in the range of 0.1 to 1 percent. Because of the high solubility of sodium minerals, sodium is ubiquitous in the water environment. Elevated sodium concentrations were noted in both of the downgradient wells, with reported values in MW403 and MW405 slightly above and slightly below the CEQG. These elevated concentrations may be indicative of impacts to the shallow groundwater regime below the site.

Quality Control Program

To ensure a high level of quality throughout the sampling and analytical stages of the project, a number of controls and procedures were followed.

Dedicated disposable bailers were used to collect all water samples. The collected samples were placed in laboratory supplied sample bottles with no headspace and stored on ice in a cooler. All samples were shipped to the lab and analyzed within the accepted holding times.

One blind field duplicate (labelled MW999) was collected from monitoring well MW403 during the November 4, 2005 sampling event. The laboratory analysis results are provided in Table 2 of Appendix E. Generally, the results of the laboratory analyses for the field duplicate sample collected are within Enviro-Test Laboratories target analysis error range for sample concentrations greater than 10 times the detection limit. The duplicate analysis also provides a check of the integrity of the field sample collection and handling procedures. The above duplicate results validate the current field protocols.

5.0 End Use Development / Site Closure Plan

5.1 Proposed End Use Development Plan

The proposed End Use Development Plan for the site is to restore the area to a natural green space. The surface of the WDF will be graded and seeded to establish rough natural grasses. This proposed end use represents a low-cost, low-impact and low maintenance approach to site development. The final landfill footprint and proposed grading are shown in plan view in Figure 05.

5.2 Cover Material

An assessment was completed to determine the volume of clay soil required for monthly and final cover to achieve the final landfill configuration. This assessment was based on the Manitoba Waste Disposal Grounds Regulation 150/91, which stipulate that wastes must be covered with 0.15 m of clay per month and 0.5 m of clay upon termination of use of an active area.

Based on the available surface area for above grade development at the WDF (refer to Section 2.3), the surface area which would require final cover is approximately 100,000 m2. Given a final cover thickness of 0.5 m, this area would require approximately 50,000 m3 of final cover material. Assuming a waste to soil ratio of 10:1 to determine the volume available for refuse placement and monthly cover, the disposal volume would consist of approximately 132,000 m3 of refuse and 15,000 m3 of monthly cover. Therefore, the total volume of cover material required, monthly and final, would be approximately 65,000 m3. Additional cover material will also be required to cover portions of the WDF that do not have at least 0.5 m of cover material. Test pits/holes should be completed throughout the WDF to identify sections that do not have sufficient cover.

Clay cover could likely be obtained from the land owned by the LGD directly west of the existing WDF. Clay cover material for the active area is currently obtained from a borrow pit located within the proposed WDF site on the adjacent land to the north. Borrow activities should be discontinued in this area so it can be filled with compacted clay in preparation for the new WDF.

5.3 Drainage

Ditching should be constructed around the entire facility to prevent surface water run-on into the WDF and direct all surface water runoff away from the site. Proposed and existing drainage features are shown on Figure 05.

5.4 Site Grading

Figure 05 highlights the limits of the development based on the proposed end use plan. Grading of the final cover material is required to minimize leachate production by minimizing surface infiltration and promoting positive surface runoff. The final surface of the cap of the WDF should be graded at approximately 4% with the exception of the outer slopes which should be completed at a slope of 5H:1V. The construction of steeper slopes will have a lower factor of safety and may include an element of risk related to satisfactory slope performance. An even greater risk can be expected if proper quality control and compaction standards are not followed during construction activities.

5.5 Landscaping

Based on the proposed end use development plan, site landscaping will consist of rough grass areas to be seeded with a mix of hearty ground cover supported by a growing medium consisting of a thin layer peat moss and sand tilled into the clay cap.

5.6 Signage

Upon closure of the site, a sign should be posted at the gate indicating that the site is closed and the location of the new facility should be provided.

5.7 Site Specific Closure Requirements

Several items were identified during the site investigation that would require attention prior to completing closure of the site. These items include containment of the active waste disposal area, fencing, and decommissioning of onsite facilities.

Active Waste Disposal Area

- Berms must be constructed around the active area to contain the wastes and any leachate generated within the wastes. The top of the berms should be at least 0.5 m higher than the proposed height of the wastes.

- Clearing of litter from the trees around the perimeter of the WDF is required. Temporary fencing is recommended to minimize the amount of blown litter from the active area.

Fencing

- According to current regulations, active waste disposal facilities must be fenced. A fence should be erected around the entire WDF as it will remain in operation until a new facility is developed. The fencing will prevent access to the site once it is closed.

Decommissioning of Onsite Facilities

- The existing WDF has several facilities that will require decommissioning as part of closure of the site. These include the soil remediation area, sludge drying pit, recycling depot, and all other buildings onsite.

Other items include the following:

- The existing burning area must be levelled, compacted and covered with 0.5 m of clay,

- Stockpiles of metals, tires, white goods, etc. must be removed from the site,

- The pile of sludge in the asbestos area should be sampled and tested to determine if treatment of the sludge is required prior to it's disposal in the active area of the WDF,

- Ponding water in the asbestos area should be removed using a vac-truck and disposed of at the City of Thompson sewage treatment plant, and

- Exposed bags of asbestos material should be buried on-site in the designated area.

6.0 Post Closure Monitoring and Maintenance

6.1 Site Maintenance

Cover Soils

The cover soils play an integral role in the minimization of leachate generation by reducing the amount of surface infiltration. It is therefore important to monitor the integrity of this layer and complete remedial works in areas where the cover has deteriorated. Cover deterioration can occur due to erosion, desiccation cracking, frost heave and cracking resulting from waste settlement. A regular inspection of the cover will identify problem areas and allow maintenance actions to be taken before the problem results in significant adverse effects. Maintenance could include adding additional fill soils, re-grading or re-vegetating exposed or eroded areas.

Monitoring should be completed monthly, from April to November, during the initial two years of post closure care. Subsequent monitoring can be conducted on a semi-annual basis in the spring and fall. Post closure monitoring and maintenance of this nature generally continues for a minimum period of 20 years following landfill closure.

Landscaping

The proposed landscaping is very low maintenance except during the initial establishment period of two to three years. During the seed establishment period, additional mowing and some chemical control may be required, along with re-seeding or over-seeding to obtain acceptable growth covers. The rough grass areas should be mowed annually or managed by controlled burning every three years.

6.2 Environmental Monitoring

It is generally accepted practice to provide post-closure environmental monitoring of a landfill site for a minimum of 20 years following closure. The purpose of the environmental monitoring plan is to provide a background database, meet regulatory requirements and demonstrate the environmental integrity of the landfill. The following program has been developed to meet these needs. The monitoring program includes surface water, groundwater, leachate and methane gas. Specific details on each program are provided below.

Surface Water

Surface water surrounding the landfill site should be monitored on an annual basis to evaluate any potential impacts on water quality from the landfill operations. Monitoring will involve the sampling of two points including the discharge point of the perimeter ditches located in the southwest corner of the WDF and of the surface water body (marsh) located immediately southwest of the facility as shown on Figure 02.

In addition, specific samples should be collected in areas adjacent to localized leachate breakouts, if any occur.

Surface water samples should be analyzed for common major and minor inorganic constituents. Analyzing for organic contaminants and EPA priority pollutants should be kept to a minimum. Analytical targets should be based on the results of detailed samples of landfill leachate. Grab samples should be collected at each sampling location during late spring. Any significant amount of suspended matter should be separated by decanting and/or filtering. Samples should be filtered using disposable in-line units. The solids residue should be recorded and also analyzed.

Groundwater

Monitoring of the groundwater system should be completed through routine sampling of perimeter monitoring points. Six (6) overburden monitoring wells were installed as part of the WDF site investigation in October 2005 (MW401-MW403, and MW405-MW407). The locations of the monitoring wells are shown on Figure 03. It should be noted that no domestic wells are located down-gradient of the site. Potable water wells are located up-gradient, with the closest being approximately 2 km from the site.

All points should be sampled on an annual basis, preferably in late spring. The monitoring wells should be purged prior to sampling to remove any standing water in the casing and to bring in fresh formation water. This will ensure that a representative groundwater sample is collected. A minimum of three well volumes should be evacuated before a sample is collected.

Groundwater samples should be analyzed for common major and minor inorganic constituents. Organic and EPA priority pollutant analyses should be kept to a minimum. Detailed chemical analysis of the leachate for inorganic, organic and EPA priority pollutants should be completed to establish which of these parameters can be best used for detective monitoring. Focusing on the parameters likely to be elevated by leachate contaminants will help reduce the overall cost of chemical analysis.

Piezometric levels should be recorded at each of the monitoring wells prior to each sampling event. This information should be used to monitor the horizontal flow gradients beneath the site and confirm that the vertical gradient through the overburden remains downward.

To initiate a database on the background water quality, groundwater samples have been collected from the overburden monitoring wells. A copy of the laboratory report is found in Appendix E. A summary of the results is provided on Table 1. The sampling procedure and interpretation of laboratory results is outlined in Section 4.5.

Leachate

Test holes completed within the former waste disposal areas indicate that the decomposing wastes are saturated with leachate. Therefore, a leachate monitoring program is recommended to determine the potential for the build up of leachate to “break out” of the containment area. It is recommended that eight monitoring wells be installed throughout the former waste disposal areas to assess the potential need for a leachate collection system. A detailed drilling program to determine the horizontal and vertical extent of the wastes would be required to assess the requirements for the leachate monitoring program and a leachate collection system.

Upon installation of monitoring wells within the former waste disposal area, leachate quality should be monitored to characterize the quality of leachate being generated and to identify what chemicals could potentially be used as target indicators in the ground and surface water monitoring programs. As a minimum, two leachate samples should be analyzed annually. Once a consistent data base has been developed, the number of samples and sampling frequency can be reduced. Analysis should include inorganics, organics and EPA priority pollutants.

Methane Gas

Gas is generated from the decomposition of organic material contained in the landfill. The main constituents of the produced gas are methane and carbon dioxide. The gas has the potential to migrate through the soil and collect in explosive concentrations in enclosed spaces and can damage vegetation and reduce the quality of groundwater and air.

The gas within the landfill is generally under positive pressure which causes lateral and vertical migration. The purpose of monitoring landfill gas is to determine the extent of this migration. It is proposed to allow passive venting of the landfill gas through the cover soils, therefore vertical migration would not a concern.

To assess lateral migration, it is recommended that four (4) gas probes be installed at the locations indicated in Figure 05. The points should be located near the toe of the landfill development. If and when measurable concentrations are detected, additional points can be installed near the property limits to assess the potential for off-site migration. Past experience has shown that a 30 metre buffer will generally be adequate for lateral control of gas migration. The proposed gas probes should be monitored on a quarterly basis during the initial two years of post closure monitoring to assess seasonal influences and then annually thereafter. Field monitoring should include the gas concentration, percent of the lower explosive limit (LEL), atmospheric pressure and air temperature.

The gas probes should be constructed using Schedule 80 PVC pipe. The upper 1.5 m of the installation should consist of solid pipe. The remainder of the installation should be screened and extend to the depth of the waste placement. The top of the probe should be completed with a sealed cap equipped with a quick connect coupler. The coupler can then be used to directly connect to a gas meter. Silica sand should be placed around the piezometer intake with a bentonite seal at surface. The probes should be installed with a protective steel casing.

7.0 Class C Cost Estimate

The following is a breakdown of the initial capital investments, annual monitoring costs, cost for site closure, post-closure monitoring costs, and associated costs for engineering. Annual costs to operate the existing WDF until its closure, including construction of berms around current and future active areas and monthly cover material, are not included.

7.1 Initial Capital Investment

The initial capital investment includes all costs associated with the closure of the site. This will include: placement and grading of final cover material, removal of stockpiles, decommissioning of onsite buildings, removal of sludge pile and ponded water in asbestos material area, decommissioning of sludge drying pit and soil remediation area, and fenceline and perimeter ditches for the entire site.

The cost for installation of the proposed environmental monitoring network has been included in the program. This includes eight (8) monitoring wells and four (4) gas probes installed within the waste disposal areas. Costs for a leachate collection system have not been included as monitoring is required to determine the need for and required extent of such a system. The cost of signage is included as an incidental to the fencing and gate.

ACTIVITY	UNITS	QUANTITY	RATE	COST
Borrow Pit Development (stripping, clearing/grubbing)	ha	3	$10,000	$30,000
Removal of Metals, Tires, White Goods, etc. Stockpiles from the Site	unit	1	$10,000	$10,000
0.5 m Final Cover Material and Grading	cu.m.	50,000	$12	$600,000
Decommissioning of Onsite Buildings	allowance	1	$25,000	$25,000
Removal of Sludge Pile and Ponded Water from Asbestos Material Collection Area	allowance	1	$10,000	$10,000
Decommissioning of Sludge Drying Pit	allowance	1	$10,000	$10,000
Decommissioning of Soil Remediation Area	allowance	1	$10,000	$10,000
Post and Wire Mesh Fence	l.m.	2,000	$40	$80,000
Perimeter Ditching (7.0 m^3 – 1,600 lineal m)	cu.m.	11,200	$10.00	$112,000
Growing Medium, Seeding, Hydro-mulching	sq.m.	100,000	$3.00	$300,000
Installation of Monitoring Well Network	Unit	12	$1,000	$12,000
Contingency (25%)				$299,750
Total				**$1,498,750**

7.2 Annual Monitoring Costs

The annual monitoring costs include the cost for surface and groundwater sampling, cover soil inspections and preparation of an annual report. Also included is an option for leachate sampling, methane gas monitoring.

ACTIVITY	UNITS	QUANTITY	RATE	COST
Surface Water Sampling	Units	2	$500	$1,000
Groundwater Sampling	Units	6	$500	$3,000
Cover Soil Inspection	Unit	1	$500	$500
Reporting	Unit	1	$5,000	$5,000
Sub-total				**$9,500**
Leachate Sampling	Units	8	$500	$4,000
Methane Gas Monitoring	Units	4	$125	$500
Total				**$14,000**

The unit rates provided above are inclusive of all time, equipment rental and materials to collect the samples, analyse the samples and complete any in-situ monitoring. Sampling and monitoring activities assume the use of local personnel provided that qualified personnel from the City are available at the time of these activities.

7.3 Post-Closure Monitoring

The cost for post closure monitoring will be comparable to the annual monitoring cost noted in Section 7.2 and would include: surface and groundwater sampling, cover soil inspection, preparation of an annual report, and potentially leachate sampling and methane gas monitoring.

7.4 Engineering

Engineering costs will include: preparation of a Closure Plan; preparation of technical specifications; tender award; contract administration; and the preparation of as-builts with respect to the closed facility. The costs associated with installation of the monitoring well network and any sampling/monitoring are inclusive and include the cost of engineering. Contract administration and inspection activities could be supplemented with the use of local personnel provided qualified personnel are available at the time of these activities.

ACTIVITY	COST
Preparation of Closure Plan and Technical Specifications	$20,000
Tender Award	$2,000
Contract Administration (assume 4 weeks @ $1,000/day plus 25% office admin)	$35,000
As-builts	$3,000
Sub-total	**$60,000**

8.0 Summary

The existing LGD of Mystery Lake WDF property is approximately 58 ha in size. Of this land, approximately 34 ha remain undeveloped. However, the land is not ideal for further development of the facility as a good portion of it is low-lying and wet. Therefore, for the purpose of this study, the remaining capacity of the WDF is considered to be limited to the available area within the previously developed and current active areas. To provide sufficient time to design, obtain an environmental licence and construct the new WDF, the existing WDF must remain in operation for approximately 2 to 3 years. The existing WDF can accommodate wastes for this period of time if the active and former waste disposal areas are further developed above grade.

Geotechnical and hydrogeological assessments conducted at the WDF indicate that the site has a high geological sensitivity rating based on the ratings in the Manitoba Conservation waste disposal grounds siting guidelines.

Clay cover material for the active area is currently obtained from a borrow pit located within the proposed WDF site. Borrow activities should be discontinued in this area so it can be filled with compacted clay in preparation for the new WDF. Additional cover material will be required on portions of the WDF that do not have at least 0.5 m of final cover material. Test pits/holes should be completed throughout the WDF to identify sections that do not have sufficient cover. Suitable cover material could likely be obtained from the land owned by the LGD directly west of the existing WDF. A geotechnical investigation would be required in this area to confirm the suitability of the soils for cover material and that sufficient quantities of the material exist.

A groundwater quality assessment consisting of the sampling of monitoring wells installed around the perimeter of the WDF indicates that concentrations of manganese, selenium and sodium are more elevated in the downstream wells as compared to the upstream wells. This may be an indication that the WDF is impacting the underlying groundwater. Continued groundwater monitoring is recommended to ascertain whether leachate from the WDF is impacting the underlying groundwater.

The proposed End Use Development Plan for the site is to complete the area as a natural green space. Specific closure requirements identified during the site inspection include the following:

- Construction of berms to contain the wastes in the active area,
- Construction of perimeter ditching and fencing,
- Placement of 0.5 m of final cover cap and site grading,
- Clearing of blown litter from the trees around the perimeter of the WDF,
- Levelling and compaction of wastes in the existing burning area and placement of cover material in this location,
- Removal of stockpiles of recyclable material from the site,
- Sampling and testing of the pile of sludge in the asbestos area to determine if treatment of the sludge is required prior to it’s disposal in the active area of the WDF,

- Removal of the pond of water in the asbestos area using a vac-truck, and disposal of the liquid at the City of Thompson sewage treatment plant,

- Burial of exposed bags of asbestos material in the designated area, and

- Decommissioning of onsite soil remediation area, sludge drying pit, recycling depot, and all other onsite buildings.

Design and implementation of an environmental monitoring program is required to demonstrate the long-term performance of the environmental control measures. The following parameters should be included in the monitoring program:

- surface and groundwater quality;

- leachate production, levels and quality;

- landfill gas; and

- cover integrity.

A “Class C” cost estimate has been developed for the proposed closure requirements. The estimate includes capital investment, annual monitoring costs, closure costs and post closure costs.

Respectfully submitted,

UMA Engineering Ltd.

Peter Bohonos, P.Eng.
Project Manager
Earth and Environmental

Reviewed By:

Steve Wiecek, P.Eng., P.Geo.
Senior Hydrogeologist
Earth and Environmental

Revised By:

Clifton Samoiloff, B.Sc.
Senior Environmental Scientist
Earth and Environmental

Reviewed By:

Ron Typliski, P.Eng.
Regional Manager
Earth and Environmental

APEGM
Certificate of Authorization
UMA Engineering Ltd. (MB)
No. 256 Date: ____________

9.0 References

Canadian Department of Agriculture, 1960: Soil Map of a Section of the Upper Nelson River Basin, Northern Manitoba, Scale 1:100,000

Manitoba Conservation Guidelines for the Siting, Design, Construction, Operation, Performance Monitoring, and Closure of a Class 1 Waste Disposal Ground in Manitoba, 1994.

Manitoba Conservation Water Resources, 2001. Groundwater Driller's Log Database.

Manitoba Energy and Mines, Mineral Resource Division, 1981: Surficial Geology Map of Manitoba, Map 81-1, Scale 1:1,000,000.

Manitoba Energy Mines and Resources, Surveys and Mapping Branch, 1980: Thompson - Mystery Lake Local Government District, Manitoba, West of Principal Meridian, 63P/12 Edition 3, Scale 1:50,000.

Manitoba Industry, Trades and Mines, Manitoba Geological Survey, 2001: Geology of the Ospwagan Lake west (63O/9 west half) and Thompson east (63P/12 west half) area, Scale 1:50,000.

Figures

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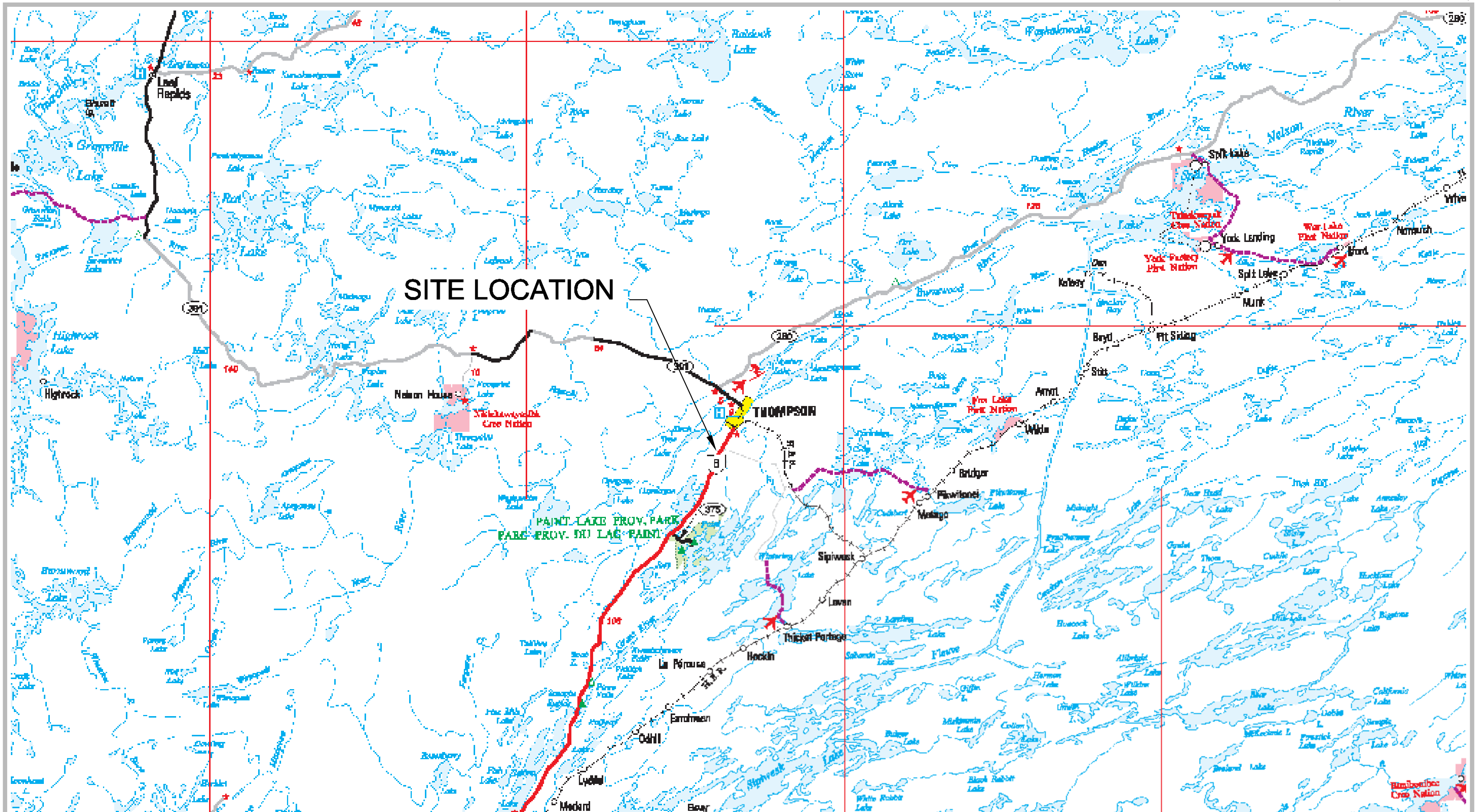

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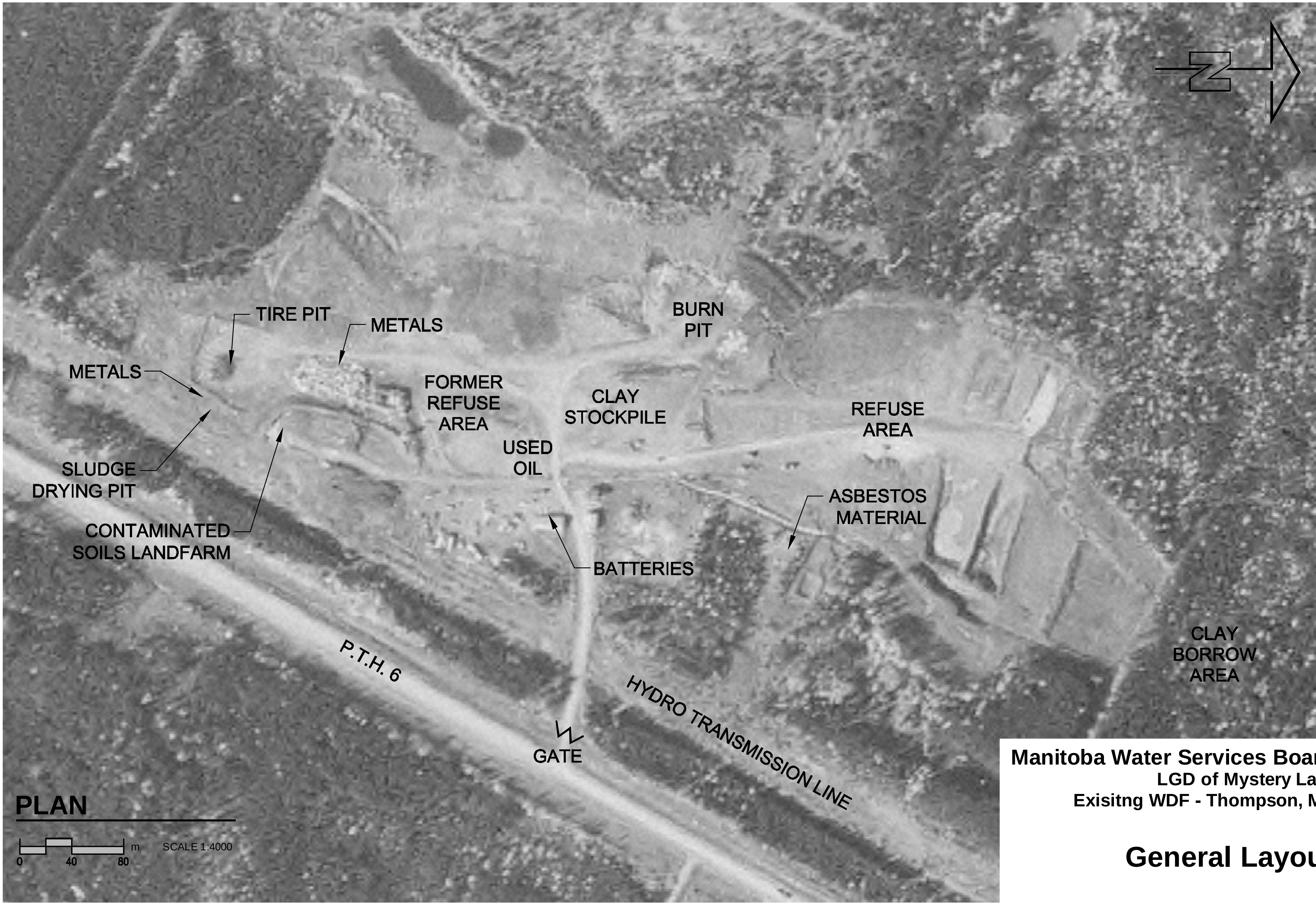
Manitoba Water Services Board
LGD of Mystery Lake
Exisitng WDF - Thompson, MB

Location Plan

UMA AECOM

Figure - 01

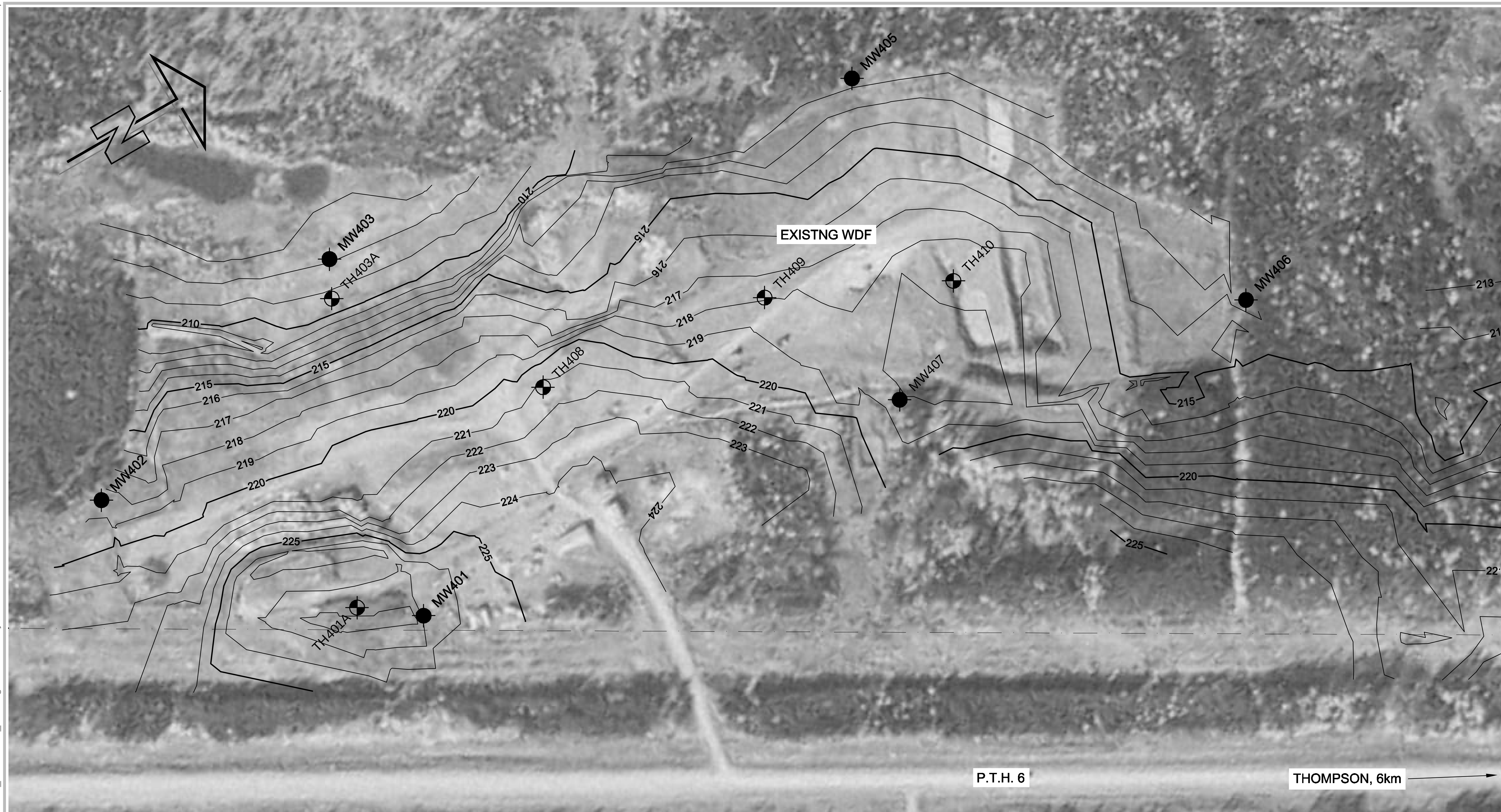


Manitoba Water Services Board
LGD of Mystery Lake
Exisitng WDF - Thompson, MB

General Layout

UMA | AECOM

Figure - 02



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LEGEND

MW MONITORING WELL

TH TEST HOLE

225 GEODETIC ELEVATION (m)

Manitoba Water Services Board
LGD of Mystery Lake
Exisitng WDF - Thompson, MB

Elevations, Test Hole and Monitoring Well Locations

Figure - 03

UMA | AECOM

B SIZE 11" x 17" (279.4mm x 431.8mm)

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LEGEND

MW MONITORING WELL

(225.120) GROUND WATER ELEVATION (GEODETIC, m)

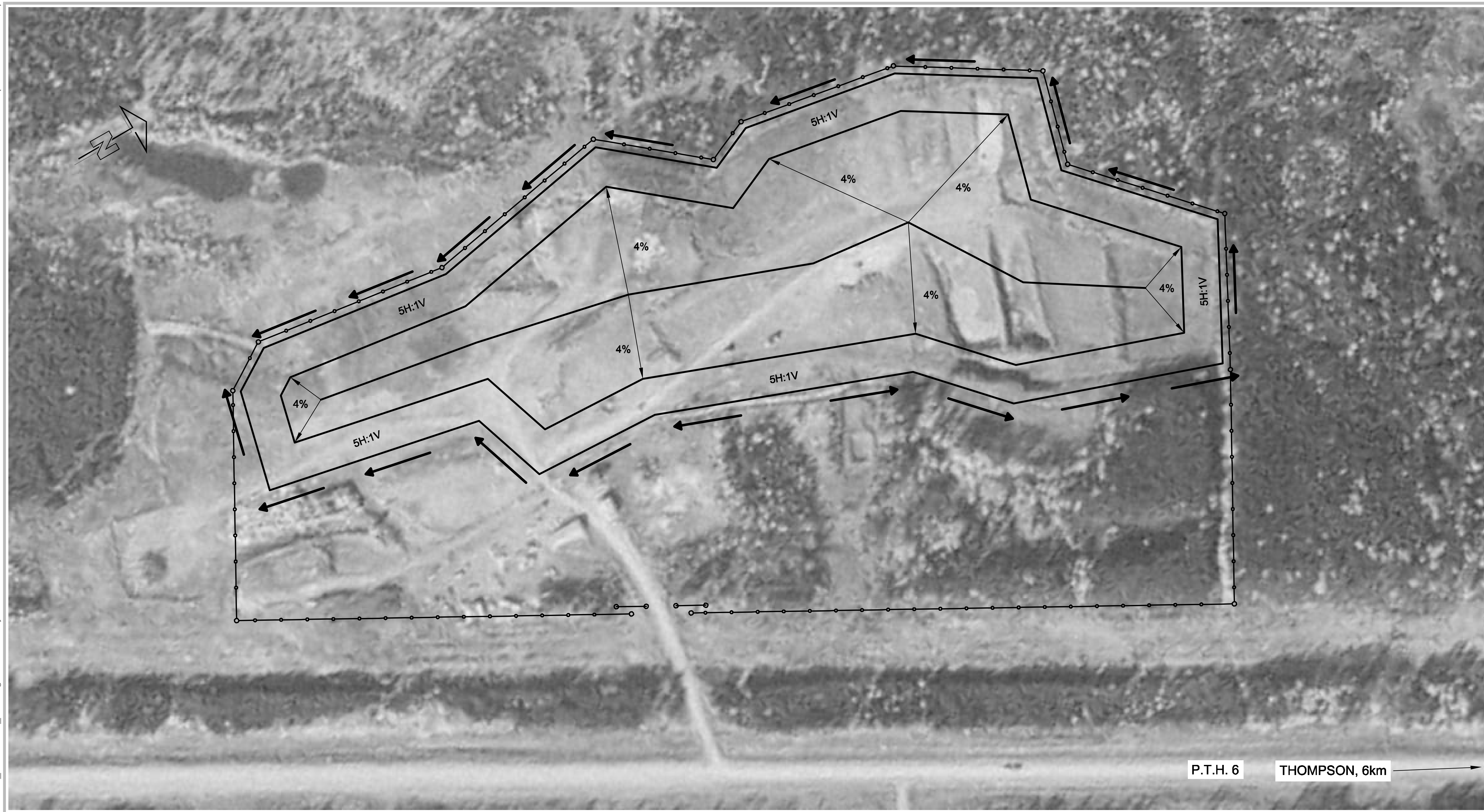
220 LINES OF EQUAL PIEZOMETRIC ELEVATION

Manitoba Water Services Board
LGD of Mystery Lake
Exisitng WDF - Thompson, MB

Groundwater Flow Direction

UMA | AECOM

Figure - 04



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LEGEND

POST AND WIRE FENCING

PERIMITER DITCHING

Manitoba Water Services Board
LGD of Mystery Lake
Exisitng WDF - Thompson, MB

Final Footprint and Grading Plan

Figure - 05

UMA | AECOM

Appendix A
Crown Land Permit

P.O. BOX 189
THOMPSON, MB R8N 1N1
PHONE (204) 677-4075 FAX (204)778-7642
e-mail: lgdmystlake@mts.net

LOCAL GOVERNMENT DISTRICT OF MYSTERY LAKE

C.A.O. : Carol Taylor

Fax

To: Marie Elliott, Deputy Minister

Intergovernmental Affairs

From: Carol Taylor

Fax: 1-204-945-5255

Pages:

Phone:

Date: March 23,2005

Re:

CC:

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply** ☐ **Please Recycle**

● **Comments:**

Good Morning:

Please find attached a copy of our permit for the landfill. Do you have any problems with my signing it or would you like to sign it? It must be in Neepewa by April 22,2005.

Carol Taylor

Manitoba

Conservation Lands Branch Box 20000, 123 Main Street W
Neepawa Mb. R0J 1H0 CANADA
Tel: (204)-476-7060 Fax: (204)-476-7539

February 22, 2005

Local Government District of Mystery Lake
Attention: Louise Hodder
Box 730
Thompson, Mb. R8N 1N5

Dear Madam:

Re: Site in Part NW¼ 18, S½ & NW¼ 19 in Twp 77-3 WPM and in Part SE¼ 24-77-4 WPM as shown on a sketch on file at Lands Branch.
waste disposal site
Crown Land Permit No. GP 50804

I am pleased to advise that your Crown Land Permit application for the above noted land has been conditionally approved under the terms and conditions outlined in the enclosed Schedule A.

Please review Schedule A. If the terms and conditions are acceptable to you, please sign and date both copies where indicated and have your Witness sign and date both copies where indicated.

Return one copy of the signed Schedule A to this office.

If we have not received a signed copy of Schedule A by April 22, 2005, we will assume that you are no longer interested in this property and your application will be cancelled. Any new application received after that date will be dealt with in accordance with the policies and regulations in effect at that time.

Your permit will be issued upon receipt of the signed copy of Schedule A.

If you have any questions concerning Permit No. GP 50804, please contact Larry Krakowka, Land Administrator at (204) 476-7515.

Yours truly,

Harley Johnasson
Director

/km
Copy: Brian Barton, Regional Land Manager

PROVINCE OF MANITOBA
MANITOBA CONSERVATION

SCHEDULE "A" TO CROWN LAND PERMIT NO. GP 50804 ("the Permit")

ISSUED BY:

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA
represented herein by the Honourable Minister of Conservation

("Manitoba")

ISSUED TO:

Local Government District of Mystery Lake

(the "Permittee")

pursuant to *The Crown Lands Act* as amended from time to time.

WHEREAS:

A) The Permittee has made an application to Manitoba for a Crown Land Permit for the Land (as described further in this Schedule);

B) The Permittee is eligible for a Crown Land Permit for the Land and the Land has been determined by Manitoba to be suitable for the use and purpose as described in this Schedule; and

C) Manitoba agrees to issue a Crown Land Permit to the Permittee, subject to the terms and conditions set out in this Schedule, which is Schedule "A" to the Permit, and the Standard Conditions attached to the Permit, for the land described as follows and as substantially similar to that set out on the map attached as Schedule A1:

Site in Part NW¼ 18, S½ & NW¼ 19 in Twp 77-3 WPM and in Part SE¼ 24-77-4 WPM as shown on a sketch on file at Lands Branch.

Area: 136.38 acres (1,800 ft. x 3,300 ft.)

(the "Land")

THE PERMIT IS SUBJECT TO THE FOLLOWING TERMS AND CONDITIONS:

1.00 TERM AND RIGHT TO USE AND OCCUPY THE LAND

1.01 The Permit shall be effective from the date it is issued by Manitoba until December 31, 2005, subject to termination or extension under section 7.

1.02 Subject to the terms and conditions of the Permit, Manitoba grants to the Permittee the right to use and occupy the Land.

2.00 PAYMENT OF FEES AND TAXES

2.01 The Permittee shall pay to Manitoba rent equal to the annual fee prescribed from time to time by the Regulations under *The Crown Lands Act*, in accordance with such Regulations and the Permit, within 30 days of receipt of an invoice from Manitoba. The Permittee acknowledges that the current annual fee is $0.00, as per Item No. 4 of an Agreement dated December 16, 1966 and signed by Manitoba, the International Nickel Company of Canada Limited, the Local Governmet District of Mystery Lake, the School District of Mystery Lake No. 2355, the Town of Thompson and the Resident Administrator of the Local Government District of Mystery Lake.

2.02 The Permittee acknowledges that an application for renewal and administration fee in relation to the Permit shall be paid by the Permittee, as prescribed by the Land Administration Fees Regulation (M.R. 216/89) and as amended from time to time.

2.03 Payments of the annual fee and the administration fees shall be made in accordance with the directions contained in the invoice from Manitoba.

2.04 Manitoba may establish a new annual fee rate where there is a change in one or more of the following factors in order to reflect these changes:
a) the appraised value of the Land as determined by Manitoba;
b) the appraised value of the buildings and improvements owned by Manitoba;
c) the policy of Manitoba as set out in an Act of the Legislature or a Regulation relating to the determination of annual fee; or
d) the use of the buildings, infrastructure or Land.

2.05 Manitoba shall give notice to the Permittee 30 days prior to the effective date of an increase in the annual fee.

2.06 The Permittee shall pay all taxes, rates, duties and assessments whatsoever, whether municipal or otherwise, now or hereafter charged on the Land or in respect of the Permittee's use and occupation thereof.

2.07 The Permittee shall pay interest to Manitoba on any arrears of annual fee or administration fees at rate equal to the rate fixed from time to time by the Minister of Finance of Manitoba under section 25(1) of *The Financial Administration Act.* Failing such rate being fixed, interest shall be payable thereon at a rate equal to the rate fixed from time to time by Manitoba.

2.08 The Permittee shall pay to Manitoba an amount equal to any and all goods and services taxes now or hereafter imposed on, or collectible by Manitoba with respect to any amounts payable by the Permittee to Manitoba hereunder, whether characterized as a goods and services tax, sales tax, value added tax or otherwise ("Sales Taxes"). The intention of the parties is that Manitoba shall be fully reimbursed by the Permittee with respect to any and all Sales Taxes payable or collectible by Manitoba now or in the future.

2.09 The Permittee is responsible for and shall pay any and all costs, charges, impositions and expenses related to the Land, including, without limitation, all water, sewer, gas, telephone, or electric power charges.

2.10 If the Permittee fails to pay any and all taxes or water, sewer, gas, telephone, or electric power charges as required, Manitoba may pay them or any of them and charge those payments to the Permittee who shall reimburse Manitoba forthwith and Manitoba may take the same steps for the recovery of those payments as it would be for the recovery of rent arrears.

2.11 The Permittee shall pay all amounts payable to Manitoba hereunder without any deduction or set-off whatsoever.

3.00 USE OF THE LAND

3.01 The Permittee shall use the Land for a waste disposal site and for no other purpose, including non-use, without prior permission in writing from Manitoba.

3.02 The Permittee agrees that the following structures and improvements on the Land are authorized under the Permit: 1 office building (35 ft. x 20 ft.).

3.03 Other than those developments and uses permitted under paragraphs 3.01 and 3.02 of this Schedule, the Permittee shall not construct, erect or alter any other buildings or structures on the Land or effect any change in use of the Land without prior permission in writing from Manitoba.

3.04 The Permittee agrees to notify Manitoba of any building destroyed, demolished, or removed from the Land within 30 days of that occurrence; and to rebuild, replace or reinstate the building within 24 months of that occurrence.

3.05 It is the responsibility of the Permittee to place and maintain all buildings within the boundaries of the Land, and to obtain any Surveyor's Certificates necessary to effect or verify this condition.

3.06 Manitoba has no obligation to survey or resurvey the Land, and the Permit shall create no such obligation on Manitoba to survey or resurvey the Land.

3.07 The Permittee agrees that removal or relocation of any existing Manitoba Hydro facilities shall be at his/her expense.

3.08 The Permittee and its officers, directors, agents, invitees and employees, as applicable, shall be bound by the rules, regulations and guidelines made by Manitoba from time to time. All such rules, regulations and guidelines will be deemed to be incorporated into and form part of the Permit. Some form of advance public notice shall be provided for changes in these rules, regulations and guidelines.

3.09 The Permittee shall comply with all federal, provincial and municipal laws and regulations, and obtain all licences and permits necessary for the lawful use of the Land, which, without restricting the generality of the foregoing, includes obtaining a work permit from the local District Resource Officer before cutting any trees or commencing any work on the Land, obtaining a building permit from the Department of Labour before constructing any structures, as may be authorized by Manitoba, in accordance with the Manitoba Building Code and applicable Municipal By-laws and regulations. The Permittee shall provide Manitoba with a copy of work permits or building permits obtained at the request of Manitoba.

3.10 The Permittee understands and agrees that the issuance of this Permit in no way implies that either Manitoba or the local government authority shall provide any services.

3.11 The Land is contained in the "Burntwood River Water Power Reserve" and this Permit is issued subject to *The Water Power Act* and Regulations thereunder.

3.12 The Permittee acknowledges that the Land is affected by Mineral Lease Nos. M4795, M4796, M4798, M4801, M4802, M4804 and M4805 and the leases are in good standing under *The Mines and Minerals Act*. These leases are held in the name of Inco Ltd, and this company retains the right to travel across the Land and to mine thereunder.

3.13 The Permittee acknowledges that the operation of the waste disposal site on the Land is governed by Operating Permit #N-02. Any expansion of the Land would require an Environment Act Licence which would require the filing of a proposal for a Class 2 development.

3.14 The Permittee acknowledges that a Manitoba Telephone System fibre optic cable is situated within the Hydro Right-of-Way paralleling Provincial Trunk Highway #6 or immediately adjacent to that Hydro faciltiy. The Permittee understands and agrees to contact the Manitoba Telephone System before any excavation occurs near this area.

4.00 MAINTENANCE OF LAND

4.01 The Permittee agrees:

a) to keep the Land, and all buildings and structures thereon, in a clean and sanitary condition free from inflammable materials, other than those contained in containers approved by the Canadian Standards Association;
b) to comply with all federal, provincial and municipal by-laws, Acts and regulations relating to the Permittee and/or the Land including, but not limited to, *The Crown Lands Act* and Regulations, *The Dangerous Goods Handling and Transportation Act* and Regulations and *The Environment Act* and Regulations, all as amended, replaced or substituted from time to time;
c) not to commit waste or damage the Land;
d) to keep the Land, and all buildings and structures thereon, in good and safe repair; and in a proper and neat condition and to repair in accordance with any notice from Manitoba;
e) to allow a person or persons on behalf of Manitoba to enter the Land, including all buildings and structures, at all reasonable times to examine the state of repair;
f) not to cut or remove any trees without prior written consent of Manitoba
g) any shoreline development to be minimal on Crown land adjacent to lakes or rivers and limited only to facilities or uses approved in writing by Manitoba. Natural vegetation and features should have minimal disturbance, and a vegetative riparian zone should be maintained or encouraged.

4.02 The Permittee shall not release upon the Land or any part thereof any Pollutants (as defined in paragraph 4.05), but if Permittee does release any Pollutants, the Permittee shall

a) at his/her expense, immediately give Manitoba notice of the release; remove the Pollutants from the Land in a manner which conforms with all laws and regulations covering the handling, removal and management of the Pollutants and as may be directed or ordered by an Environment Officer or Director of the Environmental Approvals Branch, or such successor as appropriate, as soon as reasonably practicable; and
b) obtain from an independent Qualified Environmental Consultant, a report verifying the complete and proper removal thereof from the Land, if requested by Manitoba, otherwise the Permittee shall report as to the extent and nature of any failure to comply with this Section.

4.03 Any Pollutants noted in paragraph 4.02 shall not become the property of Manitoba notwithstanding any rule of the law to the contrary (save and except where such Pollutants are brought or created upon the Land by Manitoba or its servants, employees or agents, and provided such person is not the Permittee or an officer, director, agent or employee of the Permittee). At the option of Manitoba, any substance contaminated by such Pollutants shall become the property of the Permittee and at the Permittee's expense, the Permittee or, at Manitoba's option, Manitoba, shall remove the contaminated substance from the Land and make good any damage done in so doing.

4.04 The Permittee shall indemnify and save harmless Manitoba from all costs or expenses, liabilities, losses, claims, damages (including consequential damages, interest, penalties, fines or monetary sanctions), legal costs or fees on a solicitor and own client basis, and fees or expenses of professional consultants incurred by Manitoba by reason of Pollutants being present on the Land and resulting from the Permittee's use or occupation of the Land or the breach of any warranty or covenant of the Permittee in this Section.

4.05 In this Section, "Pollutants" means any product, solid, liquid, gas, smoke, odour, waste, radiation or organism, or any combination of these, that is foreign to or in excess of the natural constituents of the environment on the Land and that:

a) has affected, is affecting or may affect the natural, physical, chemical or biological quality of the air, land and water; or
b) is, or is likely to be, injurious or damaging to the health or safety of a person(s), or injurious or damaging to property or to plant or animal life.

5.00 NO ASSIGNMENT OF PERMIT WITHOUT CONSENT

5.01 The Permittee shall not assign the Permit without the prior written consent of Manitoba, that consent not be unreasonably withheld. If the Permittee is a corporation, any change in ownership or control of the Permittee is deemed to be a proposed assignment.

5.02 Manitoba shall not unreasonably withhold consent to the assignment of the Permit for collateral (financing and security) purposes.

5.03 The Permittee shall submit an application on a form specified by Manitoba for approval to assign the Permit or any interest in the Permit.

5.04 Notwithstanding paragraphs 5.01 or 5.02, Manitoba may, in its sole discretion, refuse to assign the Permit if:

a) the Permittee has not paid any and all outstanding rent and taxes in respect of the Land and improvements, or
b) the proposed assignee is not eligible to hold a Permit in accordance with then current laws, regulations and policies of Manitoba.

5.05 The Permittee shall not sublet or rent out the Land.

5.06 The Permit shall be binding upon the executors, administrators, heirs, successors and any permitted assigns of the Permittee.

6.00 RESPONSIBILITY AND INSURANCE

6.01 Nothing contained in the Permit shall create any liability on the part of Manitoba or Manitoba Hydro for any damages caused or purported to be caused in respect to the Land by raising or lowering waters bordering upon or adjacent to the Land.

6.02 The Permittee shall use due care in the occupation of the Land to ensure that no person is injured, no property is damaged or lost and no rights are infringed.

6.03 The Permittee shall be solely responsible for and indemnify and save harmless Manitoba, its officers, employees and agents from and against all claims, liabilities and demands with respect to:

a) any injury to persons (including death), damage or loss to property caused by, or related to the occupation of the Land or the performance of the Permit or the breach of any term or condition of the Permit by the Permittee, any agent, invitee, officer, director or employee of the Permittee or any other person authorized by the Permittee to occupy the Land, and
b) any omission or wrongful or negligent act of the Permittee, any agent, invitee, officer, director or employee of the Permittee or of any other person authorized by the Permittee to occupy the Land;

unless such claims, liabilities, and demands arise out of the acts or omissions of Manitoba, its officers, employees or agents, and provided such person is not the Permittee or an officer, director, agent or employee of the Permittee.

6.04 It is the responsibility of the Permittee to discuss his/her insurance requirements with his/her insurance adviser/broker and to arrange for his/her own insurance coverage(s). However, at a minimum, the Permittee shall purchase and maintain comprehensive general liability insurance with a minimum limit of $1,000,000 per occurrence or claim. Manitoba reserves the right to require the Permittee to purchase and maintain a different minimum amount of liability insurance as specified by Manitoba from time to time by providing at least 180 days notice in writing of the change in the minimum amount to the Permittee. Evidence of insurance in the form of a Certificate of Insurance shall be provided by the Permittee upon request.

6.05 Notwithstanding paragraph 6.03, the Permittee agrees that any buildings, including any buildings existing at the issuance of the Permit, on the Land shall be maintained entirely at the Permittee's own risk, and the Permittee agrees to assume full responsibility for any damage or injury to persons or property situated on the Land resulting from flooding, erosion, ice damage, or temporary or permanent loss of Land accessibility. The Permittee agrees not to institute any action or make any claim against Manitoba or any employee or agent of Manitoba, including Manitoba Hydro, in respect to any personal injury caused by or related to flooding, whether or not the damage was occasioned by flooding resulting from the regulation or control of the adjacent waterway by Manitoba or Manitoba Hydro.

6.06 Notwithstanding paragraph 6.03, the Permittee agrees to indemnify and save harmless Manitoba and all employees and agents of Manitoba, including Manitoba Hydro, from and against all claims, liabilities and demands in respect of any damage to property or injury to persons located on the Land, which has been caused by flooding, erosion, ice damage, or temporary or permanent loss to Land accessibility.

6.07 The Permittee agrees not to institute any action or make any claim against the local government authority with respect to damage to any building or personal property or any injury to persons located on the Land that may be caused by flooding, erosion, ice damage, or temporary or permanent loss of land accessibility, as described herein and the Permittee agrees to enter into a written Agreement with the local government authority if the local government authority deems it necessary.

7.00 TERMINATION AND EXTENSION

7.01 The Permittee acknowledges that the Permit does not operate to prevent the sale or lease of the Land at any time during its term and is subject to the condition that Manitoba may give the Permittee notice of the cancellation thereof; and at the expiration of 30 days from the service of the notice, the Permit shall be cancelled.

7.02 Subject to 7.01 and provided that there has been no uncured default by the Permittee, including payment of rent, Manitoba may, in its discretion, automatically renew the Permit for a 1 year term on an annual basis and in accordance with then current laws, regulations or policies respecting rental rates and rental property of this type, unless otherwise notified by the Permittee.

7.03 Without restricting any other remedies available, Manitoba may, at its sole option, immediately terminate the Permit in writing if:

a) the Permittee has failed to make any payment due hereunder, has misrepresented any fact on the application for the Crown Land Permit, or has failed to comply with anyterm or condition of the Permit and has not remedied that failure to comply within 30 days of receipt of notice in writing from Manitoba;

b) the Permittee makes an assignment for the benefit of creditors, becomes bankrupt or insolvent, takes the benefit of, or becomes subject to, any statutes that may be in force relating to bankrupt or insolvent debtors (the appointment of a receiver or receiver and manager of the assets of the Permittee being conclusive evidence of insolvency), or if any certificate or order is made or granted for the winding-up or dissolution of the Permittee, voluntarily or otherwise;

c) the Permittee suffers a lien under *The Builders' Lien Act* (Manitoba) or any similar or successor legislation registered against the Land or Manitoba's interest therein and does not contest the validity or the amount of the lien and do all things necessary to obtain and register a discharge forthwith after the lien has come to the notice of the Permittee.

7.04 Where the Permittee terminates the Permit under paragraph 7.02 or Manitoba terminates the Permit in accordance with paragraph 7.01 or 7.03, or upon the expiration of the term or any renewal term of the Permit:

a) the Permittee shall deliver up possession of the Land to Manitoba and shall not remain in possession of the Land following the date of expiration or termination of the Permit; and

b) at the option of Manitoba:

(i) the Permittee and Manitoba may agree on the fair market value of the buildings or structures added to the Land by the Permittee and Manitoba may purchase such buildings or structures by paying to the Permittee that fair market value. If they fail to reach an agreement regarding the fair market value within 180 days of notice of termination being given by Manitoba, such value shall be determined by reference to the Land Value Appraisal Commission, or such other body as may hereafter be substituted therefor from time to time, or

(ii) the Permittee shall remove all buildings and structures added to the Land by the Permittee within six months of such expiry or termination, or such other term as agreed to by Manitoba, and where those buildings and structures are not removed within six months or the term agreed to by Manitoba, they shall become the property of Manitoba. At the end of such six months or term agreed to by Manitoba, any assets left on the property as at such date shall vest in Manitoba, and the Permittee shall be deemed to have released and quit-claimed any interest therein to and in favour of Manitoba. No compensation or payment whatsoever shall be payable therefor by Manitoba to the Permittee in such event.

7.05 Where Manitoba terminates the Permit in accordance with paragraph 7.01 in instances where the Permittee is entering into a purchase or lease Agreement in respect of the Landwith Manitoba, all buildings and structures added to the Land by the Permittee shall be dealt with in accordance with the terms of that Agreement.

7.06 Where Manitoba terminates the Permit in accordance with paragraph 7.01 and 7.03 in instances where collateral assignments are recorded, it shall provide notice in writing of such termination to the holder of such collateral assignments (the "Security Holder"). The Security Holder:

a) shall then be allowed a reasonable time frame of not less than 30 days as stipulated in the notice, to cure defaults of the Permittee, and upon doing so the Permit shall be deemed not to have terminated;
b) shall not be obligated to go into possession; and
c) shall be allowed to assign the Permittee's interest in the Permit to a third party purchaser, subject to the prior written consent of Manitoba being required, but which shall not be unreasonably withheld; provided that as a condition of any such assignment, such subsequent assignee shall execute such documentation as Manitoba considers reasonable to bind the assignee directly to Manitoba on the terms and conditions as contained in the Permit, and all defaults of the Permittee shall be cured and brought to good standing. In the event of such permitted assignment, the Permit shall be deemed not to have terminated.

8.00 ENTIRE PERMIT

8.01 The Permit, including this Schedule and any Standard Conditions attached to the Permit, constitutes the entire Permit. There are no undertakings, representations, warranties, covenants, guarantees, agreements or promises, express or implied, verbal or otherwise, other than those contained in the Permit.

8.02 No amendment or change to, or modification of, the Permit shall be valid unless it is in writing.

9.00 APPLICABLE LAW

9.01 The Permit shall be governed by, interpreted, performed and enforced in accordance with the laws of Manitoba.

10.00 NOTICES

10.01 Any notice or other communication to Manitoba under the Permit shall be in writing and shall be delivered or sent by mail, postage prepaid to: Manitoba Conservation, Lands Branch, Attention: Director, Box 20,000, 123 Main Street West, Neepawa, Mb., R0J 1H0.

10.02 Any notice or other communication to the Permittee under the Permit shall be in writing and shall be delivered personally to the Permittee or an officer, director or employee of the Permittee or sent by mail, postage prepaid, to: Box 730, Thompson, Mb., R8N 1N5.

10.03 Any notice or communication sent by mail shall be deemed to have been received on the third business day following the date of mailing. If mail service is disrupted by labour controversy, notice shall be delivered personally.

10.04 Either party may provide notice of change of address to the other in writing and thereafter all notices or communications shall be provided to the new address.

10.05 Any notice or other communication signed by any employee, officer or minister of Manitoba acting in that capacity shall be deemed for the purposes of the Permit to be a notice or other communication executed by Manitoba.

10.06 Notwithstanding paragraphs 10.02 and 10.03 any written notice to be served or given by Manitoba to the Permittee under the Permit shall be effectively given or served by posting the same in a conspicuous place on the Land.

11.00 ADDITIONAL PROVISIONS

11.01 Time shall be of the essence of the Permit.

11.02 If any provision of the Permit is illegal or invalid or unenforceable at law it shall be deemed to be severed from the Permit and the remaining provisions shall nevertheless continue to be in full force and effect.

11.03 No waiver of any default under the Permit shall be binding unless acknowledged in writing by Manitoba. Any condoning, excusing or overlooking by Manitoba of any default shall not operate as a waiver of Manitoba's rights hereunder in respect of any subsequent default.

11.04 All headings in this Schedule are inserted for convenience of reference only and will not affect the construction and interpretation of the Permit.

11.05 If this Permit is issued to two or more persons as Permittee, the liability of each to pay rent and taxes and to perform all other obligations hereunder shall be joint and several. If the Permittee is a corporation, each person acknowledging the terms of the Permit on behalf of the Permittee by so signing hereby agrees to guarantee to Manitoba the performance by the Permittee of all obligations of the Permittee hereunder, and each such person shall be jointly and severally liable with the Permittee as Permittee hereunder.

11.06 If the Permittee remains in possession of the Land after the termination of the Permit and Manitoba accepts rent, the tenancy, in the absence of written Agreement, will be from month to month only and shall be subject to all terms of the Permit, including rent, except that the tenancy shall be from month to month.

11.07 The Permittee shall not be entitled to file a caveat against title to the Land respecting the Permit under *The Real Property Act* (Manitoba) as it may be amended, replaced or substituted from time to time.

11.08 Sections 4 and 6 shall survive the termination or expiration of the Permit

THE PERMITTEE or the Permittee's duly authorized representative, on the dates noted below, acknowledges that he/she has read and understands all the terms and conditions of the Permit and agrees to be bound by same.

WITNESS SIGNED IN THE PRESENCE OF	**PERMITTEE** Local Government District of Mystery Lake
______________________ **Print Name of Witness**	______________________ **Name of Permittee**
______________________ **Signature of Witness**	______________________ **Signature of Permittee**
DATE: ______________	DATE: ______________

Appendix B
Site Photographs

Photo 1 – View of poorly drained portions of contaminated soils area.

Photo 2 – View south of ponded water on west side of waste disposal facility.


Photo 3 – View south of ponded water on north side of waste disposal facility.


Photo 4 - View west of ponded water and garbage in north ditch.

Photo 5 - View south of active garbage disposal area. Note the absence of containment berms.

Photo 6 - View west of the north edge of the active garbage disposal area. Note the absence of containment berms.

Photo 7 - View of blown litter along the northern perimeter of the waste disposal facility.

Photo 8 - View of blown litter along the eastern perimeter of the waste disposal facility.

Photo 9 - View of blown litter along the western perimeter of the waste disposal facility.

Photo 10 - View of clay and vegetation covered former waste area.

Photo 11 - View of aboveground petroleum storage tanks in operations area.

Photo 12 - View of unburied plastic bags containing asbestos material within the asbestos material collection area.


Photo 13 – View of sludge pile in the asbestos material collection area.


Photo 14 – View of pond of water adjacent to the sludge pile in the asbestos material collection area.

Photo 15 – View of used oil filter/container Eco-Centre near the entrance to the waste disposal facility.


Photo 16 – View of used tire and metals stockpiles at southeast end of the waste disposal facility.

Photo 17 – View of a former waste disposal area overlooking the marsh located southwest of the waste disposal facility.

Photo 18 – View West- The burning area at the west end of the waste disposal facility is visible.


Photo 19 – View Southwest - The burning area at the west end of the waste disposal facility is visible.

Photo 20 – View North - The operator's shed, bulldozer garage, used oil filter/container Eco-Centre, two sheds and an abandoned trailer area are visible in the operations area.

Photo 21 – View South - The recycling depot and a metals stockpile in the operations area are visible.


Photo 22 – View North – Overall view of the north end of the waste disposal facility. The burning area and a portion of the former waste disposal areas are visible.

Photo 23 – View North - The active area at the north end of the waste disposal facility is visible.

Appendix C
Test Hole Logs

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW401**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 226.76

SAMPLE TYPE	GRAB	SHELBY TUBE	SPLIT SPOON	BULK	NO RECOVERY	CORE
BACKFILL TYPE	BENTONITE	GRAVEL	SLOUGH	GROUT	CUTTINGS	SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	CLAY - silty, brown, moist, firm, high plastic				Top of PVC Casing = 227.859 m	
						226
1	CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with equal amounts of pale brown, low plastic clay lenses, 5 mm in thickness					
					Water Level = 225.12 m (05/11/21)	225
2	SAND - some silt, brown, moist, dense, fine grained					
						224
3	REFUSAL AT 3.0 m					
						223
4						
						222
5						
						221
6						
						220
7						
						219
8						
						218
9						
						217
10						

UMA AECOM	LOGGED BY: ED	COMPLETION DEPTH: 3.05 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW402**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 217.95

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		CLAY - silty, brown, moist, firm, high plastic				Top of PVC Casing = 218.559 m Water Level = 217.08 m (05/11/21)	217
1.5		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with equal amounts of pale brown, low plastic clay lenses, 5 mm in thickness - trace fine sand lenses between the varves					216
2.4		SAND - some silt, brown, moist, dense, fine grained					215
3.8		REFUSAL AT 3.8 m					214

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Elevation scale: 217, 216, 215, 214, 213, 212, 211, 210, 209

UMA | AECOM

LOGGED BY: ED	COMPLETION DEPTH: 3.81 m
REVIEWED BY: PB	COMPLETION DATE: 4/10/05
PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW403**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 207.88

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	CLAY - silty, some silt inclusions, brown, moist, firm, high plastic				Top of PVC Casing = 208.623 m Water Level = 208.073 m (05/11/21)	
1						207
	CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with pale brown, low plastic clay lenses					
2						206
3	SILT AND CLAY - pale gray, very moist, clayey silt, varved with silty, brown, moist, firm, high plastic clay					205
4						204
5						203
6						202
7						201
8						200
9						199
10						198

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

UMA AECOM	LOGGED BY: ED	COMPLETION DEPTH: 10.67 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 2

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW403**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 207.88

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	SLOTTED PIEZOMETER	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
10								
			END OF HOLE AT 10.7 m IN SILT AND CLAY					197
11								
								196
12								
								195
13								
								194
14								
								193
15								
								192
16								
								191
17								
								190
18								
								189
19								
								188
20								

UMA | AECOM

LOGGED BY: ED	COMPLETION DEPTH: 10.67 m
REVIEWED BY: PB	COMPLETION DATE: 4/10/05
PROJECT ENGINEER: Peter Bohonos	

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW405**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 211.47

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		CLAY (Fill) - silty, brown, moist, soft, medium plastic				Top of PVC Casing = 212.411 m	211
		CLAY AND ORGANICS - some silt, black, moist, soft, low plastic				Water Level = 210.511 m (05/11/21)	
1		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with pale brown, low plastic clay lenses					210
2							209
3		SILT AND CLAY - pale gray, very moist, clayey silt, varved with silty, brown, moist, firm, high plastic clay					208
4							207
5							206
6							205
7							204
		END OF HOLE AT 7.6 m IN SILT AND CLAY					
8							203
9							202
10							

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

UMA AECOM	LOGGED BY: ED	COMPLETION DEPTH: 7.62 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW406**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 213.68

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0	CLAY - silty, brown, moist, firm, high plastic				Top of PVC Casing = 214.583 m	213
1	CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with pale brown, low plastic clay lenses					212
2					Water Level = 211.333 m (05/11/21)	211
3						210
4	SILT AND CLAY - pale gray, very moist, clayey silt, varved with silty, brown, moist, firm, high plastic clay					209
5						208
6						207
7						206
8	END OF HOLE AT 7.6 m IN SILT AND CLAY					205
9						204
10						

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

UMA | AECOM

LOGGED BY: ED	COMPLETION DEPTH: 7.62 m
REVIEWED BY: PB	COMPLETION DATE: 5/10/05
PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **MW407**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m): 218.28

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

BACKFILL TYPE: BENTONITE, GRAVEL, SLOUGH, GROUT, CUTTINGS, SAND

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	ELEVATION (m)
0		CLAY - silty, brown, moist, firm, high plastic				Top of PVC Casing = 219.088 m	218
1.2		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with pale brown, low plastic clay lenses					217
5.2		SAND - some silt, moist, dense, fine grained					213
7.3		REFUSAL AT 7.3 m					211

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Elevation scale (m): 218, 217, 216, 215, 214, 213, 212, 211, 210, 209

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

UMA | AECOM

LOGGED BY: ED	COMPLETION DEPTH: 7.32 m
REVIEWED BY: PB	COMPLETION DATE: 4/10/05
PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **TH401A**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - silty, brown, moist, stiff, high plastic					
1							1
		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with equal amounts of pale brown, low plastic clay lenses, 5 mm in thickness					
2							2
3		- some medium grained sand					3
4		REFUSAL AT 4.0 m					4
5							5
6							6
7							7
8							8
9							9
10							

UMA | AECOM

LOGGED BY: ED	COMPLETION DEPTH: 3.96 m
REVIEWED BY: PB	COMPLETION DATE: 4/10/05
PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **TH403A**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m):

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - silty, brown, moist, soft, high plastic - some garbage					
2		GARBAGE					2
3		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with pale brown, low plastic clay lenses					3
4		END OF HOLE AT 4.3 m IN CLAY					4

Depth scale: 0 1 2 3 4 5 6 7 8 9 10

UMA | AECOM	LOGGED BY: ED	COMPLETION DEPTH: 4.27 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **TH408**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0 – 4.6		CLAY (Fill) - silty, dark brown, some metals and paper, moist, soft, high plastic					
4.6		END OF HOLE AT 4.6 m IN CLAY					

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

	LOGGED BY: ED	COMPLETION DEPTH: 4.57 m
UMA AECOM	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

ENVIRONMENTAL EXISTING WDG SITE.GPJ UMA.GDT 3/17/06

PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **TH409**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m):

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - silty, brown, moist, firm, high plastic					
		GARBAGE					
1							1
2							2
3		CLAY (Fill) - silty, brown, moist, firm, high plastic					3
4							4
		GARBAGE					
5							5
6		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with clayey silt lenses					6
7							7
		END OF HOLE AT 7.6 m IN CLAY					
8							8
9							9
10							

UMA AECOM	LOGGED BY: ED	COMPLETION DEPTH: 7.62 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

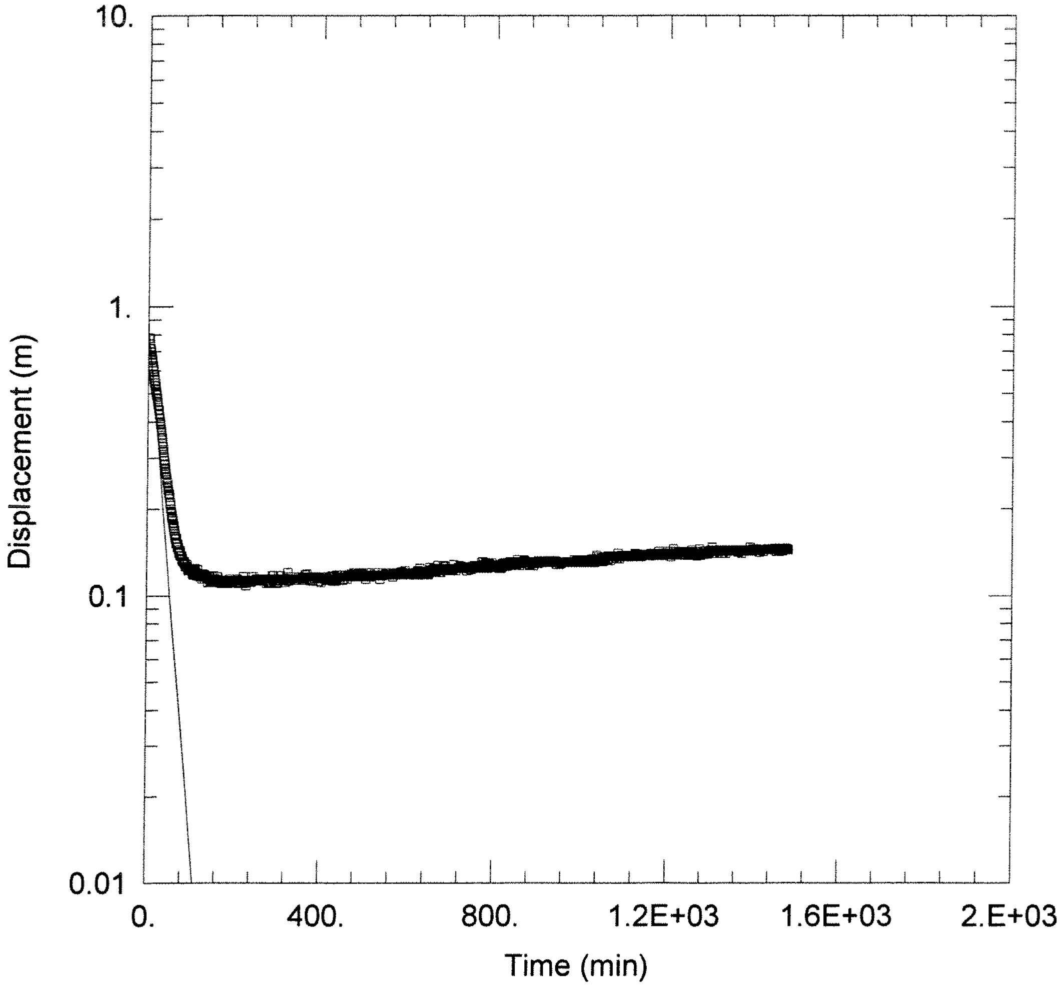
PROJECT: Engineering Assessment Study for a WDF	CLIENT: Manitoba Water Services Board	TESTHOLE NO: **TH410**
LOCATION: Existing LGD of Mystery Lake Waste Disposal Facility, Thompson, MB		PROJECT NO.: 0326 060 00 02
CONTRACTOR: Paddock Drilling Ltd.	METHOD: 127 mm solid stem augers	ELEVATION (m):

SAMPLE TYPE: GRAB, SHELBY TUBE, SPLIT SPOON, BULK, NO RECOVERY, CORE

DEPTH (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	⊗ Vapour Reading ⊗ (ppm) 10 100 1000	COMMENTS	DEPTH (m)
0		CLAY (Fill) - silty, brown, moist, firm, high plastic					
		GARBAGE					
1							1
2							2
3		CLAY AND SILT - silty, brown, moist, firm, high plastic clay, varved with low plastic clay lenses					3
4							4
		END OF HOLE AT 4.6 m IN CLAY					
5							5
6							6
7							7
8							8
9							9
10							

UMA AECOM	LOGGED BY: ED	COMPLETION DEPTH: 4.57 m
	REVIEWED BY: PB	COMPLETION DATE: 4/10/05
	PROJECT ENGINEER: Peter Bohonos	Page 1 of 1

Appendix D
Hydrograph Plots



WELL TEST ANALYSIS

Data Set: P:\0326\060-00\4 Development\4 Test Results and Analysis\MW401.aqt
Date: 01/20/06 Time: 14:28:39

PROJECT INFORMATION

Company: UMA Engineering Ltd.
Client: City of Thompson
Project: 326 060 00
Test Location: Thompson, MB
Test Well: MW401
Test Date: November 3, 2005

AQUIFER DATA

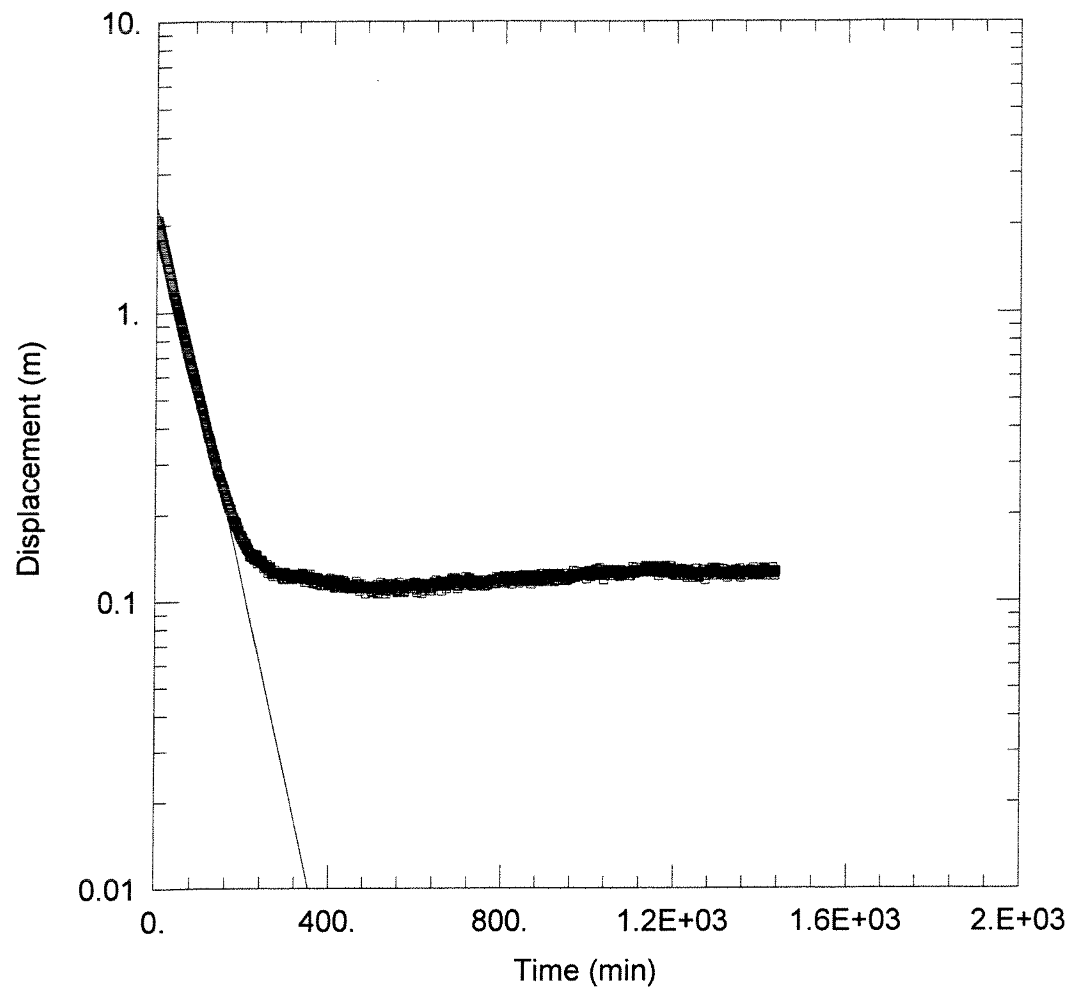
Saturated Thickness: 0.9 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW401)

Initial Displacement: 0.78 m
Casing Radius: 0.05 m
Wellbore Radius: 0.075 m
Well Skin Radius: 0.125 m
Screen Length: 1.5 m
Total Well Penetration Depth: 1.45 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.000122 cm/sec
y0 = 0.8268 m



WELL TEST ANALYSIS

Data Set: P:\0326\060-00\4 Development\4 Test Results and Analysis\MW402.aqt
Date: 01/20/06 Time: 14:29:17

PROJECT INFORMATION

Company: UMA Engineering Ltd
Client: City of Thompson
Project: 326 060 00
Test Location: Thompson, MB
Test Well: MW402
Test Date: November 3, 2005

AQUIFER DATA

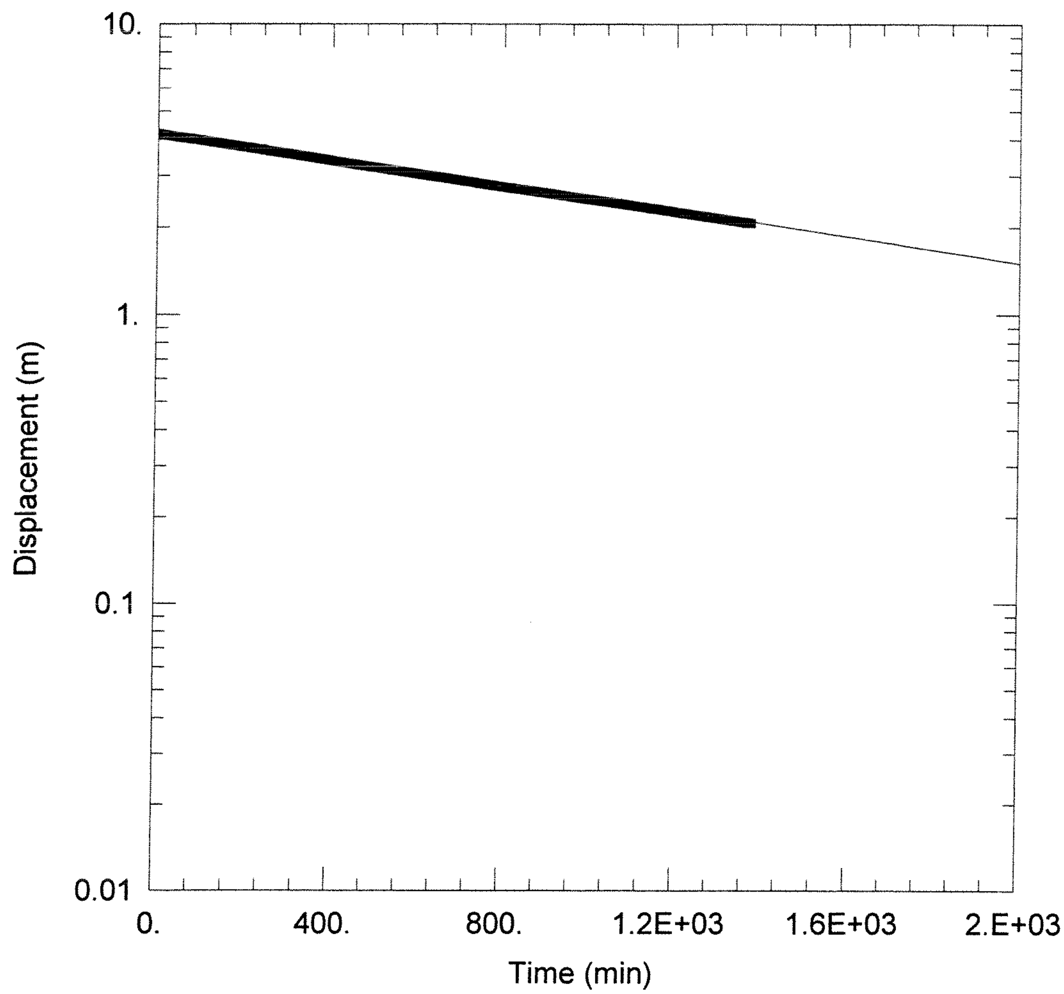
Saturated Thickness: 1.2 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW402)

Initial Displacement: 2.08 m
Wellbore Radius: 0.075 m
Screen Length: 1.5 m
Gravel Pack Porosity: 0.3
Casing Radius: 0.05 m
Well Skin Radius: 0.125 m
Total Well Penetration Depth: 1.2 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.452E-05 cm/sec
y0 = 2.311 m



WELL TEST ANALYSIS

Data Set: P:\0326\060-00\4 Development\4 Test Results and Analysis\MW403.aqt
Date: 01/20/06 Time: 14:29:59

PROJECT INFORMATION

Company: UMA Engineering Ltd.
Client: City of Thompson
Project: 0326 060 00
Test Location: Thompson, MB
Test Well: MW403
Test Date: November 3, 2005

AQUIFER DATA

Saturated Thickness: 11.05 m
Anisotropy Ratio (Kz/Kr): 1.

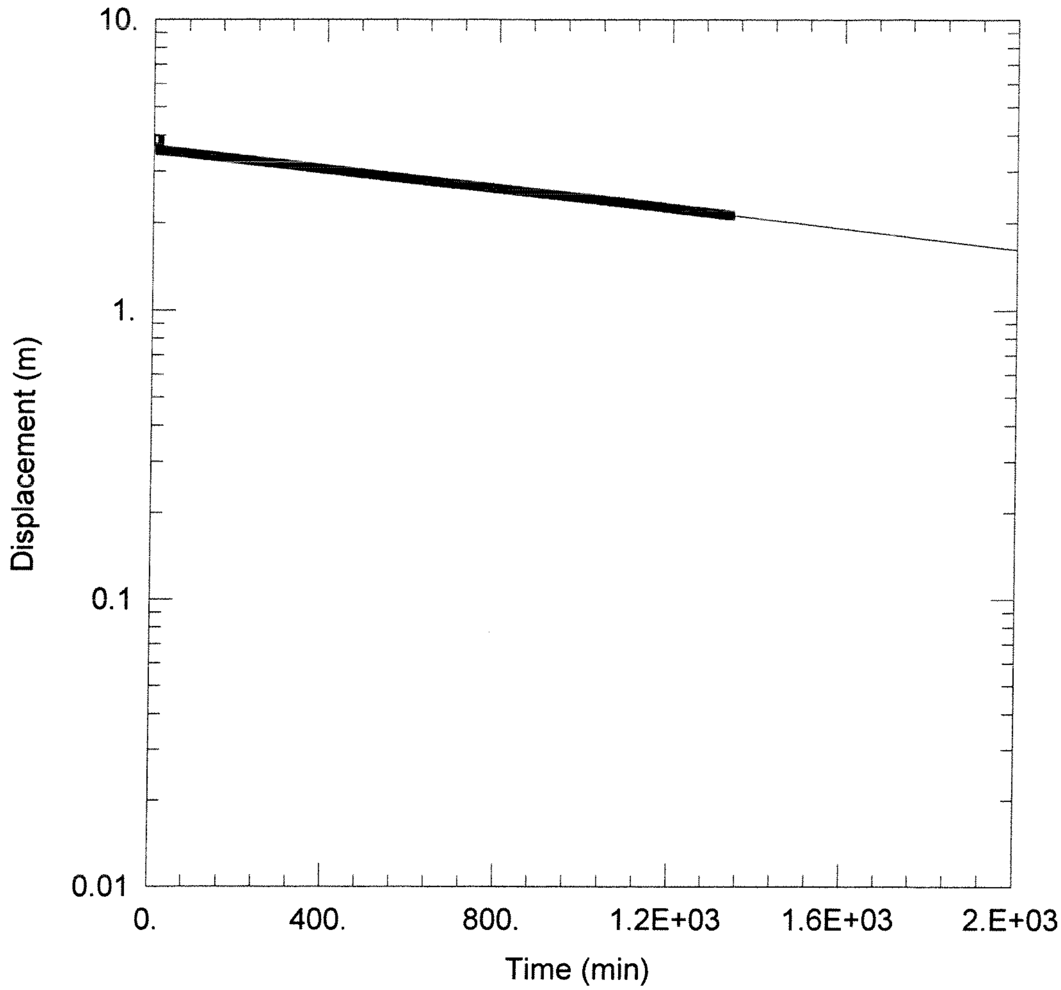
WELL DATA (MW403)

Initial Displacement: 4.18 m
Wellbore Radius: 0.075 m
Screen Length: 1.5 m
Gravel Pack Porosity: 0.3
Casing Radius: 0.05 m
Well Skin Radius: 0.125 m
Total Well Penetration Depth: 1.5 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.315E-06 cm/sec
y0 = 4.313 m



WELL TEST ANALYSIS

Data Set: P:\0326\060-00\4 Development\4 Test Results and Analysis\MW405.aqt
Date: 01/20/06 Time: 14:30:23

PROJECT INFORMATION

Company: UMA Engineering Ltd.
Client: City of Thompson
Project: 0326 060 00
Test Location: Thompson, MB
Test Well: MW405
Test Date: November 3, 2005

AQUIFER DATA

Saturated Thickness: 6.64 m
Anisotropy Ratio (Kz/Kr): 1.

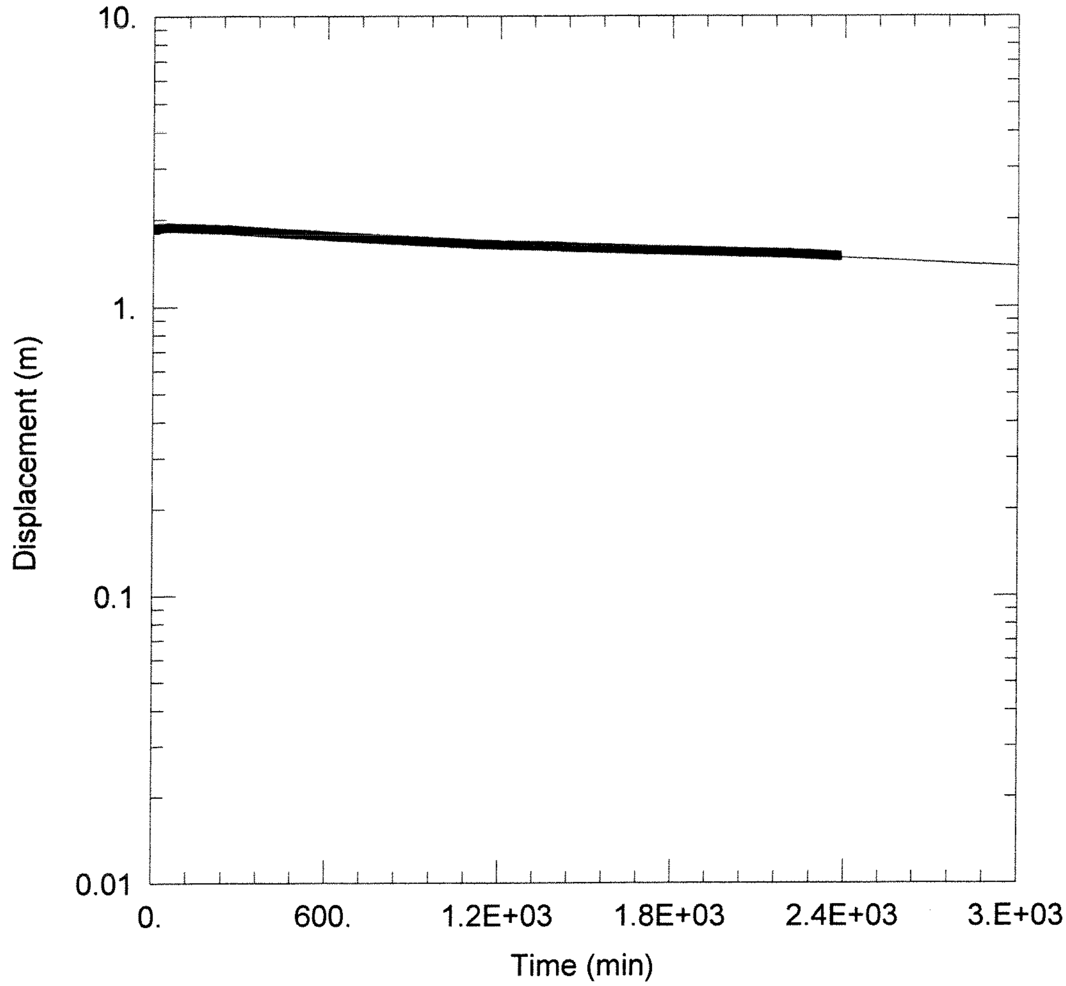
WELL DATA (MW405)

Initial Displacement: 3.87 m
Wellbore Radius: 0.075 m
Screen Length: 1.5 m
Gravel Pack Porosity: 0.3
Casing Radius: 0.05 m
Well Skin Radius: 0.125 m
Total Well Penetration Depth: 1.5 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.048E-06 cm/sec
y0 = 3.683 m



WELL TEST ANALYSIS

Data Set: P:\0326\060-00\4 Development\4 Test Results and Analysis\MW406.aqt
Date: 01/20/06 Time: 14:30:54

PROJECT INFORMATION

Company: UMA Engineering Ltd.
Client: City of Thompson
Project: 0326 060 00
Test Location: Thompson, MB
Test Well: MW406
Test Date: November 2, 2005

AQUIFER DATA

Saturated Thickness: 5.24 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW406)

Initial Displacement: 1.85 m
Wellbore Radius: 0.075 m
Screen Length: 1.5 m
Gravel Pack Porosity: 0.3
Casing Radius: 0.05 m
Well Skin Radius: 0.125 m
Total Well Penetration Depth: 1.5 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.842E-07 cm/sec
y0 = 1.918 m

Appendix E
Laboratory Data

Table 1. Summary of Analytical Results - November 2005
Existing Waste Disposal Facility - Local Government District of Mystery Lake

Parameter	MDL	CCME Guidelines[1] Community Water	MW401 05/11/04	MW402 05/11/04	MW403 05/11/04	MW405 05/11/04	MW406 05/11/04
Trace Organincs							
Benzene	0.0005	0.005	-	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Toluene	0.0005	0.024	-	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Ethylbenzene	0.0005	0.0024	-	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Xylenes	0.0005	0.3	-	< 0.0005	< 0.0005	< 0.0005	< 0.0005
TVH	0.1	--	-	< 0.1	< 0.1	< 0.1	< 0.1
TEH	0.1	--	-	< 0.1	< 0.1	< 0.1	< 0.1
Inorganics							
Alkalinity - Total (as $CaCO_3$)	1	--	597	469	521	505	106
Ammonia (NH_3)	0.01	--	-	0.06	0.64	0.05	0.06
Bicarbonate (HCO_3)	2	--	728	572	636	617	129
Carbonate (CO_3)	0.6	--	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
Chemical Oxygen Demand	8	--	-	< 8	< 8	24	< 8
Chloride	9	250*	< 9	26	33	21	20
Conductivity	0.4	--	1330	1050	1790	1830	316
Cyanide - Free	0.01	0.2	-	< 0.01	< 0.01	< 0.01	< 0.01
Hardness (as $CaCO_3$)	0.2	-	858	516	432	590	76.7
Hydroxide (OH)	0.4	--	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Kjeldahl Nitrogen - Total	0.2	--	-	< 0.2	0.8	0.2	0.3
Nitrate+Nitrite-N	0.01	--	0.50	1.46	0.32	0.01	0.15
pH	0.01	6.5-8.5*	7.32	7.41	7.80	7.65	8.11
Phospohrus - Total	0.001	--	-	0.032	0.145	0.148	0.052
Sulphate	9	500*	241	92	481	9	27
Turbidity	0.05	1	-	**70**	**190**	**190**	**8.7**
Total Dissolved Solids	5	500*	**921**	**660**	**1300**	**1300**	190
Total Solids	5	--	-	870	1600	1600	210
Total Suspended Solids	5	--	-	180	300	200	14
Metals (Total)							
Aluminum	0.02	0.1	**0.47**	**0.14**	**0.29**	**0.49**	**0.24**
Antimony	0.001	0.006	< 0.001	< 0.001	< 0.001	< 0.001	0.001
Arsenic	0.0005	0.025	< 0.0005	< 0.0005	0.0054	0.0016	< 0.0005
Barium	0.0003	1	0.115	0.0889	0.0755	0.115	0.0121
Beryllium	0.001	--	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Bismuth	0.0001	--	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Boron	0.03	5	< 0.03	0.15	0.23	0.05	< 0.03
Cadmium	0.0002	0.005	0.0008	0.0021	0.0002	0.0019	0.0012
Calcium	0.1	--	245	121	90.6	147	23.1
Cesium	0.0001	--	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Chromium	0.001	0.05	0.004	0.006	0.002	0.002	0.001
Cobalt	0.0002	--	0.0010	0.0004	0.0012	0.0009	0.0004
Copper	0.001	1*	0.012	0.004	0.007	0.011	0.010
Iron	0.05	0.3*	**0.61**	0.18	**0.41**	**0.63**	0.23
Lead	0.0005	0.01	0.0048	0.0041	0.0011	0.0017	0.0014
Lithium	0.01	--	0.02	0.02	0.05	0.03	< 0.01
Magnesium	0.01	--	60.0	52.1	49.9	54.2	4.61
Manganese	0.0003	0.05*	0.0341	0.0110	**0.384**	**0.143**	0.0346
Molybdenum	0.0002	--	< 0.0002	0.0012	0.0119	0.0077	< 0.0002
Nickel	0.002	--	0.041	0.015	0.005	0.048	0.010
Phosphorus	0.05	--	0.15	0.11	0.14	0.13	0.10
Potassium	0.1	--	1.3	3.8	8.1	4.2	1.2
Rubidium	0.0002	--	0.0022	0.0008	0.0033	0.0030	0.0010
Selenium	0.001	0.01	0.004	0.004	0.006	**0.012**	0.003
Silver	0.001	--	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sodium	0.03	200*	13.5	19.0	**262**	196	3.05
Strontium	0.0001	--	0.319	0.412	0.629	0.582	0.0389
Tellurium	0.001	--	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thallium	0.0001	--	0.0001	< 0.0001	0.0001	< 0.0001	< 0.0001
Tin	0.0006	--	< 0.0006	0.0011	< 0.0006	0.0008	0.0047
Titanium	0.0009	--	0.0252	0.0097	0.0189	0.0222	0.0060
Tungsten	0.0002	--	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Uranium	0.0001	0.02	0.0041	0.0109	0.0161	0.0144	0.0001
Vanadium	0.001	--	0.002	< 0.001	0.004	0.002	< 0.001
Zinc	0.01	5*	0.05	0.02	0.02	0.04	0.17
Zirconium	0.0004	--	0.0015	0.0005	0.0012	0.0014	< 0.0004

Notes:
All units in mg/L expect the following (conductivity, umho/cm; pH, pH units; turbidity, NTU)
1. *Canadian Environmental Quality Guidelines,* Canadian Council of Ministers of the Environment, (updated 2004).
< indicates concentration is less than the method detection limit (MDL).
Bolded and shaded areas exceed CCME Community Water guideline.
* indicates aesthetic objective only.
-- indicates no guideline established
\- indicates analysis not conducted

Table 2. QA/QC Results - November 2005
Existing Waste Disposal Facility - Local Government District of Mystery Lake

Parameter	MDL	MW403	MW99	RPD
		05/11/04	05/11/04	
Alkalinity - Total (as $CaCO_3$)	1	521	507	0.7
Bicarbonate (HCO_3)	2	636	618	0.7
Carbonate (CO_3)	0.6	< 0.6	< 0.6	0.0
Chloride	9	33	34	0.7
Conductivity	0.4	1790	1790	0.0
Hardness (as $CaCO_3$)	0.2	432	465	1.8
Hydroxide (OH)	0.4	< 0.4	< 0.4	0.0
Nitrate+Nitrite-N	0.01	0.32	0.31	0.8
pH	0.01	7.80	7.89	0.3
Sulphate	9	481	454	1.4
Total Dissolved Solids	5	1300	1230	1.4
Aluminum	0.02	0.29	0.92	26.0
Antimony	0.001	< 0.001	< 0.001	0.0
Arsenic	0.0005	0.0054	0.0055	0.5
Barium	0.0003	0.0755	0.083	2.4
Beryllium	0.001	< 0.001	< 0.001	0.0
Bismuth	0.0001	< 0.0001	< 0.0001	0.0
Boron	0.03	0.23	0.27	4.0
Cadmium	0.0002	0.0002	0.0411	49.5
Calcium	0.1	90.6	100	2.5
Cesium	0.0001	< 0.0001	0.0001	0.0
Chromium	0.001	0.002	0.003	10.0
Cobalt	0.0002	0.0012	0.0022	14.7
Copper	0.001	0.007	0.009	6.3
Iron	0.05	0.41	1.45	28.0
Lead	0.0005	0.0011	0.0035	26.1
Lithium	0.01	0.05	0.04	5.6
Magnesium	0.01	49.9	52.3	1.2
Manganese	0.0003	0.384	0.428	2.7
Molybdenum	0.0002	0.0119	0.0101	4.1
Nickel	0.002	0.005	0.015	25.0
Phosphorus	0.05	0.14	0.24	13.2
Potassium	0.1	8.1	8.3	0.6
Rubidium	0.0002	0.0033	0.0048	9.3
Selenium	0.001	0.006	0.004	10.0
Silver	0.001	< 0.001	< 0.001	0.0
Sodium	0.03	262	273	1.0
Strontium	0.0001	0.629	0.632	0.1
Tellurium	0.001	< 0.001	< 0.001	0.0
Thallium	0.0001	0.0001	< 0.0001	0.0
Tin	0.0006	< 0.0006	0.0009	0.0
Titanium	0.0009	0.0189	0.0533	23.8
Tungsten	0.0002	< 0.0002	< 0.0002	0.0
Uranium	0.0001	0.0161	0.0158	0.5
Vanadium	0.001	0.004	0.005	5.6
Zinc	0.01	0.02	0.03	10.0
Zirconium	0.0004	0.0012	0.002	12.5

Notes:
All units in mg/L expect the following (conductivity, umho/cm; pH, pH units; turbidity, NTU)
"RPD" indicates Relative Percent Difference.
"NA" indicates variability not availale as the sample concentration is not ten times the detection limit.
Variability of duplicate samples with idenitcal concentrrations or below detection limits indicated as zero.

EnviroTest
LABORATORIES

ANALYTICAL REPORT

UMA ENGINEERING
ATTN: PETER BOHONOS
1479 BUFFALO PLACE
WINNIPEG MB R3T 1L7

DATE: 17-NOV-05

Lab Work Order #: L338009 **Sampled By:** MA **Date Received:** 07-NOV-05

Project P.O. #:

Project Reference:

Comments: The portion of the sample for metals analysis was preserved by the client prior to submission.

APPROVED BY: Paul Nicolas

PAUL NICOLAS
Project Manager

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-1 MW 401								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Routine Soluble + Metal scan								
pH								
PH	7.32		0.01	pH units		08-NOV-05	DXN	R344368
TDS calculated								
TDS (Calculated)	921		5	mg/L		10-NOV-05		
Sulphate Soluble								
Sulphate (SO4) - Soluble	241		9	mg/L		07-NOV-05	CLM	R344055
Nitrate + Nitrite Soluble								
Nitrate+Nitrite-N	0.50	RAMB	0.01	mg/L		07-NOV-05	CLM	R344055
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Aluminum (Al)-Total	0.47		0.02	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Arsenic (As)-Total	<0.0005		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Boron (B)-Total	<0.03		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Barium (Ba)-Total	0.115		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Beryllium (Be)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Calcium (Ca)-Total	245		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cadmium (Cd)-Total	0.0008		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cobalt (Co)-Total	0.0010		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Chromium (Cr)-Total	0.004		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cesium (Cs)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Copper (Cu)-Total	0.012		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Iron (Fe)-Total	0.61		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Potassium (K)-Total	1.3		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lithium (Li)-Total	0.02		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Magnesium (Mg)-Total	60.0		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Manganese (Mn)-Total	0.0341		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Molybdenum (Mo)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Sodium (Na)-Total	13.5		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Nickel (Ni)-Total	0.041		0.002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Phosphorus (P)-Total	0.15		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lead (Pb)-Total	0.0048		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Rubidium (Rb)-Total	0.0022		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Antimony (Sb)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Selenium (Se)-Total	0.004		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tin (Sn)-Total	<0.0006		0.0006	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Strontium (Sr)-Total	0.319		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tellurium (Te)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Titanium (Ti)-Total	0.0252		0.0009	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Thallium (Tl)-Total	0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Uranium (U)-Total	0.0041		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Vanadium (V)-Total	0.002		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tungsten (W)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zinc (Zn)-Total	0.05		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zirconium (Zr)-Total	0.0015		0.0004	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Hardness Calculated								
Hardness (as CaCO3)	858		0.3	mg/L		10-NOV-05		
Conductivity								
Conductivity	1330		0.4	umhos/cm		08-NOV-05	DXN	R344368
Chloride Soluble								

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-1 MW 401								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Routine Soluble + Metal scan								
Chloride Soluble								
Chloride (Cl) - Soluble	<9		9	mg/L		07-NOV-05	CLM	R344055
Alkalinity								
Alkalinity, Total (as CaCO3)	597		1	mg/L		08-NOV-05	DXN	R344368
Bicarbonate (HCO3)	728		2	mg/L		08-NOV-05	DXN	R344368
Carbonate (CO3)	<0.6		0.6	mg/L		08-NOV-05	DXN	R344368
Hydroxide (OH)	<0.4		0.4	mg/L		08-NOV-05	DXN	R344368
L338009-2 MW 402								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Sulphate Dissolved								
Sulphate (SO4) - Dissolved	92		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Nitrate + Nitrite Dissolved								
Nitrate+Nitrite-N - Dissolved	1.46	RAMB	0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Chloride Dissolved								
Chloride (Cl) - Dissolved	26		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Ammonia Dissolved								
Ammonia (NH3) - Dissolved	0.06		0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Phosphorus, Total								
Total Phosphorous	0.032	RAMB	0.001	mg/L		10-NOV-05	MEB	R345178
pH								
PH	7.41		0.01	pH units		07-NOV-05	DXN	R344056
Turbidity								
Turbidity	70		0.05	NTU		07-NOV-05	DXN	R343905
Total Suspended Solids								
Total Suspended Solids	180		5	mg/L		07-NOV-05	LVP	R344261
Total Solids								
Total Solids	870		5	mg/L		07-NOV-05	LVP	R344261
Total Kjeldahl Nitrogen								
Total Kjeldahl Nitrogen	<0.2		0.2	mg/L	09-NOV-05	15-NOV-05	CLM	R346542
Total Dissolved Solids								
Total Dissolved Solids	660		5	mg/L		07-NOV-05	LVP	R344261
Hardness Calculated								
Hardness (as CaCO3)	516		0.2	mg/L		07-NOV-05		
Cyanide, Free								
Cyanide, Free	<0.01		0.01	mg/L		07-NOV-05	MB	R343922
Conductivity								
Conductivity	1050		0.4	umhos/cm		07-NOV-05	DXN	R344056
Chemical Oxygen Demand								
Chemical Oxygen Demand	<8		8	mg/L		08-NOV-05	SXG	R344384
BTEX and TVH (C5-C10)								
Benzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Toluene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Ethylbenzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
m+p-xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
o-xylene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
Xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Alkalinity								
Alkalinity, Total (as CaCO3)	469		1	mg/L		07-NOV-05	DXN	R344056

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-2 MW 402								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Alkalinity								
Bicarbonate (HCO3)	572		2	mg/L		07-NOV-05	DXN	R344056
Carbonate (CO3)	<0.6		0.6	mg/L		07-NOV-05	DXN	R344056
Hydroxide (OH)	<0.4		0.4	mg/L		07-NOV-05	DXN	R344056
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
TEH (C11-C30)	<0.1		0.1	mg/L	08-NOV-05	09-NOV-05	HDT	R344530
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Aluminum (Al)-Total	0.14		0.02	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Arsenic (As)-Total	<0.0005		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Boron (B)-Total	0.15		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Barium (Ba)-Total	0.0889		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Beryllium (Be)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Calcium (Ca)-Total	121		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cadmium (Cd)-Total	0.0021		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cobalt (Co)-Total	0.0004		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Chromium (Cr)-Total	0.006		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cesium (Cs)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Copper (Cu)-Total	0.004		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Iron (Fe)-Total	0.18		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Potassium (K)-Total	3.8		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lithium (Li)-Total	0.02		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Magnesium (Mg)-Total	52.1		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Manganese (Mn)-Total	0.0110		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Molybdenum (Mo)-Total	0.0012		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Sodium (Na)-Total	19.0		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Nickel (Ni)-Total	0.015		0.002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Phosphorus (P)-Total	0.11		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lead (Pb)-Total	0.0041		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Rubidium (Rb)-Total	0.0008		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Antimony (Sb)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Selenium (Se)-Total	0.004		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tin (Sn)-Total	0.0011		0.0006	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Strontium (Sr)-Total	0.412		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tellurium (Te)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Titanium (Ti)-Total	0.0097		0.0009	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Thallium (Tl)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Uranium (U)-Total	0.0109		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Vanadium (V)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tungsten (W)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zinc (Zn)-Total	0.02		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zirconium (Zr)-Total	0.0005		0.0004	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
L338009-3 MW 403								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Sulphate Dissolved								
Sulphate (SO4) - Dissolved	481		9	mg/L	07-NOV-05	08-NOV-05	ALW	R344388

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-3 MW 403								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Nitrate + Nitrite Dissolved								
Nitrate+Nitrite-N - Dissolved	0.32	RAMB	0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Chloride Dissolved								
Chloride (Cl) - Dissolved	33		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Ammonia Dissolved								
Ammonia (NH3) - Dissolved	0.64		0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Phosphorus, Total								
Total Phosphorous	0.145	RAMB	0.001	mg/L		10-NOV-05	MEB	R345178
pH								
PH	7.80		0.01	pH units		07-NOV-05	DXN	R344056
Turbidity								
Turbidity	190		0.05	NTU		07-NOV-05	DXN	R343905
Total Suspended Solids								
Total Suspended Solids	300		5	mg/L		07-NOV-05	LVP	R344261
Total Solids								
Total Solids	1600		5	mg/L		07-NOV-05	LVP	R344261
Total Kjeldahl Nitrogen								
Total Kjeldahl Nitrogen	0.8		0.2	mg/L	09-NOV-05	15-NOV-05	CLM	R346542
Total Dissolved Solids								
Total Dissolved Solids	1300		5	mg/L		07-NOV-05	LVP	R344261
Hardness Calculated								
Hardness (as CaCO3)	432		0.2	mg/L		07-NOV-05		
Cyanide, Free								
Cyanide, Free	<0.01		0.01	mg/L		07-NOV-05	MB	R343922
Conductivity								
Conductivity	1790		0.4	umhos/cm		07-NOV-05	DXN	R344056
Chemical Oxygen Demand								
Chemical Oxygen Demand	<8		8	mg/L		08-NOV-05	SXG	R344384
BTEX and TVH (C5-C10)								
Benzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Toluene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Ethylbenzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
m+p-xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
o-xylene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
Xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Alkalinity								
Alkalinity, Total (as CaCO3)	521		1	mg/L		07-NOV-05	DXN	R344056
Bicarbonate (HCO3)	636		2	mg/L		07-NOV-05	DXN	R344056
Carbonate (CO3)	<0.6		0.6	mg/L		07-NOV-05	DXN	R344056
Hydroxide (OH)	<0.4		0.4	mg/L		07-NOV-05	DXN	R344056
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
TEH (C11-C30)	<0.1		0.1	mg/L	08-NOV-05	09-NOV-05	HDT	R344530
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Aluminum (Al)-Total	0.29		0.02	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Arsenic (As)-Total	0.0054		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Boron (B)-Total	0.23		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Barium (Ba)-Total	0.0755		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Beryllium (Be)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-3 MW 403								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Metal scan								
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Calcium (Ca)-Total	90.6		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cadmium (Cd)-Total	0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cobalt (Co)-Total	0.0012		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Chromium (Cr)-Total	0.002		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cesium (Cs)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Copper (Cu)-Total	0.007		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Iron (Fe)-Total	0.41		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Potassium (K)-Total	8.1		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lithium (Li)-Total	0.05		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Magnesium (Mg)-Total	49.9		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Manganese (Mn)-Total	0.384		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Molybdenum (Mo)-Total	0.0119		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Sodium (Na)-Total	262		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Nickel (Ni)-Total	0.005		0.002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Phosphorus (P)-Total	0.14		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lead (Pb)-Total	0.0011		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Rubidium (Rb)-Total	0.0033		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Antimony (Sb)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Selenium (Se)-Total	0.006		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tin (Sn)-Total	<0.0006		0.0006	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Strontium (Sr)-Total	0.629		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tellurium (Te)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Titanium (Ti)-Total	0.0189		0.0009	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Thallium (Tl)-Total	0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Uranium (U)-Total	0.0161		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Vanadium (V)-Total	0.004		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tungsten (W)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zinc (Zn)-Total	0.02		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zirconium (Zr)-Total	0.0012		0.0004	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
L338009-4 MW 405								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Sulphate Dissolved								
Sulphate (SO4) - Dissolved	9		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Nitrate + Nitrite Dissolved								
Nitrate+Nitrite-N - Dissolved	0.01	RAMB	0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Chloride Dissolved								
Chloride (Cl) - Dissolved	21		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Ammonia Dissolved								
Ammonia (NH3) - Dissolved	0.05		0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Phosphorus, Total								
Total Phosphorous	0.148	RAMB	0.001	mg/L		10-NOV-05	MEB	R345178
pH								
PH	7.65		0.01	pH units		07-NOV-05	DXN	R344056
Turbidity								
Turbidity	190		0.05	NTU		07-NOV-05	DXN	R343905
Total Suspended Solids								
Total Suspended Solids	200		5	mg/L		07-NOV-05	LVP	R344261

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-4 MW 405								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Total Solids								
Total Solids	1600		5	mg/L		07-NOV-05	LVP	R344261
Total Kjeldahl Nitrogen								
Total Kjeldahl Nitrogen	0.2		0.2	mg/L	09-NOV-05	15-NOV-05	CLM	R346542
Total Dissolved Solids								
Total Dissolved Solids	1300		5	mg/L		07-NOV-05	LVP	R344261
Hardness Calculated								
Hardness (as CaCO3)	590		0.2	mg/L		07-NOV-05		
Cyanide, Free								
Cyanide, Free	<0.01		0.01	mg/L		07-NOV-05	MB	R343922
Conductivity								
Conductivity	1830		0.4	umhos/cm		07-NOV-05	DXN	R344056
Chemical Oxygen Demand								
Chemical Oxygen Demand	24		8	mg/L		08-NOV-05	SXG	R344384
BTEX and TVH (C5-C10)								
Benzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Toluene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Ethylbenzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
m+p-xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
o-xylene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
Xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Alkalinity								
Alkalinity, Total (as CaCO3)	505		1	mg/L		07-NOV-05	DXN	R344056
Bicarbonate (HCO3)	617		2	mg/L		07-NOV-05	DXN	R344056
Carbonate (CO3)	<0.6		0.6	mg/L		07-NOV-05	DXN	R344056
Hydroxide (OH)	<0.4		0.4	mg/L		07-NOV-05	DXN	R344056
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
TEH (C11-C30)	<0.1		0.1	mg/L	08-NOV-05	09-NOV-05	HDT	R344530
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Aluminum (Al)-Total	0.49		0.02	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Arsenic (As)-Total	0.0016		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Boron (B)-Total	0.05		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Barium (Ba)-Total	0.115		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Beryllium (Be)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Calcium (Ca)-Total	147		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cadmium (Cd)-Total	0.0019		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cobalt (Co)-Total	0.0009		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Chromium (Cr)-Total	0.002		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cesium (Cs)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Copper (Cu)-Total	0.011		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Iron (Fe)-Total	0.63		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Potassium (K)-Total	4.2		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lithium (Li)-Total	0.03		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Magnesium (Mg)-Total	54.2		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Manganese (Mn)-Total	0.143		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Molybdenum (Mo)-Total	0.0077		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Sodium (Na)-Total	196		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-4 MW 405								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Metal scan								
Nickel (Ni)-Total	0.048		0.002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Phosphorus (P)-Total	0.13		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lead (Pb)-Total	0.0017		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Rubidium (Rb)-Total	0.0030		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Antimony (Sb)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Selenium (Se)-Total	0.012		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tin (Sn)-Total	0.0008		0.0006	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Strontium (Sr)-Total	0.582		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tellurium (Te)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Titanium (Ti)-Total	0.0222		0.0009	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Thallium (Tl)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Uranium (U)-Total	0.0144		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Vanadium (V)-Total	0.002		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tungsten (W)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zinc (Zn)-Total	0.04		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zirconium (Zr)-Total	0.0014		0.0004	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
L338009-5 MW 406								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
Sulphate Dissolved								
Sulphate (SO4) - Dissolved	27		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Nitrate + Nitrite Dissolved								
Nitrate+Nitrite-N - Dissolved	0.15	RAMB	0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Chloride Dissolved								
Chloride (Cl) - Dissolved	20		9	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Ammonia Dissolved								
Ammonia (NH3) - Dissolved	0.06		0.01	mg/L	07-NOV-05	07-NOV-05	CLM	R344055
Phosphorus, Total								
Total Phosphorous	0.052	RAMB	0.001	mg/L		10-NOV-05	MEB	R345178
pH								
PH	8.11		0.01	pH units		07-NOV-05	DXN	R344056
Turbidity								
Turbidity	8.7		0.05	NTU		07-NOV-05	DXN	R343905
Total Suspended Solids								
Total Suspended Solids	14		5	mg/L		07-NOV-05	LVP	R344261
Total Solids								
Total Solids	210		5	mg/L		07-NOV-05	LVP	R344261
Total Kjeldahl Nitrogen								
Total Kjeldahl Nitrogen	0.3		0.2	mg/L	09-NOV-05	15-NOV-05	CLM	R346542
Total Dissolved Solids								
Total Dissolved Solids	190		5	mg/L		07-NOV-05	LVP	R344261
Hardness Calculated								
Hardness (as CaCO3)	76.7		0.2	mg/L		07-NOV-05		
Cyanide, Free								
Cyanide, Free	<0.01		0.01	mg/L		07-NOV-05	MB	R343922
Conductivity								
Conductivity	316		0.4	umhos/cm		07-NOV-05	DXN	R344056
Chemical Oxygen Demand								
Chemical Oxygen Demand	<8		8	mg/L		08-NOV-05	SXG	R344384

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-5 MW 406								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
WDG Monitoring Well								
BTEX and TVH (C5-C10)								
Benzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Toluene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Ethylbenzene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
m+p-xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
o-xylene	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
Xylenes	<0.0005		0.0005	mg/L		08-NOV-05	TJJ	R344763
Alkalinity								
Alkalinity, Total (as CaCO3)	106		1	mg/L		07-NOV-05	DXN	R344056
Bicarbonate (HCO3)	129		2	mg/L		07-NOV-05	DXN	R344056
Carbonate (CO3)	<0.6		0.6	mg/L		07-NOV-05	DXN	R344056
Hydroxide (OH)	<0.4		0.4	mg/L		07-NOV-05	DXN	R344056
Total Volatiles	<0.1		0.1	mg/L		08-NOV-05	TJJ	R344763
TEH (C11-C30)	<0.1		0.1	mg/L	08-NOV-05	09-NOV-05	HDT	R344530
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Aluminum (Al)-Total	0.24		0.02	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Arsenic (As)-Total	<0.0005		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Boron (B)-Total	<0.03		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Barium (Ba)-Total	0.0121		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Beryllium (Be)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Calcium (Ca)-Total	23.1		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cadmium (Cd)-Total	0.0012		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cobalt (Co)-Total	0.0004		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Chromium (Cr)-Total	0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Cesium (Cs)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Copper (Cu)-Total	0.010		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Iron (Fe)-Total	0.23		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Potassium (K)-Total	1.2		0.1	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lithium (Li)-Total	<0.01		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Magnesium (Mg)-Total	4.61		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Manganese (Mn)-Total	0.0346		0.0003	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Molybdenum (Mo)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Sodium (Na)-Total	3.05		0.03	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Nickel (Ni)-Total	0.010		0.002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Phosphorus (P)-Total	0.10		0.05	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Lead (Pb)-Total	0.0014		0.0005	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Rubidium (Rb)-Total	0.0010		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Antimony (Sb)-Total	0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Selenium (Se)-Total	0.003		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tin (Sn)-Total	0.0047		0.0006	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Strontium (Sr)-Total	0.0389		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tellurium (Te)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Titanium (Ti)-Total	0.0060		0.0009	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Thallium (Tl)-Total	<0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Uranium (U)-Total	0.0001		0.0001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Vanadium (V)-Total	<0.001		0.001	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Tungsten (W)-Total	<0.0002		0.0002	mg/L	09-NOV-05	10-NOV-05	DAG	R344974

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-5 MW 406								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Metal scan								
Zinc (Zn)-Total	0.17		0.01	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
Zirconium (Zr)-Total	<0.0004		0.0004	mg/L	09-NOV-05	10-NOV-05	DAG	R344974
L338009-6 MW 999								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Routine Soluble + Metal scan								
pH								
PH	7.89		0.01	pH units		07-NOV-05	DXN	R344056
TDS calculated								
TDS (Calculated)	1230		5	mg/L		14-NOV-05		
Sulphate Soluble								
Sulphate (SO4) - Soluble	454		9	mg/L		08-NOV-05	ALW	R344388
Nitrate + Nitrite Soluble								
Nitrate+Nitrite-N	0.31	RAMB	0.01	mg/L		07-NOV-05	CLM	R344055
Metal scan								
Silver (Ag)-Total	<0.001		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Aluminum (Al)-Total	0.92		0.02	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Arsenic (As)-Total	0.0055		0.0005	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Boron (B)-Total	0.27		0.03	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Barium (Ba)-Total	0.0830		0.0003	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Beryllium (Be)-Total	<0.001		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Bismuth (Bi)-Total	<0.0001		0.0001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Calcium (Ca)-Total	100		0.1	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Cadmium (Cd)-Total	0.0411		0.0002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Cobalt (Co)-Total	0.0022		0.0002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Chromium (Cr)-Total	0.003		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Cesium (Cs)-Total	0.0001		0.0001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Copper (Cu)-Total	0.009		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Iron (Fe)-Total	1.45		0.05	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Potassium (K)-Total	8.3		0.1	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Lithium (Li)-Total	0.04		0.01	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Magnesium (Mg)-Total	52.3		0.01	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Manganese (Mn)-Total	0.428		0.0003	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Molybdenum (Mo)-Total	0.0101		0.0002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Sodium (Na)-Total	273		0.03	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Nickel (Ni)-Total	0.015		0.002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Phosphorus (P)-Total	0.24		0.05	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Lead (Pb)-Total	0.0035		0.0005	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Rubidium (Rb)-Total	0.0048		0.0002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Antimony (Sb)-Total	<0.001		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Selenium (Se)-Total	0.004		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Tin (Sn)-Total	0.0009		0.0006	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Strontium (Sr)-Total	0.632		0.0001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Tellurium (Te)-Total	<0.001		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Titanium (Ti)-Total	0.0533		0.0009	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Thallium (Tl)-Total	<0.0001		0.0001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Uranium (U)-Total	0.0158		0.0001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Vanadium (V)-Total	0.005		0.001	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Tungsten (W)-Total	<0.0002		0.0002	mg/L	10-NOV-05	10-NOV-05	DAG	R345886

ENVIRO-TEST ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Extracted	Analyzed	By	Batch
L338009-6 MW 999								
Sample Date: 04-NOV-05 08:00								
Matrix: WATER								
Routine Soluble + Metal scan								
Metal scan								
Zinc (Zn)-Total	0.03		0.01	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Zirconium (Zr)-Total	0.0020		0.0004	mg/L	10-NOV-05	10-NOV-05	DAG	R345886
Hardness Calculated								
Hardness (as CaCO3)	465		0.3	mg/L		14-NOV-05		
Conductivity								
Conductivity	1790		0.4	umhos/cm		07-NOV-05	DXN	R344056
Chloride Soluble								
Chloride (Cl) - Soluble	34		9	mg/L		07-NOV-05	CLM	R344055
Alkalinity								
Alkalinity, Total (as CaCO3)	507		1	mg/L		07-NOV-05	DXN	R344056
Bicarbonate (HCO3)	618		2	mg/L		07-NOV-05	DXN	R344056
Carbonate (CO3)	<0.6		0.6	mg/L		07-NOV-05	DXN	R344056
Hydroxide (OH)	<0.4		0.4	mg/L		07-NOV-05	DXN	R344056

Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
RAMB	Result Adjusted For Method Blank

Methods Listed (if applicable):

ETL Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
ALK-TOT-WP	Water	Alkalinity		APHA 4500B, 2510B, 2320B, 1998

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

BTX,TVH-WP	Water	BTEX and TVH (C5-C10)		EPA SW846,5030,8015

Volatile organic compounds are extracted (purged) by bubbling nitrogen through a water sample. The purged sample components are trapped in a tube containing a sorbent material. When purging is complete, the tube is heated and back flushed with helium to desorb the trapped compounds onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the method analytes which are then detected with a photoionization detector (PID) followed by a flame ionization detector (FID).

CL-DIS-WP	Water	Chloride Dissolved		APHA4500;1998/LACHAT;MAR 1997

Chloride - Colourimetric using Mercuric Thiocyanate

CL-SOL-WP	Water	Chloride Soluble		APHA4500;1998/LACHAT;MAR 1997

Chloride - Colourimetric using Mercuric Thiocyanate

CN-FREE-WP	Water	Cyanide, Free		APHA 4500CN C E-Strong acid Dist Colorim
COD-WP	Water	Chemical Oxygen Demand		APHA 5220 D

The Chemical Oxygen Demand (COD) test is used to estimate the amount of organic matter in the water. The sample is added to HACH brand COD tubes, which contain a premixed volume of reagents. The sample is then heated for two hours on the COD reactor with a strong oxidizing agent, potassium dichromate. The COD reagents also contain silver and mercury ions. Silver is used as a catalyst and mercury is used to complex chloride interference. Oxidizable organic compounds react, reducing the dichromate ion to green chromic ion.

For the 10 - 150 mg/L range the remaining Cr6+ is measured colormetrically and a decrease in absorbance at 420 nm is proportional to the COD. For the 100 - 1500 mg/L range the amount of Cr3+ produced is measured colormetrically and an increase in absorbance at 620 nm is proportional to the COD. Samples with concentrations > 1500 mg/L can be diluted into either linear range.

EC-WP	Water	Conductivity		APHA 4500B, 2510B, 2320B, 1998

Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.

ETL-HARDNESS-DIS-WP	Water	Hardness Calculated		Calculated
ETL-HARDNESS-TOT-WP	Water	Hardness Calculated		Calculated
IONBALANCE-OP05-WP	Water			APHA 1030E
MET-SCAN-TOT-LOW-WP	Water	Metal scan		EPA 200.8 Rev 5.4 May 1994
N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen		Quickchem method 10-107-06-2-E Lachat

Samples are digested with a sulphuric acid solution, cooled, diluted with water, and analyzed for ammonia. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulphate through this digestion process. Analysis is performed by Flow Injection
Analysis (FIA). The pH of the digested sample is raised to a known, basic pH by neutralization with a concentrated buffer solution. This neutralization converts the ammonium cation to ammonia. The ammonia produced is heated with saliclyate and hypochlorite to produce blue colour which is proportional to the ammonia concentration.

N2N3-DIS-WP	Water	Nitrate + Nitrite Dissolved		APHA4500;1998/LACHAT;MAR 1997
N2N3-SOL-WP	Water	Nitrate + Nitrite Soluble		APHA4500;1998/LACHAT;MAR 1997
NH3-DIS-WP	Water	Ammonia Dissolved		APHA4500;1998/LACHAT;MAR 1997

Ammonia - Colourimeric using Salicylate-nitroprusside and hypochlorite, in an alkaline phosphate buffer.

P-TOTAL-WP	Water	Phosphorus, Total		APHA, 1998

Samples are digested using a sulphuric acid-persulphate mixture to convert organic phosphorous to orthophosphate. The samples are analyzed by either the Flow Injection Analysis (FIA) or the Segmented Flow Analysis (SFA) method. The absorbance measured by the instrument is proportional to the concentration of orthophosphate in the sample, and is reported as phosphorous. Samples are analyzed for total or total dissolved phosphorous depending on the sample pretreatment.

Reference Information

reference electrode.

SO4-DIS-WP	Water	Sulphate Dissolved	APHA4500;1998/LACHAT;MAR 1997

Sulphate - Turbidimetric

SO4-SOL-WP	Water	Sulphate Soluble	APHA4500;1998/LACHAT;MAR 1997

Sulphate - Turbidimetric

SOLIDS-TDS-WP	Water	Total Dissolved Solids	APHA 2540

The residue remaining in a prepared casserole after passing the sample through a 1.2 um Whatman GF/C glass microfibre filter and drying at 180 degrees C. Samples may be dried at 105 degrees C if the client specifically requests this drying temperature.

SOLIDS-TOT-WP	Water	Total Solids	APHA 2540

The sum of the homogeneous suspended and dissolved material in the sample dried at 105 degrees C in a prepared casserole.

SOLIDS-TOTSUS-WP	Water	Total Suspended Solids	APHA 2540

The residue retained by a prepared 1.5 um Whatman 934-AH glass microfibre filter dried at 105 degrees C.

TEH-WP	Water	Tot. Extr. Hydrocarbons (C11-C30)	EPA SW846,8000A

This is the semi-quantitative determination of total extractable hydrocarbons (TEH) C11-C30 in water, soil and sediment samples. A water sample volume of 240 mLs in a 250 mL glass amber bottle is shaken with 2-4 mL hexane for one hour on a wrist action shaker, then sonicated for 5 minutes. / soil/sediment sample of 25 grams is weighed out with sodium sulphate and extracted with 10 mLs hexane/acetone for one hour on a wrist action shake then sonicated for 5 minutes. After extraction, the solvent layer is drawn off and analysed against a calibrated diesel standard on a gas chromatograph equipped with a flame ionization detector. All results are reported on a dry weight basis. By special request, the result can be calculated on C10-C24 t meet specific regulations.

TURBIDITY-WP	Water	Turbidity	APHA, 1998, 2130B

A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particles is detected by the photocell. The electrical response is proportional to the sample turbidity.

TVH-WP	Water	TVH (C5-C10)	EPA SW846,5030,8015

Volatile organic compounds are extracted (purged) by bubbling nitrogen through a water sample. The purged sample components are trapped in a tub containing a sorbent material. When purging is complete, the tube is heated and back flushed with helium to desorb the trapped compounds onto a ga chromatographic column. The gas chromatograph is temperature programmed to separate the method analytes which are then detected with a photoionization detector (PID) followed by a flame ionization detector (FID).

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WP	Enviro-Test Laboratories - Winnipeg, Manitoba, Canada		

Reference Information

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency. The Laboratory warning units are determined under column heading D.L.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
< - Less than
D.L. - Detection Limit
N/A - Result not available. Refer to qualifier code and definition for explanation

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
UNLESS OTHERWISE STATED, SAMPLES ARE NOT CORRECTED FOR CLIENT FIELD BLANKS.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

Enviro-Test Laboratories has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, Enviro-Test Laboratories assumes no liability for the use or interpretation of the results.

EnviroTest LABORATORIES

Enviro-Test Quality Control Report

Workorder: L338009

Client: UMA ENGINEERING
1479 BUFFALO PLACE
WINNIPEG MB R3T 1L7

Contact: PETER BOHONOS

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TOT-WP	**Water**							
Batch R344056								
WG375519-5 CVS								
Alkalinity, Total (as CaCO3)			100		%		93-107	07-NOV-05
WG375519-6 DUP		**L338009-2**						
Alkalinity, Total (as CaCO3)		469	470		mg/L	0.16	3.8	07-NOV-05
Bicarbonate (HCO3)		572	573		mg/L	0.16	20	07-NOV-05
Carbonate (CO3)		<0.6	<0.6	RPD-NA	mg/L	N/A	20	07-NOV-05
Hydroxide (OH)		<0.4	<0.4	RPD-NA	mg/L	N/A	20	07-NOV-05
Batch R344368								
WG375934-5 CVS								
Alkalinity, Total (as CaCO3)			100		%		93-107	08-NOV-05
WG375934-6 DUP		**L338009-1**						
Alkalinity, Total (as CaCO3)		597	589		mg/L	1.3	3.8	08-NOV-05
Bicarbonate (HCO3)		728	719		mg/L	1.3	20	08-NOV-05
Carbonate (CO3)		<0.6	<0.6	RPD-NA	mg/L	N/A	20	08-NOV-05
Hydroxide (OH)		<0.4	<0.4	RPD-NA	mg/L	N/A	20	08-NOV-05
BTX,TVH-WP	**Water**							
Batch R344763								
WG376384-1 CCV								
Benzene			89		%		87-113	08-NOV-05
Ethylbenzene			97		%		87-113	08-NOV-05
m+p-xylenes			96		%		87-113	08-NOV-05
o-xylene			97		%		87-113	08-NOV-05
Toluene			99		%		87-113	08-NOV-05
Total Volatiles			97		%		87-113	08-NOV-05
Xylenes			97		%		70-130	08-NOV-05
WG376384-2 CCV								
Benzene			89		%		87-113	08-NOV-05
Ethylbenzene			99		%		87-113	08-NOV-05
m+p-xylenes			98		%		87-113	08-NOV-05
o-xylene			100		%		87-113	08-NOV-05
Toluene			103		%		87-113	08-NOV-05
Total Volatiles			102		%		87-113	08-NOV-05
Xylenes			99		%		70-130	08-NOV-05
WG376384-3 CVS								
Benzene			98		%		87-113	08-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BTX,TVH-WP	**Water**							
Batch R344763								
WG376384-3 CVS								
Ethylbenzene			91		%		87-113	08-NOV-05
m+p-xylenes			112		%		87-113	08-NOV-05
o-xylene			93		%		87-113	08-NOV-05
Toluene			95		%		87-113	08-NOV-05
Total Volatiles			97		%		87-113	08-NOV-05
Xylenes			102		%		70-130	08-NOV-05
WG376350-3 DUP		**L338009-4**						
Benzene		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
Ethylbenzene		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
m+p-xylenes		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
o-xylene		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
Toluene		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
Total Volatiles		<0.1	<0.1	RPD-NA	mg/L	N/A	12	08-NOV-05
Xylenes		<0.0005	<0.0005	RPD-NA	mg/L	N/A	12	08-NOV-05
WG376350-1 MB								
Benzene			<0.0005		mg/L		0.0005	08-NOV-05
Ethylbenzene			<0.0005		mg/L		0.0005	08-NOV-05
m+p-xylenes			<0.0005		mg/L		0.0005	08-NOV-05
o-xylene			<0.0005		mg/L		0.0005	08-NOV-05
Toluene			<0.0005		mg/L		0.0005	08-NOV-05
Total Volatiles			<0.1		mg/L		0.1	08-NOV-05
Xylenes			<0.0005		mg/L		0.0005	08-NOV-05
WG376350-2 MS		**L338009-5**						
Benzene			78	H	%		82-117	08-NOV-05
Ethylbenzene			88		%		83-106	08-NOV-05
m+p-xylenes			108		%		86-112	08-NOV-05
o-xylene			91		%		83-110	08-NOV-05
Toluene			92		%		82-109	08-NOV-05
Total Volatiles			90		%		80-120	08-NOV-05
Xylenes			99		%		70-130	08-NOV-05
CL-DIS-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Chloride (Cl) - Dissolved			107	H	%		93-107	07-NOV-05
WG375512-2 CVS								
Chloride (Cl) - Dissolved			106		%		93-107	07-NOV-05
WG375150-1 MB								
Chloride (Cl) - Dissolved			<9		mg/L		9	07-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-SOL-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Chloride (Cl) - Soluble			107	H	%		93-107	07-NOV-05
WG375512-2 CVS								
Chloride (Cl) - Soluble			106		%		93-107	07-NOV-05
WG375512-5 DUP		**WG375512-4**						
Chloride (Cl) - Soluble		131	131		mg/L	0.28	15	07-NOV-05
WG375512-1 MB								
Chloride (Cl) - Soluble			<9		mg/L		9	07-NOV-05
CN-FREE-WP	**Water**							
Batch R343922								
WG375333-2 CCV								
Cyanide, Free			97		%		87-113	07-NOV-05
WG375333-1 CVS								
Cyanide, Free			98		%		87-113	07-NOV-05
WG375333-4 MB								
Cyanide, Free			<0.01		mg/L		0.01	07-NOV-05
WG375333-3 MS		**L338027-1**						
Cyanide, Free			101		%		80-121	07-NOV-05
COD-WP	**Water**							
Batch R344384								
WG375927-3 CCV								
Chemical Oxygen Demand			97		%		93-107	08-NOV-05
WG375927-2 CVS								
Chemical Oxygen Demand			95		%		93-107	08-NOV-05
WG375927-4 DUP		**L336770-1**						
Chemical Oxygen Demand		12	10	J	mg/L	2	25	08-NOV-05
WG375927-1 MB								
Chemical Oxygen Demand			<8		mg/L		8	08-NOV-05
EC-WP	**Water**							
Batch R344056								
WG375519-2 CCV								
Conductivity			101		%		97-103	07-NOV-05
WG375519-1 CVS								
Conductivity			100		%		93-107	07-NOV-05
WG375519-6 DUP		**L338009-2**						
Conductivity		1050	1040		umhos/cm	0.067	3.8	07-NOV-05
WG375519-7 DUP		**L338046-1**						
Conductivity		3970	3970		umhos/cm	0.14	3.8	07-NOV-05
Batch R344368								
WG375934-2 CCV								
Conductivity			101		%		97-103	08-NOV-05
WG375934-1 CVS								

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WP	**Water**							
Batch R344368								
WG375934-1 CVS								
Conductivity			99		%		93-107	08-NOV-05
WG375934-6 DUP		**L338009-1**						
Conductivity		1330	1330		umhos/cm	0.023	3.8	08-NOV-05
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376632-4 CCV								
Aluminum (Al)-Total			102		%		93-107	09-NOV-05
Antimony (Sb)-Total			99		%		93-107	09-NOV-05
Arsenic (As)-Total			98		%		93-107	09-NOV-05
Barium (Ba)-Total			96		%		93-107	09-NOV-05
Beryllium (Be)-Total			98		%		93-107	09-NOV-05
Bismuth (Bi)-Total			102		%		93-107	09-NOV-05
Boron (B)-Total			94		%		93-107	09-NOV-05
Cadmium (Cd)-Total			98		%		93-107	09-NOV-05
Calcium (Ca)-Total			99		%		93-107	09-NOV-05
Cesium (Cs)-Total			98		%		93-107	09-NOV-05
Chromium (Cr)-Total			101		%		93-107	09-NOV-05
Cobalt (Co)-Total			98		%		93-107	09-NOV-05
Copper (Cu)-Total			98		%		93-107	09-NOV-05
Iron (Fe)-Total			99		%		93-107	09-NOV-05
Lead (Pb)-Total			100		%		93-107	09-NOV-05
Lithium (Li)-Total			95		%		93-107	09-NOV-05
Magnesium (Mg)-Total			102		%		93-107	09-NOV-05
Manganese (Mn)-Total			98		%		93-107	09-NOV-05
Molybdenum (Mo)-Total			100		%		93-107	09-NOV-05
Nickel (Ni)-Total			99		%		93-107	09-NOV-05
Phosphorus (P)-Total			100		%		93-107	09-NOV-05
Potassium (K)-Total			98		%		93-107	09-NOV-05
Rubidium (Rb)-Total			100		%		93-107	09-NOV-05
Selenium (Se)-Total			95		%		93-107	09-NOV-05
Silver (Ag)-Total			99		%		93-107	09-NOV-05
Sodium (Na)-Total			104		%		93-107	09-NOV-05
Strontium (Sr)-Total			99		%		93-107	09-NOV-05
Tellurium (Te)-Total			99		%		93-107	09-NOV-05
Thallium (Tl)-Total			102		%		93-107	09-NOV-05
Tin (Sn)-Total			99		%		93-107	09-NOV-05
Titanium (Ti)-Total			99		%		93-107	09-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376632-4 CCV								
Tungsten (W)-Total			99		%		93-107	09-NOV-05
Uranium (U)-Total			101		%		93-107	09-NOV-05
Vanadium (V)-Total			101		%		93-107	09-NOV-05
Zinc (Zn)-Total			99		%		93-107	09-NOV-05
Zirconium (Zr)-Total			100		%		93-107	09-NOV-05
WG376632-2 CVS								
Aluminum (Al)-Total			94		%		75-125	09-NOV-05
Antimony (Sb)-Total			94		%		75-125	09-NOV-05
Arsenic (As)-Total			94		%		75-125	09-NOV-05
Barium (Ba)-Total			94		%		75-125	09-NOV-05
Beryllium (Be)-Total			99		%		75-125	09-NOV-05
Bismuth (Bi)-Total			95		%		75-125	09-NOV-05
Boron (B)-Total			97		%		75-125	09-NOV-05
Cadmium (Cd)-Total			94		%		75-125	09-NOV-05
Calcium (Ca)-Total			93		%		75-125	09-NOV-05
Cesium (Cs)-Total			95		%		75-125	09-NOV-05
Chromium (Cr)-Total			93		%		75-125	09-NOV-05
Cobalt (Co)-Total			95		%		75-125	09-NOV-05
Copper (Cu)-Total			95		%		75-125	09-NOV-05
Iron (Fe)-Total			93		%		75-125	09-NOV-05
Lead (Pb)-Total			96		%		75-125	09-NOV-05
Lithium (Li)-Total			103		%		75-125	09-NOV-05
Magnesium (Mg)-Total			95		%		75-125	09-NOV-05
Manganese (Mn)-Total			95		%		75-125	09-NOV-05
Molybdenum (Mo)-Total			95		%		75-125	09-NOV-05
Nickel (Ni)-Total			94		%		75-125	09-NOV-05
Phosphorus (P)-Total			92		%		75-125	09-NOV-05
Potassium (K)-Total			94		%		75-125	09-NOV-05
Rubidium (Rb)-Total			96		%		75-125	09-NOV-05
Selenium (Se)-Total			95		%		75-125	09-NOV-05
Silver (Ag)-Total			99		%		75-125	09-NOV-05
Sodium (Na)-Total			94		%		75-125	09-NOV-05
Strontium (Sr)-Total			96		%		75-125	09-NOV-05
Tellurium (Te)-Total			95		%		75-125	09-NOV-05
Thallium (Tl)-Total			96		%		75-125	09-NOV-05
Tin (Sn)-Total			95		%		75-125	09-NOV-05
Titanium (Ti)-Total			94		%		75-125	09-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376632-2 CVS								
Tungsten (W)-Total			96		%		75-125	09-NOV-05
Uranium (U)-Total			96		%		75-125	09-NOV-05
Vanadium (V)-Total			101		%		75-125	09-NOV-05
Zinc (Zn)-Total			92		%		75-125	09-NOV-05
Zirconium (Zr)-Total			96		%		75-125	09-NOV-05
WG376632-3 CVS								
Aluminum (Al)-Total			91		%		75-125	09-NOV-05
Antimony (Sb)-Total			95		%		75-125	09-NOV-05
Arsenic (As)-Total			96		%		75-125	09-NOV-05
Barium (Ba)-Total			97		%		75-125	09-NOV-05
Beryllium (Be)-Total			105		%		75-125	09-NOV-05
Bismuth (Bi)-Total			95		%		75-125	09-NOV-05
Boron (B)-Total			98		%		75-125	09-NOV-05
Cadmium (Cd)-Total			98		%		75-125	09-NOV-05
Calcium (Ca)-Total			97		%		75-125	09-NOV-05
Cesium (Cs)-Total			92		%		75-125	09-NOV-05
Chromium (Cr)-Total			97		%		75-125	09-NOV-05
Cobalt (Co)-Total			97		%		75-125	09-NOV-05
Copper (Cu)-Total			96		%		75-125	09-NOV-05
Iron (Fe)-Total			96		%		75-125	09-NOV-05
Lead (Pb)-Total			97		%		75-125	09-NOV-05
Lithium (Li)-Total			107		%		75-125	09-NOV-05
Magnesium (Mg)-Total			97		%		75-125	09-NOV-05
Manganese (Mn)-Total			97		%		75-125	09-NOV-05
Molybdenum (Mo)-Total			101		%		75-125	09-NOV-05
Nickel (Ni)-Total			97		%		75-125	09-NOV-05
Phosphorus (P)-Total			97		%		75-125	09-NOV-05
Potassium (K)-Total			97		%		75-125	09-NOV-05
Rubidium (Rb)-Total			100		%		75-125	09-NOV-05
Selenium (Se)-Total			96		%		75-125	09-NOV-05
Silver (Ag)-Total			106		%		75-125	09-NOV-05
Sodium (Na)-Total			95		%		75-125	09-NOV-05
Strontium (Sr)-Total			100		%		75-125	09-NOV-05
Tellurium (Te)-Total			96		%		75-125	09-NOV-05
Thallium (Tl)-Total			96		%		75-125	09-NOV-05
Tin (Sn)-Total			101		%		75-125	09-NOV-05
Titanium (Ti)-Total			99		%		75-125	09-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376632-3 CVS								
Tungsten (W)-Total			99		%		75-125	09-NOV-05
Uranium (U)-Total			102		%		75-125	09-NOV-05
Vanadium (V)-Total			105		%		75-125	09-NOV-05
Zinc (Zn)-Total			94		%		75-125	09-NOV-05
Zirconium (Zr)-Total			100		%		75-125	09-NOV-05
WG376308-4 DUP		**WG376308-3**						
Aluminum (Al)-Total		0.24	0.24		mg/L	3.4	15	10-NOV-05
Antimony (Sb)-Total		0.001	0.001	J	mg/L	0.000	0.0031	10-NOV-05
Arsenic (As)-Total		<0.0005	<0.0005	RPD-NA	mg/L	N/A	15	10-NOV-05
Barium (Ba)-Total		0.0121	0.0144	H	mg/L	18	15	10-NOV-05
Beryllium (Be)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Bismuth (Bi)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Boron (B)-Total		<0.03	<0.03	RPD-NA	mg/L	N/A	15	10-NOV-05
Cadmium (Cd)-Total		0.0012	0.0013	J	mg/L	0.0001	0.00061	10-NOV-05
Calcium (Ca)-Total		23.1	24.7		mg/L	6.7	15	10-NOV-05
Cesium (Cs)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Chromium (Cr)-Total		0.001	0.002	J	mg/L	0.001	0.0031	10-NOV-05
Cobalt (Co)-Total		0.0004	0.0004	J	mg/L	0.0000	0.00061	10-NOV-05
Copper (Cu)-Total		0.010	0.012		mg/L	14	15	10-NOV-05
Iron (Fe)-Total		0.23	0.23	J	mg/L	0.01	0.15	10-NOV-05
Lead (Pb)-Total		0.0014	0.0016	J	mg/L	0.0002	0.0015	10-NOV-05
Lithium (Li)-Total		<0.01	<0.01	RPD-NA	mg/L	N/A	15	10-NOV-05
Magnesium (Mg)-Total		4.61	4.86		mg/L	5.4	15	10-NOV-05
Manganese (Mn)-Total		0.0346	0.0372		mg/L	7.4	15	10-NOV-05
Molybdenum (Mo)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Nickel (Ni)-Total		0.010	0.010	J	mg/L	0.000	0.0061	10-NOV-05
Phosphorus (P)-Total		0.10	0.11	J	mg/L	0.02	0.15	10-NOV-05
Potassium (K)-Total		1.2	1.3		mg/L	14	15	10-NOV-05
Rubidium (Rb)-Total		0.0010	0.0013	J	mg/L	0.0003	0.00061	10-NOV-05
Selenium (Se)-Total		0.003	0.002	J	mg/L	0.000	0.0031	10-NOV-05
Silver (Ag)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Sodium (Na)-Total		3.05	3.23		mg/L	5.8	15	10-NOV-05
Strontium (Sr)-Total		0.0389	0.0416		mg/L	6.8	15	10-NOV-05
Tellurium (Te)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Thallium (Tl)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Tin (Sn)-Total		0.0047	0.0053	J	mg/L	0.0006	0.0018	10-NOV-05
Titanium (Ti)-Total		0.0060	0.0093	J,H	mg/L	0.0033	0.0028	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376308-4 DUP		**WG376308-3**						
Tungsten (W)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Uranium (U)-Total		0.0001	0.0001	J	mg/L	0.0000	0.00031	10-NOV-05
Vanadium (V)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Zinc (Zn)-Total		0.17	0.20	H	mg/L	16	15	10-NOV-05
Zirconium (Zr)-Total		<0.0004	0.0005	RPD-NA	mg/L	N/A	15	10-NOV-05
WG376308-2 LCS								
Aluminum (Al)-Total			102		%		80-120	09-NOV-05
Antimony (Sb)-Total			92		%		80-120	09-NOV-05
Arsenic (As)-Total			94		%		80-120	09-NOV-05
Barium (Ba)-Total			96		%		80-120	09-NOV-05
Beryllium (Be)-Total			96		%		80-120	09-NOV-05
Bismuth (Bi)-Total			98		%		80-120	09-NOV-05
Boron (B)-Total			89		%		80-120	09-NOV-05
Cadmium (Cd)-Total			94		%		89-112	09-NOV-05
Calcium (Ca)-Total			100		%		80-120	09-NOV-05
Cesium (Cs)-Total			97		%		80-120	09-NOV-05
Chromium (Cr)-Total			97		%		80-120	09-NOV-05
Cobalt (Co)-Total			96		%		80-120	09-NOV-05
Copper (Cu)-Total			98		%		92-121	09-NOV-05
Iron (Fe)-Total			96		%		80-120	09-NOV-05
Lead (Pb)-Total			98		%		91-117	09-NOV-05
Lithium (Li)-Total			91		%		80-120	09-NOV-05
Magnesium (Mg)-Total			100		%		92-120	09-NOV-05
Manganese (Mn)-Total			96		%		80-120	09-NOV-05
Molybdenum (Mo)-Total			98		%		80-120	09-NOV-05
Nickel (Ni)-Total			96		%		80-120	09-NOV-05
Phosphorus (P)-Total			105		%		73-127	09-NOV-05
Potassium (K)-Total			92		%		80-120	09-NOV-05
Rubidium (Rb)-Total			97		%		80-120	09-NOV-05
Selenium (Se)-Total			92		%		80-120	09-NOV-05
Silver (Ag)-Total			97		%		80-120	09-NOV-05
Sodium (Na)-Total			91		%		80-120	09-NOV-05
Strontium (Sr)-Total			97		%		80-120	09-NOV-05
Tellurium (Te)-Total			92		%		80-120	09-NOV-05
Thallium (Tl)-Total			99		%		80-120	09-NOV-05
Tin (Sn)-Total			97		%		80-120	09-NOV-05
Titanium (Ti)-Total			99		%		80-120	09-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376308-2 LCS								
Tungsten (W)-Total			97		%		80-120	09-NOV-05
Uranium (U)-Total			100		%		80-120	09-NOV-05
Vanadium (V)-Total			96		%		80-120	09-NOV-05
Zinc (Zn)-Total			105		%		83-126	09-NOV-05
Zirconium (Zr)-Total			96		%		80-120	09-NOV-05
WG376308-1 MB								
Aluminum (Al)-Total			<0.02		mg/L		0.1	09-NOV-05
Antimony (Sb)-Total			<0.001		mg/L		0.005	09-NOV-05
Arsenic (As)-Total			<0.0005		mg/L		0.0025	09-NOV-05
Barium (Ba)-Total			<0.0003		mg/L		0.0015	09-NOV-05
Beryllium (Be)-Total			<0.001		mg/L		0.005	09-NOV-05
Bismuth (Bi)-Total			<0.0001		mg/L		0.0005	09-NOV-05
Boron (B)-Total			<0.03		mg/L		0.15	09-NOV-05
Cadmium (Cd)-Total			<0.0002		mg/L		0.001	09-NOV-05
Calcium (Ca)-Total			<0.1		mg/L		0.5	09-NOV-05
Cesium (Cs)-Total			<0.0001		mg/L		0.0005	09-NOV-05
Chromium (Cr)-Total			<0.001		mg/L		0.005	09-NOV-05
Cobalt (Co)-Total			<0.0002		mg/L		0.001	09-NOV-05
Copper (Cu)-Total			<0.001		mg/L		0.005	09-NOV-05
Iron (Fe)-Total			<0.05		mg/L		0.25	09-NOV-05
Lead (Pb)-Total			<0.0005		mg/L		0.0025	09-NOV-05
Lithium (Li)-Total			<0.01		mg/L		0.05	09-NOV-05
Magnesium (Mg)-Total			<0.01		mg/L		0.05	09-NOV-05
Manganese (Mn)-Total			<0.0003		mg/L		0.0015	09-NOV-05
Molybdenum (Mo)-Total			<0.0002		mg/L		0.001	09-NOV-05
Nickel (Ni)-Total			<0.002		mg/L		0.01	09-NOV-05
Phosphorus (P)-Total			<0.05		mg/L		0.25	09-NOV-05
Potassium (K)-Total			<0.1		mg/L		0.5	09-NOV-05
Rubidium (Rb)-Total			<0.0002		mg/L		0.001	09-NOV-05
Selenium (Se)-Total			<0.001		mg/L		0.005	09-NOV-05
Silver (Ag)-Total			<0.001		mg/L		0.005	09-NOV-05
Sodium (Na)-Total			<0.03		mg/L		0.15	09-NOV-05
Strontium (Sr)-Total			<0.0001		mg/L		0.0005	09-NOV-05
Tellurium (Te)-Total			<0.001		mg/L		0.005	09-NOV-05
Thallium (Tl)-Total			<0.0001		mg/L		0.0005	09-NOV-05
Tin (Sn)-Total			<0.0006		mg/L		0.003	09-NOV-05
Titanium (Ti)-Total			<0.0009		mg/L		0.0045	09-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R344974								
WG376308-1 MB								
Tungsten (W)-Total			<0.0002		mg/L		0.001	09-NOV-05
Uranium (U)-Total			<0.0001		mg/L		0.0005	09-NOV-05
Vanadium (V)-Total			<0.001		mg/L		0.005	09-NOV-05
Zinc (Zn)-Total			<0.01		mg/L		0.05	09-NOV-05
Zirconium (Zr)-Total			<0.0004		mg/L		0.002	09-NOV-05
Batch R345886								
WG377806-4 CCV								
Aluminum (Al)-Total			100		%		93-107	10-NOV-05
Antimony (Sb)-Total			98		%		93-107	10-NOV-05
Arsenic (As)-Total			98		%		93-107	10-NOV-05
Barium (Ba)-Total			98		%		93-107	10-NOV-05
Beryllium (Be)-Total			96		%		93-107	10-NOV-05
Bismuth (Bi)-Total			101		%		93-107	10-NOV-05
Boron (B)-Total			98		%		93-107	10-NOV-05
Cadmium (Cd)-Total			99		%		93-107	10-NOV-05
Calcium (Ca)-Total			100		%		93-107	10-NOV-05
Cesium (Cs)-Total			100		%		93-107	10-NOV-05
Chromium (Cr)-Total			101		%		93-107	10-NOV-05
Cobalt (Co)-Total			100		%		93-107	10-NOV-05
Copper (Cu)-Total			99		%		93-107	10-NOV-05
Iron (Fe)-Total			101		%		93-107	10-NOV-05
Lead (Pb)-Total			99		%		93-107	10-NOV-05
Lithium (Li)-Total			98		%		93-107	10-NOV-05
Magnesium (Mg)-Total			99		%		93-107	10-NOV-05
Manganese (Mn)-Total			99		%		93-107	10-NOV-05
Molybdenum (Mo)-Total			98		%		93-107	10-NOV-05
Nickel (Ni)-Total			99		%		93-107	10-NOV-05
Phosphorus (P)-Total			98		%		93-107	10-NOV-05
Potassium (K)-Total			99		%		93-107	10-NOV-05
Rubidium (Rb)-Total			97		%		93-107	10-NOV-05
Selenium (Se)-Total			99		%		93-107	10-NOV-05
Silver (Ag)-Total			98		%		93-107	10-NOV-05
Sodium (Na)-Total			101		%		93-107	10-NOV-05
Strontium (Sr)-Total			97		%		93-107	10-NOV-05
Tellurium (Te)-Total			99		%		93-107	10-NOV-05
Thallium (Tl)-Total			101		%		93-107	10-NOV-05
Tin (Sn)-Total			97		%		93-107	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG377806-4 CCV								
Titanium (Ti)-Total			97		%		93-107	10-NOV-05
Tungsten (W)-Total			99		%		93-107	10-NOV-05
Uranium (U)-Total			100		%		93-107	10-NOV-05
Vanadium (V)-Total			99		%		93-107	10-NOV-05
Zinc (Zn)-Total			100		%		93-107	10-NOV-05
Zirconium (Zr)-Total			98		%		93-107	10-NOV-05
WG377806-2 CVS								
Aluminum (Al)-Total			96		%		75-125	10-NOV-05
Antimony (Sb)-Total			101		%		75-125	10-NOV-05
Arsenic (As)-Total			97		%		75-125	10-NOV-05
Barium (Ba)-Total			96		%		75-125	10-NOV-05
Beryllium (Be)-Total			99		%		75-125	10-NOV-05
Bismuth (Bi)-Total			98		%		75-125	10-NOV-05
Boron (B)-Total			105		%		75-125	10-NOV-05
Cadmium (Cd)-Total			96		%		75-125	10-NOV-05
Calcium (Ca)-Total			97		%		75-125	10-NOV-05
Cesium (Cs)-Total			99		%		75-125	10-NOV-05
Chromium (Cr)-Total			97		%		75-125	10-NOV-05
Cobalt (Co)-Total			97		%		75-125	10-NOV-05
Copper (Cu)-Total			97		%		75-125	10-NOV-05
Iron (Fe)-Total			97		%		75-125	10-NOV-05
Lead (Pb)-Total			99		%		75-125	10-NOV-05
Lithium (Li)-Total			95		%		75-125	10-NOV-05
Magnesium (Mg)-Total			98		%		75-125	10-NOV-05
Manganese (Mn)-Total			98		%		75-125	10-NOV-05
Molybdenum (Mo)-Total			97		%		75-125	10-NOV-05
Nickel (Ni)-Total			96		%		75-125	10-NOV-05
Phosphorus (P)-Total			97		%		75-125	10-NOV-05
Potassium (K)-Total			97		%		75-125	10-NOV-05
Rubidium (Rb)-Total			97		%		75-125	10-NOV-05
Selenium (Se)-Total			97		%		75-125	10-NOV-05
Silver (Ag)-Total			96		%		75-125	10-NOV-05
Sodium (Na)-Total			98		%		75-125	10-NOV-05
Strontium (Sr)-Total			97		%		75-125	10-NOV-05
Tellurium (Te)-Total			98		%		75-125	10-NOV-05
Thallium (Tl)-Total			100		%		75-125	10-NOV-05
Tin (Sn)-Total			96		%		75-125	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG377806-2 CVS								
Titanium (Ti)-Total			95		%		75-125	10-NOV-05
Tungsten (W)-Total			98		%		75-125	10-NOV-05
Uranium (U)-Total			98		%		75-125	10-NOV-05
Vanadium (V)-Total			96		%		75-125	10-NOV-05
Zinc (Zn)-Total			96		%		75-125	10-NOV-05
Zirconium (Zr)-Total			96		%		75-125	10-NOV-05
WG377806-3 CVS								
Aluminum (Al)-Total			95		%		75-125	10-NOV-05
Antimony (Sb)-Total			99		%		75-125	10-NOV-05
Arsenic (As)-Total			99		%		75-125	10-NOV-05
Barium (Ba)-Total			98		%		75-125	10-NOV-05
Beryllium (Be)-Total			96		%		75-125	10-NOV-05
Bismuth (Bi)-Total			97		%		75-125	10-NOV-05
Boron (B)-Total			96		%		75-125	10-NOV-05
Cadmium (Cd)-Total			98		%		75-125	10-NOV-05
Calcium (Ca)-Total			100		%		75-125	10-NOV-05
Cesium (Cs)-Total			96		%		75-125	10-NOV-05
Chromium (Cr)-Total			100		%		75-125	10-NOV-05
Cobalt (Co)-Total			99		%		75-125	10-NOV-05
Copper (Cu)-Total			97		%		75-125	10-NOV-05
Iron (Fe)-Total			99		%		75-125	10-NOV-05
Lead (Pb)-Total			100		%		75-125	10-NOV-05
Lithium (Li)-Total			97		%		75-125	10-NOV-05
Magnesium (Mg)-Total			99		%		75-125	10-NOV-05
Manganese (Mn)-Total			100		%		75-125	10-NOV-05
Molybdenum (Mo)-Total			99		%		75-125	10-NOV-05
Nickel (Ni)-Total			100		%		75-125	10-NOV-05
Phosphorus (P)-Total			99		%		75-125	10-NOV-05
Potassium (K)-Total			101		%		75-125	10-NOV-05
Rubidium (Rb)-Total			98		%		75-125	10-NOV-05
Selenium (Se)-Total			99		%		75-125	10-NOV-05
Silver (Ag)-Total			102		%		75-125	10-NOV-05
Sodium (Na)-Total			99		%		75-125	10-NOV-05
Strontium (Sr)-Total			100		%		75-125	10-NOV-05
Tellurium (Te)-Total			98		%		75-125	10-NOV-05
Thallium (Tl)-Total			98		%		75-125	10-NOV-05
Tin (Sn)-Total			97		%		75-125	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG377806-3 CVS								
Titanium (Ti)-Total			99		%		75-125	10-NOV-05
Tungsten (W)-Total			100		%		75-125	10-NOV-05
Uranium (U)-Total			107		%		75-125	10-NOV-05
Vanadium (V)-Total			100		%		75-125	10-NOV-05
Zinc (Zn)-Total			97		%		75-125	10-NOV-05
Zirconium (Zr)-Total			99		%		75-125	10-NOV-05
WG376937-4 DUP		**WG376937-3**						
Aluminum (Al)-Total		0.08	0.09	J	mg/L	0.01	0.061	10-NOV-05
Antimony (Sb)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Arsenic (As)-Total		0.0037	0.0039	J	mg/L	0.0002	0.0015	10-NOV-05
Barium (Ba)-Total		0.0070	0.0069		mg/L	1.2	15	10-NOV-05
Beryllium (Be)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Bismuth (Bi)-Total		0.0001	0.0001	J	mg/L	0.0000	0.00031	10-NOV-05
Boron (B)-Total		<0.03	<0.03	RPD-NA	mg/L	N/A	15	10-NOV-05
Cadmium (Cd)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Calcium (Ca)-Total		7.2	7.4		mg/L	2.1	15	10-NOV-05
Cesium (Cs)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Chromium (Cr)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Cobalt (Co)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Copper (Cu)-Total		<0.001	0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Iron (Fe)-Total		0.10	0.11	J	mg/L	0.00	0.15	10-NOV-05
Lead (Pb)-Total		<0.0005	<0.0005	RPD-NA	mg/L	N/A	15	10-NOV-05
Lithium (Li)-Total		<0.01	<0.01	RPD-NA	mg/L	N/A	15	10-NOV-05
Magnesium (Mg)-Total		1.94	1.97		mg/L	1.7	15	10-NOV-05
Manganese (Mn)-Total		0.0058	0.0060		mg/L	4.2	15	10-NOV-05
Molybdenum (Mo)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Nickel (Ni)-Total		<0.002	<0.002	RPD-NA	mg/L	N/A	15	10-NOV-05
Phosphorus (P)-Total		0.14	0.12	J	mg/L	0.01	0.15	10-NOV-05
Potassium (K)-Total		0.8	0.8	J	mg/L	0.0	0.31	10-NOV-05
Rubidium (Rb)-Total		0.0014	0.0015	J	mg/L	0.0001	0.00061	10-NOV-05
Selenium (Se)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Silver (Ag)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Sodium (Na)-Total		1.43	1.45		mg/L	1.4	15	10-NOV-05
Strontium (Sr)-Total		0.0202	0.0209		mg/L	3.7	15	10-NOV-05
Tellurium (Te)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Thallium (Tl)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Tin (Sn)-Total		<0.0006	<0.0006	RPD-NA	mg/L	N/A	15	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG376937-4 DUP		**WG376937-3**						
Titanium (Ti)-Total		0.0010	0.0013	J	mg/L	0.0002	0.0028	10-NOV-05
Tungsten (W)-Total		<0.0002	<0.0002	RPD-NA	mg/L	N/A	15	10-NOV-05
Uranium (U)-Total		<0.0001	<0.0001	RPD-NA	mg/L	N/A	15	10-NOV-05
Vanadium (V)-Total		<0.001	<0.001	RPD-NA	mg/L	N/A	15	10-NOV-05
Zinc (Zn)-Total		0.01	0.01	J	mg/L	0.00	0.031	10-NOV-05
Zirconium (Zr)-Total		0.0007	0.0005	J	mg/L	0.0002	0.0012	10-NOV-05
WG376937-2 LCS								
Aluminum (Al)-Total			106		%		80-120	10-NOV-05
Antimony (Sb)-Total			96		%		80-120	10-NOV-05
Arsenic (As)-Total			95		%		80-120	10-NOV-05
Barium (Ba)-Total			96		%		80-120	10-NOV-05
Beryllium (Be)-Total			93		%		80-120	10-NOV-05
Bismuth (Bi)-Total			97		%		80-120	10-NOV-05
Boron (B)-Total			98		%		80-120	10-NOV-05
Cadmium (Cd)-Total			93		%		89-112	10-NOV-05
Calcium (Ca)-Total			100		%		80-120	10-NOV-05
Cesium (Cs)-Total			98		%		80-120	10-NOV-05
Chromium (Cr)-Total			99		%		80-120	10-NOV-05
Cobalt (Co)-Total			99		%		80-120	10-NOV-05
Copper (Cu)-Total			100		%		92-121	10-NOV-05
Iron (Fe)-Total			99		%		80-120	10-NOV-05
Lead (Pb)-Total			99		%		91-117	10-NOV-05
Lithium (Li)-Total			89		%		80-120	10-NOV-05
Magnesium (Mg)-Total			100		%		92-120	10-NOV-05
Manganese (Mn)-Total			99		%		80-120	10-NOV-05
Molybdenum (Mo)-Total			97		%		80-120	10-NOV-05
Nickel (Ni)-Total			101		%		80-120	10-NOV-05
Phosphorus (P)-Total			126		%		73-127	10-NOV-05
Potassium (K)-Total			97		%		80-120	10-NOV-05
Rubidium (Rb)-Total			98		%		80-120	10-NOV-05
Selenium (Se)-Total			91		%		80-120	10-NOV-05
Silver (Ag)-Total			92		%		80-120	10-NOV-05
Sodium (Na)-Total			102		%		80-120	10-NOV-05
Strontium (Sr)-Total			98		%		80-120	10-NOV-05
Tellurium (Te)-Total			91		%		80-120	10-NOV-05
Thallium (Tl)-Total			98		%		80-120	10-NOV-05
Tin (Sn)-Total			97		%		80-120	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG376937-2 LCS								
Titanium (Ti)-Total			95		%		80-120	10-NOV-05
Tungsten (W)-Total			97		%		80-120	10-NOV-05
Uranium (U)-Total			98		%		80-120	10-NOV-05
Vanadium (V)-Total			98		%		80-120	10-NOV-05
Zinc (Zn)-Total			96		%		83-126	10-NOV-05
Zirconium (Zr)-Total			96		%		80-120	10-NOV-05
WG376937-1 MB								
Aluminum (Al)-Total			<0.02		mg/L		0.1	10-NOV-05
Antimony (Sb)-Total			<0.001		mg/L		0.005	10-NOV-05
Arsenic (As)-Total			<0.0005		mg/L		0.0025	10-NOV-05
Barium (Ba)-Total			<0.0003		mg/L		0.0015	10-NOV-05
Beryllium (Be)-Total			<0.001		mg/L		0.005	10-NOV-05
Bismuth (Bi)-Total			<0.0001		mg/L		0.0005	10-NOV-05
Boron (B)-Total			<0.03		mg/L		0.15	10-NOV-05
Cadmium (Cd)-Total			<0.0002		mg/L		0.001	10-NOV-05
Calcium (Ca)-Total			<0.1		mg/L		0.5	10-NOV-05
Cesium (Cs)-Total			<0.0001		mg/L		0.0005	10-NOV-05
Chromium (Cr)-Total			<0.001		mg/L		0.005	10-NOV-05
Cobalt (Co)-Total			<0.0002		mg/L		0.001	10-NOV-05
Copper (Cu)-Total			<0.001		mg/L		0.005	10-NOV-05
Iron (Fe)-Total			<0.05		mg/L		0.25	10-NOV-05
Lead (Pb)-Total			<0.0005		mg/L		0.0025	10-NOV-05
Lithium (Li)-Total			<0.01		mg/L		0.05	10-NOV-05
Magnesium (Mg)-Total			<0.01		mg/L		0.05	10-NOV-05
Manganese (Mn)-Total			<0.0003		mg/L		0.0015	10-NOV-05
Molybdenum (Mo)-Total			<0.0002		mg/L		0.001	10-NOV-05
Nickel (Ni)-Total			<0.002		mg/L		0.01	10-NOV-05
Phosphorus (P)-Total			<0.05		mg/L		0.25	10-NOV-05
Potassium (K)-Total			<0.1		mg/L		0.5	10-NOV-05
Rubidium (Rb)-Total			<0.0002		mg/L		0.001	10-NOV-05
Selenium (Se)-Total			<0.001		mg/L		0.005	10-NOV-05
Silver (Ag)-Total			<0.001		mg/L		0.005	10-NOV-05
Sodium (Na)-Total			<0.03		mg/L		0.15	10-NOV-05
Strontium (Sr)-Total			<0.0001		mg/L		0.0005	10-NOV-05
Tellurium (Te)-Total			<0.001		mg/L		0.005	10-NOV-05
Thallium (Tl)-Total			<0.0001		mg/L		0.0005	10-NOV-05
Tin (Sn)-Total			<0.0006		mg/L		0.003	10-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SCAN-TOT-LOW-WP	**Water**							
Batch R345886								
WG376937-1 MB								
Titanium (Ti)-Total			<0.0009		mg/L		0.0045	10-NOV-05
Tungsten (W)-Total			<0.0002		mg/L		0.001	10-NOV-05
Uranium (U)-Total			<0.0001		mg/L		0.0005	10-NOV-05
Vanadium (V)-Total			<0.001		mg/L		0.005	10-NOV-05
Zinc (Zn)-Total			<0.01		mg/L		0.05	10-NOV-05
Zirconium (Zr)-Total			<0.0004		mg/L		0.002	10-NOV-05
N-TOTKJ-WP	**Water**							
Batch R346542								
WG378469-2 CCV								
Total Kjeldahl Nitrogen			102		%		93-107	15-NOV-05
WG378469-1 CVS								
Total Kjeldahl Nitrogen			101		%		93-107	15-NOV-05
WG376780-5 DUP		**WG376780-4**						
Total Kjeldahl Nitrogen		2.7	2.7		mg/L	0.73	20	15-NOV-05
WG376780-2 LCS								
Total Kjeldahl Nitrogen			99		%		79-115	15-NOV-05
WG376780-1 MB								
Total Kjeldahl Nitrogen			<0.2		mg/L		0.2	15-NOV-05
WG376780-3 MS		**L339266-12**						
Total Kjeldahl Nitrogen			102	E	%		79-115	15-NOV-05
N2N3-DIS-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Nitrate+Nitrite-N - Dissolved			97		%		93-107	07-NOV-05
WG375512-2 CVS								
Nitrate+Nitrite-N - Dissolved			105		%		93-107	07-NOV-05
WG375150-1 MB								
Nitrate+Nitrite-N - Dissolved			0.02		mg/L		0.05	07-NOV-05
N2N3-SOL-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Nitrate+Nitrite-N			97		%		93-107	07-NOV-05
WG375512-2 CVS								
Nitrate+Nitrite-N			105		%		93-107	07-NOV-05
WG375512-5 DUP		**WG375512-4**						
Nitrate+Nitrite-N		0.50	0.50		mg/L	0.078	15	07-NOV-05
WG375512-1 MB								
Nitrate+Nitrite-N			0.02		mg/L		0.05	07-NOV-05
IH3-DIS-WP	**Water**							

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-DIS-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Ammonia (NH3) - Dissolved			100		%		93-107	07-NOV-05
WG375512-2 CVS								
Ammonia (NH3) - Dissolved			98		%		93-107	07-NOV-05
WG375150-1 MB								
Ammonia (NH3) - Dissolved			<0.01		mg/L		0.01	07-NOV-05
P-TOTAL-WP	**Water**							
Batch R345178								
WG376628-1 CCV								
Total Phosphorous			103		%		93-107	10-NOV-05
WG376628-2 CCV								
Total Phosphorous			99		%		93-107	10-NOV-05
WG376427-2 CVS								
Total Phosphorous			101		%		93-107	10-NOV-05
WG376427-3 CVS								
Total Phosphorous			94		%		93-107	10-NOV-05
WG376427-4 DUP		**L338005-1**						
Total Phosphorous		0.363	0.338		mg/L	7.1	17	10-NOV-05
WG376427-1 MB								
Total Phosphorous			0.005		mg/L		0.005	10-NOV-05
WG376427-5 MS		**L338009-3**						
Total Phosphorous			103		%		84-114	10-NOV-05
PH-WP	**Water**							
Batch R344056								
WG375519-4 CCV								
PH			100		%		93-107	07-NOV-05
WG375519-3 CVS								
PH			101		%		97-103	07-NOV-05
WG375519-6 DUP		**L338009-2**						
PH		7.41	7.45		pH units	0.45	3.8	07-NOV-05
WG375519-7 DUP		**L338046-1**						
PH		7.05	7.06		pH units	0.20	3.8	07-NOV-05
Batch R344368								
WG375934-4 CCV								
PH			100		%		93-107	08-NOV-05
WG375934-3 CVS								
PH			101		%		97-103	08-NOV-05
WG375934-6 DUP		**L338009-1**						
PH		7.32	7.35		pH units	0.35	3.8	08-NOV-05
;O4-DIS-WP	**Water**							

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-DIS-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Sulphate (SO4) - Dissolved			100		%		93-107	07-NOV-05
WG375512-2 CVS								
Sulphate (SO4) - Dissolved			98		%		93-107	07-NOV-05
WG375150-1 MB								
Sulphate (SO4) - Dissolved			<9		mg/L		9	07-NOV-05
Batch R344388								
WG375888-3 CCV								
Sulphate (SO4) - Dissolved			100		%		93-107	08-NOV-05
WG375888-2 CVS								
Sulphate (SO4) - Dissolved			100		%		93-107	08-NOV-05
SO4-SOL-WP	**Water**							
Batch R344055								
WG375512-3 CCV								
Sulphate (SO4) - Soluble			100		%		93-107	07-NOV-05
WG375512-2 CVS								
Sulphate (SO4) - Soluble			98		%		93-107	07-NOV-05
WG375512-5 DUP		**WG375512-4**						
Sulphate (SO4) - Soluble		133	132		mg/L	0.24	15	07-NOV-05
WG375512-1 MB								
Sulphate (SO4) - Soluble			<9		mg/L		9	07-NOV-05
Batch R344388								
WG375888-3 CCV								
Sulphate (SO4) - Soluble			100		%		93-107	08-NOV-05
WG375888-2 CVS								
Sulphate (SO4) - Soluble			100		%		93-107	08-NOV-05
WG375888-5 DUP		**WG375888-4**						
Sulphate (SO4) - Soluble		126	126		mg/L	0.73	15	08-NOV-05
WG375888-1 MB								
Sulphate (SO4) - Soluble			<9		mg/L		9	08-NOV-05
SOLIDS-TDS-WP	**Water**							
Batch R344261								
WG375047-3 CVS								
Total Dissolved Solids			100		%		96-104	07-NOV-05
WG375047-4 CVS								
Total Dissolved Solids			101		%		96-104	07-NOV-05
WG375047-6 DUP		**L338024-1**						
Total Dissolved Solids		1500	1500		mg/L	0.81	7.7	07-NOV-05
WG375047-1 MB								
Total Dissolved Solids			<5		mg/L		5	07-NOV-05
WG375047-2 MB								
Total Dissolved Solids			<5		mg/L		5	07-NOV-05

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SOLIDS-TOT-WP	**Water**							
Batch R344261								
WG375047-6 DUP		**L338024-1**						
Total Solids		2000	2000		mg/L	0.099	20	07-NOV-05
WG375047-1 MB								
Total Solids			<5		mg/L		5	07-NOV-05
WG375047-2 MB								
Total Solids			<5		mg/L		5	07-NOV-05
SOLIDS-TOTSUS-WP	**Water**							
Batch R344261								
WG375047-3 CVS								
Total Suspended Solids			102		%		86-108	07-NOV-05
WG375047-4 CVS								
Total Suspended Solids			100		%		86-108	07-NOV-05
WG375047-5 DUP		**L337755-1**						
Total Suspended Solids		71	73		mg/L	2.8	15	07-NOV-05
WG375047-6 DUP		**L338024-1**						
Total Suspended Solids		420	420		mg/L	0.95	15	07-NOV-05
WG375047-1 MB								
Total Suspended Solids			<5		mg/L		5	07-NOV-05
WG375047-2 MB								
Total Suspended Solids			<5		mg/L		5	07-NOV-05
TEH-WP	**Water**							
Batch R344530								
WG376129-2 CCV								
TEH (C11-C30)			103		%		70-130	09-NOV-05
WG376129-1 CVS								
TEH (C11-C30)			97		%		87-129	09-NOV-05
WG375661-2 LCS								
TEH (C11-C30)			135	H	%		73-131	09-NOV-05
WG375661-1 MB								
TEH (C11-C30)			<0.1		mg/L		0.1	09-NOV-05
TURBIDITY-WP	**Water**							
Batch R343905								
WG375328-2 CCV								
Turbidity			101		%		97-103	07-NOV-05
WG375328-1 CVS								
Turbidity			101		%		93-107	07-NOV-05
WG375328-4 DUP		**L338009-2**						
Turbidity		70	70		NTU	0.0	15	07-NOV-05
WG375328-3 MB								
Turbidity			<0.05		NTU		0.05	07-NOV-05
TVH-WP	**Water**							

Enviro-Test Quality Control Report

Workorder: L338009

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TVH-WP	**Water**							
Batch R344763								
WG376384-1 CCV								
Total Volatiles			97		%		87-113	08-NOV-05
WG376384-2 CCV								
Total Volatiles			102		%		87-113	08-NOV-05
WG376384-3 CVS								
Total Volatiles			97		%		87-113	08-NOV-05
WG376350-3 DUP		**L338009-4**						
Total Volatiles		<0.1	<0.1	RPD-NA	mg/L	N/A	12	08-NOV-05
WG376350-1 MB								
Total Volatiles			<0.1		mg/L		0.1	08-NOV-05
WG376350-2 MS		**L338009-5**						
Total Volatiles			90		%		80-120	08-NOV-05

ENVIRO-TEST QC REPORT

Workorder # L338009

Legend:

Limit	95% Confidence Interval (Laboratory Warning Limits)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Qualifier:

RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.
A	Method blank exceeds acceptance limit. Blank correction not applied, unless the qualifier "RAMB" (result adjusted for method blank) appears in the Analytical Report.
B	Method blank result exceeds acceptance limit, however, it is less than 5% of sample concentration. Blank correction not applied.
E	Matrix spike recovery may fall outside the acceptance limits due to high sample background.
F	Silver recovery low, likely due to elevated chloride levels in sample.
G	Outlier - No assignable cause for nonconformity has been determined.
H	Result falls within the 99% Confidence Interval (Laboratory Control Limits)
J	Duplicate results and limit(s) are expressed in terms of absolute difference.
K	The sample referenced above is of a non-standard matrix type; standard QC acceptance criteria may not be achievable.

ETL Enviro-Test MTC

Manitoba Technology Centre Ltd.

CHAIN OF CUSTODY
ANALYTICAL REQUEST FORM

45 Logan Avenue, Winnipeg, Manitoba R3E 3L5 — Telephone: (204) 945-3705 — Fax: (204) 945-0763
9936 - 67th Avenue, Edmonton, Alberta T6E 3L5 — Telephone: (780) 413-5227 — Fax: (780) 437-2311
Edmonton Toll Free Line — Telephone: 1-800-668-9878 — Fax: 1-800-286-7319
#313 - 44 Avenue N.E., Calgary, Alberta T2E 6L5 — Telephone: (403) 291-9897 — Fax: (403) 291-0298
General Purpose Bldg., 124 Veterinary Road, Saskatoon, Sask. S7N 5E3 — Telephone: (306) 668-8370 — Fax: (306) 668-8383
1081 Barton Street, Thunder Bay, Ontario P7B 5N3 — Telephone: (807) 623-6463 — Fax: (807) 623-7598

DATE SUBMITTED: 2005 11 04 DATE REQUIRED:

SERVICE REQUESTED:
☑ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE)

PRICING (CHECK ONE):
AS PER QUOTE #: Q11674 ☒
AS PER LIST PRICE: ☐

ANALYSIS REQUESTED:

L338009

SAMPLE ID	SAMPLED BY	DATE / TIME SAMPLED	SAMPLE TYPE	TEST 79	TPH	TEH	ROUTINE WATER	TOTAL METALS										SAMPLE RECEIVED (Y OR N)	SAMPLE BROKEN (Y OR N)	LAB SAMPLE NO.
MW 401	AA	2005 11 04	WATER				X	X												
MW 402	↓	↓	↓	X	X	X	X	X												
MW 403				X	X	X	X	X												
MW 405				X	X	X	X	X												
MW 406				X	X	X	X	X												
MW 999				X	X	X	X	X												
							X	X												
			PRESERVED / FILTERED					X												

NOTES & CONDITIONS:

1. Quote number must be provided to ensure proper pricing.
2. All hazardous samples submitted must be labeled to comply with WHMIS regulations. This must include the nature of the hazard, as well as a contact name and phone number that the lab can contact for further information.
3. ETL's liability limited to cost of analysis.

NOTE: Failure to properly complete all portions of this form may delay analysis.

***NOTE:* Shaded areas MUST be completed in full by client for sample processing to occur.**

CLIENT: UMA

CONTACT: PETER BONONOS

REPORT ADDRESS: 1479 BUFFALO
PL WINNIPEG

BILLING ADDRESS:

NO. SAMPLES SUBMITTED:

NO. BOTTLES/SAMPLES:

PHONE: 204 284 0580

FAX:

E-MAIL: YES ☒ NO ☐

E-MAIL ADDRESS: PETER.BONONOS@UMA.AECOM.COM

P.O. NO.:

JOB NO.:

RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME
AA	DATE 2005 11 04 TIME 1:30PM	[signature] ETL LAB:	DATE 07 Nov 05 TIME 8:00
RELINQUISHED BY:	DATE TIME	RECEIVED BY: ETL LAB:	DATE TIME

SAMPLE CONDITION UPON RECEIPT: ☑ ACCEPTABLE ☐ NON ACCEPTABLE

FROZEN: ______ COLD: ______ AMBIENT: ______

OTHER (*BREAKAGE, LEAKAGE, ETC.*):

WHITE - File Copy
GREEN - Final Report
PINK - Invoicing
BLUE - Client Support
YELLOW - Customer

LGD of Mystery Lake Waste Geotechnical and Topographic Investigation for the Waste Disposal Ground, JR Cousin Consultants Ltd., 2011

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P&R 14.31 JRCC

M-617.01

LGD of MYSTERY LAKE

Geotechnical and Topographic Investigation for the Waste Disposal Ground

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: June 8/11

PROVINCE OF MANITOBA
G. R. COUSIN
11/06/08
REGISTERED PROFESSIONAL ENGINEER

Prepared by: J. R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

June 2011

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. J. R. Cousin Consultants Ltd. (JRCC) wishes to thank the LGD of Mystery Lake who assisted with organization and onsite works.

REMARKS

Conclusions reached in this report are based upon the generalization of data available to us at the time of forming our opinions. Information in this document may rely on previous studies, investigative work and data by others. JRCC cannot be responsible for actual site conditions proved to be at variance with any generalized data. This report was completed in accordance with generally accepted professional engineering principles and practice. Any use of this report by a third party is the responsibility of the third party, JRCC accepts no responsibility for third party decisions or actions based on the report. No other warranty or guarantee expressed, implied or statutory is made.

TABLE OF CONTENTS

1.0 INTRODUCTION

J. R. Cousin Consultants Ltd. (JRCC) conducted a geotechnical investigation for the Waste Disposal Ground (WDG) Expansion at the LGD of Mystery Lake. The LGD of Mystery Lake existing WDG is located on Part NW ¼ 18, S ½ and NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM, approximately 4 km south of the City of Thompson. The WDG services the LGD of Mystery Lake, the City of Thompson, the Town of Churchill and the Wuskawatim Generating Station. However, the Town of Churchill and the Wuskawatim Generating Station area scheduled to discontinue use of the WDG in the near future.

A total of thirteen test holes were drilled at the WDG site. Test hole locations are shown on Plan 1 attached in the Appendix. The test holes were drilled to determine suitability of the insitu soils for use as a clay landfill liner and clay leachate pond liner.

This report outlines the findings of the geotechnical investigation at the WDG site and evaluates the soils to determine their suitability for use as a landfill liner. The report also identifies potential difficulties (i.e. depth to bedrock, soil types and subsurface water elevations) associated with construction.

2.0 BACKGROUND

The existing WDG is nearing capacity and requires expansion. The LGD of Mystery Lake intends to construct a lined expansion cell to the west of the municipal waste disposal area during Phase I and lined expansions to the north and east during future phases. A lined leachate collection pond will be constructed as part of the Phase I works. An upgraded burn area, soil remediation area and other various storage compounds will be constructed as part of future works.

The geotechnical investigation was required to evaluate potential use of insitu and re-worked soils as a clay landfill or leachate pond liner and for use in cell dike construction. Hydraulic conductivity tests were performed on Shelby tube samples to assess whether the insitu soils comply with the Manitoba Conservation criteria of $1x10^{-7}$ cm/sec or less for a landfill liner.

A previous geotechnical and topographic investigation was completed by AECOM in 2005. Eight test holes were drilled around the perimeter of the WDG and three holes were drilled within the former waste cells to determine the depth of waste. Shelby tube samples and laboratory analysis of the soils was not completed and therefore it is unknown if the soils could achieve a hydraulic conductivity of 1×10^{-7} cm/s insitu or when re-worked.

3.0 TOPOGRAPHIC INVESTIGATION

The onsite topographic survey was completed on April 14, 2011. The existing WDG and the areas for the proposed cell expansion and leachate pond area were surveyed with a GPS Total Station.

The survey found that the top of the existing former and current waste disposal area slopes from an elevation of approximately 219.0 m in the east to 215.0 m in the west at a grade of approximately2.0 % - 5.0%. The existing ground surrounding the WDG is approximately 4 m - 6 m lower than the top of waste and slopes to the southwest. The leachate pond area is relatively flat at an elevation of approximately 209.0 m. There is a rock outcrop east of the former and current waste disposal area which slopes up to a maximum elevation of approximately 225.0 m towards PTH 6.

Contour lines from the topographic survey are shown on Plan 2 attached in the Appendix.

4.0 GEOTECHNICAL FIELD INVESTIGATION

The onsite investigation at the LGD of Mystery Lake was conducted on April 13, 2011. Maple Leaf Drilling Ltd. was employed to complete the test holes utilizing a DR150 track mounted drill rig under direct supervision by JRCC's field representative.

A total of thirteen test holes were drilled during the investigation. Three test holes were drilled in the leachate pond area (TH1 – TH3), three test holes were drilled in the Phase I expansion cell area (TH4 – TH 6), four test holes were drilled in the areas for future expansion (TH7 - TH10) and three test holes were drilled through the former waste disposal areas (TH11 – TH13). All test holes were drilled to a depth of 6.0 m with the exception of TH11, which was dug to a depth of 2.0 m.

4.1 WDG Site

The subsurface soil profile within each test hole was logged, water conditions were noted and representative soil samples were taken as the soils varied along the profile. The samples were visually field-classified. Eight selected bagged samples from the test holes were sealed and submitted to National Testing Laboratories Ltd. for testing and analysis, along with three Shelby tube samples for hydraulic conductivity testing. Details of the laboratory analysis are provided in Section 5.0. Following drilling, the depth of standing water was measured and any caving of the holes was determined. Test holes were backfilled with bentonite and the excavated soils upon termination of drilling. Test hole locations are shown on Plan 1 attached in the Appendix.

4.1.1 Soil Profile

The test holes taken across the site were fairly consistent with slight variations in the layer thicknesses and amount of silt in each layer. Bedrock was not encountered in any of the test holes. Details of the test holes can be found in the soils logs attached in the Appendix.

<u>Leachate Pond Area</u>
The soil profile observed in the test holes taken in the leachate pond area (TH1 – TH3) consisted of a surficial peat layer an average of 0.4 m thick, followed by a light brown

high plastic clay layer an average of 3.3 m thick, followed by a grey low-medium plastic clay layer with some silt lenses an average of 2.3 m thick.

Phase I Expansion Cell Area

The soil profile observed in the test holes taken in the Phase I cell expansion area (TH4 – TH6) consisted of a surficial peat layer an average of 0.4 m thick, followed by a brown high plastic clay layer an average of 3.0 m thick, followed by a grey high plastic clay layer with a trace of silt an average of 2.6 m thick.

Future Phase Expansion Cell Areas

The soil profile observed in the test holes taken in the proposed future phases of cell expansion (TH7 – TH10) consisted of a surficial peat layer an average of 0.4 m thick, followed by a brown high plastic clay layer an average of 3.0 m thick, followed by a grey low-medium plastic clay layer with silt lenses an average of 2.6 m thick.

Existing Waste

Test holes were taken in the existing waste to determine the depth of waste and to evaluate the soils serving as the existing landfill liner. TH11 was drilled to a depth of 2.0 m to determine if the area at the south end of the WDG was formerly used for waste disposal.

The soil profile observed in the test holes taken in the former waste disposal areas to a depth of 6.0 m (TH12 and TH13) consisted of an approximately 0.15 m thick soil cover layer followed by garbage an average of 4.6 m thick, and finally a brown high plastic clay layer with a trace of silt, observed to be at least 1.2 m thick.

4.1.2 Groundwater

Short-term groundwater conditions were assessed in each test hole by observing standing water in the test holes prior to backfilling the holes. No standing water was observed in the test holes with the exception of TH1 and TH2, taken in the leachate pond area. The infiltrating water was caused by standing water on the ground surface around the test holes which flowed into the holes.

TH6 was left open for 4 hours to allow for longer-term water infiltration to occur. After the elapsed time, no standing water was observed in the hole. Caving of the hole was observed at approximately 3.6 m.

Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. The test holes were taken during a period of snow melt which may have contributed to the standing water observed on the ground surface in the leachate pond area. Other assumptions relating to the groundwater elevation cannot be made at this time as water levels will normally fluctuate seasonally.

Contractors will be made aware of the geotechnical conditions encountered onsite, as some dewatering of the ground surface may be required during construction.

5.0 LABORATORY TESTING, ANALYSIS AND DISCUSSION

5.1 Laboratory Analysis

Two representative soil samples from the leachate pond area, two samples from the proposed Phase I cell expansion area, two samples from the future expansion areas and two samples from the clay layer beneath the existing waste were submitted to National Testing Laboratories Ltd. on April 21, 2011, for analysis and a professional assessment. The analysis included the determination of the following:

- Moisture Content (ASTM D2216)
- Atterberg Limits (plastic limit, liquid limit, and plasticity index, ASTM D4318)
- Soil Classification (ASTM D2487)
- Particle Size Analysis (Hydrometer test, ASTM D422)
- Hydraulic Conductivity (ASTM D2435)

The WDG soils were analyzed to determine their suitability as a re-worked or insitu liner for a WDG cell or leachate pond, which requires a hydraulic conductivity of 1 x 10^{-7} cm/sec or less.

The laboratory analysis of the soils indicated that they are low to high plastic clay soils with a trace of silt. The overall Plasticity Index of the samples varied between 18 and 43 and the percentage of clay from 85.5% to 96.4%. Based on past experience, the laboratory has commented that homogeneous soils with a plasticity index greater than 25 and a clay content greater than 50% would typically be expected to have a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. Plasticity index analysis (i.e. Atterberg limits) of the soils indicated that all of the soil samples submitted were considered suitable for use as an insitu clay liner or when re-worked and re-compacted with the exception of TH8 from 3.9 – 6.0 m, which had a Plasticity Index of 18 and clay content of 85.5%.

The results indicate that the suitability of the soils for a clay liner is dependent upon the soils being homogeneous with no preferential flow paths. These preferential flow paths can be caused by lenses of unsuitable material, rocks or boulders or fissures in the soil.

Three Shelby tube samples (TH3 1.5 – 2.1 m, TH6 3.0 – 3.6 m, and TH8 3.0 – 3.6 m) were submitted to determine the insitu hydraulic conductivity, to determine the potential use as a WDG or leachate pond liner. Note that the Shelby tube sample from TH8 was taken in the layer of high plastic clay existing above the unfavourable clay layer which starts approximately 3.9 m from the ground surface. The samples achieved hydraulic conductivities of 8.9×10^{-9} cm/sec, 1.4×10^{-8} cm/sec and 9.9×10^{-9} cm/sec, respectively which are less than the required 1×10^{-7} cm/sec for a clay lined cell. Therefore the soils would likely be suitable for a clay lined cell in an insitu state.

Details of National Testing Laboratories test results and analysis, dated May 27, 2011 are attached in the Appendix.

6.0 WDG CELL LINER REQUIREMENTS

6.1 Current Guidelines

Manitoba Conservation guidelines require that a standard WDG cell and leachate pond clay liner be 1.0 metre in thickness and have a hydraulic conductivity (i.e. the potential rate of fluid movement through the soil) of 1×10^{-7} cm/sec or less. This low rate is to protect the underlying groundwater and surrounding lands from leachate seepage. Generally, the higher a soil's plasticity the more likely a soil can achieve a hydraulic conductivity of 1×10^{-7} cm/sec.

6.2 Typical Clay Liner Construction Options

The insitu (undisturbed) soils can be used to construct the liner of a WDG cell or leachate pond if the soils can consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec or less in their insitu state.

If the insitu soils cannot be used, the liner can be constructed by excavating and re-compacting suitable high plastic clay soils to form the liner.

If the clay content of the soils is so low that even when excavated and re-compacted, the soils cannot consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec, a liner constructed of high plastic clay from a borrow pit, or a synthetic geomembrane liner would be required.

6.3 Liner for the LGD of Mystery Lake WDG

The following are the typical options for lining a WDG cell and leachate pond including using the insitu soil if it can achieve a hydraulic conductivity of 1×10^{-7} cm/sec, re-working and re-compacting the existing soil, to achieve a hydraulic conductivity of 1×10^{-7} cm/sec, or utilizing a synthetic geomembrane liner.

6.3.1 Insitu Soil

Based on the geotechnical investigation and laboratory analysis the soils in the leachate pond area from 0.4 m to 3.7 m below ground are suitable for use as an insitu clay liner. The soils in the Phase I expansion area from 0.4 – at least 6.0 m below ground are suitable for use as an insitu clay liner. The soils from the area for future cell expansion are suitable for an insitu clay liner from 0.3 – 3.4 m below ground.

In this option the vertical cutoff walls in the WDG perimeter dikes and the leachate pond dikes would be made of re-worked and re-compacted clay soils extended a minimum of 1.0 m into the insitu clay horizontal liner.

Using the insitu clay for the horizontal bottom liner in the leachate pond area, the Phase I expansion area and the future expansion area would be possible, provided that the soils are uniform throughout the proposed construction sites and no preferential flow paths exist.

If some unsuitable soils or boulders are encountered during excavation of the cells, they need to be removed and replaced with re-worked medium to high plastic clay from a borrow site or from previously excavated material.

6.3.2 Re-Worked Soil

The WDG cell and leachate pond liner could be constructed by re-working and re-compacting the insitu soils to form the bottom liner and vertical cut-off walls in the WDG cell and leachate pond dikes.

This option would provide a lower hydraulic conductivity in the horizontal layer and reduce the risk of not meeting the Manitoba Conservation guideline of a hydraulic conductivity of 1 x 10^{-7} cm/sec or less in the liner. However, this would add significant cost to the project and based on the Shelby tube samples taken at the site, the insitu hydraulic conductivity meets the guidelines and re-compaction of the bottom liner is not necessary.

If during final design, the insitu clay liner in the leachate pond extends below 3.7 m or the insitu liner in the future expansion cell area extends below 3.4 m, a re-worked and re-compacted horizontal liner may be required in those areas.

6.3.3 Geomembrane Liner

The WDG liner could be constructed with a synthetic geomembrane liner, using insitu soils as the bedding material for the liner and sand from a borrow pit used as a liner cover. The cost of installing a geomembrane liner would be significantly greater than utilizing a clay liner and unnecessary based on the laboratory test results of the insitu clay.

6.3.4 Liner Under the Existing Waste

Laboratory analysis of the bagged samples from the clay liner beneath the existing waste found an average plasticity index of 41 and average clay content of 91.3% and a similar soil structure to the samples which did have an insitu hydraulic conductivity of less than 1×10^{-7} cm/sec. Based on these results, it is likely that the clay liner under the existing waste does meet the Manitoba Conservation guideline for a WDG liner.

Shelby tube samples could not be completed in the layer and therefore insitu hydraulic conductivity testing could not be completed.

6.3.5 Summary

An insitu clay liner can be utilized in design of the leachate pond, Phase I expansion cell and future expansion cells. If unsuitable soils are encountered, specifications will indicate they will be replaced with high plastic clay borrow material. An insitu liner likely exists under the existing waste disposal areas, however this was not confirmed with insitu hydraulic conductivity testing.

7.0 SUMMARY, RECOMMENDATIONS AND CLOSURE

7.1 Summary

The topography of the WDG was surveyed and found that the top of the existing former and current waste disposal area slopes from east to west. The existing ground surrounding the WDG is approximately 4.0 – 6.0 m lower than the top of waste and slopes to the southwest. There is a rock outcrop east of the former and current waste disposal area which slopes up towards PTH 6.

Soils at the existing WDG were investigated by JRCC. Representative soil samples were analyzed by National Testing Laboratories Ltd. to determine their suitability for a clay liner. Based on the geotechnical investigation and laboratory analysis, all of the soils tested are suitable for construction of an insitu clay liner in accordance with Manitoba Conservation guidelines with the exception of TH8 (3.9 – 6.0 m).

It is not unusual to encounter differing soil types across a large area when constructing a liner for a WDG cell. If the soil type from TH8 (3.9 – 6.0 m) is encountered elsewhere at the WDG specifications will indicate they will be replaced with high plastic clay borrow soil and re-compacted to achieve the required hydraulic conductivity.

If the insitu soils were re-worked and compacted, they would also meet the Manitoba Conservation guideline of 1×10^{-7} cm/sec, however, this option would be significantly more costly than utilizing an insitu liner.

The vertical cutoff walls in the WDG perimeter dikes and the leachate pond dikes would have to be made of re-worked and re-compacted clay soils extended a minimum of 1.0 m into the insitu clay horizontal liner.

Bagged samples taken in the layer below the existing waste suggest that the existing liner likely meets the Manitoba Conservation guideline of 1 x 10^{-7} cm/sec. Shelby tube samples were not taken in the clay layer and therefore insitu hydraulic conductivity testing could not be completed.

No water infiltration was observed in the test holes, with the exception of TH1 and TH2 in the leachate pond area which had standing water at the ground surface. Contractors will have to be made aware of these conditions prior to construction, however water levels can vary seasonally.

7.2 Recommendations

It is recommended that an insitu clay horizontal bottom layer be used for the leachate pond area between 0.4 – 3.7 m below ground, the Phase I expansion cell area between 0.4 – 6.0 m below ground and in the future expansion area between 0.4 – 3.4 m below ground. If unsuitable material such as the soil found in TH8 (3.9 – 6.0 m) is encountered during WDG liner or leachate pond liner construction, specifications will indicate that it will be replaced with high plastic clay borrow material. It is recommended the vertical cut-off walls be constructed of re-worked and re-compacted clay and extended a minimum of 1.0 m into the insitu clay layer.

7.3 Closure

The conclusions and recommendations in this report are based on the results of the site investigation and laboratory analysis. In addition, soil and groundwater conditions between test hole locations were generalized to provide an overall assessment of the geotechnical site conditions. If conditions that appear different from those encountered at the test hole locations as described in this report, or if the assumptions stated herein are not in agreement with the design, JRCC should be informed in order that the recommendations can be reviewed and adjusted as required.

The site investigation was conducted for the purpose of identifying geotechnical conditions at the potential expansion cell sites and leachate pond site. Although no environmental issues were identified during the site investigation, it does not necessarily follow that such issues do not exist. If the client or any other parties have any environmental concerns regarding the proposed site and works, an appropriate environmental assessment must be conducted.

It is not uncommon for soil conditions to be highly variable across a site. Previous construction activities and placement of fill at a site can augment the variability of soil conditions, especially surficial soil conditions. A contingency must be included in any construction budget to allow for potential variations in soil conditions, which may result in modification of the design and construction procedures.

APPENDIX

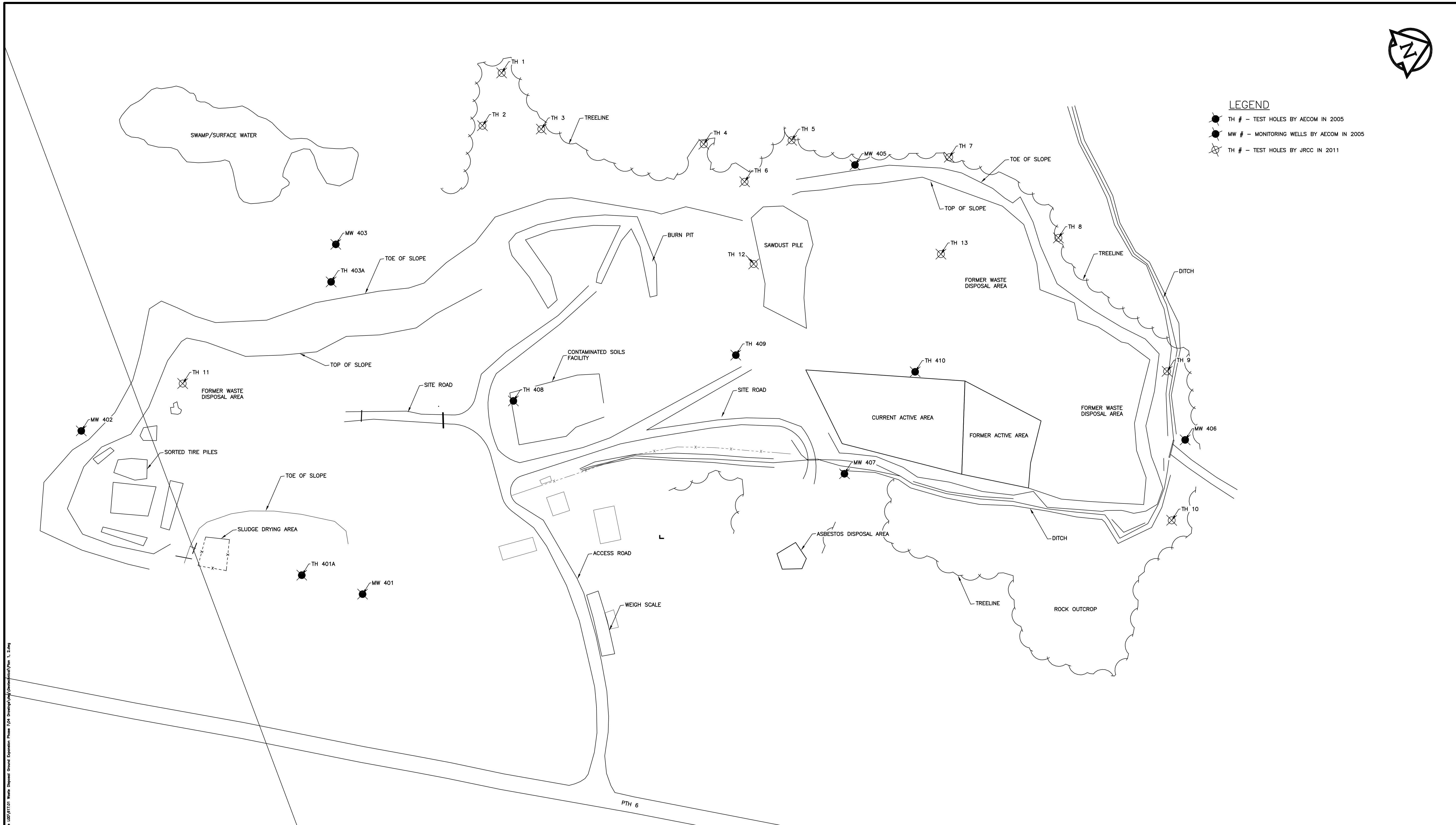
Plan 1: Test Hole Location Plan

Plan 2: Topographic Survey Plan with Contour Lines

Test Hole Logs

National Testing Laboratories Ltd. Test Results

Plans



No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM STAMP

ENGINEER'S SEAL

PRELIMINARY

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND

CODE: M-617.01

TITLE: TEST HOLE LOCATION PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/06/08	1	1 of 2

SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM STAMP

ENGINEER'S SEAL

PRELIMINARY

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND

CODE: M-617.01

TITLE: TOPOGRAPHIC SURVEY PLAN WITH CONTOUR LINES

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/06/08	2	2 of 2

Test Hole Logs

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX

GW. : Well graded gravels and gravel sand mixtures, little or no fines

GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines

GM. : Silty gravels, gravel-sand-silt mixtures

GC. : Clayey gravels, gravel-sand-clay mixtures

SW. : Well graded sands, gravelly sands, little or no fines

SP. : Poorly graded sands, or gravelly sands, little or no fines

SM. : Silty sands, sand-silt mixtures

SC. : Clayey sands, sand-clay mixtures

ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity

CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays

OL. : Organic silts and organic silty clays of low plasticity

CI. : Inorganic clays of medium or intermediate plasticity

MH. : Inorganic silts, fine sandy or silty soils

CH. : Inorganic clays of high plasticity, fat clays

OH. : Organic clays of medium to high plasticity, organic silts

Pt. : Peat, humus, swamp soils with high organic contents

TOPSOIL

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171154.68 N
567715.20 E

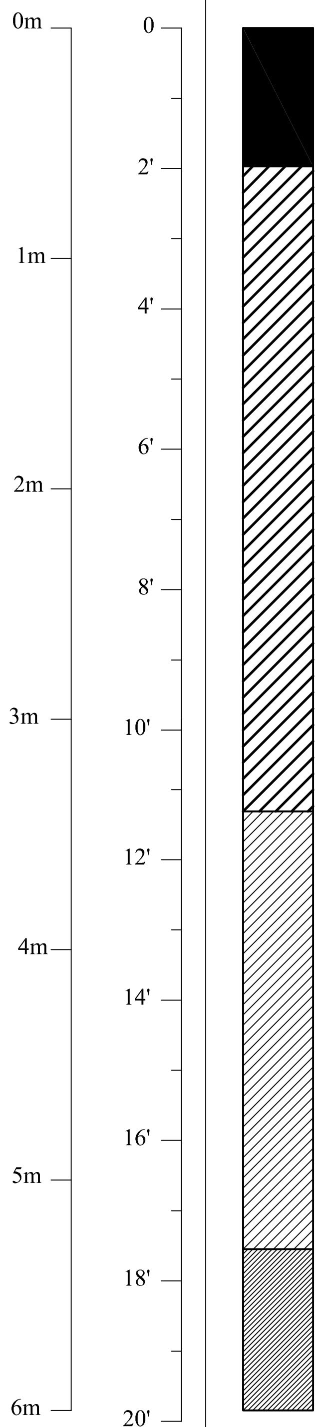
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

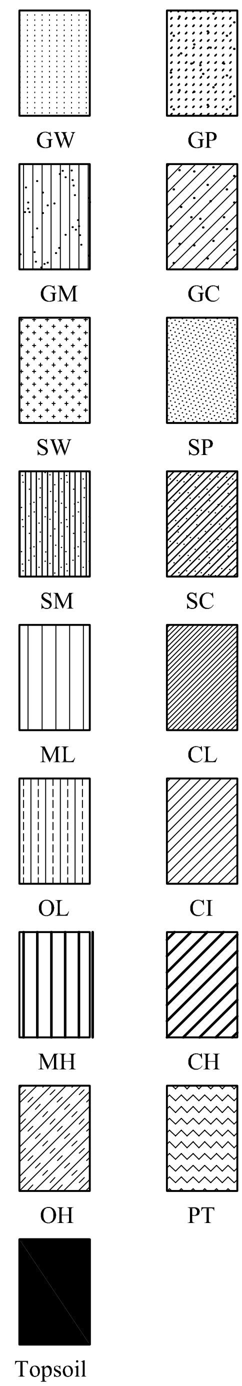
ELEVATION : 208.14 m

TEST HOLE # 1

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	PEAT - black, organic, wet, loose, some roots
	CLAY - high plastic, light brown, wet, trace silt
	CLAY - medium to high plastic, grey, wet, trace silt
	CLAY - medium to high plastic, grey, wet, increased silt



BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed, surface water observed around the hole



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171129.72 N
567745.42 E

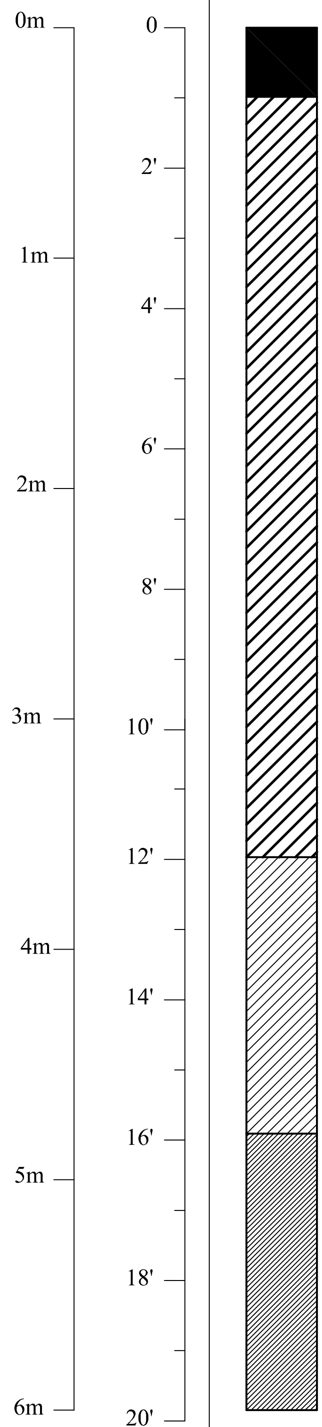
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 207.49 m

TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION



PEAT - black, organic, wet, loose, some roots

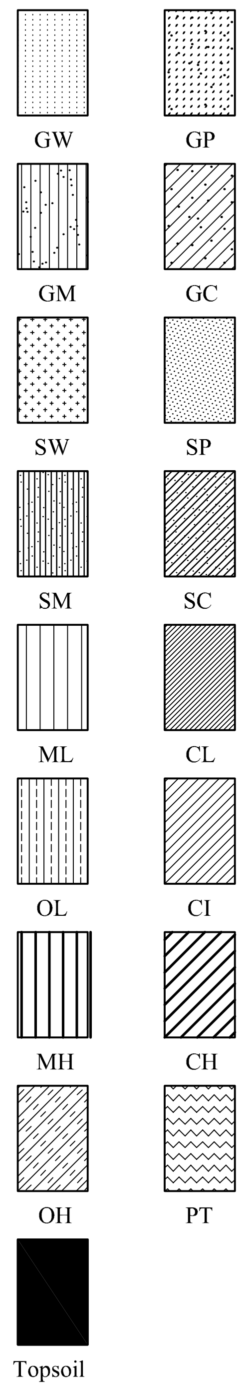
CLAY - high plastic, light brown, wet, stiff, trace silt

CLAY - high plastic, grey, moist, very stiff, trace silt

CLAY - medium to high plastic, grey, wet, firm, increased silt

BOTTOM OF HOLE: 6.0m

NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed, surface water observed around the hole



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171167.60 N
567761.44 E

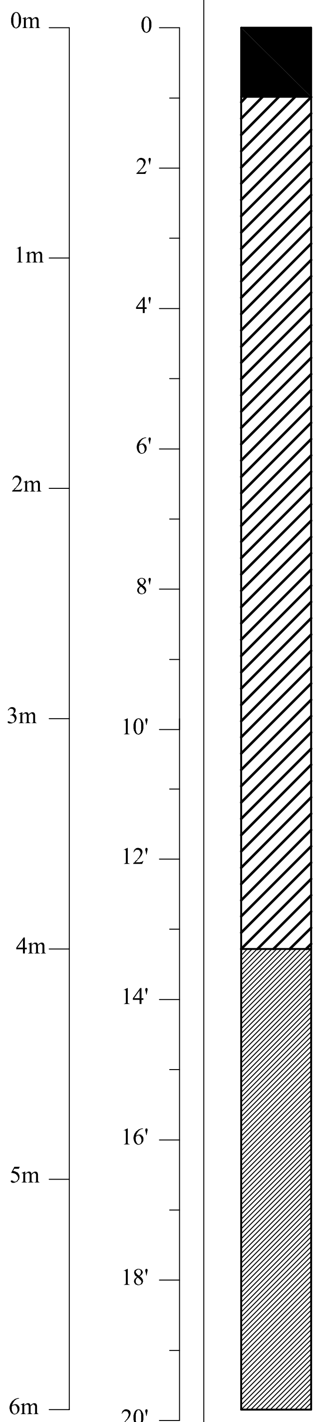
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 208.13 m

TEST HOLE # 3

DEPTH OF SAMPLE	FIELD CLASSIFICATION



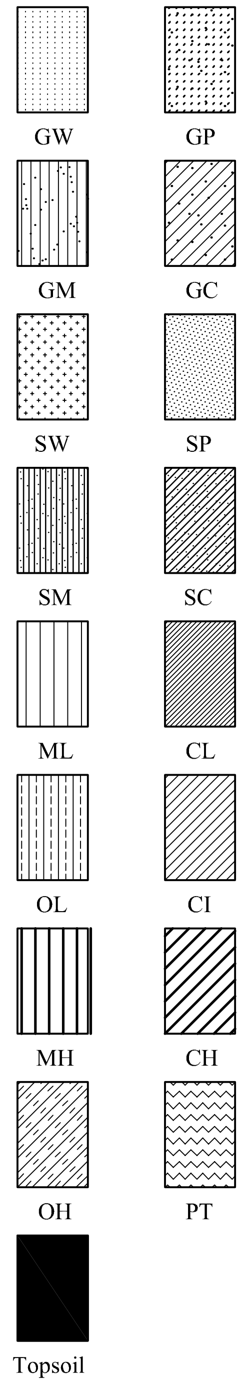
PEAT - black, organic, moist, loose, some roots

CLAY - high plastic, light brown, moist, firm, trace silt

CLAY - medium to low plastic, grey, moist, firm, silt lenses

BOTTOM OF HOLE: 6.0m

NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171270.91 N
567809.40 E

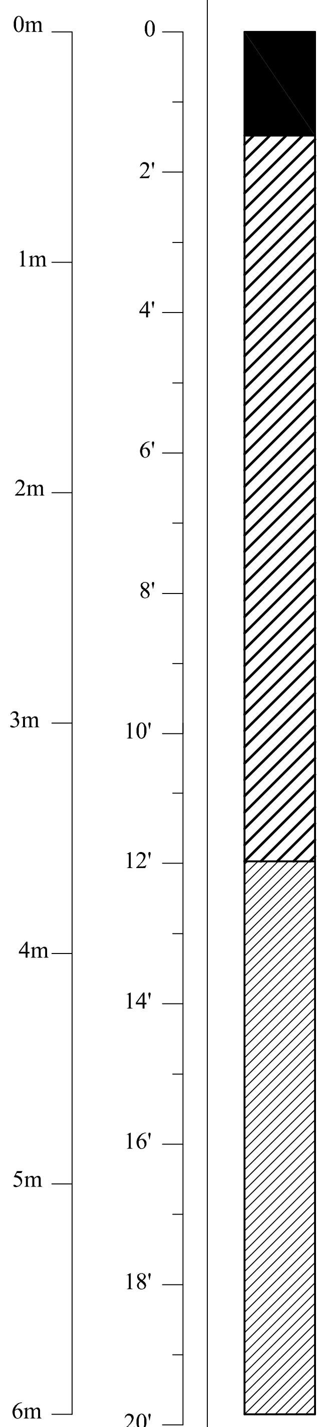
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 209.61 m

TEST HOLE # 4

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0.45m (0 – 1.5')	PEAT - black, organic, moist, loose, some roots
0.45m – 3.6m	CLAY - high plastic, light brown, moist, stiff, trace silt
3.6m – 6.0m	CLAY - medium to high plastic, grey, wet, stiff, silt content increases with depth



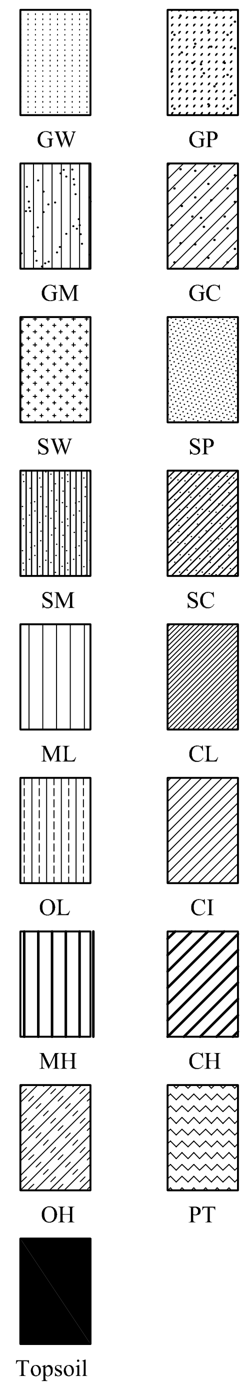
PEAT - black, organic, moist, loose, some roots

CLAY - high plastic, light brown, moist, stiff, trace silt

CLAY - medium to high plastic, grey, wet, stiff, silt content increases with depth

BOTTOM OF HOLE: 6.0m

NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

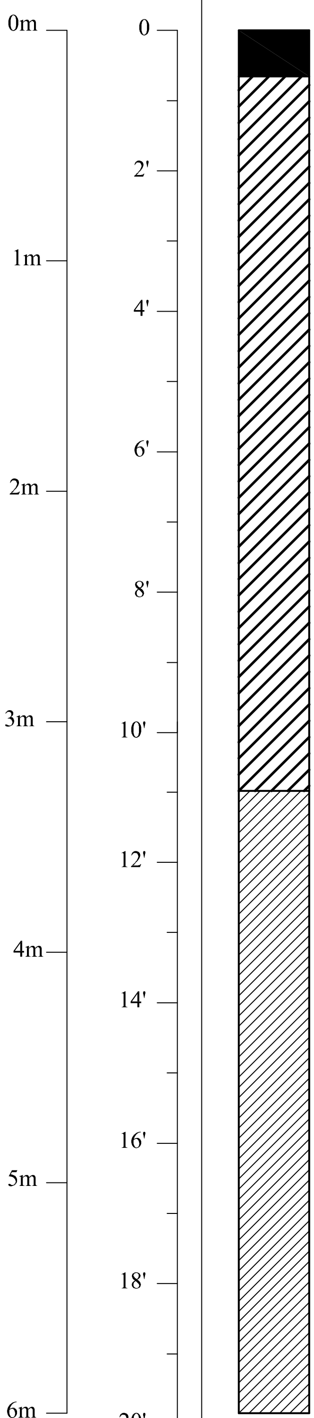
LOCATION : 6171329.55 N
567827.42 E

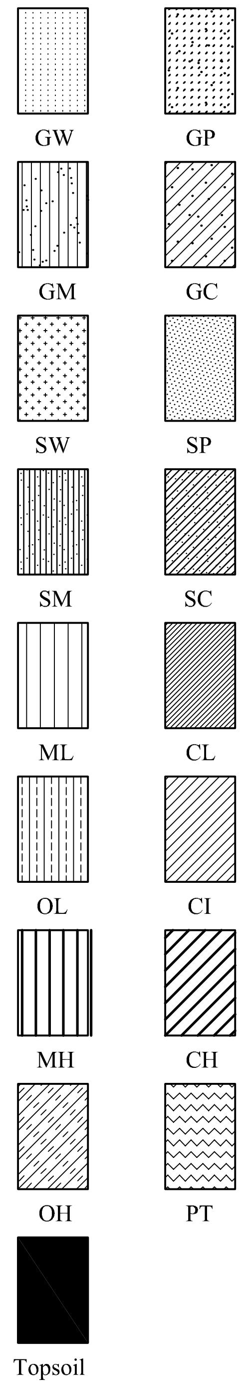
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 209.88 m

TEST HOLE # 5

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	PEAT - black, organic, moist, loose, some roots CLAY - high plastic, light brown, moist, firm, trace silt CLAY - high plastic, grey, moist, stiff, silt content increases with depth BOTTOM OF HOLE: 6.0m NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed



The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171288.86 N
567843.71 E

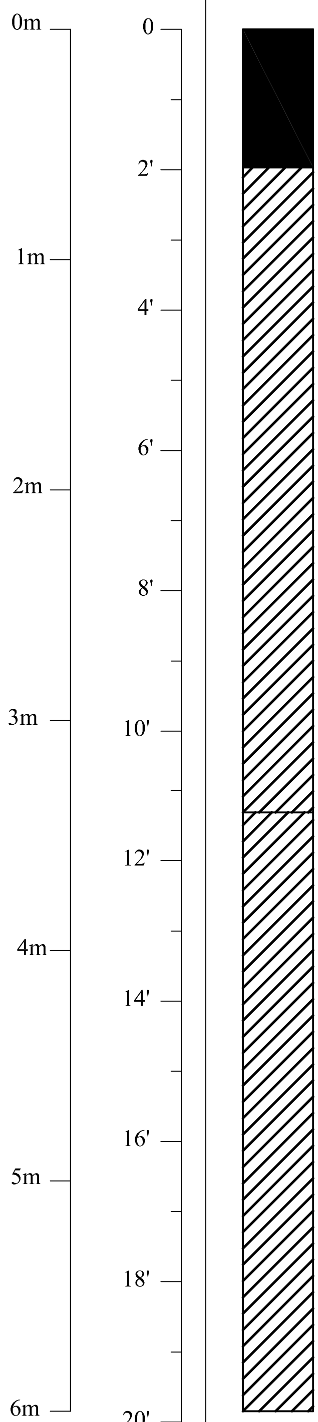
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 210.19 m

TEST HOLE # 6

DEPTH OF SAMPLE	FIELD CLASSIFICATION

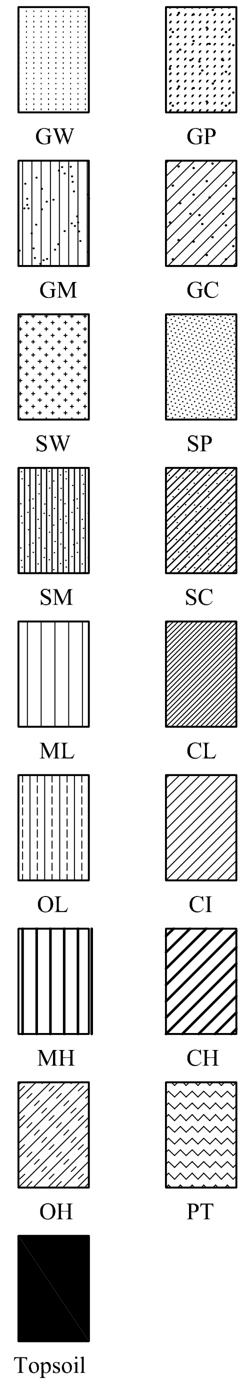


PEAT - black, organic, moist, loose, some roots

CLAY - high plastic, light brown, moist, stiff, trace silt

CLAY - high plastic, grey, moist, firm, trace silt

BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole after 4.0 h, no bedrock encountered, caving of the hole observed at 3.6 m after 4.0 h



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171429.28 N
567875.52 E

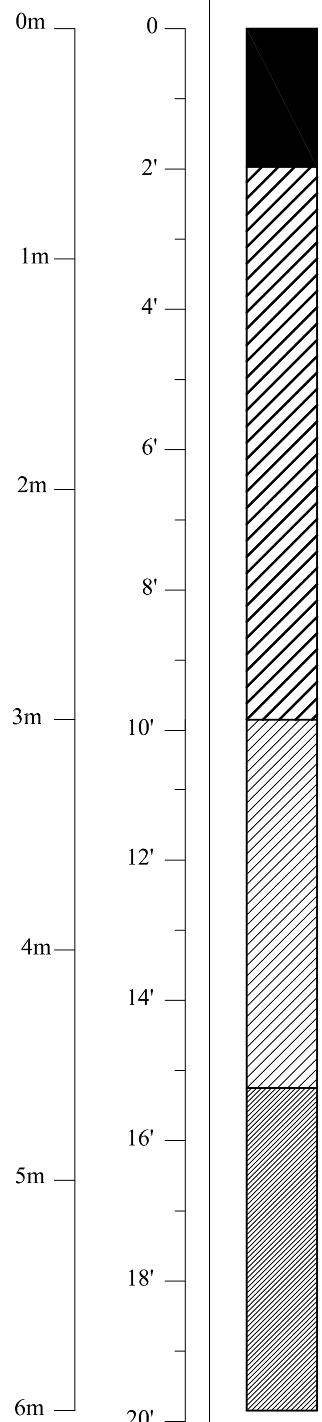
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

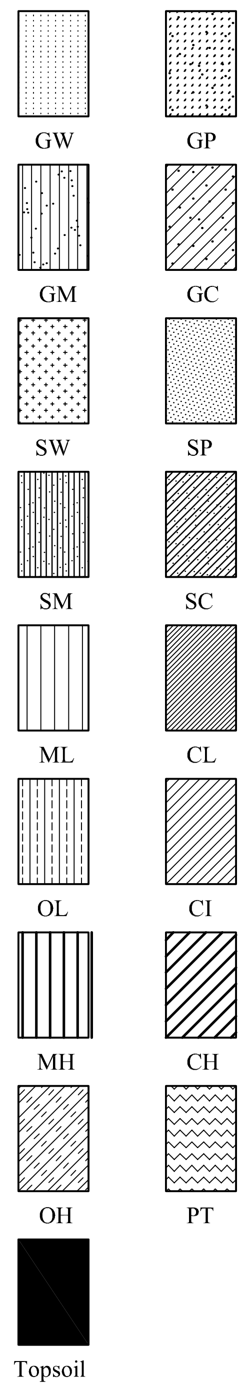
ELEVATION : 209.79 m

TEST HOLE # 7

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0.6m (0 – 2')	PEAT - black, organic, moist, loose, some roots
0.6m – 3m (2' – 10')	CLAY - high plastic, light brown, wet, soft, trace silt
3m – 4.6m (10' – 15')	CLAY - high plastic, grey, wet, stiff, trace silt
4.6m – 6m (15' – 20')	CLAY - medium to high plastic, grey, wet, firm, silty



BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole, no bedrock encountered, sloughing of the hole observed at 3.6 m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171482.16 N
567954.14 E

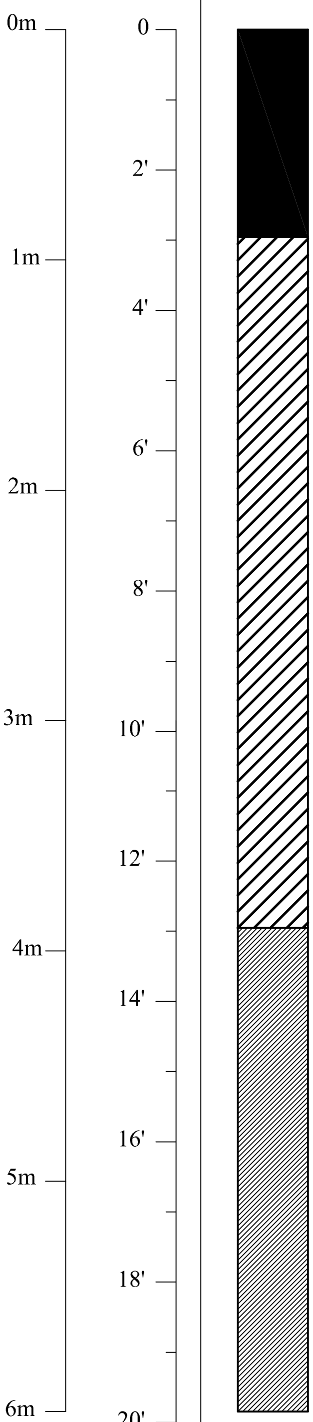
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 210.88 m

TEST HOLE # 8

DEPTH OF SAMPLE	FIELD CLASSIFICATION

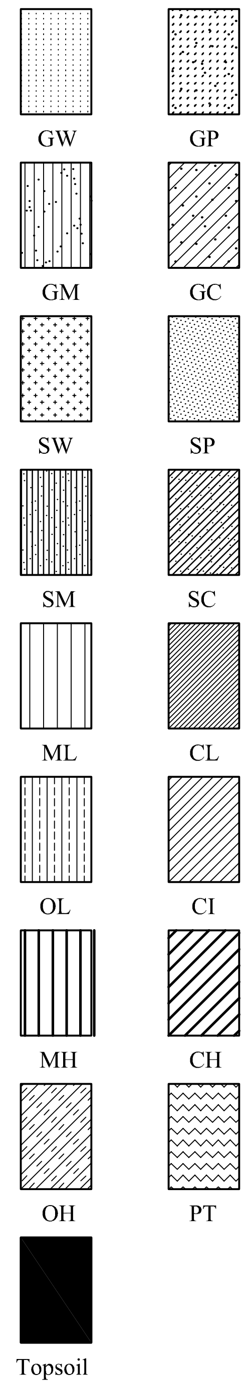


PEAT - black, organic, moist, loose, some roots

CLAY - high plastic, light brown, moist, hard, trace silt

CLAY - low plastic, grey, moist, soft, silt content
increases with depth

BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole, no bedrock encountered, no caving of the hole observed



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171522.36 N
568067.31 E

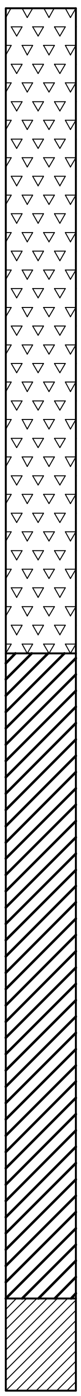
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

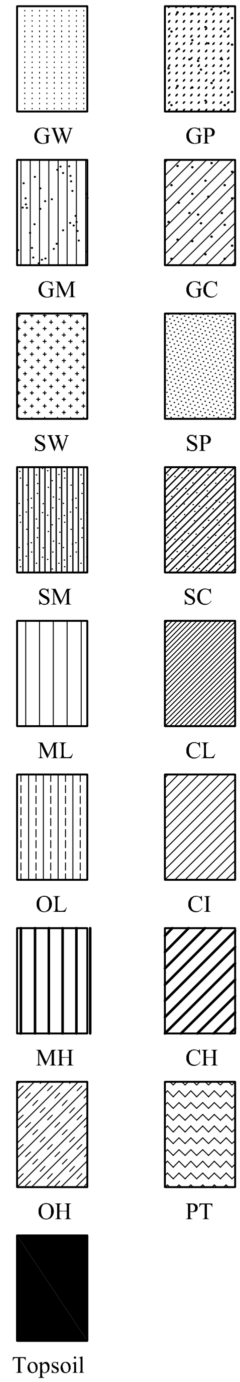
DATE : April 13, 2011

ELEVATION : 211.67 m

TEST HOLE # 9

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	
	2'	
1m		
	4'	GARBAGE/PEAT - plastic, cloth, etc.
	6'	
2m		
	8'	
3m	10'	
	12'	
4m		CLAY - high plastic, brown, wet, stiff, trace silt
	14'	
	16'	
5m		
	18'	
		CLAY - medium to high plastic, grey, wet, soft, silty
6m	20'	BOTTOM OF HOLE: 6.0m NOTE - some water infiltration observed in the hole, no bedrock encountered, caving of the hole observed in the garbage layer





J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171490.51 N
568166.36 E

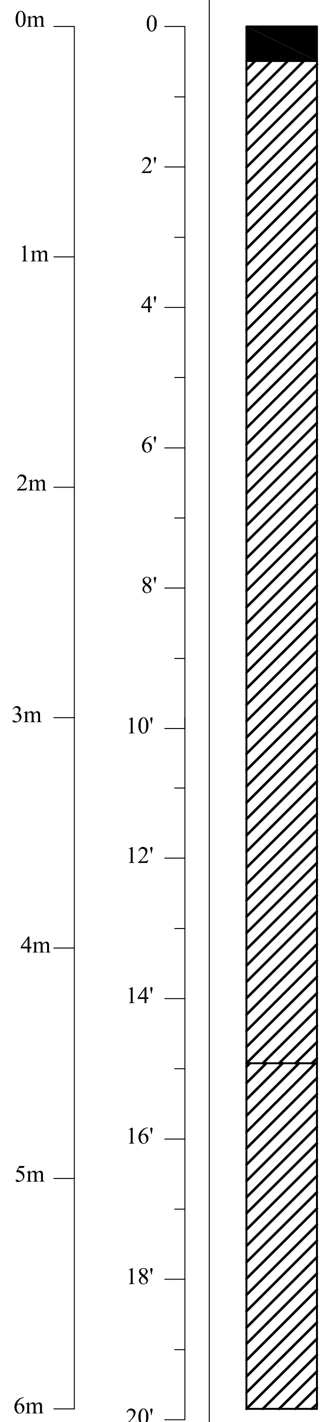
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 214.83 m

TEST HOLE # 10

DEPTH OF SAMPLE	FIELD CLASSIFICATION

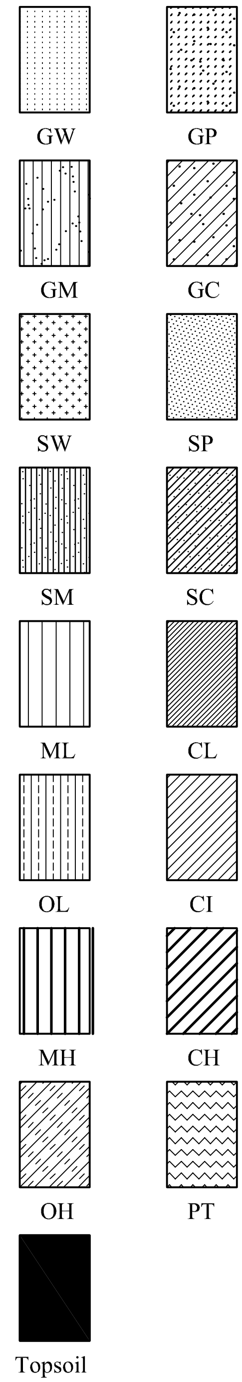


PEAT - black, organic, moist, loose, some roots

CLAY - high plastic, brown, dry, firm, trace silt

CLAY - high plastic, grey, moist, firm, trace silt

BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole, no bedrock encountered, caving of the hole observed at 3.0 m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6170872.19 N
567844.70 E

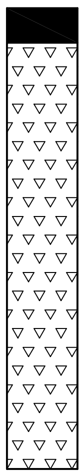
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

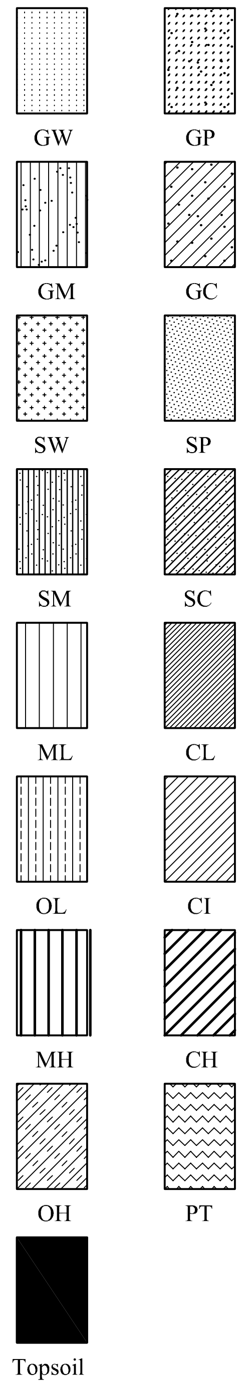
DATE : April 13, 2011

ELEVATION : 216.13 m

TEST HOLE # 11

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	SOIL - black cover soil
2'	
1m	GARBAGE - plastic, cloth, etc.
4'	
6'	
2m	BOTTOM OF HOLE: 2.0m NOTE - no water infiltration observed in the hole, no bedrock encountered, caving of the hole observed at 3.0 m
8'	
3m / 10'	
12'	
4m	
14'	
16'	
5m	
18'	
6m / 20'	





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171275.63 N
567899.87 E

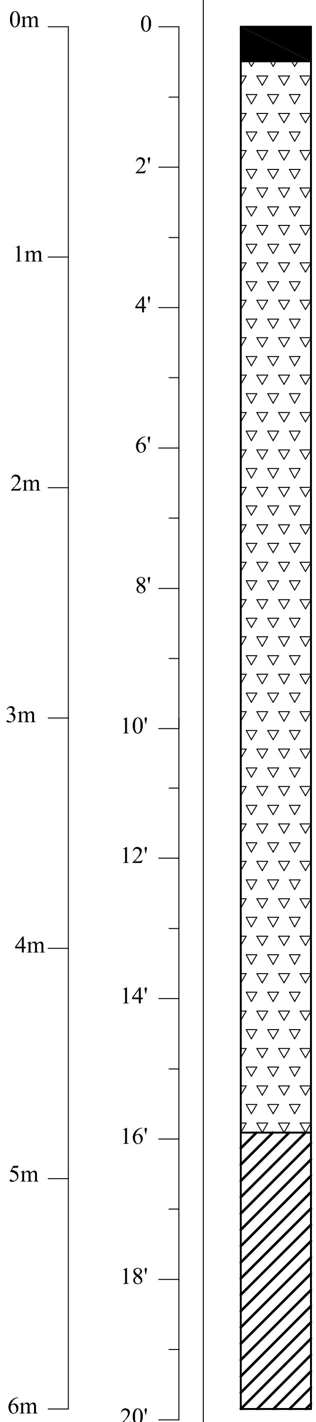
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : April 13, 2011

ELEVATION : 214.70 m

TEST HOLE # 12

DEPTH OF SAMPLE	FIELD CLASSIFICATION

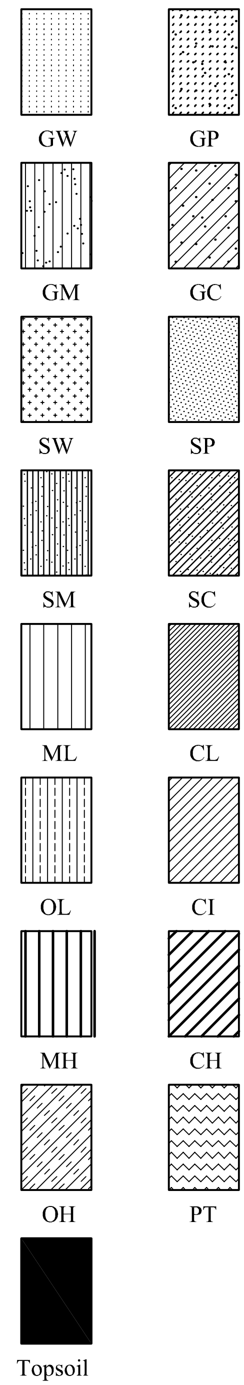


SOIL - black cover soil

GARBAGE - plastic, cloth, etc.

CLAY - high plastic, brown, moist, very stiff, trace silt

BOTTOM OF HOLE: 6.0m
NOTE - no water infiltration observed in the hole, no bedrock encountered, caving of the hole observed in the garbage layer



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171401.11 N
567937.24 E

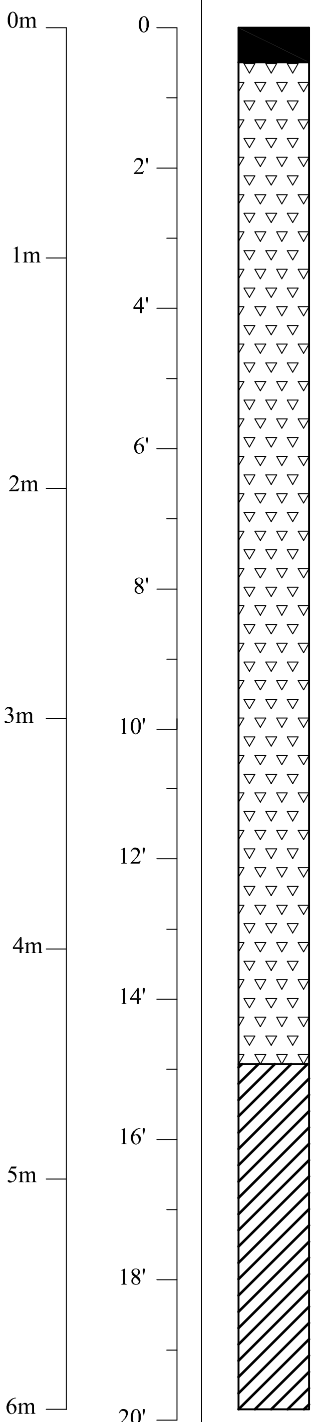
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

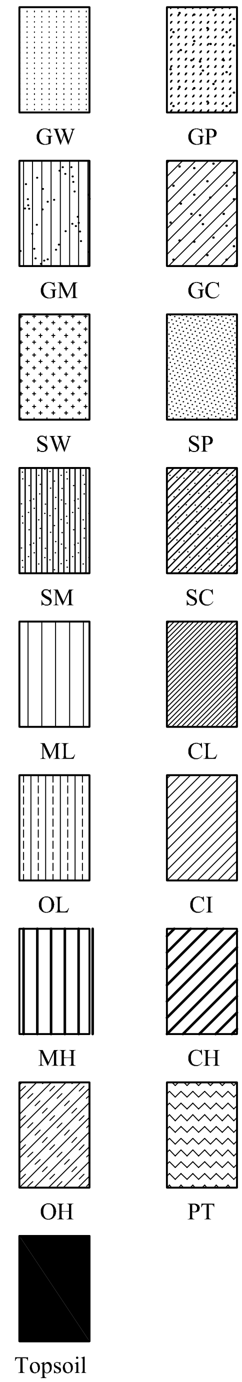
DATE : April 13, 2011

ELEVATION : 216.96 m

TEST HOLE # 13

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	SOIL - black cover soil
	GARBAGE - plastic, cloth, etc.
	CLAY - high plastic, brown, moist, very stiff, some silt
	BOTTOM OF HOLE: 6.0m NOTE - no water infiltration observed in the hole, no bedrock encountered, caving of the hole observed in the garbage layer





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National Testing Laboratories Ltd. Test Results

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

199 Henlow Bay
Winnipeg, MB R3Y 1G4
Phone (204) 488-6999
Fax (204) 488-6947
Email info@nationaltestlabs.com
www.nationaltestlabs.com

J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

Attention: Brett McCormac

May 27, 2011

Project: Mystery Lake Waste Disposal Facility

Soil samples were submitted to our laboratory on April 21, 2011. The following tests were conducted on selected soil samples:

- water content (ASTM D2216)
- particle size analysis (ASTM D422)
- liquid limit, plastic limit, and plasticity index (ASTM D4318)
- hydraulic conductivity (ASTM D2435)
- soil classification (ASTM D2487)
- visual classification

The test results for the soil samples are summarized in the following tables and in the attached particle size analysis and hydraulic conductivity reports.

An assessment of the bagged soil samples was conducted to determine whether the soil represented by the bagged samples could be used in-situ as a landfill liner and would obtain a hydraulic conductivity of less than 1.0 x 10^{-7} cm/sec without being reworked, and when re-moulded and re-compacted.

Based upon previous testing conducted in our laboratory, homogeneous soil samples with a plasticity index greater than 25 and a clay content greater than 50% will typically have a hydraulic conductivity of 1.0 x 10^{-7} cm/sec or less. Sample TH8 3.9-6.0 m had a plasticity index of 18, which does not fall within this range. Hydraulic conductivity testing of a representative Shelby tube sample of this material is recommended to determine its suitability for use as a lagoon liner. The remaining bagged samples were considered suitable for use as a lagoon liner. Our comments regarding the potential use of the material as a lagoon liner are based upon the soil being homogeneous with no preferential flow paths and being properly placed and compacted to maximum density near its optimum moisture content. It should be noted that estimating the hydraulic conductivity of a soil based upon classification test results (plasticity index and particle size analysis) alone might be misleading if the soil contains layers of sand, silt, or organic material.

The hydraulic conductivity results for the 3 Shelby tube samples are less than the specified maximum hydraulic conductivity value of 1.0 x 10^{-7} cm/s for lagoon liners.

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Aron Piamsalee

Aron Piamsalee, B.Sc., EIT
Geotechnical Project Manager

TABLE 2
HYDRAULIC CONDUCTIVITY SUMMARY
MYSTERY LAKE WASTE DISPOSAL FACILITY

Sample ID	Depth (m)	Hydraulic Conductivity, "k_{20}"
TH3	1.5 – 2.1	8.9 x 10^{-9} cm/s
TH6	3.0 – 3.6	1.4 x 10^{-8} cm/s
TH8	3.0 – 3.6	9.9 x 10^{-9} cm/s

THE NATIONAL TESTING LABORATORIES LIMITED

TABLE 1
SUMMARY OF WATER CONTENT, PARTICLE SIZE, ATTERBERG LIMITS, SOIL CLASSIFICATION TEST DATA
MYSTERY LAKE WASTE DISPOSAL FACILITY

Testhole	Depth (m)	Visual Classification	Water Content (%)	Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification ASTM D2487	Potential Use as a Lagoon Liner without being Reworked	Potential Use as a Lagoon Liner when re-moulded and re-compacted
					Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm								
TH3	0.3-4.0	brown, firm, moist, high plasticity clay, trace silt	35.7	0.0	0.0	0.0	0.2	3.4	96.4	62	23	39	CH(Fat Clay)	Yes	Yes
TH3	4.0-6.0	grey, firm, moist, low plasticity clay, trace silt	32.8	0.0	0.0	0.0	0.1	8.9	91.0	47	19	28	CL(Lean Clay)	Yes	Yes
TH6	0.6-3.4	brown, stiff, moist, high plasticity clay, trace silt	33.3	0.0	0.0	0.0	0.1	6.5	93.4	62	21	41	CH(Fat Clay)	Yes	Yes
TH6	3.4-6.0	grey, stiff, moist, high plasticity clay, trace silt	32.6	0.0	0.0	0.0	0.1	6.4	93.5	52	21	31	CH(Fat Clay)	Yes	Yes
TH8	0.9-3.9	brown, stiff, moist, high plasticity clay, trace silt	32.4	0.0	0.0	0.2	0.1	6.9	92.8	66	23	43	CH(Fat Clay)	Yes	Yes
TH8	3.9-6.0	grey, firm, moist, low plasticity clay, some silt	31.9	0.0	0.0	0.0	0.1	14.4	85.5	36	18	18	CL(Lean Clay)	HC Testing Recommended	
TH12	4.8-6.0	brown, firm, moist, high plasticity clay, trace silt	33.2	0.0	0.0	0.2	0.1	4.2	95.5	63	23	43	CH(Fat Clay)	Yes	Yes
TH13	4.5-6.0	brown, firm, moist, high plasticity clay, some silt, trace sand	32.0	0.0	0.0	0.3	1.0	11.7	87.0	63	24	39	CH(Fat Clay)	Yes	Yes

Notes:
1.A high speed stirring device was used for 1 minute to disperse the test samples for particle size analysis.
2.Atterberg limits conducted in accordance with ASTM D4318 Method B (one-point liquid limit).
3.The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis.

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Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

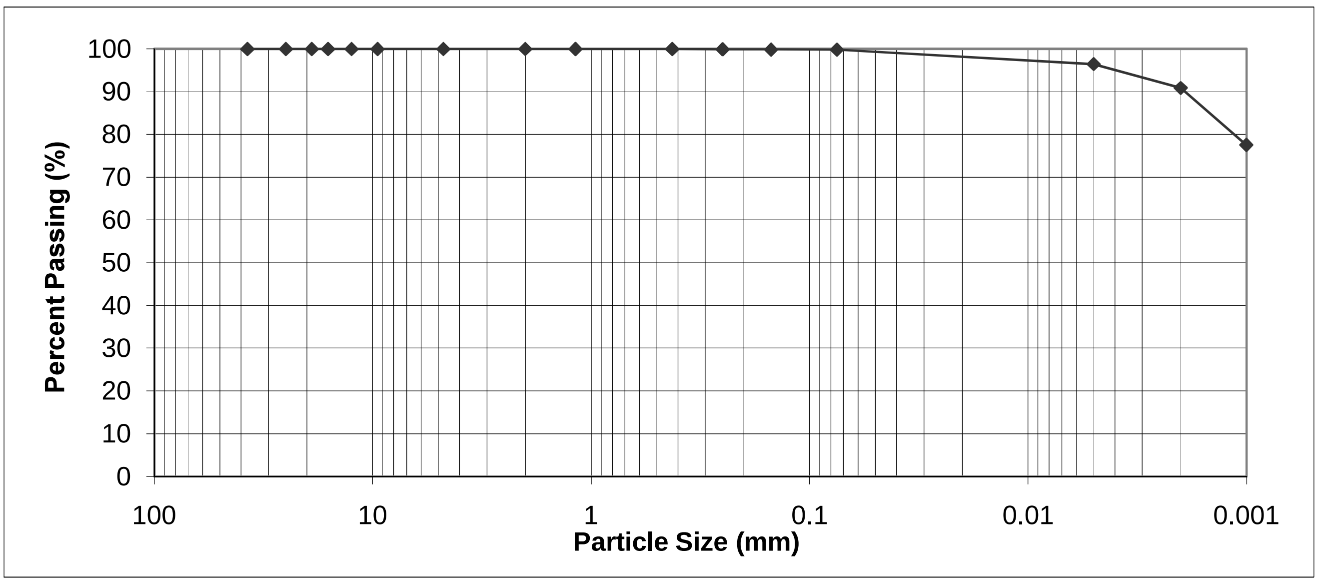
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH3 0.3 - 4.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING	PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0	1.18 mm	100.0
25.00 mm	100.0	0.425 mm	100.0
19.00 mm	100.0	0.250 mm	99.9
16.00 mm	100.0	0.150 mm	99.9
12.50 mm	100.0	0.075 mm	99.8
9.50 mm	100.0	0.005 mm	96.4
4.75 mm	100.0	0.002 mm	90.9
2.00 mm	100.0	0.001 mm	77.5

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.2	3.4	96.4	77.5

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

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PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

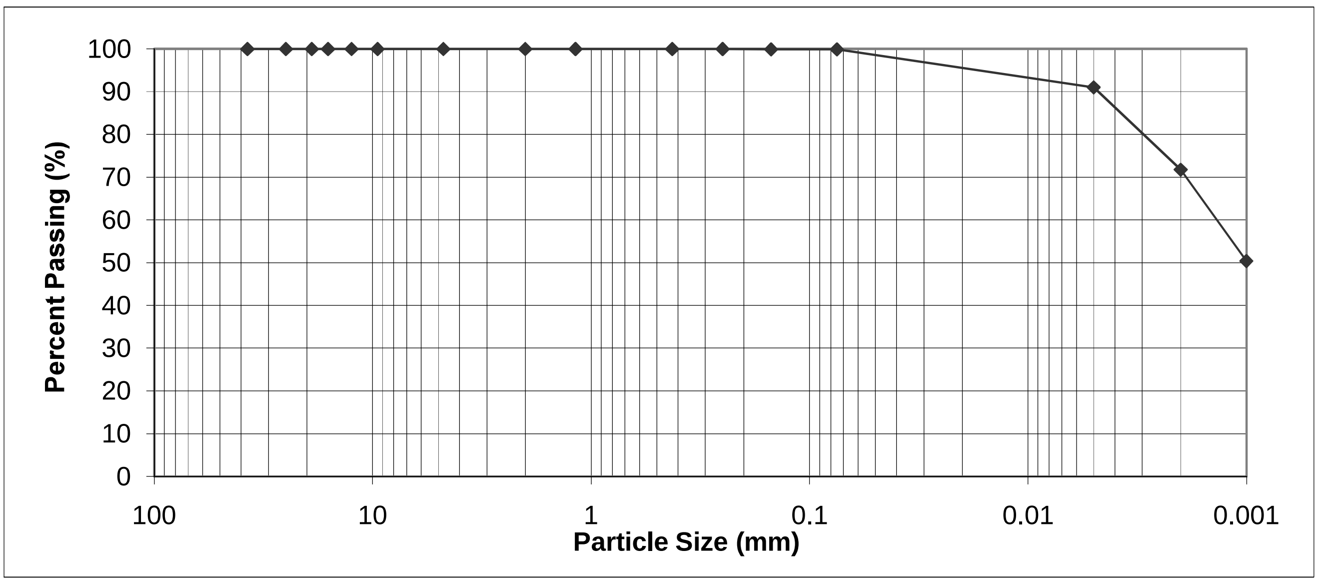
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH3 4.0 - 6.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING	PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0	1.18 mm	100.0
25.00 mm	100.0	0.425 mm	100.0
19.00 mm	100.0	0.250 mm	100.0
16.00 mm	100.0	0.150 mm	99.9
12.50 mm	100.0	0.075 mm	99.9
9.50 mm	100.0	0.005 mm	91.0
4.75 mm	100.0	0.002 mm	71.7
2.00 mm	100.0	0.001 mm	50.4

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.1	8.9	91.0	50.4

May 27, 2011

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PARTICLE SIZE ANALYSIS
ASTM D422

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Winnipeg, Manitoba
R3Y 1G4

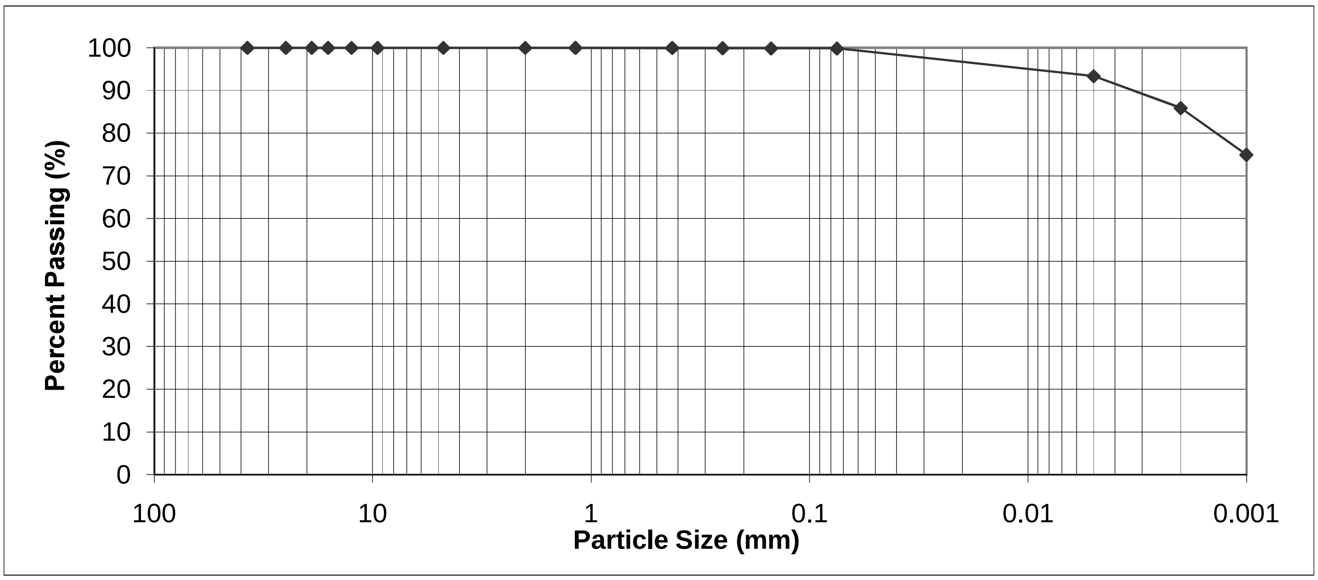
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH6 0.6 - 3.4 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	99.9
0.150 mm	99.9
0.075 mm	99.9
0.005 mm	93.4
0.002 mm	85.9
0.001 mm	75.0

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.1	6.5	93.4	75.0

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

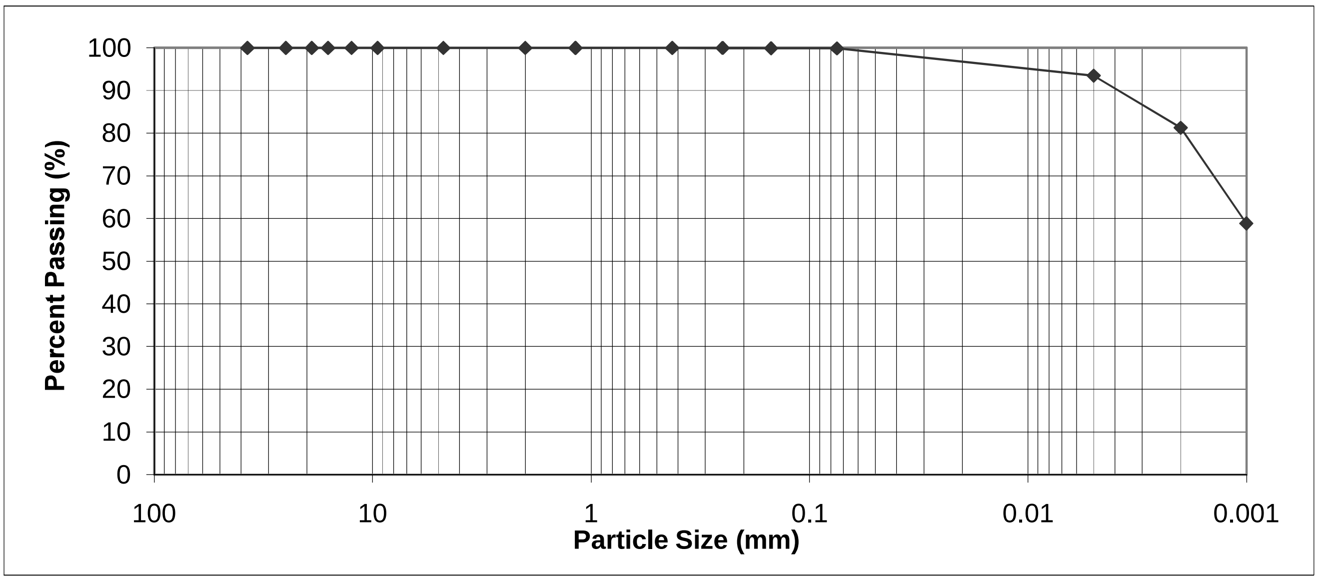
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH6 3.4 - 6.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	100.0
0.150 mm	99.9
0.075 mm	99.9
0.005 mm	93.5
0.002 mm	81.3
0.001 mm	58.8

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.1	6.4	93.5	58.8

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

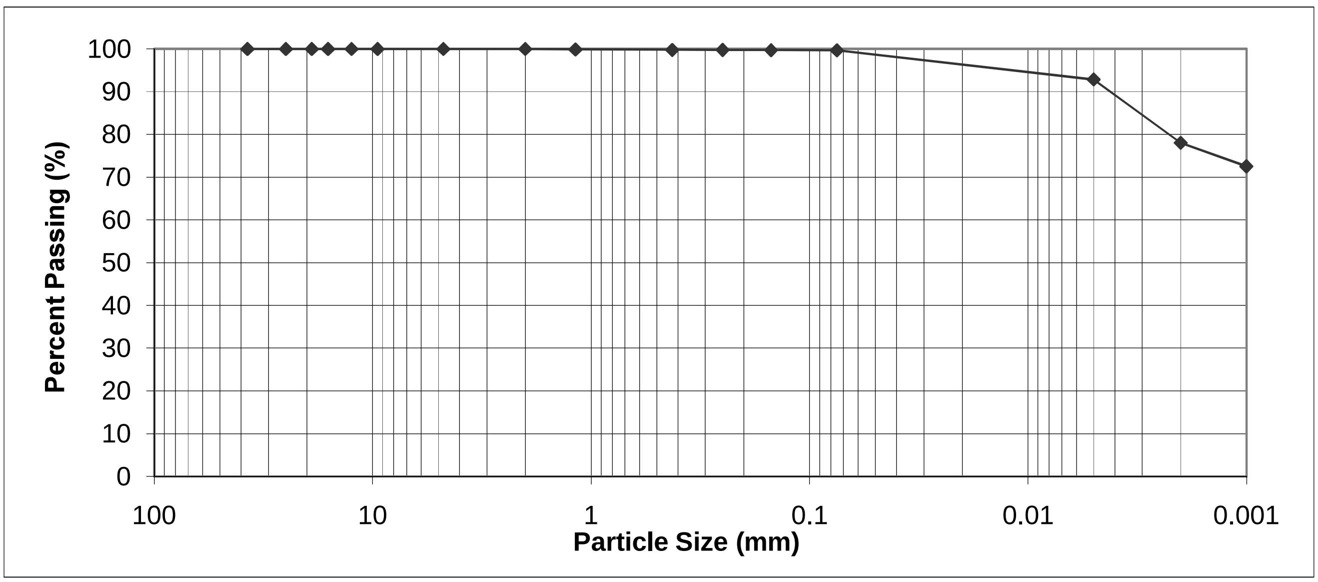
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH8 0.9 - 3.9 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.8
0.250 mm	99.8
0.150 mm	99.7
0.075 mm	99.7
0.005 mm	92.8
0.002 mm	78.0
0.001 mm	72.5

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.2	0.1	6.9	92.8	72.5

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

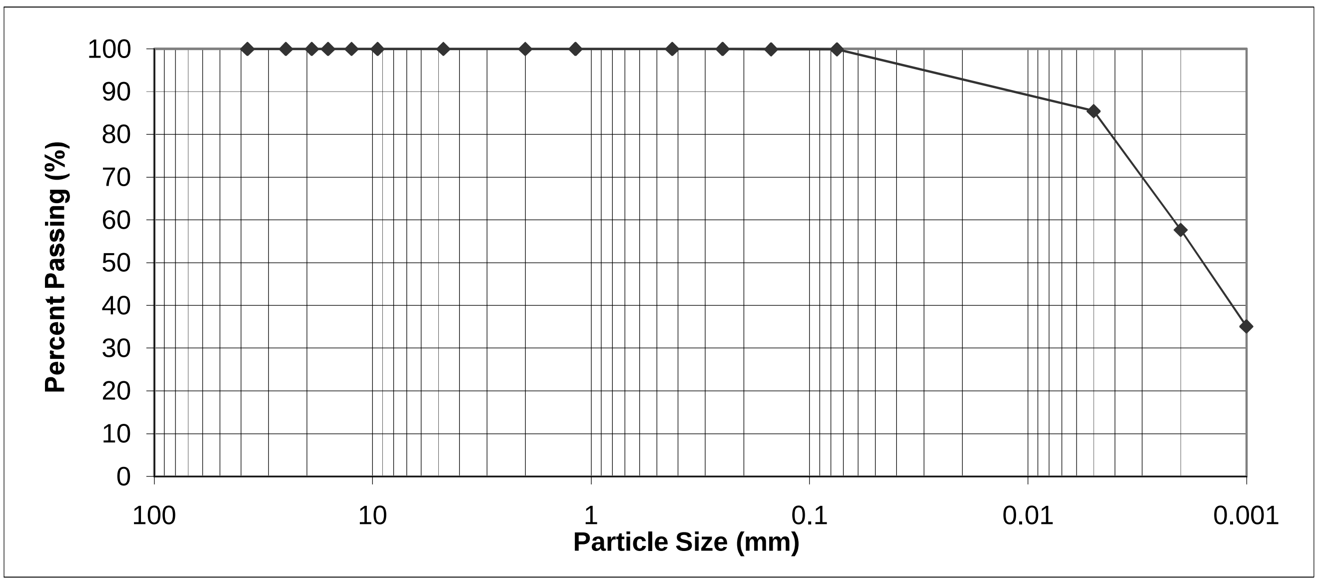
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH8 3.9 - 6.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	100.0
0.150 mm	99.9
0.075 mm	99.9
0.005 mm	85.5
0.002 mm	57.7
0.001 mm	35.1

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.1	14.4	85.5	35.1

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

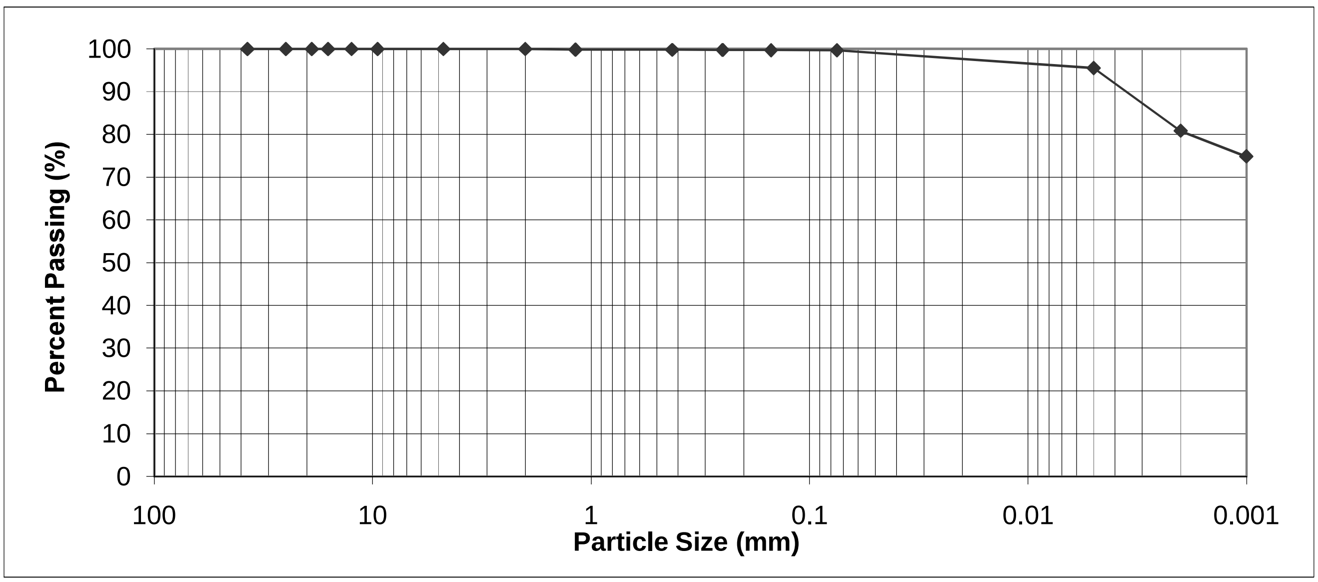
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH12 4.8 - 6.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.8
0.425 mm	99.8
0.250 mm	99.8
0.150 mm	99.7
0.075 mm	99.7
0.005 mm	95.5
0.002 mm	80.8
0.001 mm	74.8

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.2	0.1	4.2	95.5	74.8

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

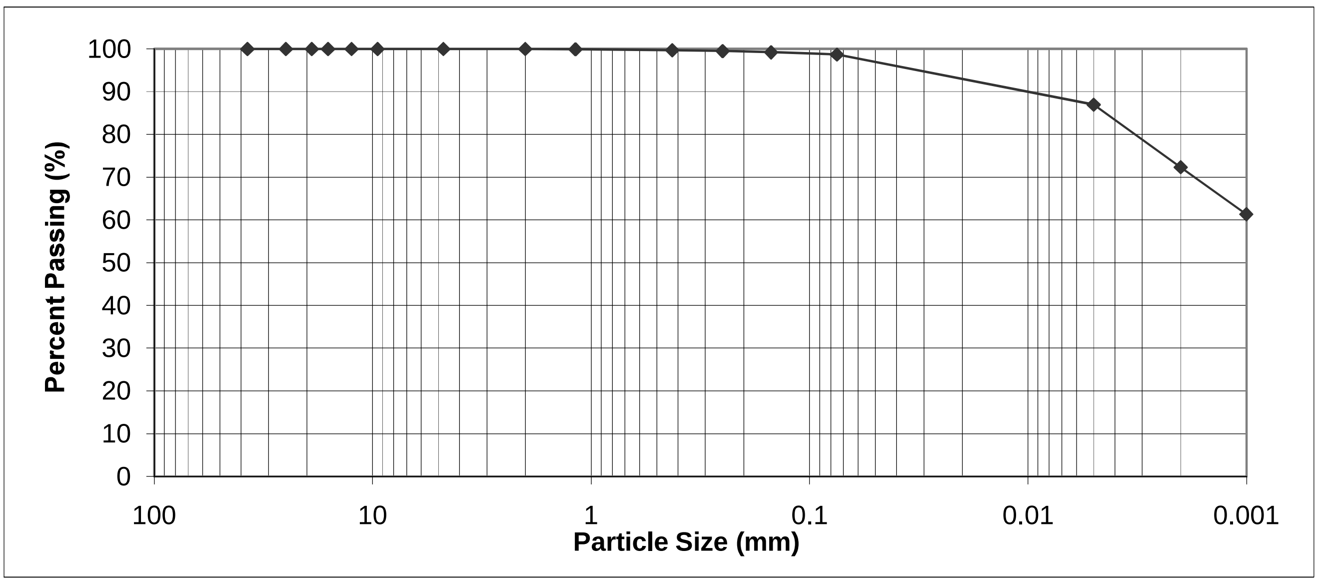
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH13 4.5 - 6.0 m

DATE RECEIVED: April 21, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.7
0.250 mm	99.5
0.150 mm	99.2
0.075 mm	98.7
0.005 mm	87.0
0.002 mm	72.3
0.001 mm	61.3

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.3	1.0	11.7	87.0	61.3

May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

HYDRAULIC CONDUCTIVITY
ASTM D5084

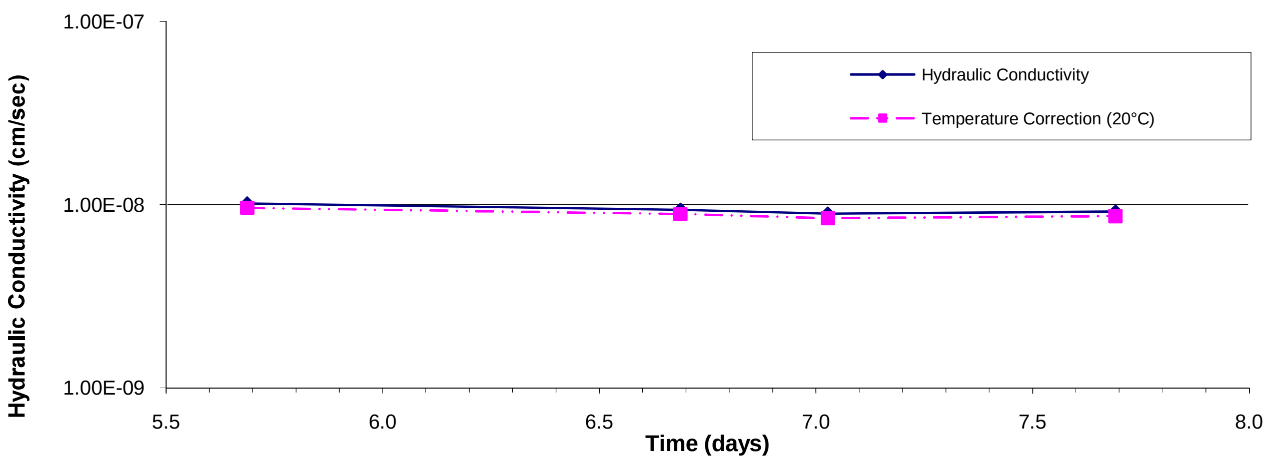
J.R.Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

SAMPLE I.D.:	**TH3 1.5 - 2.1 m**
SOIL TYPE:	Brown, stiff, moist, high plasticity clay
DATE TESTED:	April 26 to May 16
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	20.1
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	9.4E-09
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**8.9E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	71.9	72.5	571.7	1.461	31.9	100.5
Final Reading	73.7	72.8	581.6	1.399	35.4	101.7



May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

HYDRAULIC CONDUCTIVITY
ASTM D5084

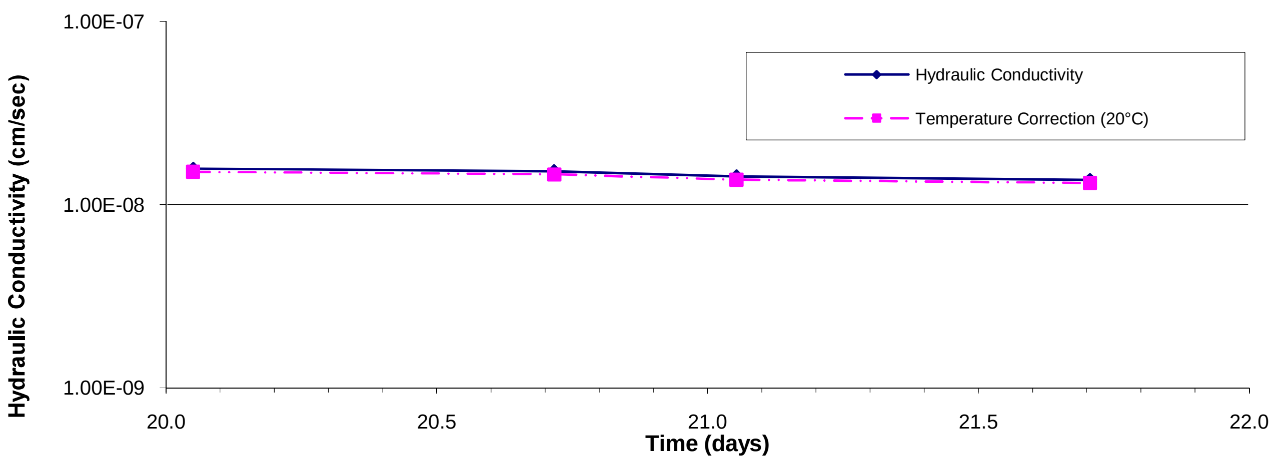
J.R.Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

SAMPLE I.D.: **TH6 3.0 - 3.6 m**
SOIL TYPE: Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED: April 22 to May 14
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
HYDRAULIC GRADIENT: 20.4
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.5E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **1.4E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	71.9	72.7	517.5	1.277	35.8	86.1
Final Reading	72.6	72.6	573.5	1.394	36.8	104.9



May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

HYDRAULIC CONDUCTIVITY
ASTM D5084

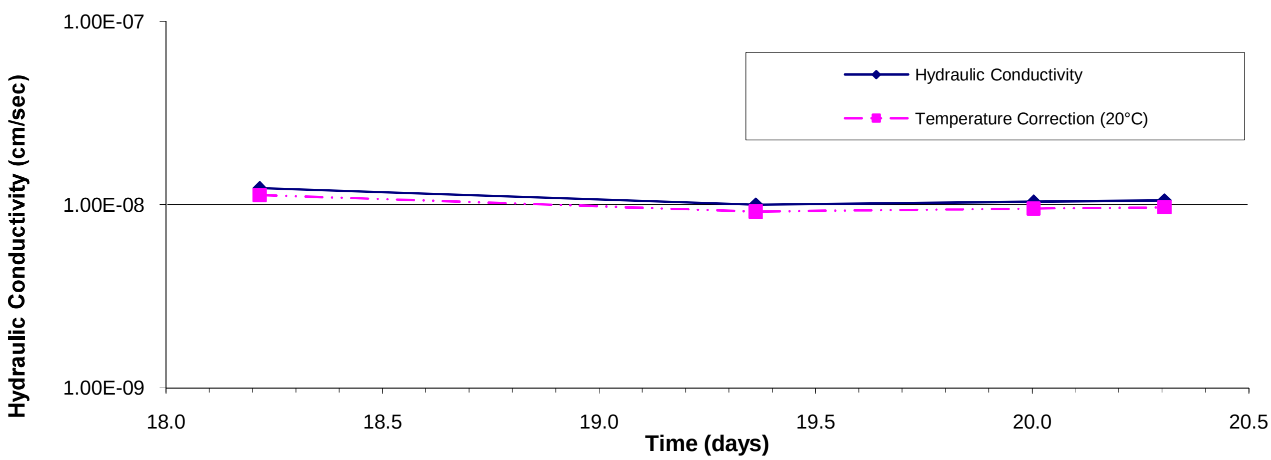
J.R.Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

SAMPLE I.D.:	**TH8 3.0 - 3.6 m**
SOIL TYPE:	Brown, stiff, moist, high plasticity clay
DATE TESTED:	April 26 to May 16
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	18.8
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	1.1E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**9.9E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	78.5	72.4	618.4	1.446	32.4	99.8
Final Reading	79.0	73.6	631.1	1.383	35.8	100.6



May 27, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works, JR Cousin Consultants Ltd., 2011

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P&R 14.32 JRCC

M-617.01

LGD of MYSTERY LAKE

Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works

PROVINCE OF MANITOBA
G. R. COUSIN
11/9/30
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: Sept 30/11

Prepared by: J. R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

September 2011

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. J. R. Cousin Consultants Ltd. (JRCC) wishes to thank the LGD of Mystery Lake who assisted with organization and onsite works.

REMARKS

Conclusions reached in this report are based upon the generalization of data available to us at the time of forming our opinions. Information in this document may rely on previous studies, investigative work and data by others. JRCC cannot be responsible for actual site conditions proved to be at variance with any generalized data. This report was completed in accordance with generally accepted professional engineering principles and practice. Any use of this report by a third party is the responsibility of the third party, JRCC accepts no responsibility for third party decisions or actions based on the report. No other warranty or guarantee expressed, implied or statutory is made.

TABLE OF CONTENTS

1.0 INTRODUCTION

J. R. Cousin Consultants Ltd. (JRCC) conducted a geotechnical investigation for the Waste Disposal Ground (WDG) Proposed Phase II Expansion at the LGD of Mystery Lake. The LGD of Mystery Lake existing WDG is located on Part NW ¼ 18, S ½ and NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM, approximately 4 km south of the City of Thompson. The proposed Phase II expansion area is east of the existing WDG as shown on Plan 1 attached in the Appendix. The WDG services the LGD of Mystery Lake, the City of Thompson, the Town of Churchill and the Wuskawatim Generating Station. However, the Town of Churchill and the Wuskawatim Generating Station area scheduled to discontinue use of the WDG in the near future.

A total of thirteen test holes were excavated at the WDG proposed Phase II expansion site and borrow pit area. Test hole locations are shown on Plan 1 attached in the Appendix. The test holes were excavated in the proposed Phase II expansion site to determine suitability of the insitu soils for use as a clay landfill liner and in the borrow pit to determine suitability of material for dike and cut-off wall construction.

This report outlines the findings of the geotechnical investigation at the WDG site and evaluates the soils to determine their suitability for use as a landfill liner. The report also identifies potential difficulties (i.e. depth to bedrock, soil types and subsurface water elevations) associated with construction.

2.0 BACKGROUND

Due to wet site conditions at the WDG, the Phase I works cannot be completed in the fall of 2011 as planned. The current active cell has reached maximum capacity and a new active area must be constructed to allow the LGD to dispose waste through the winter and during construction of the Phase I works in the summer of 2012. The LGD of Mystery Lake proposed to construct a lined expansion cell to the east of the municipal waste disposal area as the proposed Phase II works.

The geotechnical investigation was required to evaluate potential use of insitu and re-worked soils as a clay landfill liner and for use in cell dike construction. Bagged soil samples were analysed by a laboratory to assess whether the insitu soils comply with the Manitoba Conservation hydraulic conductivity criteria of $1x10^{-7}$ cm/sec or less for a landfill liner.

A previous geotechnical and topographic investigation was completed by AECOM in 2005. Eight test holes were excavated around the perimeter of the WDG and three holes were excavated within the former waste cells to determine the depth of waste. Shelby tube samples and laboratory analysis of the soils was not completed and therefore it is unknown if the soils could achieve a hydraulic conductivity of 1×10^{-7} cm/s insitu or when re-worked.

A geotechnical and topographic investigation was completed by JRCC in April 2011 to access the soils in the Phase I expansion area, the leachate pond area, future expansion areas and through the existing waste to assess the existing landfill liner. Shelby tube samples and laboratory analysis of the soils was completed and it was determined that insitu clay liners with a hydraulic conductivity of 1 x 10^{-7} cm/s did exist across the testing area.

3.0 TOPOGRAPHIC INVESTIGATION

The onsite topographic survey was completed on August 18 and 19, 2011. The proposed Phase II expansion area was surveyed with a GPS Total Station. Some areas of thick bush in the proposed Phase II expansion were not surveyed due to loss of satellite reception.

The survey confirmed data obtained during the Phase I topographic survey and evaluated test hole elevations. Elevations in the proposed Phase II Expansion area ranged from 214.70 m in the north end to 225.27 m in the south end.

Contour lines from the topographic survey are shown on Plan 2 attached in the Appendix.

4.0 GEOTECHNICAL FIELD INVESTIGATION

The onsite geotechnical investigation at the LGD of Mystery Lake was conducted on August 18, 2011. Smook Contractors was employed to complete the test holes utilizing a Komatsu 270 track mounted excavator under direct supervision by JRCC's field representative.

A total of thirteen test holes were excavated during the investigation. Ten test holes were excavated in the proposed Phase II expansion area (TH14 – 19 and TH21 - 24), one test hole (TH20) was excavated in the area for future expansion. One test hole (TH25) was excavated in the potential borrow pit area and one test hole (TH26) was excavated on the path from the WDG to the borrow pit area. Test holes were excavated to a depth between 4.1 m and 5.4 m or to bedrock refusal.

4.1 Proposed Phase II Expansion Area

The subsurface soil profile within each test hole was logged, water conditions were noted and representative soil samples were taken as the soils varied along the profile. The samples were visually field-classified. Eight selected bagged samples from the test holes were sealed and submitted to National Testing Laboratories Ltd. for testing and analysis. Details of the laboratory analysis are provided in Section 5.0. Following excavation, the depth of standing water was measured and any caving of the test holes was determined. Test holes were backfilled with the excavated soils and compacted upon termination of excavation. Test hole locations are shown on Plan 1 attached in the Appendix.

4.1.1 Soil Profile

The soil profile in the test holes and the depth of bedrock varied significantly across the test holes taken in the proposed Phase II expansion area. Soil profiles were generalized for TH14 – TH21, TH22 – TH24 and TH25 and TH26. Details of individual test holes can be found in the soils logs attached in the Appendix.

Proposed Phase II Expansion Area TH14 – TH21

The average soil profile observed in TH14 – TH21 consisted of an average of 0.5 m of black topsoil followed by a sandy, silty low plastic clay to bedrock. The bedrock elevation varied between 0.6 m below ground in TH18 to 3.7 m below ground in TH15, with an average bedrock elevation of 3.0 m below the surface. TH20 had existing waste from 0 – 2.2 m below ground and TH21 had a medium plastic clay layer from 1.5 – 3.4 m below ground.

Proposed Phase II Expansion Area TH22 – TH24

The soil profile in TH22 consisted of existing waste from 0 – 2.4 m below ground and low - medium plastic clay soils from 2.4 – 4.5 m below ground. TH23 and TH24 consisted of an average of 0.8 m of topsoil followed by medium to high plastic clay to a depth of 4.9 and 5.4 m, respectively. Bedrock was not encountered in the test holes.

Borrow Pit Area and Path to Borrow Pit (TH25 and TH26)

TH25 and TH26 found high plastic clay from the ground surface to a depth of 4.1 and 4.2 m, respectively. TH25 became low – medium plastic at 1.6 m below ground surface. Bedrock was not encountered in the test holes.

4.1.2 Groundwater

Short-term groundwater conditions were assessed in each test hole by observing standing water in the test holes prior to backfilling the holes. No standing water was observed in the test holes with the exception of TH20 which had leachate water infiltration at the bottom of the waste layer and TH21 which had high rate water infiltration from the surface.

TH15 was left open for approximately 2 hours to allow longer-term water infiltration to occur. When the hole was re-visited caving of the test hole walls occurred and no standing water was observed.

Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time as water levels will normally fluctuate seasonally.

Contractors will be made aware of the geotechnical conditions encountered onsite, as some dewatering of the ground surface may be required during construction.

5.0 LABORATORY TESTING, ANALYSIS AND DISCUSSION

5.1 Laboratory Analysis

Eight representative samples were submitted to National Testing Laboratories Ltd. on August 23, 2011, for analysis and a professional assessment. The analysis included the determination of the following:

- Moisture Content (ASTM D2216)
- Atterberg Limits (plastic limit, liquid limit, and plasticity index, ASTM D4318)
- Soil Classification (ASTM D2487)
- Particle Size Analysis (Hydrometer test, ASTM D422)

The WDG soils were analyzed to determine their suitability as a re-worked or insitu liner for a WDG cell, which requires a hydraulic conductivity of 1 x 10^{-7} cm/sec or less.

Laboratory analysis of the soils indicated that soils from TH15 and TH21 had a clay content ranging between 61.2% and 73.6% and a Plasticity Index of 12. The soil from TH22 (2.4 – 4.5 m) had a clay content of 80.2% and a Plasticity Index of 16. The soils from TH23 – TH26 had a clay content ranging from 97.7% to 99.5% and a Plasticity Index between 24 and 45. Based on past experience, the laboratory has commented that homogeneous soils with a plasticity index greater than 25 and a clay content greater than 50% would typically be expected to have a hydraulic conductivity of 1 x 10^{-7} cm/sec or less.

Based on these comments and Plasticity Index analysis (i.e. Atterberg limits) of the soils indicated that the soils from TH23 (0.4 – 3.2 m), TH24 (1.2 – 3.7 m), TH25 (0 – 1.6 m) and TH26 (0 – 2.2 m) were considered suitable for use as an insitu clay liner or when re-worked and re-compacted. The soils from TH15 (0.6 – 1.9 m), TH21 (1.5 – 3.4 m), TH22 (2.4 – 4.5 m) and TH25 (1.6 – 4.1 m) had clay contents above 50% but had Plasticity Index less than 25 and therefore hydraulic conductivity testing of the soils would be required to determine if the soils could achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec or less.

Upon further discussion with the National Testing Lab the sample from TH22 (2.4 – 4.5 m) had silt varves within the clay matrix and hydraulic conductivity testing would be highly recommended before use as an insitu clay liner. TH25 (1.6 – 4.5 m) had trace silt varves within the clay matrix. The sample had a high clay content but a low liquid limit as a result of the chemical properties of the clay. National Testing Laboratories has advised the material would most likely be suitable for use as a landfill liner when re-worked and re-compacted, however it could not be known until hydraulic conductivity testing of the clay is performed.

The results indicate that the suitability of the soils for a clay liner is dependent upon the soils being homogeneous with no preferential flow paths. These preferential flow paths can be caused by lenses of unsuitable material, rocks or boulders or fissures in the soil.

Details of National Testing Laboratories test results and analysis, dated September 2, 2011 are attached in the Appendix.

6.0 WDG CELL LINER REQUIREMENTS

6.1 Current Guidelines

Manitoba Conservation guidelines require that a standard WDG cell clay liner be 1.0 metre in thickness and have a hydraulic conductivity (i.e. the potential rate of fluid movement through the soil) of 1×10^{-7} cm/sec or less. This low rate is to protect the underlying groundwater and surrounding lands from leachate seepage. Generally, the higher a soil's plasticity the more likely a soil can achieve a hydraulic conductivity of 1×10^{-7} cm/sec.

6.2 Typical Clay Liner Construction Options

The insitu (undisturbed) soils can be used to construct the liner of a WDG cell if the soils can consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec or less in their insitu state.

If the insitu soils cannot be used, the liner can be constructed by excavating and re-compacting suitable high plastic clay soils to form the liner.

If the clay content of the soils is so low that even when excavated and re-compacted, the soils cannot consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec, a liner constructed of high plastic clay from a borrow pit, or a synthetic geomembrane liner would be required.

6.3 Liner for the Proposed Phase II Expansion Cell

The following are the typical options for lining a WDG cell including using the insitu soil if it can achieve a hydraulic conductivity of 1×10^{-7} cm/sec, re-working and re-compacting the existing soil or clay soil from a borrow source to achieve a hydraulic conductivity of 1×10^{-7} cm/sec, or utilizing a synthetic geomembrane liner.

6.3.1 Insitu Soil

Based on the geotechnical investigation and laboratory analysis the soils in the proposed Phase II expansion area under TH14 – 22 are not capable of achieving an insitu hydraulic conductivity of 1 x 10^{-7} cm/s.

The soils below the surficial topsoil in the vicinity of TH23 – TH24 are suitable for use as an insitu clay liner. The clay under the existing waste layer in TH22 may be suitable for use as an insitu clay liner if additional hydraulic conductivity tests are completed. Additional test holes and laboratory testing are required in the vicinity of TH22 to determine the edge of the 1.0 m thick insitu suitable clay. Future test hole locations are shown on Plan 3 attached in the Appendix.

Once the edge of the horizontal clay liner in determined, vertical cut-off walls in the WDG perimeter dikes would be made of re-worked and re-compacted clay soils and extended a minimum of 1.0 m into the insitu clay horizontal liner creating the east WDG border.

Using the insitu clay for the horizontal bottom liner in the proposed Phase II expansion area would be possible, provided that the soils are uniform throughout the proposed construction area and no preferential flow paths exist.

If some unsuitable soils or boulders are encountered during excavation of the cell, they need to be removed and replaced with re-worked medium to high plastic clay from a borrow site or from previously excavated material.

6.3.2 Re-Worked Soil

The soils below the surficial topsoil (or existing waste) layer in the vicinity of TH22 – TH24 would most likely be suitable for use as a clay liner when re-worked and re-compacted. In this option (re-worked clay option) approximately 1.25 m of suitable clay soil would be excavated from its native state and re-worked and re-compacted to form a minimum 1.0 m thick horizontal clay liner. The vertical cut-off walls in the WDG perimeter dikes would be made of re-worked and re-compacted clay soils extended a minimum of 1.0 m into the insitu clay horizontal liner.

This re-worked clay option would provide a lower hydraulic conductivity in the horizontal layer and reduce the risk of not meeting the Manitoba Conservation guideline of a hydraulic conductivity of 1 x 10^{-7} cm/sec or less in the liner. However, this would add significant cost to the project and based on the laboratory analysis of bagged samples taken at the site in TH23 and TH24, the insitu hydraulic conductivity meets the guidelines and re-compaction of the bottom liner is not necessary.

Based on the geotechnical investigation and laboratory analysis the soils in the proposed Phase II expansion area under TH14 – 21 are not capable of achieving a hydraulic conductivity of 1 x 10^{-7} cm/s when re-worked and re-compacted. If expansion was to occur over this area, a minimum 1.0 m thick clay liner would have to be hauled from a borrow pit and re-compacted and re-worked.

The clay soils from the borrow area were found to be marginally suitable for use as a landfill liner when re-worked and re-compacted. The sample from TH25 (1.6 – 4.1 m) had a high clay content (98.8%), but a low liquid limit (45) which resulted in a plasticity index of 24. The sample was deemed a lean clay and hydraulic conductivity testing was recommended prior to use as a landfill liner. Before use of the borrow pit soil, it is recommended that additional test holes in the borrow pit area be conducted as well as re-worked hydraulic conductivity testing of the sample from TH25 (1.6 – 4.1 m). Future test hole locations are shown on Plan 3 attached in the Appendix.

6.3.3 Geomembrane Liner

The WDG liner could be constructed with a synthetic geomembrane liner, using insitu soils as the bedding material for the liner and sand from a borrow pit used as a liner cover. The cost of installing a geomembrane liner would be significantly greater than utilizing re-worked and re-compacted clay from the borrow pit.

6.3.4 Summary

The clay soils east of the WDG in the vicinity of TH23 – 24 can be utilized as an insitu clay liner. Additional test holes and laboratory testing are required in the vicinity of TH22 to determine the edge of the 1.0 m thick suitable clay liner. The soil east of TH22 – 24 under TH14 – TH21 cannot be utilized as a landfill liner whether re-worked or re-compacted and if expansion was to occur over this area a minimum 1.0 m thick clay liner would have to be hauled from the borrow pit and re-worked and re-compacted. Additional soils testing in the borrow pit and additional laboratory analysis of the borrow pit soil is required before use as a landfill liner.

7.0 SUMMARY, RECOMMENDATIONS AND CLOSURE

7.1 Summary

The topographic survey at the WDG confirmed the data obtained during the Phase I topographic survey and evaluated test hole elevations. The survey found the elevations is the proposed Phase II expansion area ranged between 214.70 at the north end to 225.77 m in the south end.

Soils at the existing WDG were investigated by JRCC. Representative soil samples were analyzed by National Testing Laboratories Ltd. to determine their suitability for a clay liner.

Based on the geotechnical investigation and laboratory analysis, the clay in the vicinity of TH23 – 24 is suitable for use as an insitu clay liner. Additional test holes and laboratory testing are required in the vicinity of TH22 to determine the edge of the 1.0 m thick suitable clay liner.

The soils in the area of TH14 – 21 are not suitable for use as a clay liner insitu or when re-worked and re-compacted. If the landfill was expanded in this area a minimum 1.0 m thick horizontal clay liner would be required to be hauled from the borrow pit and re-worked and re-compacted. Additional soils testing in the borrow pit and additional laboratory analysis of the borrow pit soil is required before use as a landfill liner.

The soils from the borrow pit were found to be marginally suitable for use as a landfill liner when re-worked and re-compacted and additional test holes and laboratory analysis including hydraulic conductivity testing is required before use as a landfill liner.

The vertical cut-off walls in the WDG perimeter dikes and the leachate pond dikes would have to be made of re-worked and re-compacted clay soils extended a minimum of 1.0 m into the insitu clay horizontal liner.

No water infiltration was observed in the test holes, with the exception of TH20 which had leachate water infiltration at the bottom of the waste layer and TH21 which had high rate water infiltration from the surface. Contractors will have to be made aware of these conditions prior to construction, however water levels can vary seasonally.

7.2 Recommendations

It is recommended that a perimeter dike with vertical cut-off walls extending a minimum 1.0 m into the horizontal clay liner wall be installed at the edge of the suitable horizontal clay liner. The location of the edge of the horizontal clay liner will be determined by further soils testing in the vicinity of TH22. If expansion in the area under TH14 – 21 is required it is recommended a minimum 1.0 m thick clay liner from the borrow pit be hauled and re-worked and re-compacted. Additional soils testing in the borrow pit and additional laboratory analysis of the borrow pit soil is required before use as a landfill liner. Future test hole locations are shown on Plan 3 attached in the Appendix.

7.3 Closure

The conclusions and recommendations in this report are based on the results of the site investigation and laboratory analysis. In addition, soil and groundwater conditions between test hole locations were generalized to provide an overall assessment of the geotechnical site conditions. If conditions that appear different from those encountered at the test hole locations as described in this report, or if the assumptions stated herein are not in agreement with the design, JRCC should be informed in order that the recommendations can be reviewed and adjusted as required.

The site investigation was conducted for the purpose of identifying geotechnical conditions at the potential expansion cell sites and leachate pond site. Although no environmental issues were identified during the site investigation, it does not necessarily follow that such issues do not exist. If the client or any other parties have any environmental concerns regarding the proposed site and works, an appropriate environmental assessment must be conducted.

It is not uncommon for soil conditions to be highly variable across a site. Previous construction activities and placement of fill at a site can augment the variability of soil conditions, especially surficial soil conditions. A contingency must be included in any construction budget to allow for potential variations in soil conditions, which may result in modification of the design and construction procedures.

8.0 NEXT STEPS

The following are the additional geotechnical investigations which must be performed at the LGD of Mystery Lake WDG. Test holes and laboratory analysis must be completed east of the existing WDG in the vicinity of TH22 to determine the extent of the insitu clay liner. Additional soils testing in the borrow pit is required as well as laboratory analysis including hydraulic conductivity testing to determine if the soils are suitable for use as a waste disposal ground liner. Future test hole locations are shown on Plan 3 attached in the Appendix.

Item #	Task	Schedule	Reason
1	Additional test holes and laboratory analysis of soils from the borrow pit including re-worked hydraulic conductivity testing	Prior to Phase I construction works	To evaluate the actual hydraulic conductivity of the borrow soil and to evaluate remainder of borrow pit soils
2	Additional test holes east of the existing WDG	Prior to dike construction east of the WDG	To determine east boundary of 1.0 m thick insitu clay liner
3	Insitu Shelby tube samples and hydraulic conductivity testing of soils in the vicinity of TH22	Prior to dike construction east of the WDG	To determine if the hydraulic conductivity of the clay is suitable for an insitu liner

APPENDIX

Plan 1: Test Hole Location Plan

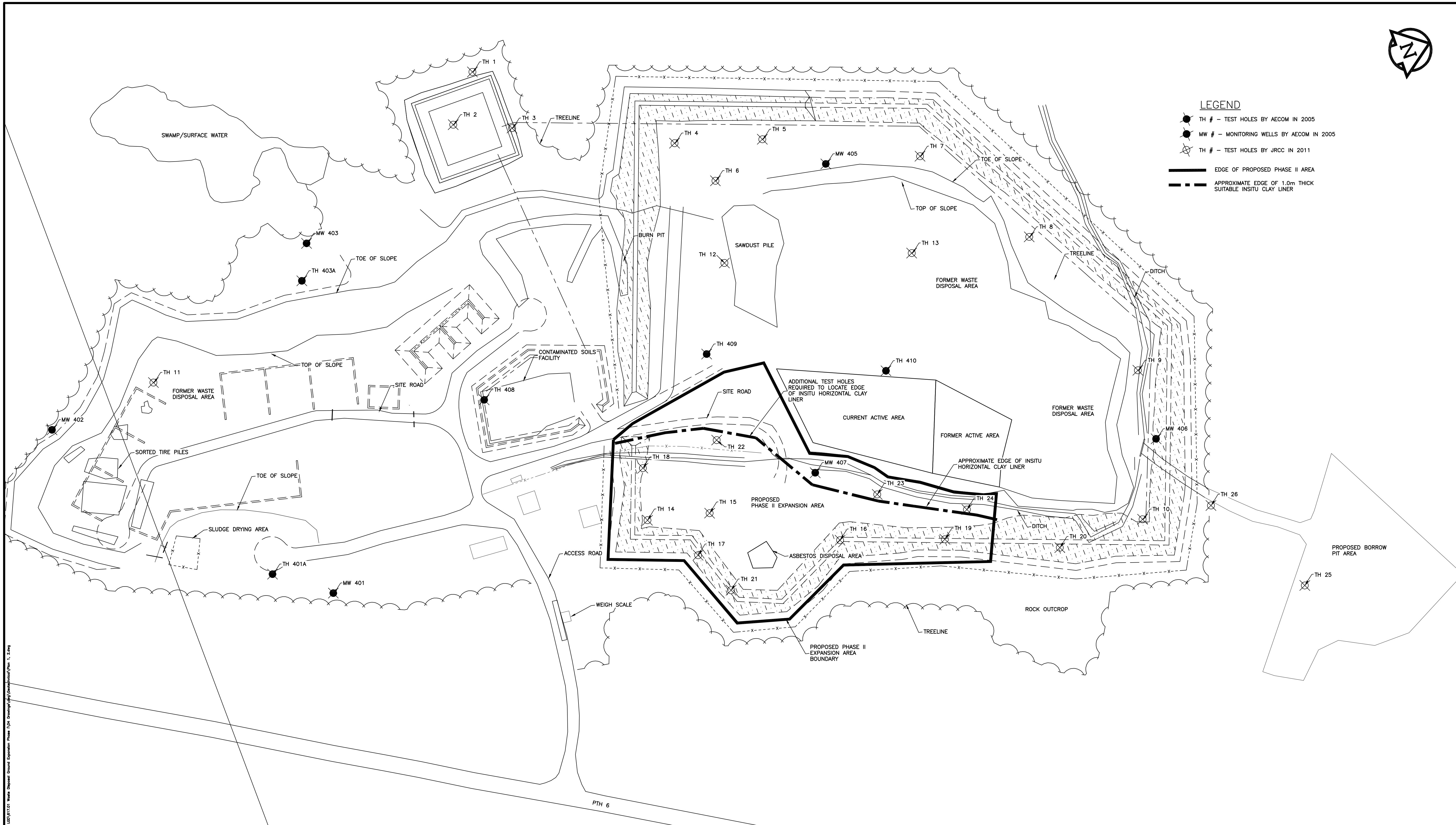
Plan 2: Topographic Survey Plan with Contour Lines

Plan 3: Past and Future Test Hole Location Plan

Test Hole Logs

National Testing Laboratories Ltd. Test Results

Plans



No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM STAMP

ENGINEER'S SEAL

PRELIMINARY

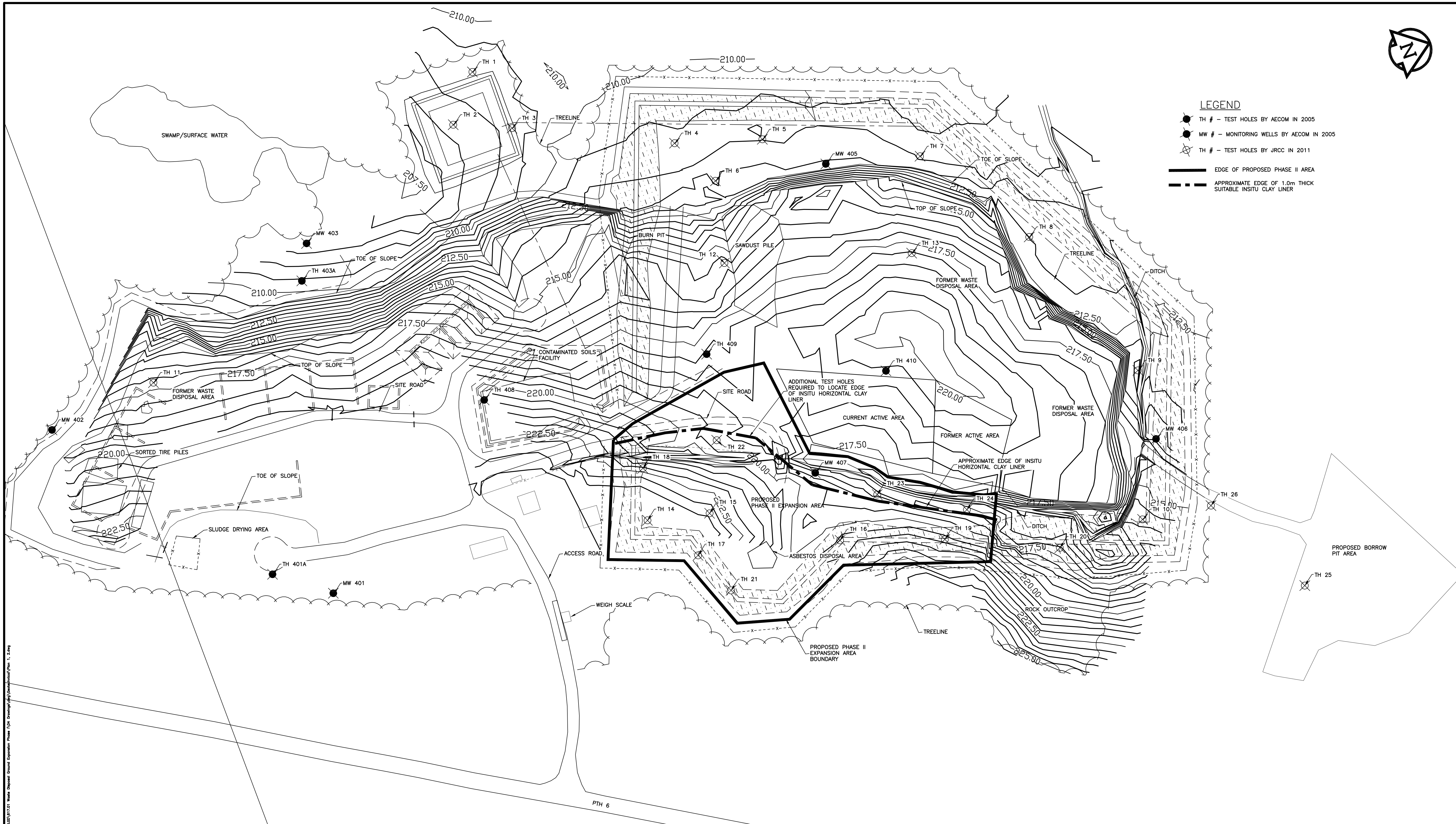
J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND

CODE: M–617.01

TITLE: TEST HOLE LOCATION PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/09/15	1	1 of 3



SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

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Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

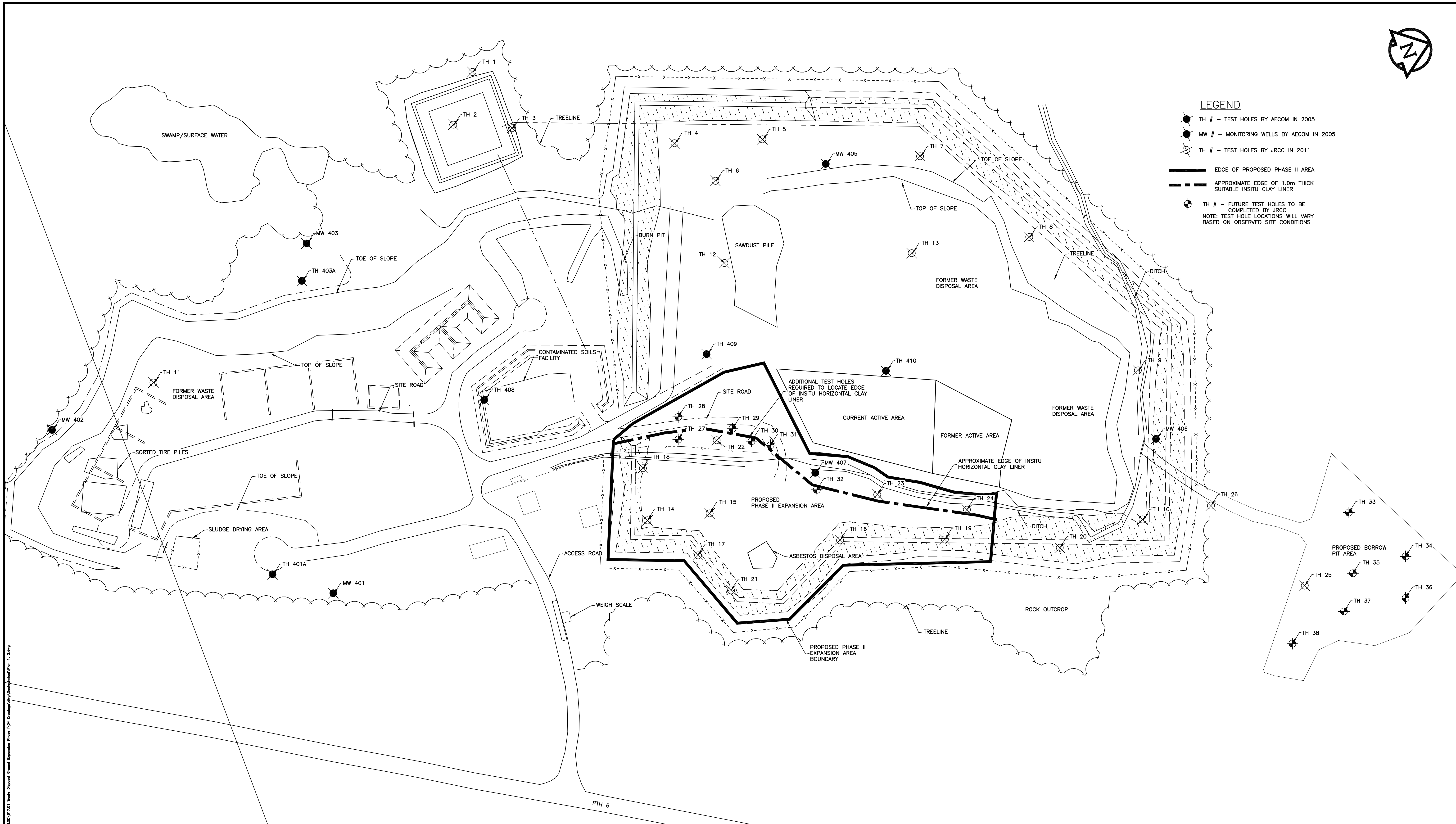
DESIGNED BY:	DRAWN BY:	REVIEWED BY:
JC	BM	JC

PROJECT:
LDG OF MYSTERY LAKE
WASTE DISPOSAL GROUND

CODE:
M–617.01

TITLE:
TOPOGRAPHIC SURVEY PLAN WITH CONTOUR LINES

SCALE:	DATE:	PLAN:	SHEET:
1:1250	11/09/15	2	2 of 3



SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

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APEGM STAMP

ENGINEER'S SEAL

PRELIMINARY

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND

CODE: M-617.01

TITLE: PAST AND FUTURE TEST HOLE LOCATION PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/09/15	3	3 of 3

Test Hole Logs

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX

GW. : Well graded gravels and gravel sand mixtures, little or no fines

GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines

GM. : Silty gravels, gravel-sand-silt mixtures

GC. : Clayey gravels, gravel-sand-clay mixtures

SW. : Well graded sands, gravelly sands, little or no fines

SP. : Poorly graded sands, or gravelly sands, little or no fines

SM. : Silty sands, sand-silt mixtures

SC. : Clayey sands, sand-clay mixtures

ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity

CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays

OL. : Organic silts and organic silty clays of low plasticity

CI. : Inorganic clays of medium or intermediate plasticity

MH. : Inorganic silts, fine sandy or silty soils

CH. : Inorganic clays of high plasticity, fat clays

OH. : Organic clays of medium to high plasticity, organic silts

Pt. : Peat, humus, swamp soils with high organic contents

TOPSOIL

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

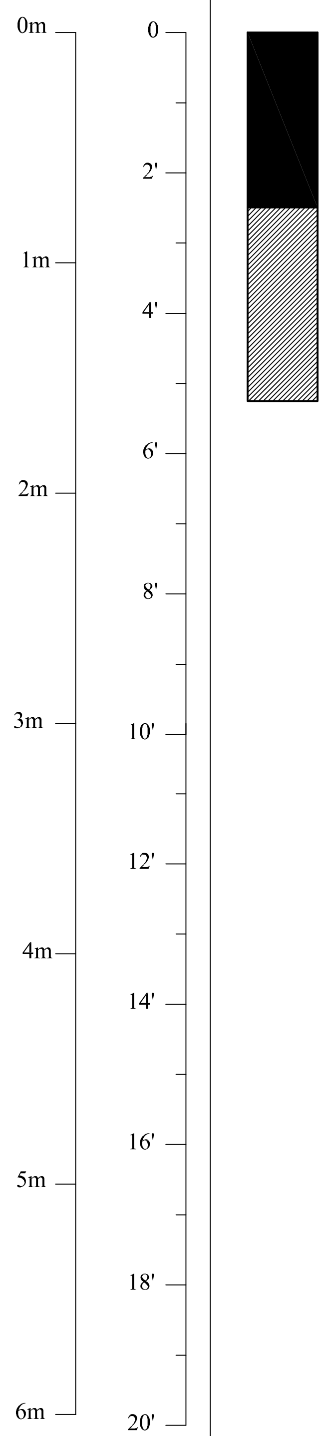
LOCATION : 6171164.05 N
568051.39 E

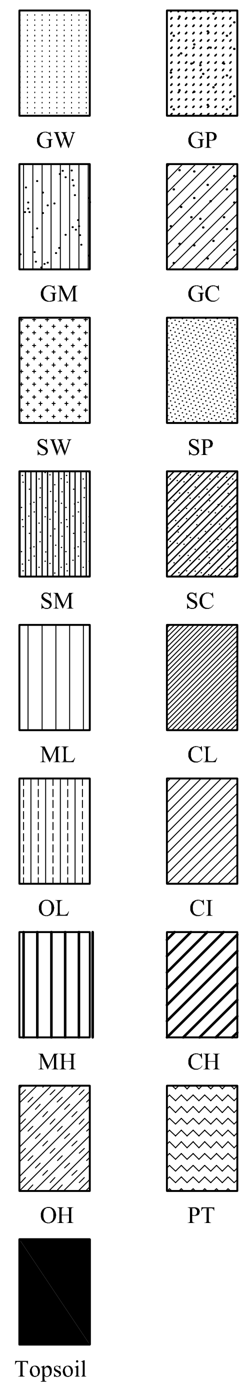
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : August 18, 2011

ELEVATION : 225.45 m

TEST HOLE # 14

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	TOPSOIL - black, organic, moist, loose, crumbly, some roots CLAY - low plastic, grey, loose, crumbly, dry BEDROCK ENCOUNTERED AT 1.6m NOTE - no water infiltration observed in the hole no caving of the hole observed



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171206.45 N
568062.06 E

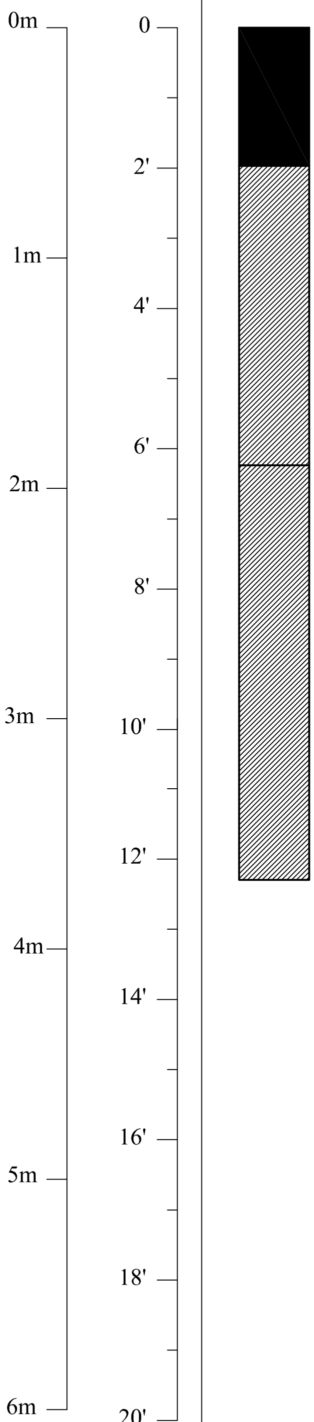
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : August 18, 2011

ELEVATION : 223.54 m

TEST HOLE # 15

DEPTH OF SAMPLE	FIELD CLASSIFICATION

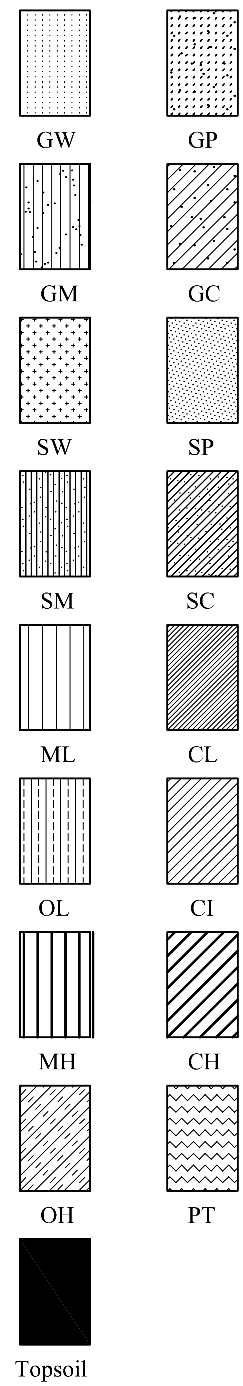


TOPSOIL - black, organic, moist, loose, crumbly, some roots

SILTY CLAY - low plastic sandy, silty, grey, loose, crumbly, moist clay varved with brown silty medium plastic clay, trace sand

SILTY CLAY - low plastic sandy, silty, grey, loose, crumbly clay

BEDROCK ENCOUNTERED AT 3.7m
NOTE - no water infiltration observed at the time of excavation, after 2 hours massive cave-in of the hole was observed



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171285.89 N
568110.39 E

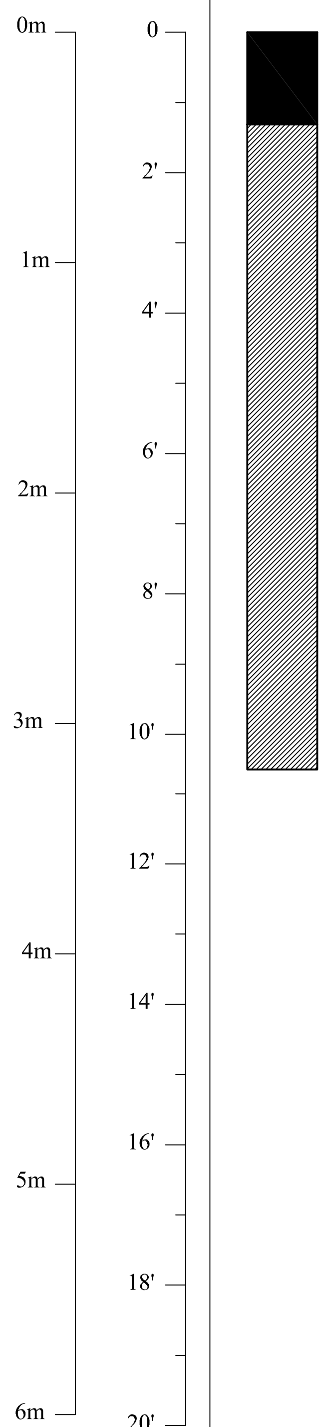
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

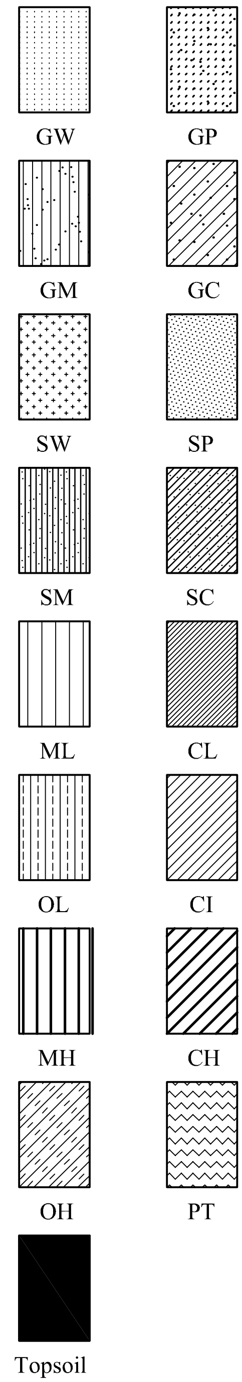
DATE : August 18, 2011

ELEVATION : 220.171 m

TEST HOLE # 16

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	TOPSOIL - black, organic, moist, loose, crumbly, some roots
	SILTY CLAY - low plastic sandy, silty, grey, loose, crumbly, moist clay varved with brown low plastic, silty clay
	BEDROCK ENCOUNTERED AT 3.2m NOTE - no water infiltration observed in the hole, caving of the walls observed





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171189.12 N
568086.25 E

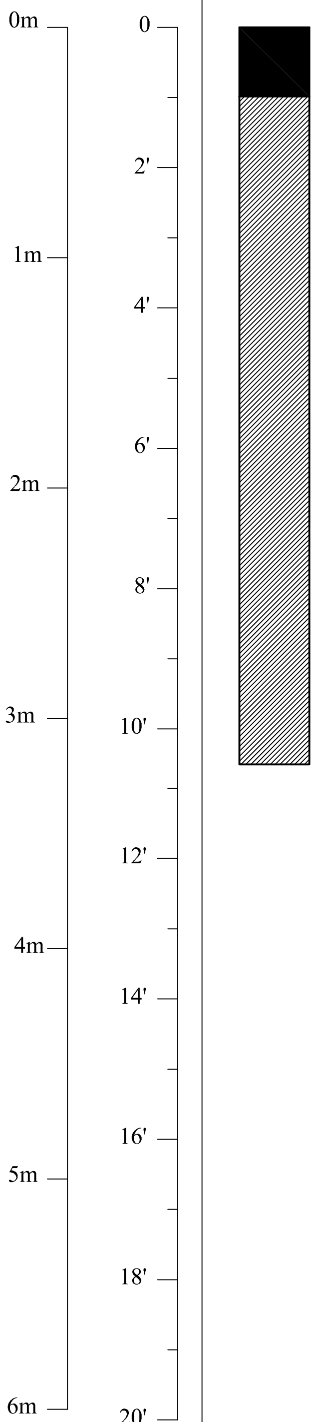
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : August 18, 2011

ELEVATION : 223.52 m

TEST HOLE # 17

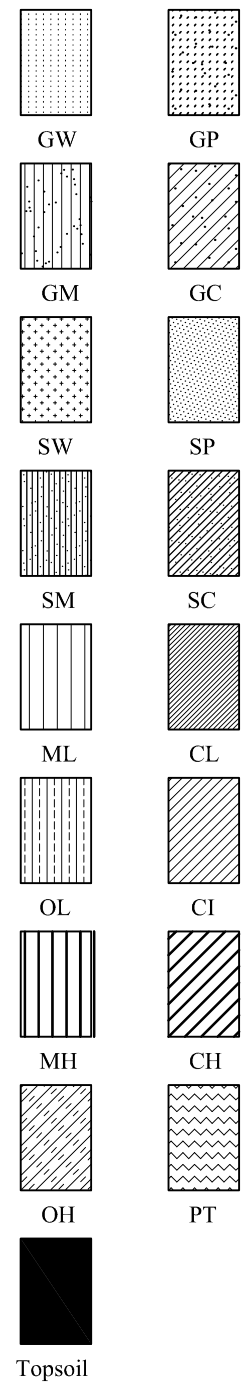
DEPTH OF SAMPLE	FIELD CLASSIFICATION



TOPSOIL - black, organic, moist, loose, crumbly, some roots

SILTY CLAY - low plastic sandy, silty, grey, loose, crumbly clay varved with brown silty medium plastic clay

BEDROCK ENCOUNTERED AT 3.2m
NOTE - no water infiltration observed in the hole, no caving of the walls observed



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171173.25 N
568016.04 E

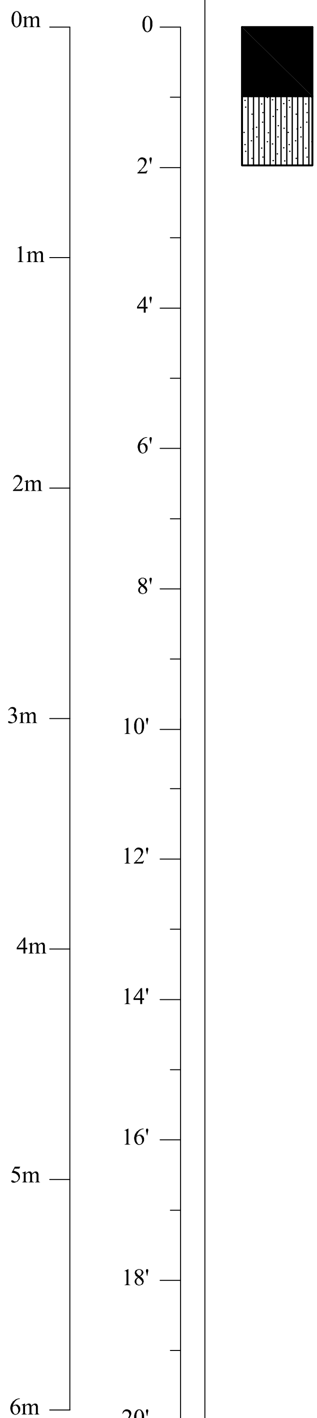
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

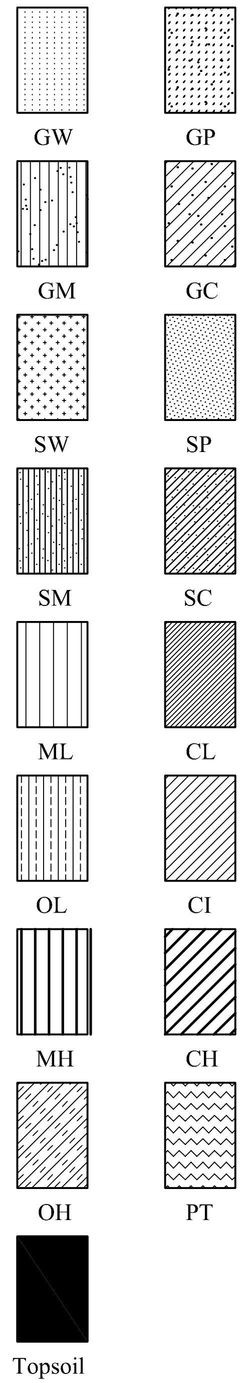
DATE : August 18, 2011

ELEVATION : 221.84 m

TEST HOLE # 18

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	TOPSOIL - black, organic, moist, loose, crumbly, some roots SANDY SILT - grey, wet, loose, crumbly, some low plastic clay BEDROCK ENCOUNTERED AT 0.6m NOTE - no water infiltration observed in the hole, no caving of the walls observed





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171355.00 N
568134.37 E

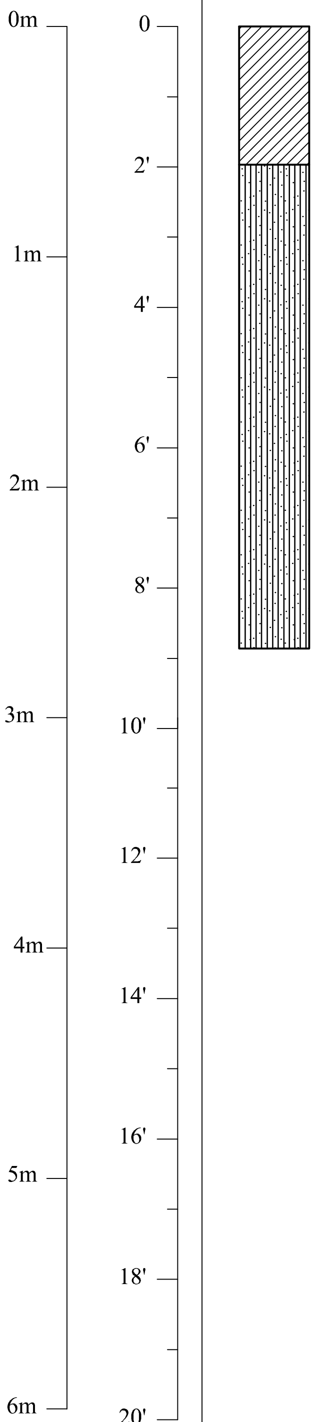
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

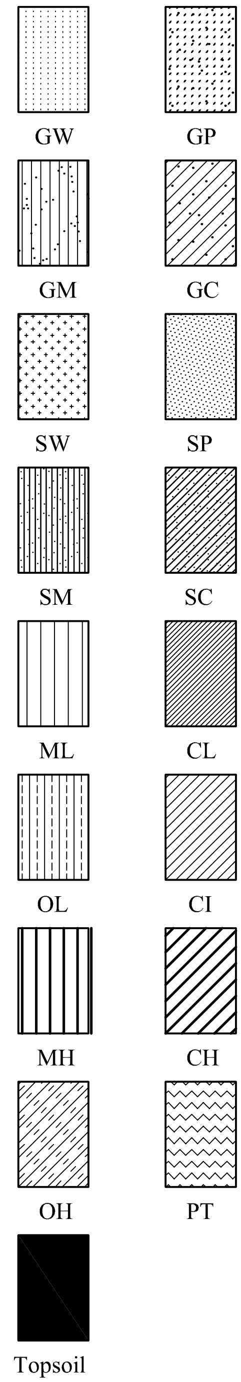
DATE : August 18, 2011

ELEVATION : 220.78 m

TEST HOLE # 19

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	CLAY - medium plastic, grey/brown, soft, moist, silty, some large boulders
	SAND - silty, moist, loose, crumbly, small stones to large boulders
	BEDROCK ENCOUNTERED AT 2.7m NOTE - no water infiltration observed in the hole, no caving of the walls observed





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171428.64 N
568166.80 E

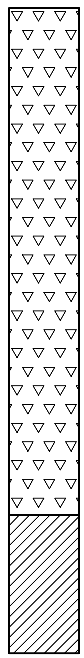
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

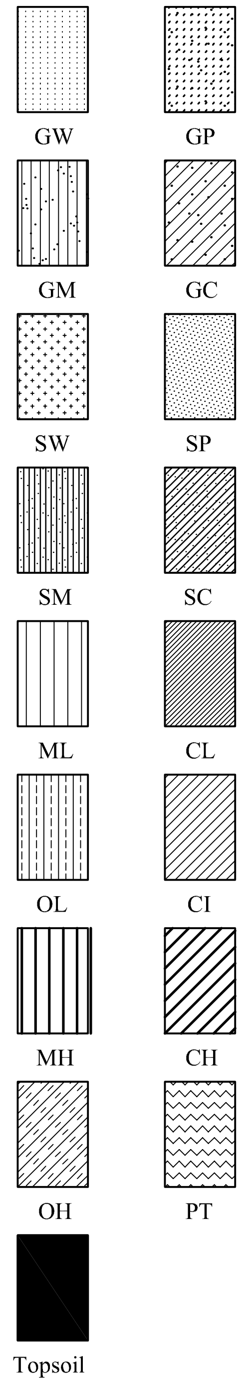
DATE : August 18, 2011

ELEVATION : 216.93 m

TEST HOLE # 20

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	
2'	
1m	GARBAGE - plastic, rags, etc. mixed with soil, odorous
4'	
6'	
2m	
8'	CLAY - medium plastic, silty clay, grey, hard, moist
	BEDROCK ENCOUNTERED AT 2.8m NOTE - leachate water infiltration observed at 2.2 m, some caving of the garbage layer was observed
3m / 10'	
12'	
4m	
14'	
16'	
5m	
18'	
6m / 20'	





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171202.60 N
568117.02 E

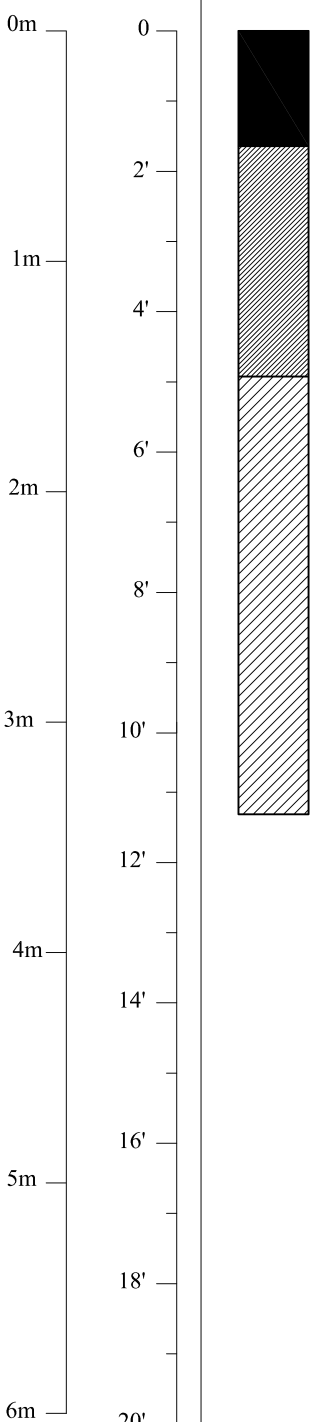
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

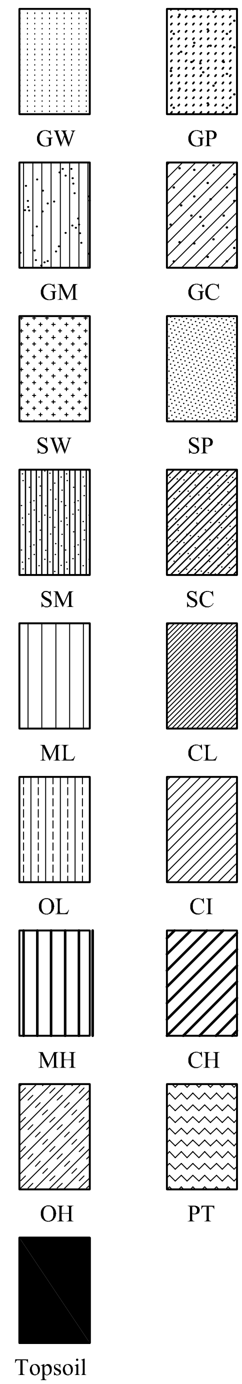
DATE : August 18, 2011

ELEVATION : 221.127 m

TEST HOLE # 21

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - black, organic, moist, loose, crumbly, some roots
2' – 4'	SILTY CLAY - low plastic, grey, loose, crumbly, moist, some small stones
6' – 10'	CLAY - low - medium plastic, grey/brown, firm, moist, silty, trace sand
3.4m	BEDROCK ENCOUNTERED AT 3.4m NOTE - high rate water infiltration observed from the surface, caving of the walls observed at the bottom of the test hole





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171228.22 N
568015.67 E

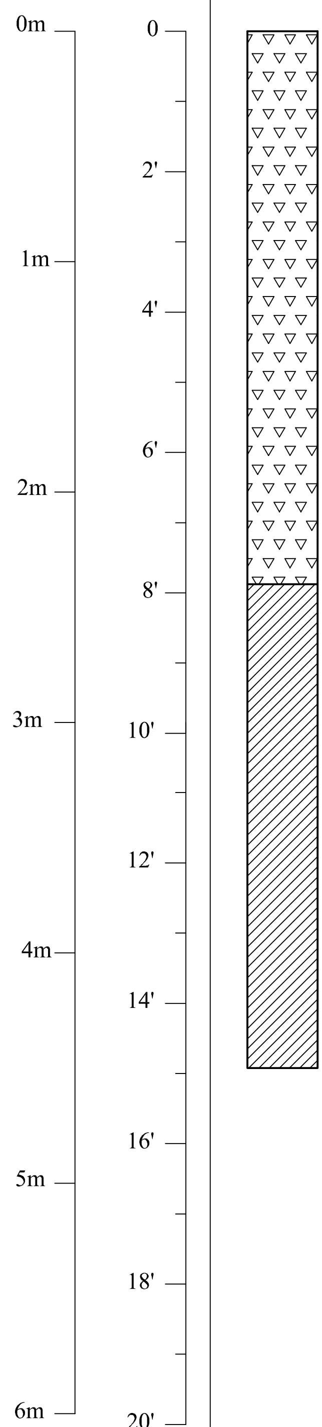
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

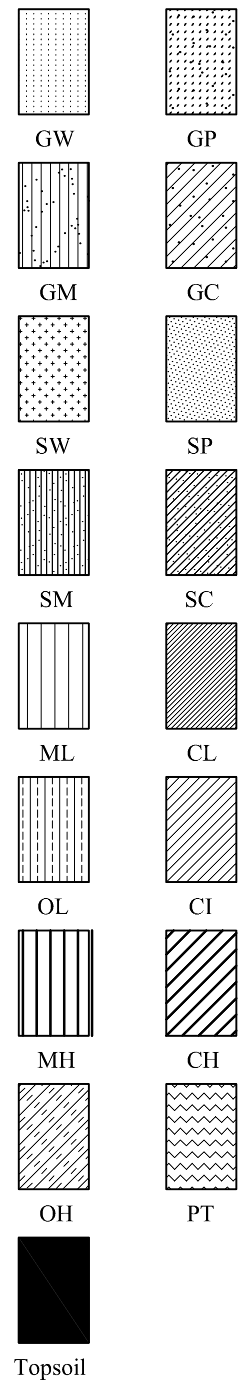
DATE : August 18, 2011

ELEVATION : 219.30 m

TEST HOLE # 22

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	GARBAGE - plastic, rags, metals, etc. mixed with soil, odorous
	CLAY - low-medium plastic, tan/brown, firm, moist, varved, some silt inclusions
	BEDROCK ENCOUNTERED AT 4.5m NOTE - no water infiltration observed in the hole, no caving of the walls observed





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

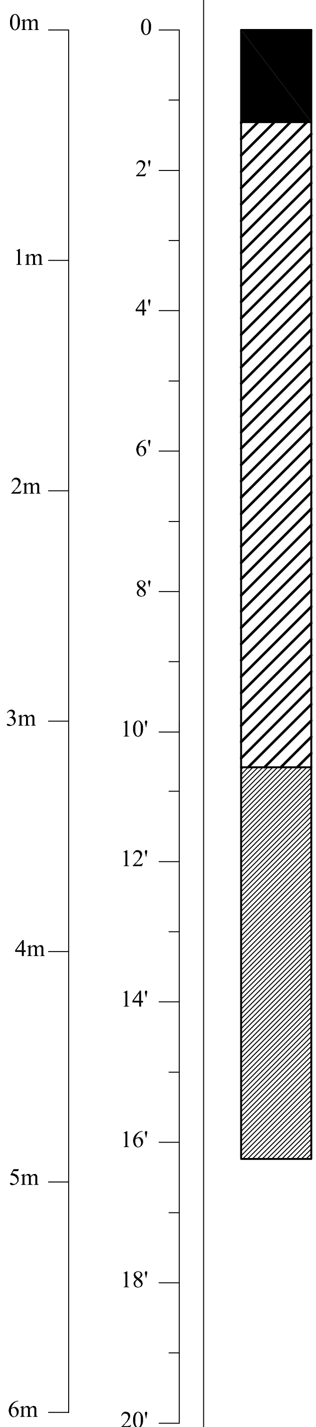
LOCATION : 6171321.04 N
568089.01 E

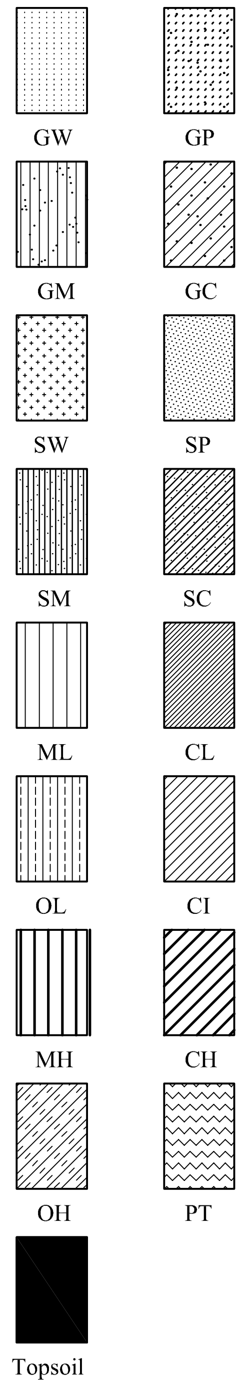
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : August 18, 2011

ELEVATION : 218.23 m

TEST HOLE # 23

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	TOPSOIL - black/brown clayey, organic, moist, loose,crumbly, some roots CLAY - medium-high plastic, brown/red, trace silt, moist, varved, firm, crumbly CLAY - low plastic, light grey, silty, trace sand, iron inclusions, wet, firm HOLE TERMINATED IN CLAY AT 4.9m NOTE - no water infiltration observed in the hole, some caving of the walls at approx. 3.5 m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171376.48 N
568119.97 E

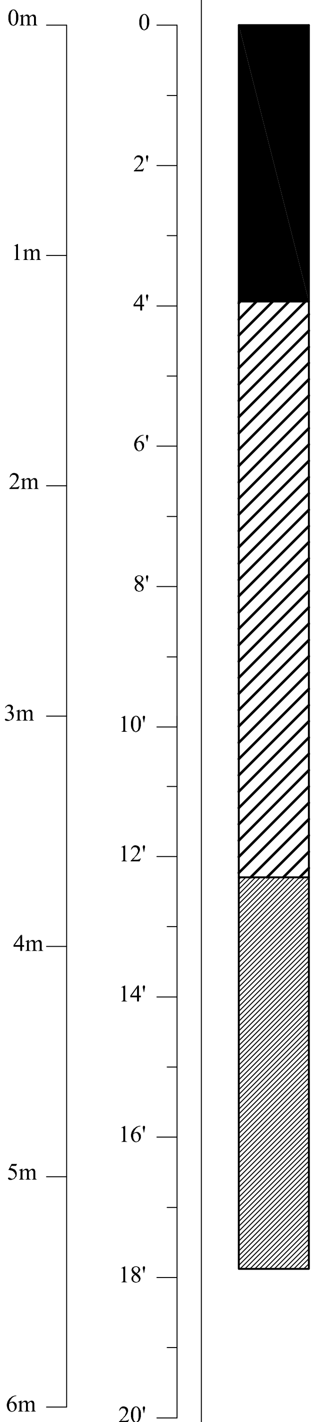
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

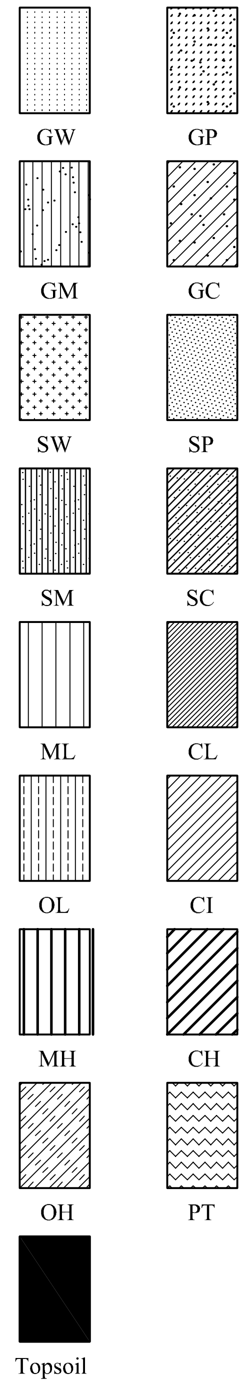
DATE : August 18, 2011

ELEVATION : 217.38 m

TEST HOLE # 24

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0 – 4'	TOPSOIL - black/brown clayey, organic, moist, loose,crumbly, some roots and logs
4' – 12'	CLAY - medium-high plastic, brown/red, trace silt, moist, varved, firm, crumbly
12' – 5.4m	CLAY - low plastic, light grey, silty, trace sand, iron inclusions, wet, firm
	HOLE TERMINATED IN CLAY AT 5.4m NOTE - water infiltration observed in the hole at approx. 1.2m, no caving of the walls observed





The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171580.87 N
568249.03 E

PROJECT : LGD of Mystery Lake - Waste Disposal Ground

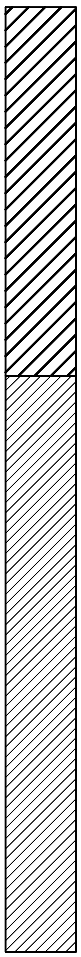
DATE : August 18, 2011

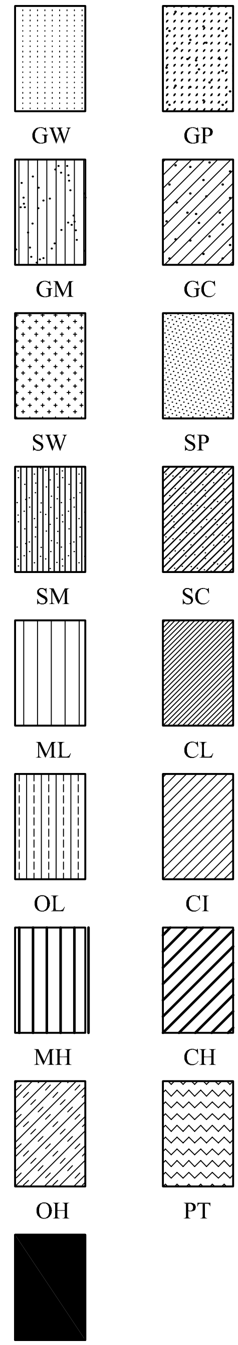
ELEVATION : 213.89 m

TEST HOLE # 25

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0 – 1.16m (approx. 3.8')	CLAY - high plastic, brown/red, firm, moist, trace silt
to 4.1m	CLAY - medium - high plastic, grey/blue, moist, stiff, uniform, trace silt
4.1m	HOLE TERMINATED IN CLAY AT 4.1m NOTE - no water infiltration observed in the hole, no caving of the walls observed

Depth scale: 0m, 1m, 2m, 3m, 4m, 5m, 6m; 0, 2', 4', 6', 8', 10', 12', 14', 16', 18', 20'





The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171537.90 N
568174.49 E

PROJECT : LGD of Mystery Lake - Waste Disposal Ground

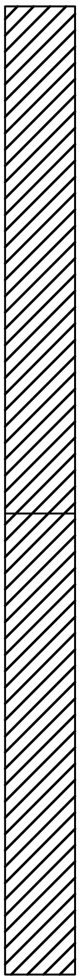
DATE : August 18, 2011

ELEVATION : 214.76 m

TEST HOLE # 26

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 2.2m (0' – 7.2')	CLAY - high plastic, brown/red, firm, crumbly, moist, trace silt
2.2m – 4.2m	CLAY - high plastic, brown, hard, trace silt
4.2m	HOLE TERMINATED IN CLAY AT 4.2m NOTE - no water infiltration observed in the hole, no caving of the walls observed

Depth scale: 0m, 1m, 2m, 3m, 4m, 5m, 6m; 0, 2', 4', 6', 8', 10', 12', 14', 16', 18', 20'



GW GP GM GC SW SP SM SC ML CL OL CI MH CH OH PT Topsoil

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of a unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil represent our opinions. J.R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

National Testing Laboratories Ltd. Test Results

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

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Winnipeg, MB R3Y 1G4
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www.nationaltestlabs.com

J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

Attention: Brett McCormac

September 2, 2011

Project: Mystery Lake Waste Disposal Facility

Soil samples were submitted to our laboratory on August 23, 2011. The following tests were conducted on selected soil samples:

- water content (ASTM D2216)
- particle size analysis (ASTM D422)
- liquid limit, plastic limit, and plasticity index (ASTM D4318)
- soil classification (ASTM D2487)
- visual classification

The test results for the soil samples are summarized in the following tables and in the attached particle size analysis.

An assessment of the bagged soil samples was conducted to determine whether the soil represented by the bagged samples could be used in-situ as a waste disposal ground liner and would obtain a hydraulic conductivity of less than 1.0×10^{-7} cm/sec without being reworked, and when re-moulded and re-compacted.

Based upon previous testing conducted in our laboratory, homogeneous soil samples with a plasticity index greater than 25 and a clay content greater than 50% will typically have a hydraulic conductivity of 1.0×10^{-7} cm/sec or less. Samples TH15 0.6-1.9 m, TH21 1.5-3.4 m, TH22 2.4-4.5 m, and TH25 1.6-4.1 m all had plasticity indexes of below 25. Hydraulic conductivity testing of these materials is recommended to determine their suitability for use as a waste disposal ground liner. The remaining bagged samples were considered suitable for use as a waste disposal ground liner. Our comments regarding the potential use of the material as a waste disposal ground liner are based upon the soil being homogeneous with no preferential flow paths and being properly placed and compacted to maximum density near its optimum moisture content. It should be noted that estimating the hydraulic conductivity of a soil based upon classification test results (plasticity index and particle size analysis) alone might be misleading if the soil contains layers of sand, silt, or organic material.

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Aron Piamsalee

Aron Piamsalee, B.Sc., EIT
Geotechnical Project Manager

TABLE 1
SUMMARY OF WATER CONTENT, PARTICLE SIZE, ATTERBERG LIMITS, SOIL CLASSIFICATION TEST DATA
MYSTERY LAKE WASTE DISPOSAL FACILITY

Testhole	Depth (m)	Visual Classification	Water Content (%)	Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification ASTM D2487	Potential Use as a waste disposal ground liner without being reworked	Potential Use as a waste disposal ground liner when re-moulded and re-compacted
					Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm								
TH15	0.6-1.9	tan to brown, firm to stiff, moist, low plasticity clay, silty, trace sand	25.9	0.4	0.2	0.4	1.7	23.7	73.6	29	17	12	CL(Lean Clay)	HC Testing Recommended	
TH21	1.5-3.4	brown, firm, moist, low plasticity clay, silty, trace sand	25.3	0.0	0.2	1.2	6.6	30.8	61.2	27	15	12	CL(Lean Clay)	HC Testing Recommended	
TH22	2.4-4.5	tan to brown, firm to stiff, moist, low plasticity clay, some silt	31.5	0.0	0.0	0.1	0.1	19.6	80.2	32	16	16	CL(Lean Clay)	HC Testing Recommended	
TH23	0.4-3.2	brown, firm to stiff, moist, high plasticity clay	34.6	0.0	0.0	0.1	0.2	0.2	99.5	70	25	45	CH(Fat Clay)	Yes	Yes
TH24	1.2-3.7	brown, stiff, moist, high plasticity clay	34.7	0.0	0.0	0.1	0.2	0.5	99.2	60	23	37	CH(Fat Clay)	Yes	Yes
TH25	0-1.6	brown, firm, moist, high plasticity clay	34.2	0.0	0.0	0.0	0.3	0.4	99.3	63	24	39	CH(Fat Clay)	Yes	Yes
TH25	1.6-4.1	tan to brown, stiff, moist, low plasticity clay, trace silt	31.6	0.0	0.0	0.1	0.1	1.0	98.8	45	21	24	CL(Lean Clay)	HC Testing Recommended	
TH26	0-2.2	brown, firm, moist, high plasticity clay, trace silt	29.3	0.0	0.0	0.1	0.4	1.8	97.7	57	20	37	CH(Fat Clay)	Yes	Yes

Notes:
1.A high speed stirring device was used for 1 minute to disperse the test samples for particle size analysis.
2.Atterberg limits conducted in accordance with ASTM D4318 Method B (one-point liquid limit).
3.The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis.

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

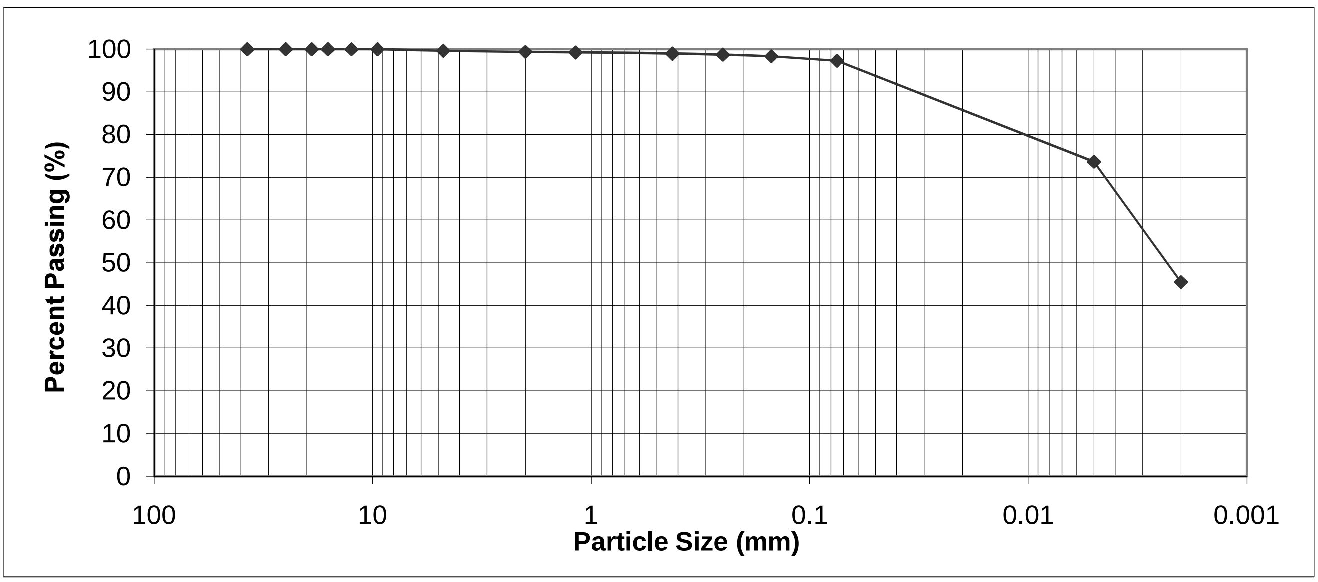
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH15 0.6-1.9 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	99.6
2.00 mm	99.4

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.3
0.425 mm	99.0
0.250 mm	98.7
0.150 mm	98.4
0.075 mm	97.3
0.005 mm	73.6
0.002 mm	45.4
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.4	0.2	0.4	1.7	23.7	73.6	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

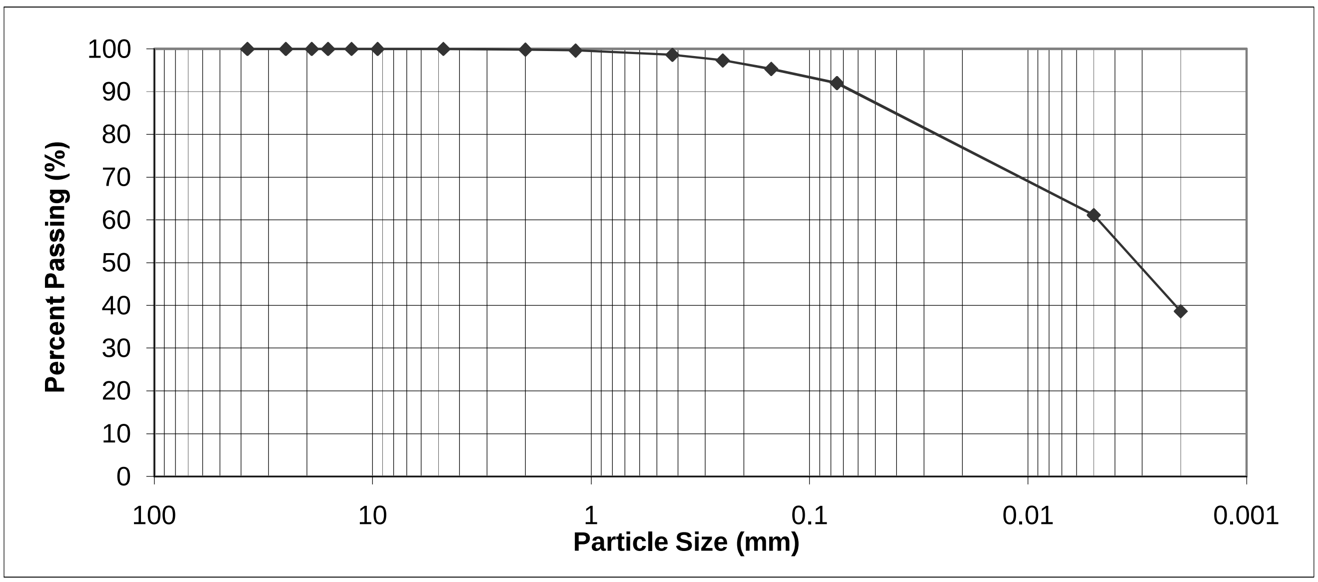
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH21 1.5-3.4 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	99.8

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.7
0.425 mm	98.6
0.250 mm	97.3
0.150 mm	95.3
0.075 mm	92.0
0.005 mm	61.2
0.002 mm	38.6
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.2	1.2	6.6	30.8	61.2	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

PARTICLE SIZE ANALYSIS
ASTM D422

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

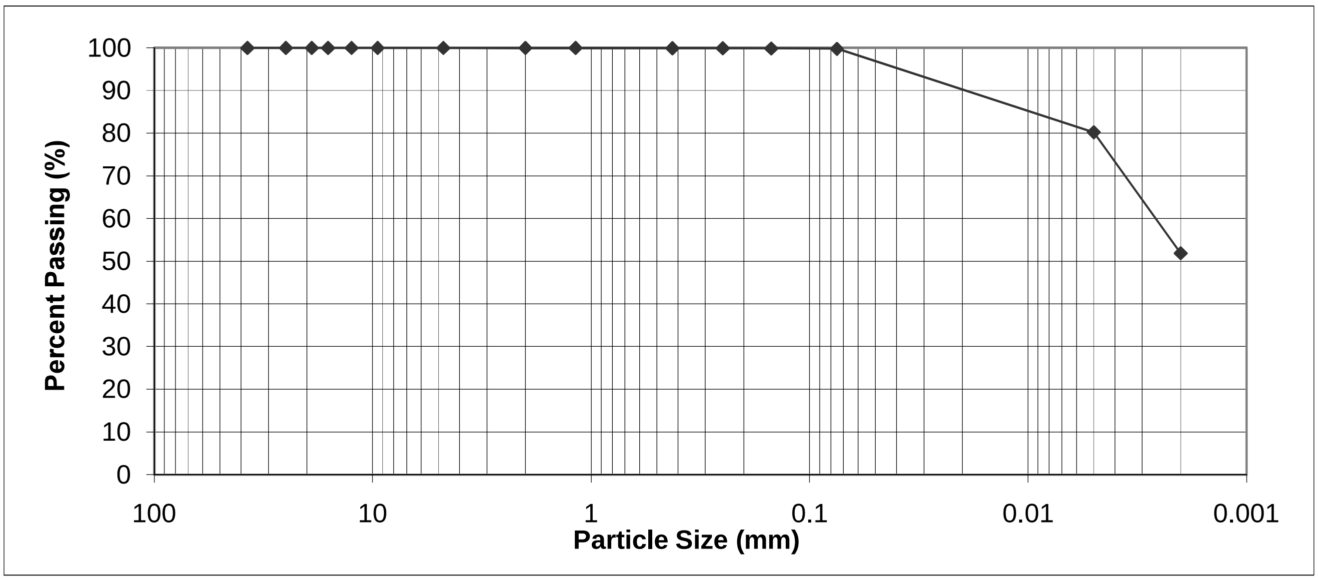
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH22 2.4-4.5 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.9
0.075 mm	99.8
0.005 mm	80.2
0.002 mm	51.8
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.1	19.6	80.2	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

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PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

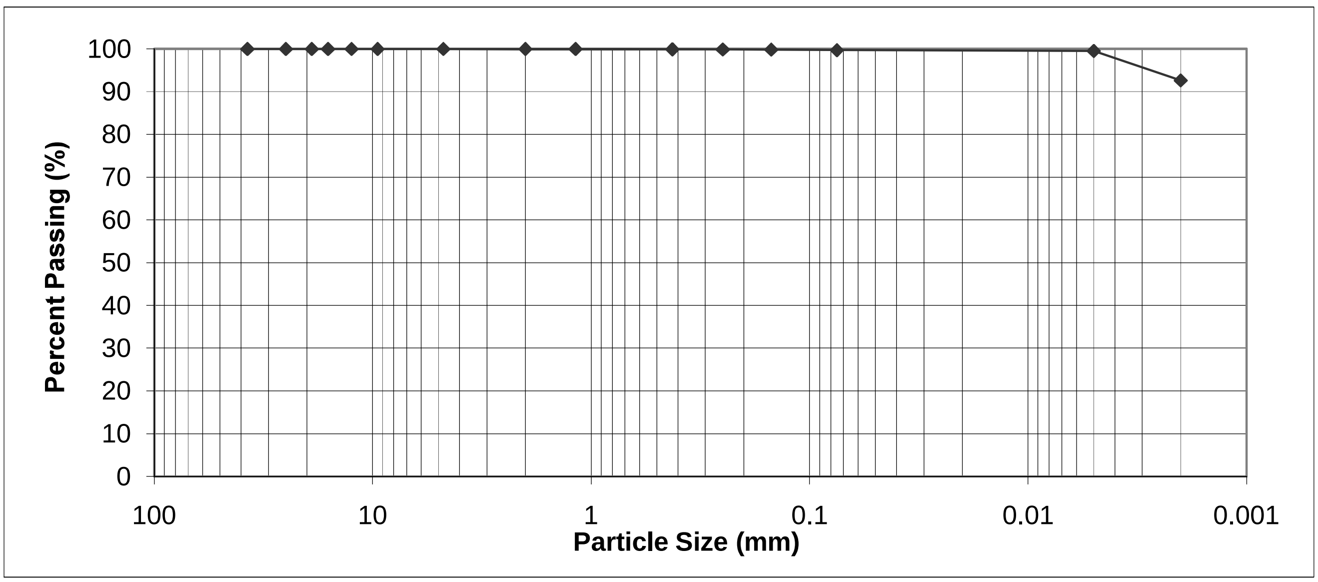
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH23 0.4-3.2 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.7
0.005 mm	99.5
0.002 mm	92.6
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.2	0.2	99.5	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

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PARTICLE SIZE ANALYSIS
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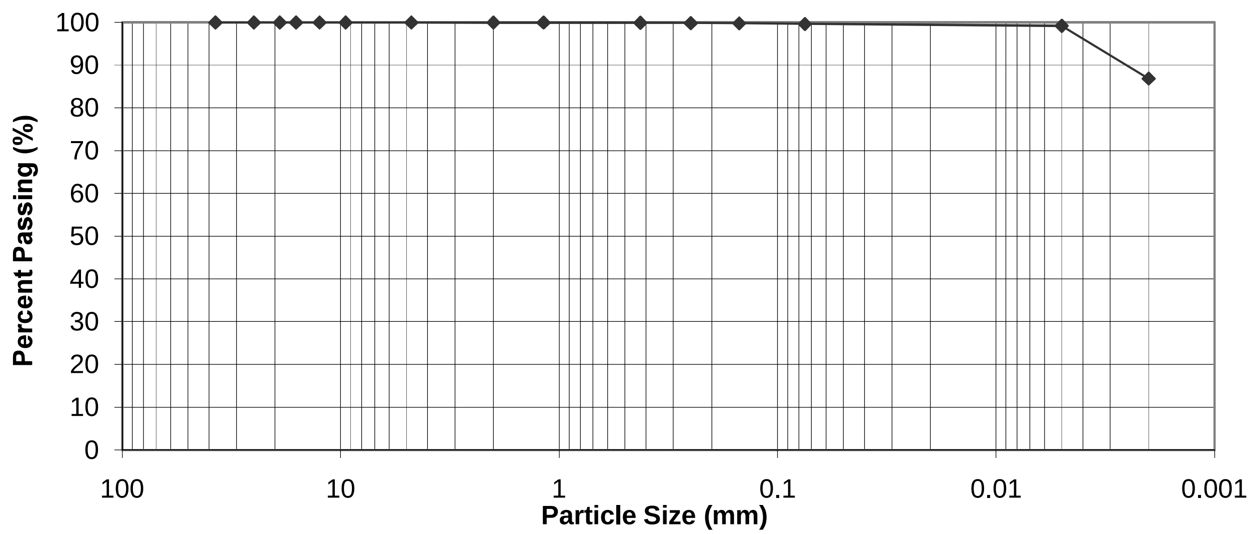
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH24 1.2-3.7 m
DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.7
0.005 mm	99.2
0.002 mm	86.8
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.2	0.5	99.2	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
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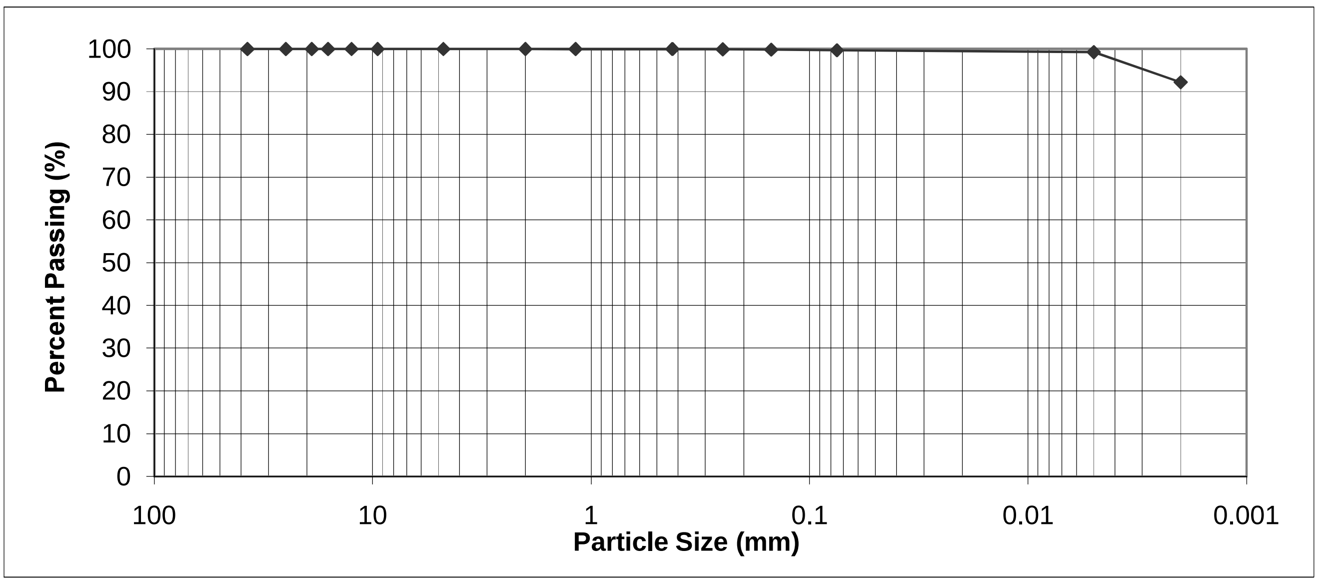
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH25 0.0-1.6 m
DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	100.0
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.7
0.005 mm	99.3
0.002 mm	92.2
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.3	0.4	99.3	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

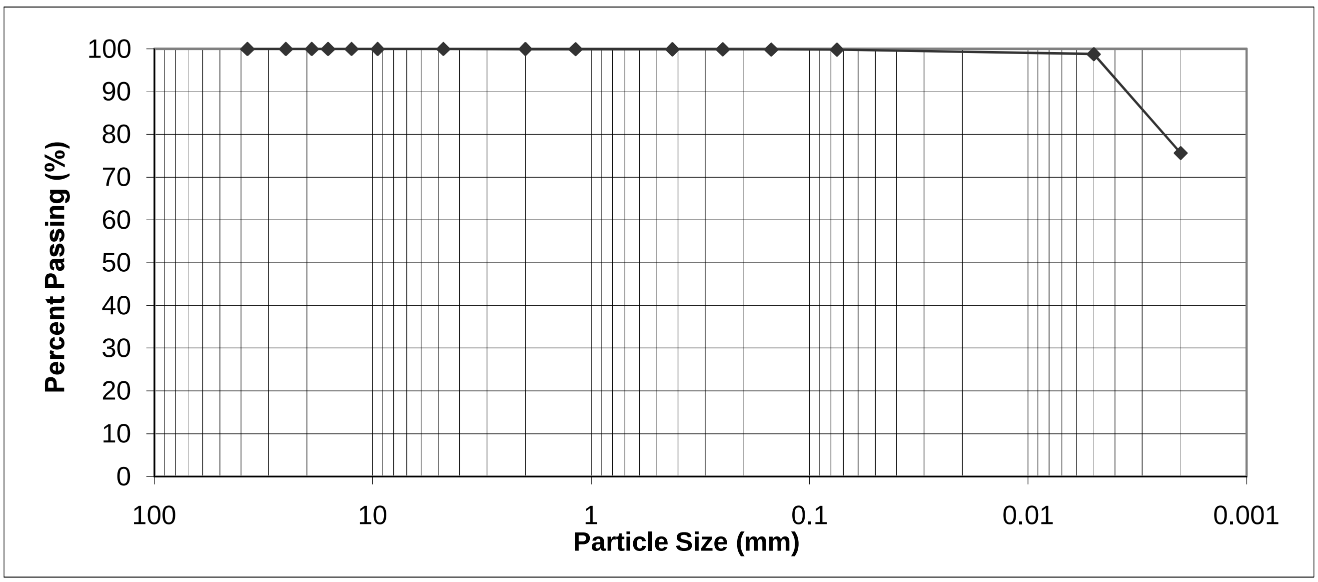
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH25 1.6-4.1 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.9
0.075 mm	99.8
0.005 mm	98.8
0.002 mm	75.6
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.1	1.0	98.8	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

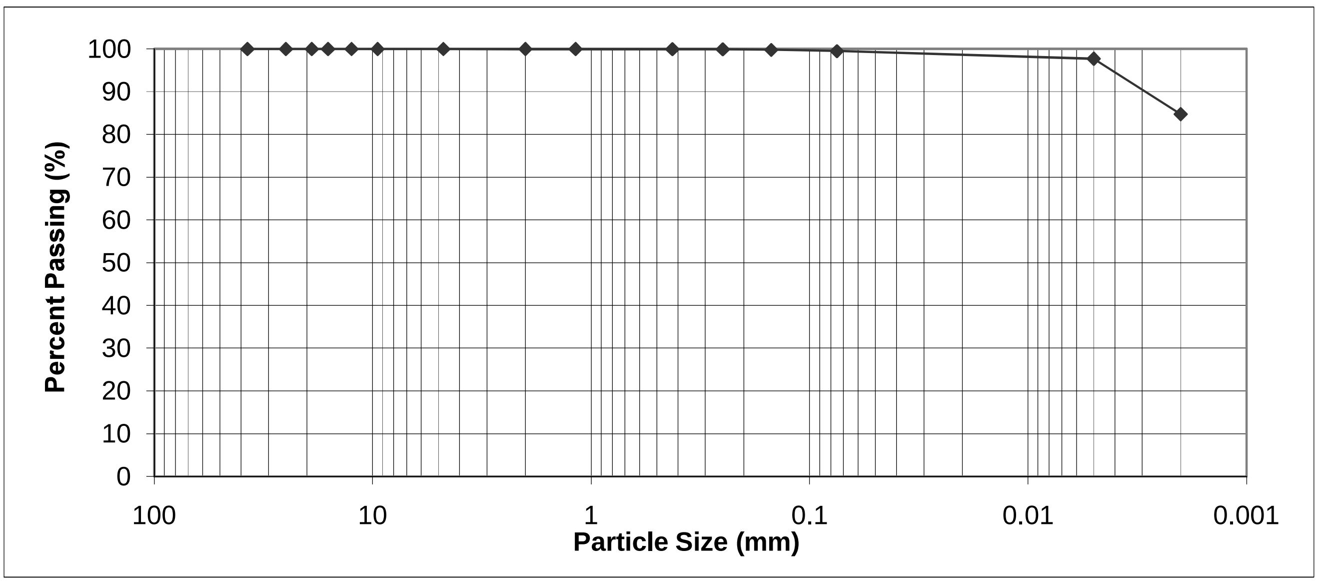
PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: J.R. Cousin Consultants Ltd.
SAMPLE ID: TH26 0.0-2.2 m

DATE RECEIVED: August 23, 2011
TESTED BY: Nathan Boenders



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.5
0.005 mm	97.7
0.002 mm	84.7
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.4	1.8	97.7	NT

Note: Colloids content not tested

September 2, 2011

REVIEWED BY: Aron Piamsalee, B.Sc, EIT

LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes, JR Cousin Consultants Ltd., 2012

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P&R 14.43 JRCC

M-617.01

LGD of MYSTERY LAKE

Geotechnical Investigation for the Waste Disposal Ground Scope Change #2 – Additional Test Holes

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: Mar 28/12

PROVINCE OF MANITOBA
G. R. COUSIN
12/03/28
REGISTERED PROFESSIONAL ENGINEER

Prepared by: J. R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

March 2012

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. J. R. Cousin Consultants Ltd. (JRCC) wishes to thank the LGD of Mystery Lake who assisted with organization and onsite works.

REMARKS

Conclusions reached in this report are based upon the generalization of data available to us at the time of forming our opinions. Information in this document may rely on previous studies, investigative work and data by others. JRCC cannot be responsible for actual site conditions proved to be at variance with any generalized data. This report was completed in accordance with generally accepted professional engineering principles and practice. Any use of this report by a third party is the responsibility of the third party, JRCC accepts no responsibility for third party decisions or actions based on the report. No other warranty or guarantee expressed, implied or statutory is made.

TABLE OF CONTENTS

1.0 INTRODUCTION

J. R. Cousin Consultants Ltd. (JRCC) conducted a geotechnical investigation for the Waste Disposal Ground (WDG) Expansion at the LGD of Mystery Lake. The existing WDG at the LGD of Mystery Lake is located on Part NW ¼ 18, S ½ and NW ¼ 19 in TWP 77-3 WPM and in Part SE ¼ 24-77-4 WPM, approximately 4 km south of the City of Thompson.

A total of 14 test holes were excavated at the WDG site. Test hole locations are shown on Plan 1 in the Appendix.

This report outlines the findings of the geotechnical investigation at the WDG site and evaluates the soils to determine their suitability for use as a landfill liner. The report also identifies potential difficulties (i.e. depth to bedrock, soil types and subsurface water elevations) associated with construction.

2.0 BACKGROUND

The geotechnical investigation was part of Scope Change #2 to determine the actual re-worked and re-compacted hydraulic conductivity of the clay soils from the borrow pit and to determine the WDG east boundary of the minimum 1.0 m thick insitu clay liner. Test holes were also completed to determine the depth of waste in the area of the vertical cut-off wall to be constructed as part of the Phase I construction works.

The additional test holes were deemed necessary based on borderline laboratory test results received during the LGD of Mystery Lake Geotechnical and Topographic Investigation for the Waste Disposal Ground Proposed Phase II Works.

3.0 GEOTECHNICAL FIELD INVESTIGATION

The onsite investigation at the LGD of Mystery Lake was conducted on October 27, 2011. Smook Contractors Ltd. was employed to complete the test holes using a track mounted excavator under direct supervision by JRCC's field representative.

A total of 14 test holes were excavated during the investigation. Two test holes were excavated to determine the depth of waste near the vertical cut-off wall to be constructed as part of the Phase I Works (TH27 – TH28). Seven test holes were excavated along the east edge of the WDG to determine the edge of the insitu horizontal clay liner (TH29 – TH33 and TH 39 – TH40). Five test holes were excavated in the borrow pit area to determine the suitability of the clay soil for use as a re-worked and re-compacted clay liner (TH34 – TH38). Test holes were excavated to a depth ranging between 3.0 m and 5.8 m.

3.1 Test Holes

The subsurface soil profile within each test hole was logged, water conditions were noted and representative soil samples were taken as the soils varied along the profile. The samples were visually field-classified. Following excavation, the depth of standing water was measured and any caving of the holes was determined. Test holes were backfilled with the excavated soils. Test hole locations are shown on Plan 1 in the Appendix.

The following are the general soil profiles from the borrow pit, east of the WDG and of the existing waste. Details of each individual test hole can be found in the test hole logs in the Appendix.

3.1.1 Soil Profile at the Borrow Pit

The general soil profile from the test holes taken in the borrow pit area (TH34 – TH38) consisted of a brown stiff high plastic clay and a brown stiff high plastic clay varved with a tan medium plastic silty clay between 1.3 and 4.8 m thick. The following layer was a grey high plastic clay observed to a maximum depth of 5.8 m.

The exception was TH38 which had medium plastic silty clay from 0 – 0.6 m followed by brown medium plastic clay varved with silty sandy grey low plastic clay.

3.1.2 Soil Profile East of the WDG

The soil profile from the test holes taken east of the WDG varied considerably. The soil profile from TH29 had existing waste from 0 – 1.3 m followed by high plastic clay varved with silty medium plastic clay. TH30 had existing waste from 0 – 3.6 m where the test hole was terminated. TH31 and TH32 had high plastic clay varved with silty low plastic clay from 0 – 5.3 and 0 - 4.8 m, respectively. TH33 had a medium plastic clay from 0 – 1.0 m and a silty, sandy low plastic clay from 1.0 – 3.6 m. TH 39 had organic topsoil from 0 – 1.9 m and silty, sandy low plastic clay from 1.9 to 4.9 m. TH40 had existing waste from 0 – 2.2 m and high plastic clay from 2.2 – 3.5 m and high plastic clay varved with silty low plastic clay from 3.5 – 4.4 m.

3.1.3 Soil Profile Through the Existing Waste

The soil profile through the existing waste consisted of 0 – 5.0 m of waste in TH27 and TH28. The excavator used for the test holes did not have the capacity to dig any deeper through the waste which was observed to an elevation of 211.07 in TH27 and 213.81 in TH28.

3.2 Groundwater

Short-term groundwater conditions were assessed in each test hole by observing standing water in the test holes prior to backfilling the holes. Water infiltration was observed in TH33 at a depth of 3.6 m with a cave-in observed at 1.0 m. Water infiltration was observed in TH29 at a depth of 1.3 m and leachate infiltration to the test hole was observed in TH40 at a depth of 2.2 m. No standing water or water infiltration was observed in the remainder of the test holes.

Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time as water levels will normally fluctuate seasonally.

Contractors will be made aware of the geotechnical conditions encountered onsite, as some dewatering of the ground surface may be required during construction.

4.0 LABORATORY TESTING, ANALYSIS AND DISCUSSION

4.1 Laboratory Analysis

Four representative bagged soil samples from the borrow pit area and four representative bagged samples from the area east of the WDG were submitted to The National Testing Laboratories Ltd. on November 3, 2011, for analysis and a professional assessment. The analysis included the determination of the following:

- Moisture Content (ASTM D2216)
- Atterberg Limits (plastic limit, liquid limit, and plasticity index, ASTM D4318)
- Soil Classification (ASTM D2487)
- Particle Size Analysis (Hydrometer test, ASTM D422)
- Hydraulic Conductivity (ASTM D2435).

The soils were analyzed to determine their suitability as a re-worked and re-compacted or insitu liner for a WDG, which requires a hydraulic conductivity of 1×10^{-7} cm/sec or less.

The laboratory analysis of the soils from the borrow pit indicated that they are low to high plastic clay soils with a trace of silt. The overall Plasticity Index of the samples varied between 26 and 33 and the percentage of clay from 89.0% to 97.8%. Laboratory analysis of the soils from the area east of the WDG indicated they are low to high plastic clay with silt. The overall Plasticity Index of the samples varied between 19 and 40 and the percentage of clay from 88.1% to 95.2%.

Based on past experience, the laboratory has commented that homogeneous soils with a Plasticity Index greater than 25 and a clay content greater than 50% would typically be expected to have a hydraulic conductivity of 1×10^{-7} cm/sec or less. Plasticity Index analysis (i.e. Atterberg limits) of the soils indicated that all of the soil samples submitted were considered suitable for use as an insitu clay liner or when re-worked and re-compacted with the exception of TH31 from 1.5 – 5.3 m, which had a Plasticity Index of 19 and clay content of 88.1%.

The results indicate that the suitability of the soils for a clay liner is dependent upon the soils being homogeneous with no preferential flow paths. These preferential flow paths can be caused by lenses of unsuitable material, rocks or boulders or fissures in the soil.

One Shelby tube sample TH29 2.0 – 2.6 m was submitted to determine the insitu hydraulic conductivity, and one bagged sample TH36 0.4 – 3.1 m was submitted to determine the re-worked and re-compacted hydraulic conductivity. The samples achieved hydraulic conductivities of 2.1×10^{-8} cm/sec and 2.1×10^{-8} cm/sec, respectively which are less than the required 1×10^{-7} cm/sec for a clay lined cell. This shows the layer of soil from TH29 from 1.3 – 4.7 m is suitable for use as an insitu clay liner and the layer of soil from TH36 from 0.4 – 3.1 is suitable as borrow material for use as a re-worked and re-compacted clay liner.

Details of The National Testing Laboratories test results and analysis, dated November 30, 2011 are in the Appendix.

5.0 WDG CELL LINER REQUIREMENTS

5.1 Current Guidelines

Manitoba Conservation guidelines require that a standard WDG cell clay liner be 1.0 metre in thickness and have a hydraulic conductivity (i.e. the potential rate of fluid movement through the soil) of 1×10^{-7} cm/sec or less. This low rate is to protect the underlying groundwater and surrounding lands from leachate seepage. Generally, the higher a soil's plasticity the more likely a soil can achieve a hydraulic conductivity of 1×10^{-7} cm/sec.

5.2 Typical Clay Liner Construction Options

The insitu (undisturbed) soils can be used to construct the liner of a WDG cell if the soils can consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec or less in their insitu state.

If the insitu soils cannot be used, the liner can be constructed by excavating and re-compacting suitable high plastic clay soils to form the liner.

If the clay content of the soils is so low that even when excavated and re-compacted, the soils cannot consistently achieve a hydraulic conductivity of 1×10^{-7} cm/sec, a liner constructed of high plastic clay from a borrow pit, or a synthetic geomembrane liner would be required.

5.3 Discussion

5.3.1 East of the WDG

Based on the soils investigation and the laboratory analysis the soils under TH29 and TH40 are suitable for use as an insitu clay liner. The soils under TH30 – TH33 and TH39 were found to not be suitable for use as an insitu clay liner. A dike constructed between TH40 and TH29 will form the east boundary of the WDG with a vertical cut-off wall extended a minimum of 1.0 m into the suitable clay. The dike will be constructed during future work phases and is shown on Plan 1 in the Appendix.

5.3.2 Borrow Pit Soils

Based on the soils investigation and laboratory analysis, the soils from the borrow pit around TH34 – TH37 are suitable for use as a re-worked and re-compacted clay liner, with the exception of TH38. All bagged samples submitted to the laboratory were deemed potential for use as a re-worked and re-compacted clay liner. This was confirmed by the bagged sample from TH36 0.4 – 3.1 which achieved a hydraulic conductivity of 2.1×10^{-8} cm/sec when re-worked and re-compacted. While the hydraulic conductivity was lower than the Manitoba Conservation requirement for a clay landfill liner of 1×10^{-7} cm/sec, it was only one order of magnitude lower which means proper compaction techniques will have to be followed to ensure the required hydraulic conductivity is met during construction of the WDG liner.

5.3.3 Vertical Cut-off Wall Through Existing Waste

The test holes taken through the existing waste for evaluation of the depth to clay found existing waste for at least 5.0 m from the surface. When the vertical cut-off wall is constructed through the waste during the Phase I works, it will have to be extended over 6.0 m from the surface of the waste as the cut-off wall will extend a minimum of 1.0 m into the existing clay liner.

6.0 RECOMMENDATIONS AND CLOSURE

6.1 Recommendations

It is recommended that a dike be constructed between TH40 and TH29 which will form the east boundary of the WDG with vertical cut-off walls in the dike extended a minimum of 1.0 m into the suitable clay.

It is recommended that the borrow pit soils be re-compacted and re-worked for use as liner material during Phase I construction works. Proper compaction techniques of the WDG liner will have to be followed to ensure the required hydraulic conductivity is met during construction because the laboratory re-worked and re-compacted hydraulic conductivity of TH36 from 0.4 –

3.1 m was only one order of magnitude lower than the Manitoba Conservation requirement for a clay landfill liner of 1 x 10^{-7} cm/sec.

When the vertical cut-off wall is constructed through the waste during the Phase I works, it will have to be extended over 6.0 m from the surface of the waste.

6.2 Closure

The conclusions and recommendations in this report are based on the results of the site investigation and laboratory analysis. In addition, soil and groundwater conditions between test hole locations were generalized to provide an overall assessment of the geotechnical site conditions. If conditions that appear different from those encountered at the test hole locations as described in this report, or if the assumptions stated herein are not in agreement with the design, JRCC should be informed in order that the recommendations can be reviewed and adjusted as required.

The site investigation was conducted for the purpose of identifying geotechnical conditions at the borrow pit site and the expansion area east of the WDG. Although no environmental issues were identified during the site investigation, it does not necessarily follow that such issues do not exist. If the client or any other parties have any environmental concerns regarding the proposed site and works, an appropriate environmental assessment must be conducted.

It is not uncommon for soil conditions to be highly variable across a site. Previous construction activities and placement of fill at a site can augment the variability of soil conditions, especially surficial soil conditions. A contingency must be included in any construction budget to allow for potential variations in soil conditions, which may result in modification of the design and construction procedures.

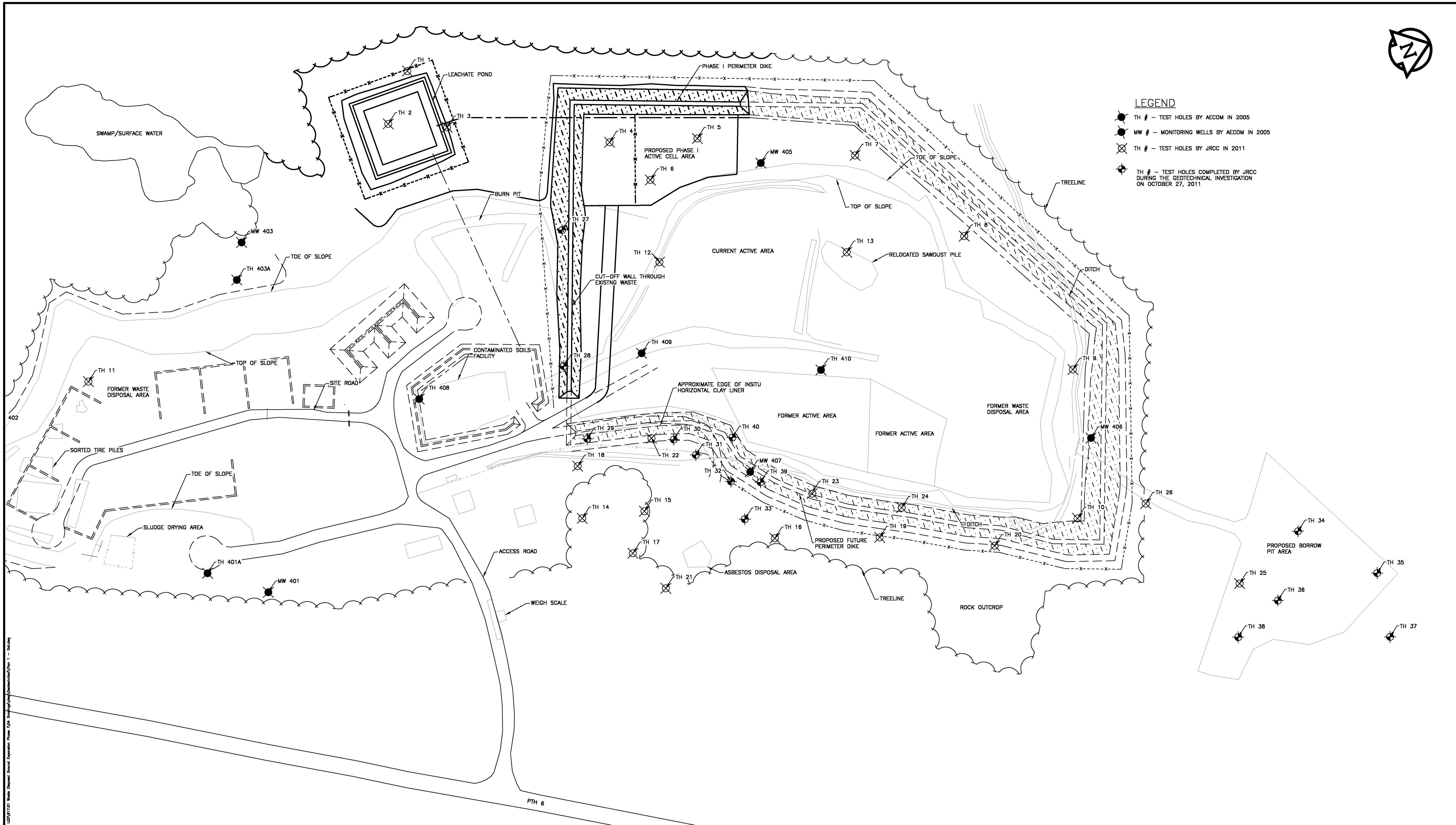
APPENDIX

Plan 1: Test Hole Location Plan

Test Hole Logs

The National Testing Laboratories Ltd. Test Results

Plan 1: Test Hole Location Plan



SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM STAMP

ENGINEER'S SEAL

PRELIMINARY

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND

CODE: M-617.01

TITLE: PAST AND CURRENT TEST HOLE LOCATION PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	12/03/23	1	1 of 1

Test Hole Logs

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX

GW. : Well graded gravels and gravel sand mixtures, little or no fines

GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines

GM. : Silty gravels, gravel-sand-silt mixtures

GC. : Clayey gravels, gravel-sand-clay mixtures

SW. : Well graded sands, gravelly sands, little or no fines

SP. : Poorly graded sands, or gravelly sands, little or no fines

SM. : Silty sands, sand-silt mixtures

SC. : Clayey sands, sand-clay mixtures

ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity

CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays

OL. : Organic silts and organic silty clays of low plasticity

CI. : Inorganic clays of medium or intermediate plasticity

MH. : Inorganic silts, fine sandy or silty soils

CH. : Inorganic clays of high plasticity, fat clays

OH. : Organic clays of medium to high plasticity, organic silts

Pt. : Peat, humus, swamp soils with high organic contents

TOPSOIL

The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171218.24 N
567857.87 E

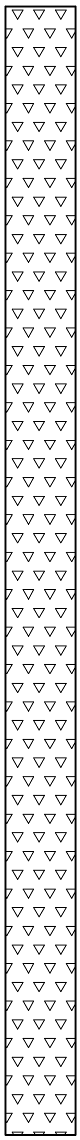
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

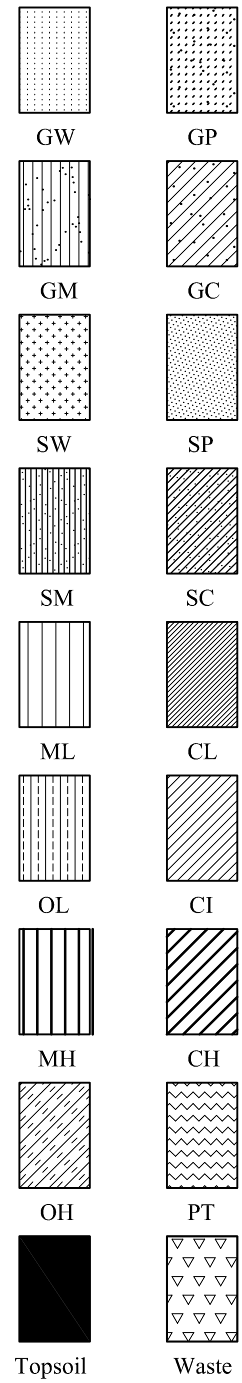
DATE : October 27, 2011

ELEVATION : 215.966 m

TEST HOLE # 27

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	
	2'	
1m		
	4'	
	6'	
2m		WASTE - mining waste mixed with scrap metal
	8'	
3m	10'	
	12'	
4m		
	14'	
	16'	BOTTOM OF HOLE: 4.9m NOTE - test hole ended in mining waste, no water infiltration, minimal caving
5m		
	18'	
6m	20'	





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171187.37 N
567947.78 E

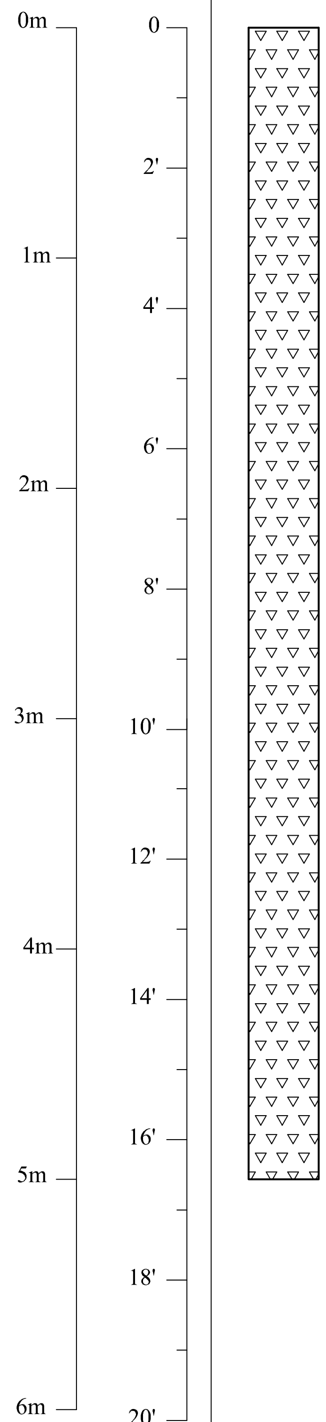
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

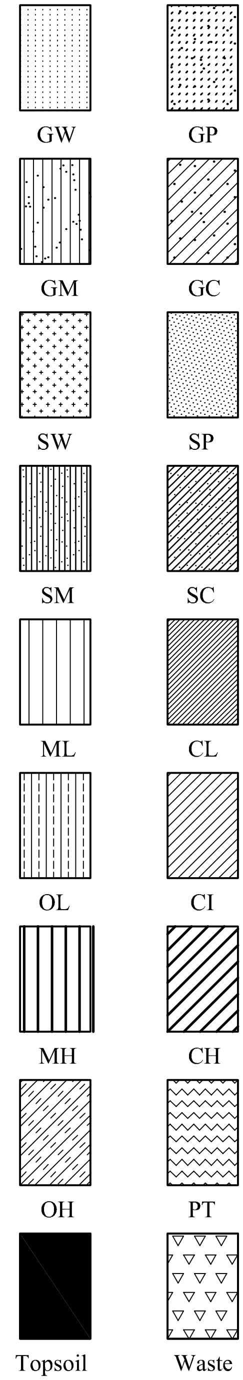
DATE : October 27, 2011

ELEVATION : 218.811 m

TEST HOLE # 28

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	WASTE - household waste mixed with some cover clay
	BOTTOM OF HOLE: 5.0m NOTE - test hole ended in waste, some water infiltration, minimal caving





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171185.85 N
568001.06 E

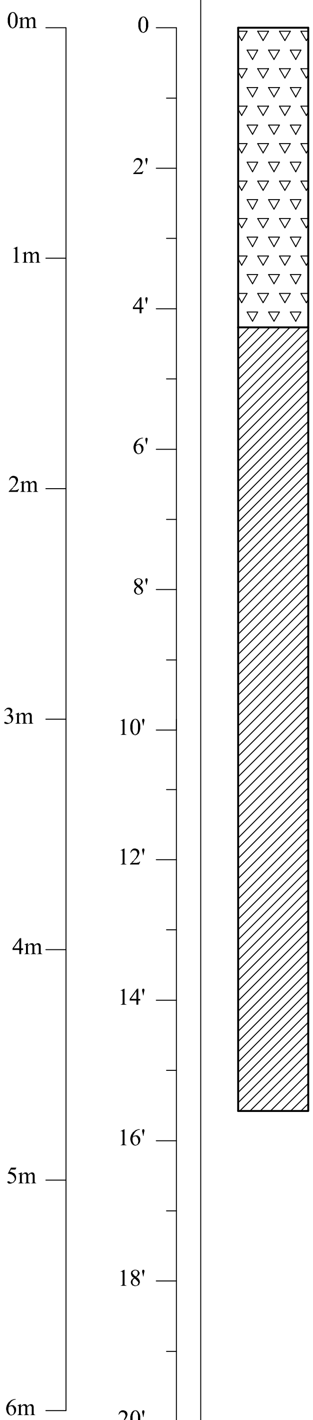
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : October 27, 2011

ELEVATION : 219.898 m

TEST HOLE # 29

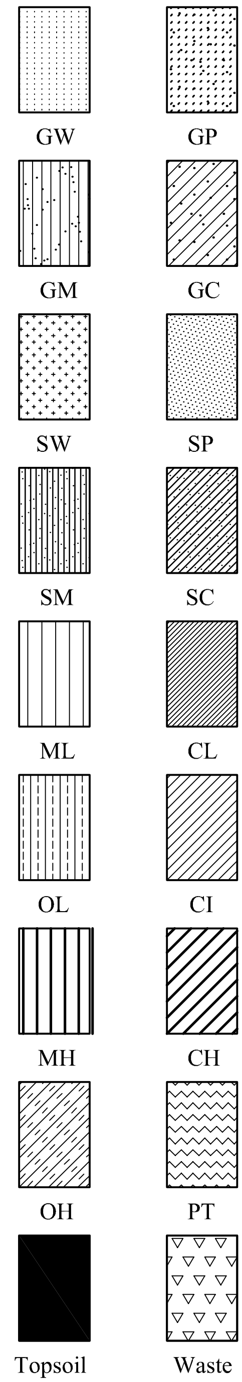
DEPTH OF SAMPLE	FIELD CLASSIFICATION



WASTE - household waste mixed with some cover clay

CLAY - high plastic, brown, moist, crumbly, stiff, lensed with light brown/tan, medium plastic, silty clay

BOTTOM OF HOLE: 4.7m
NOTE - no caving of hole, slight water infiltration at 1.3m



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171242.53 N
568021.78 E

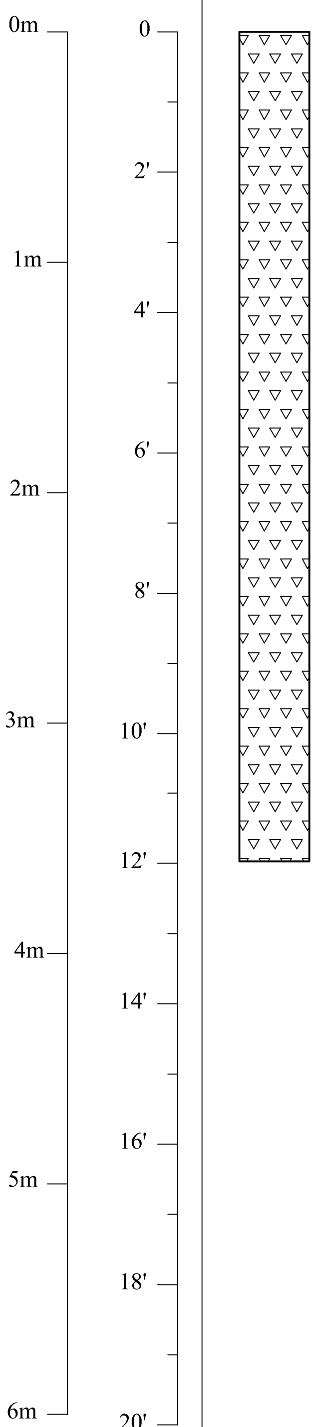
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : October 27, 2011

ELEVATION : 218.886 m

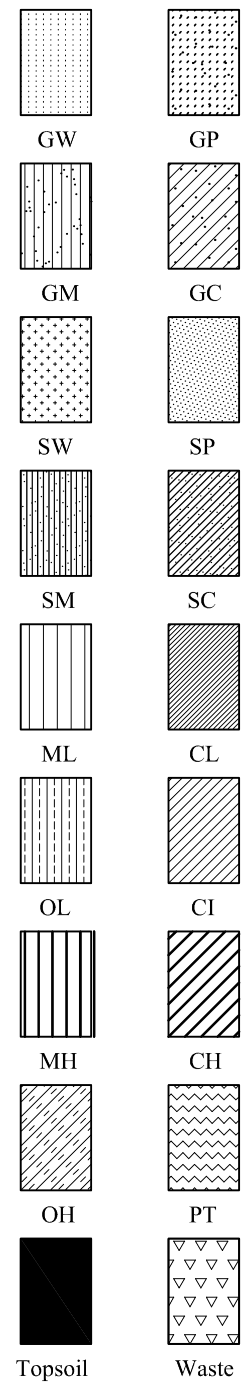
TEST HOLE # 30

DEPTH OF SAMPLE	FIELD CLASSIFICATION



WASTE - household waste mixed with some cover clay

BOTTOM OF HOLE: 3.6m
NOTE - caving of hole, high rate leachate infiltration, odorous



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171253.45 N
568037.11 E

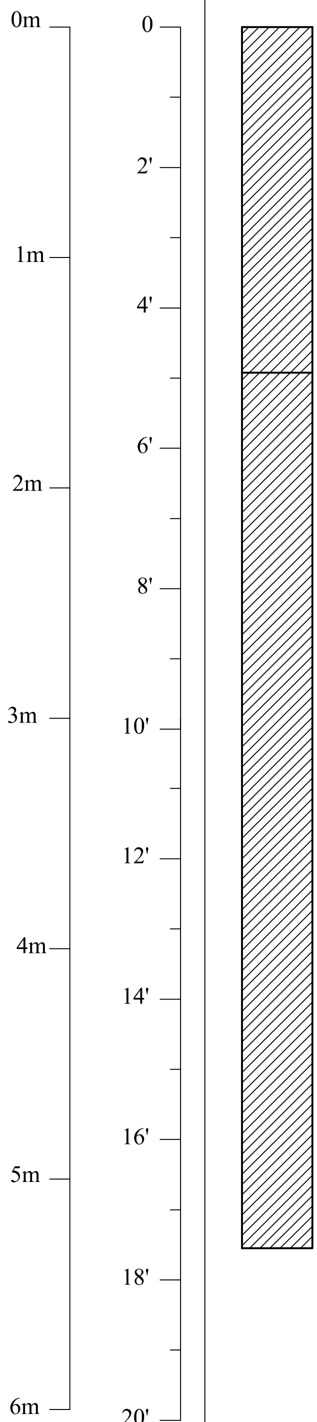
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

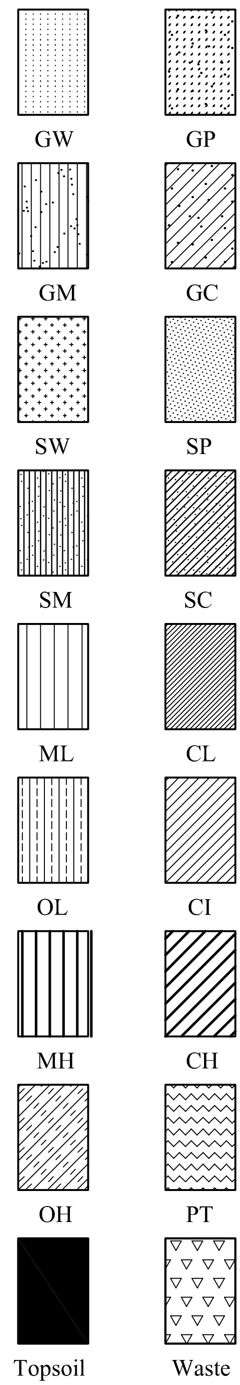
DATE : October 27, 2011

ELEVATION : 219.405 m

TEST HOLE # 31

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	CLAY - medium plastic, grey, damp, loose, crumbly, stiff
	CLAY - medium plastic, brown, moist, crumbly, stiff, lensed with light brown/tan, low plastic, silty clay
	BOTTOM OF HOLE: 5.3m NOTE - no caving of the hole, no water infiltration





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171270.34 N
568062.75 E

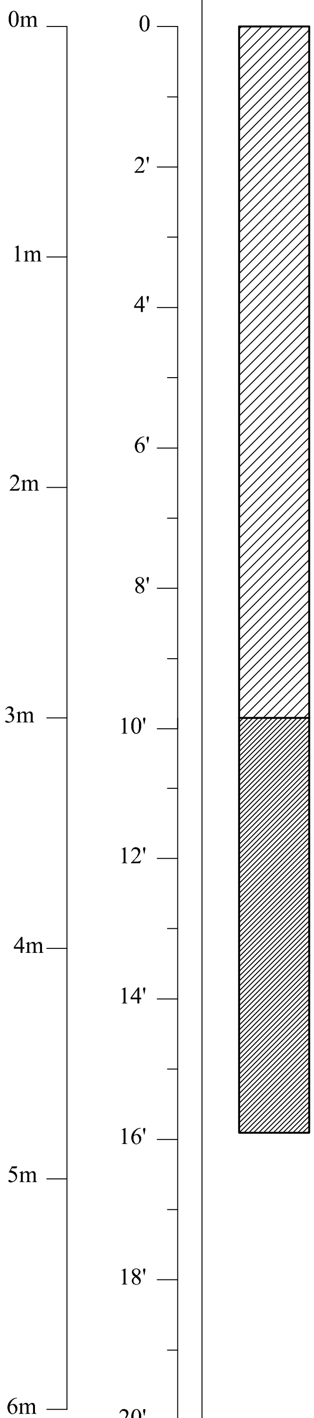
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : October 27, 2011

ELEVATION : 219.961 m

TEST HOLE # 32

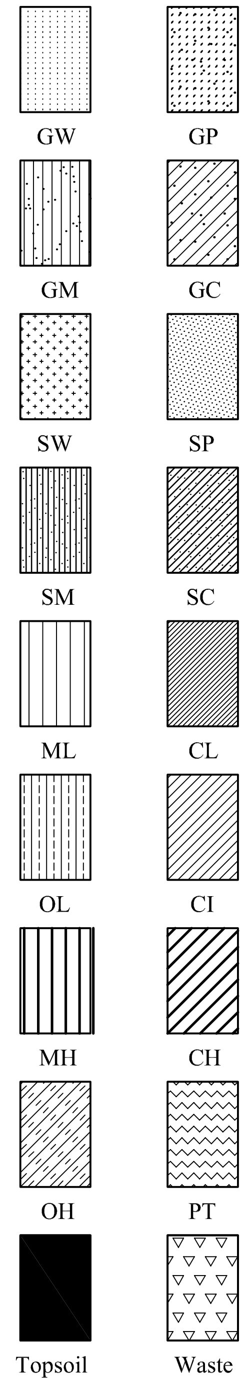
DEPTH OF SAMPLE	FIELD CLASSIFICATION



CLAY - medium plastic, brown, layered with a light brown medium plastic clay with silt

CLAY - medium plastic, brown, layered with a light brown medium plastic very silty clay

BOTTOM OF HOLE: 4.8m
NOTE - no caving of hole, no water infiltration after 30 mins



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171270.60 N
568090.80 E

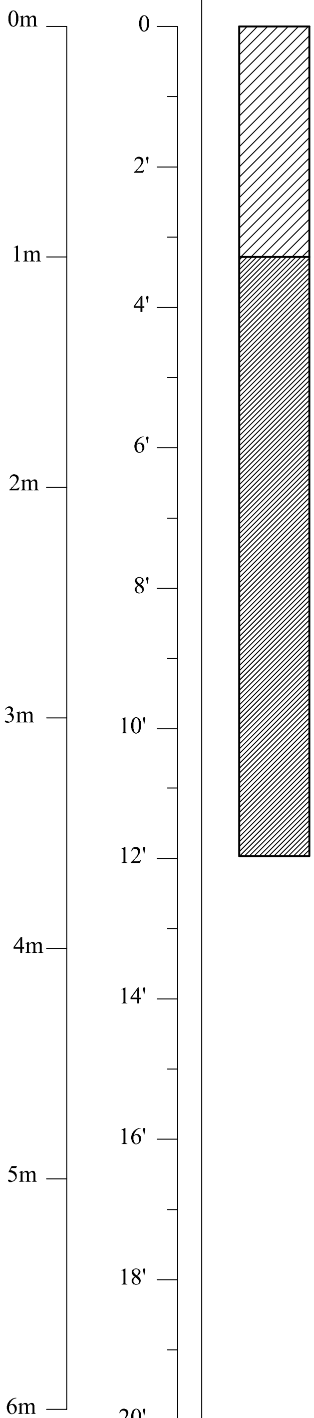
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

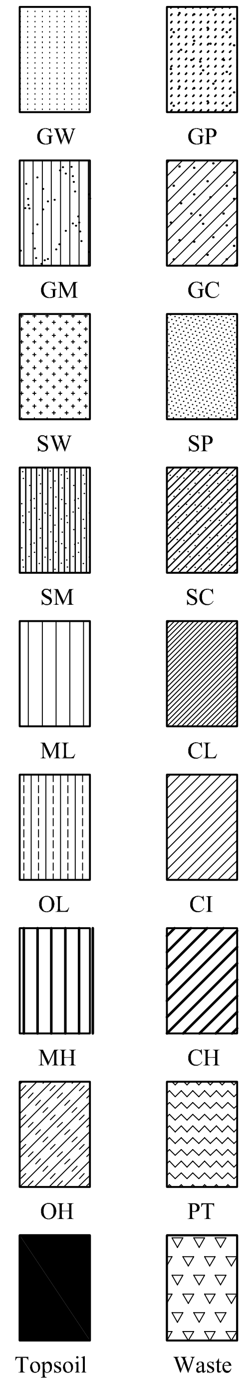
DATE : October 27, 2011

ELEVATION : 219.051 m

TEST HOLE # 33

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m–1.0m (0–3.3')	CLAY - medium plastic, brown, moist, loose crumbly
1.0m–3.6m	CLAY - low plastic, wet, soft, silty, sandy, some layers of brown medium plastic clay
3.6m	BOTTOM OF HOLE: 3.6m NOTE - caving of hole at 1.0 m, high rate water infiltration at 3.6 m





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171631.52 N
56228.32 E

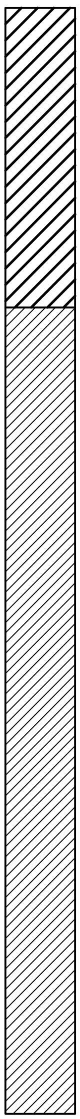
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

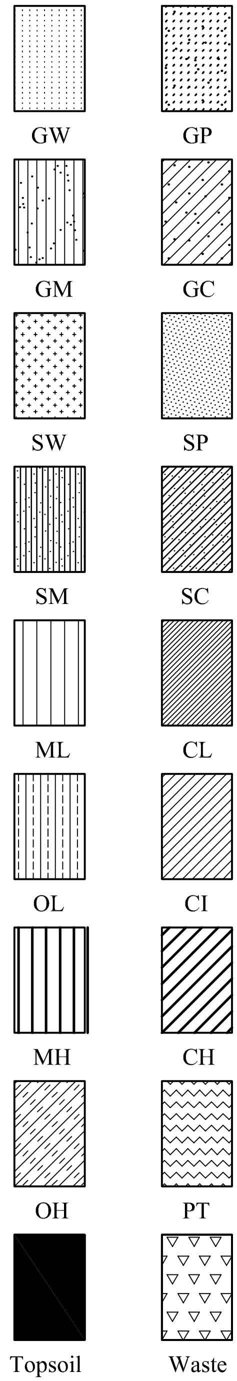
DATE : October 27, 2011

ELEVATION : 213.634 m

TEST HOLE # 34

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	
2'	CLAY - high plastic, brown, stiff, damp/moist
1m / 4'	
6' / 2m	CLAY - high plastic, brown, stiff layered with grey, moist, soft, silty, medium plastic clay
8'	
3m / 10'	
12'	
4m / 14'	
16'	BOTTOM OF HOLE: 4.8m NOTE - no caving of hole, no water infiltration
5m	
18'	
6m / 20'	





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171673.76 N
568274.40 E

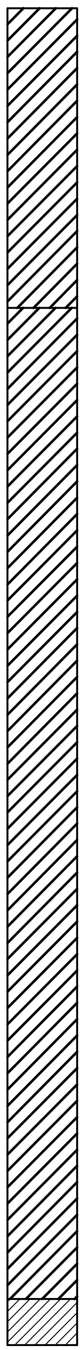
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

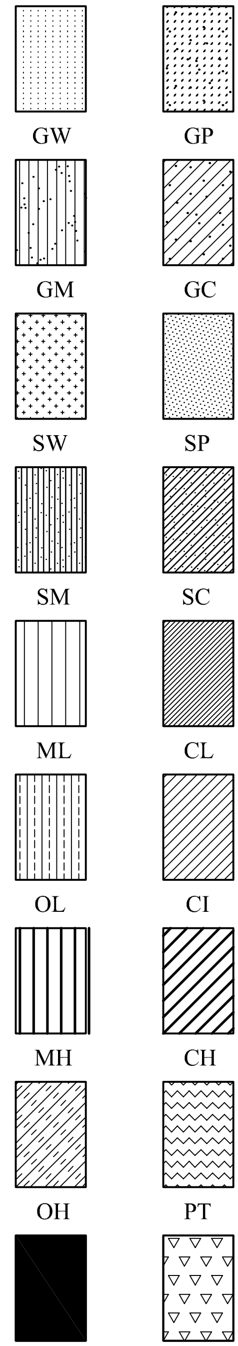
DATE : October 27, 2011

ELEVATION : 213.321 m

TEST HOLE # 35

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	
	2'	CLAY - high plastic, brown, stiff layered with grey, moist, soft, silty, medium plastic clay
1m	4'	
2m	6'	
	8'	
3m	10'	CLAY - high plastic, grey, hard, moist
	12'	
4m	14'	
5m	16'	
	18'	CLAY - medium plastic, grey, silty
6m	20'	BOTTOM OF HOLE: 5.8m NOTE - no caving of hole, no water infiltration





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171602.07 N
568269.15 E

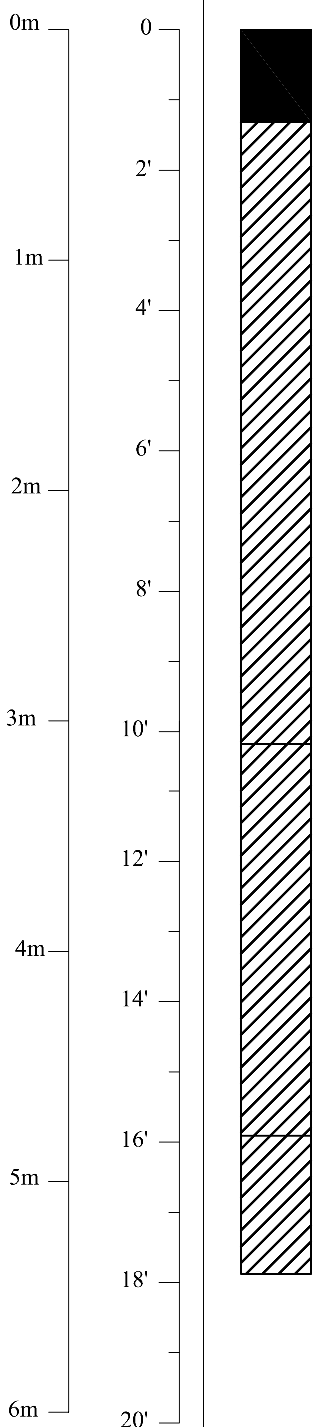
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

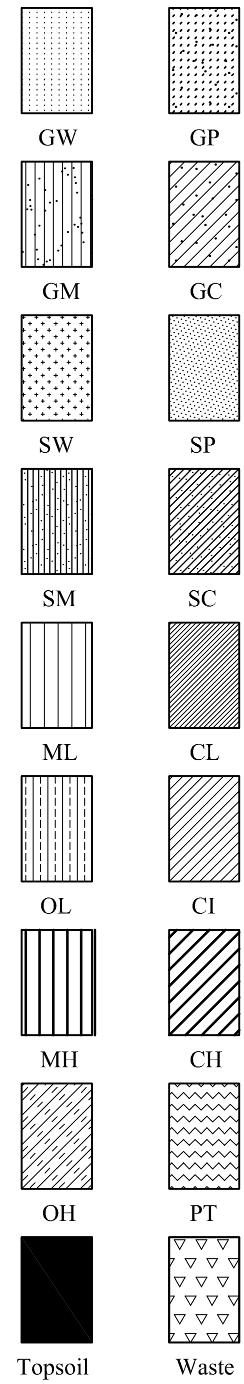
DATE : October 27, 2011

ELEVATION : 215.197 m

TEST HOLE # 36

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	TOPSOIL - black, clayey, organic
	CLAY - high plastic, brown, stiff layered with grey, moist, soft, silty, medium plastic clay
	CLAY - high plastic, grey, hard, moist
	CLAY - high plastic, grey, soft, wet
	BOTTOM OF HOLE: 5.4m
	NOTE - no caving of hole, no water infiltration





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171667.30 N
568319.01 E

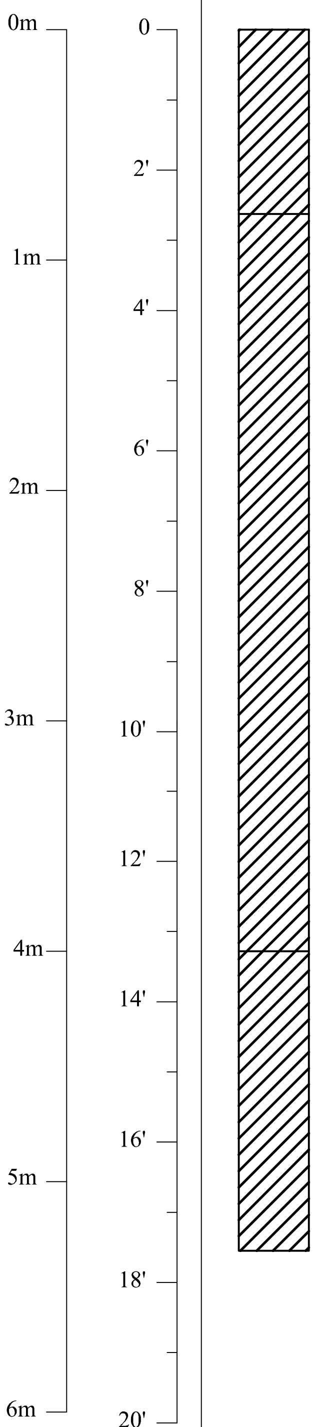
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : October 27, 2011

ELEVATION : 217.924 m

TEST HOLE # 37

DEPTH OF SAMPLE	FIELD CLASSIFICATION

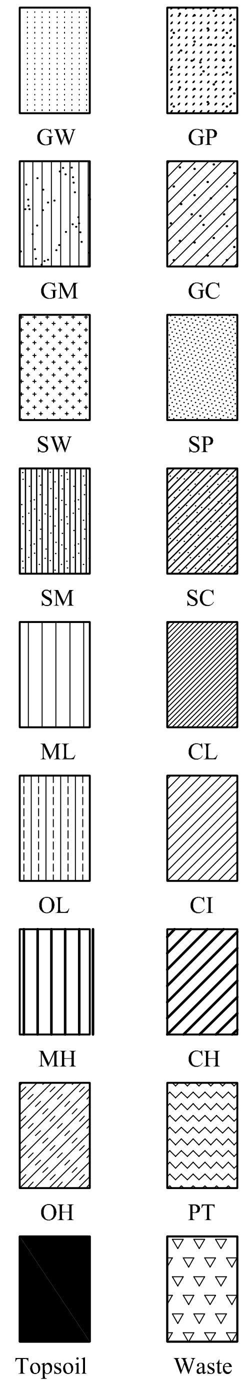


CLAY - high plastic, brown, stiff, damp

CLAY - high plastic, brown, stiff layered with grey, damp, stiff, silty, medium plastic clay

CLAY - high plastic, grey, hard, damp

BOTTOM OF HOLE: 5.3m
NOTE - no caving of hole, no water infiltration



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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171567.38 N
568283.97 E

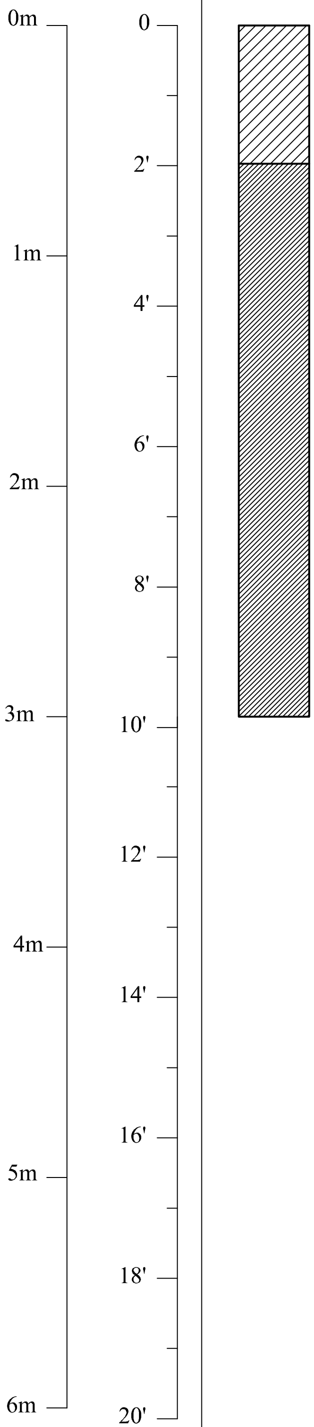
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

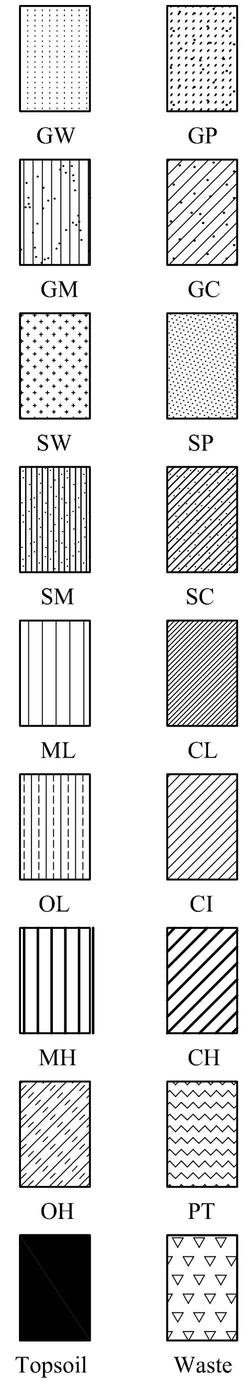
DATE : October 27, 2011

ELEVATION : 216.174 m

TEST HOLE # 38

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0 – 2'	CLAY - medium plastic, grey, silty, hard, moist, trace sand
2' – 3.0m	CLAY - medium plastic, brown layered with silty, sandy grey, low plastic clay
3m / 10'	BOTTOM OF HOLE: 3.0m NOTE - no caving of hole, no water infiltration





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : 6171289.60 N
568070.16 E

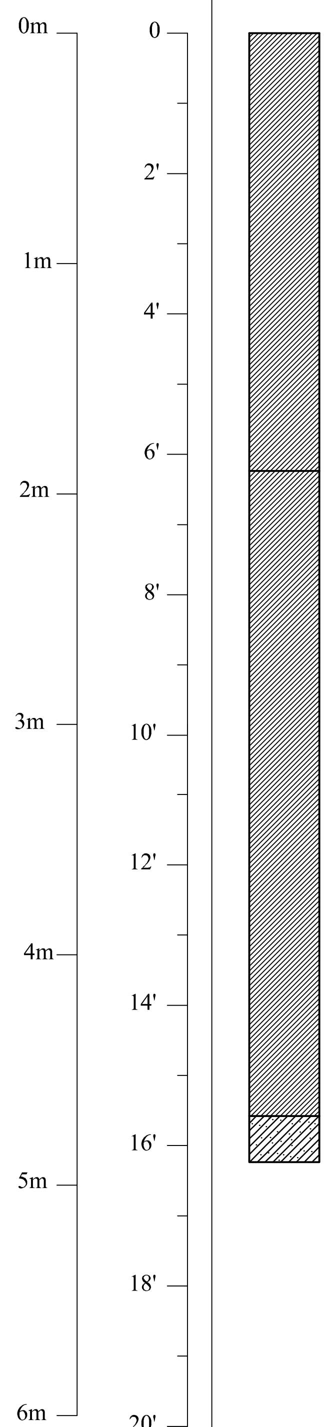
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

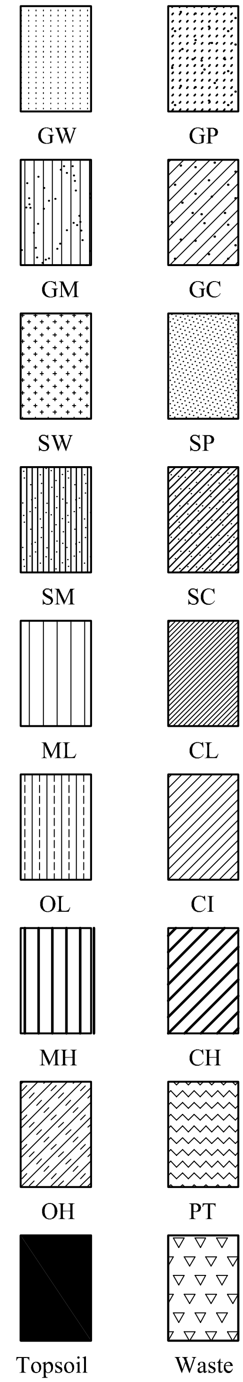
DATE : October 27, 2011

ELEVATION : 218.280 m

TEST HOLE # 39

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	CLAY - black, organic clay mixed with waste
	CLAY - low plastic, light brown/tan, silty layered with brown, medium plastic clay
	SILT - sandy, light brown/tan, trace low plastic clay
	BOTTOM OF HOLE: 4.9m NOTE - no caving of hole, no water infiltration





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J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

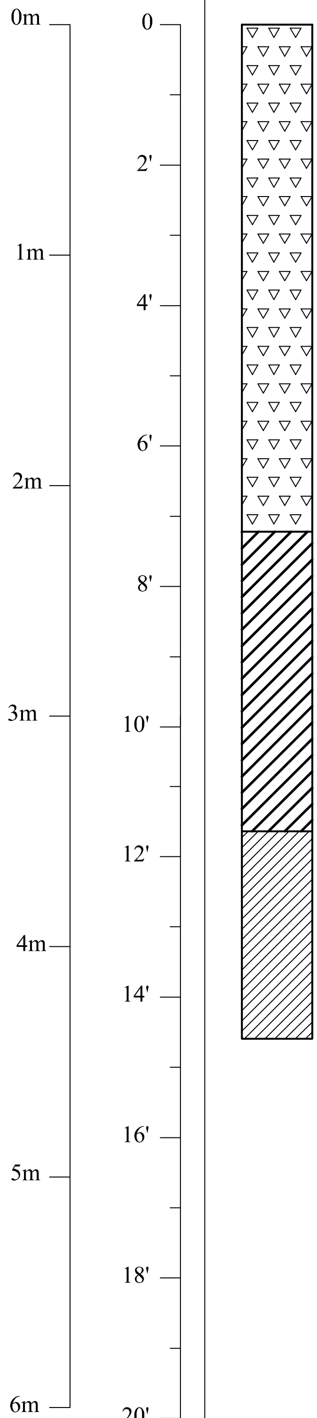
LOCATION : 6171281.60 N
568034.20 E

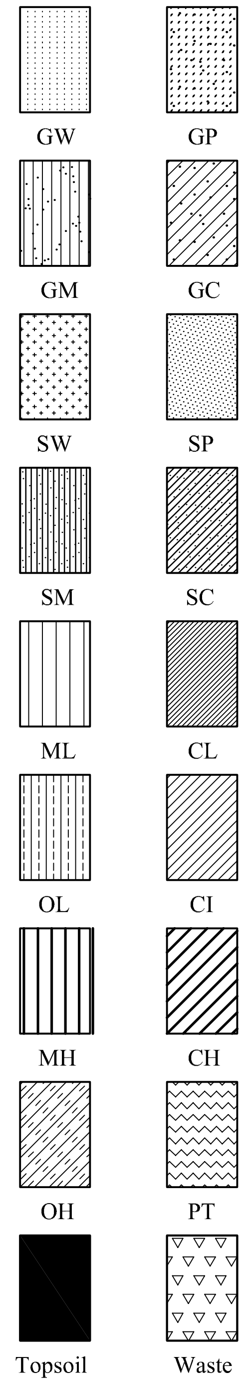
PROJECT : LGD of Mystery Lake - Waste Disposal Ground

DATE : October 27, 2011

ELEVATION : 218.157 m

TEST HOLE # 40

DEPTH OF SAMPLE	FIELD CLASSIFICATION
	WASTE - household waste mixed with some clay soil CLAY - medium to high plastic, brown, hard, moist CLAY - medium plastic, brown, hard, moist, layered with light brown/tan, silty clay BOTTOM OF HOLE: 4.4m NOTE - no caving of hole, leachate infiltration at 2.2 m



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The National Testing Laboratories Ltd. Test Results

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

199 Henlow Bay
Winnipeg, MB R3Y 1G4
Phone (204) 488-6999
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Email info@nationaltestlabs.com
www.nationaltestlabs.com

J.R. Cousin Consultants Ltd.
91 A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

Attention: Brett McCormac

November 30, 2011

Project: Mystery Lake Waste Disposal Facility

Soil samples were submitted to our laboratory on November 3, 2011. The following tests were conducted on selected soil samples:

- water content (ASTM D2216)
- particle size analysis (ASTM D422)
- liquid limit, plastic limit, and plasticity index (ASTM D4318)
- hydraulic conductivity (ASTM D5084)
- soil classification (ASTM D2487)
- visual classification

The test results for the soil samples are summarized in the following tables and in the attached particle size analysis and hydraulic conductivity reports.

An assessment of the bagged soil samples was conducted to determine whether the soil represented by the bagged samples could be used in-situ as a landfill liner and would obtain a hydraulic conductivity of less than 1.0×10^{-7} cm/sec without being reworked, and when re-moulded and re-compacted.

Based upon previous testing conducted in our laboratory, homogeneous soil samples with a plasticity index greater than 25 and a clay content greater than 50% will typically have a hydraulic conductivity of 1.0×10^{-7} cm/sec or less. Sample TH31 1.5 – 5.3 m had a plasticity index of 19, which does not fall within this range. Hydraulic conductivity testing of this material is recommended to determine its suitability for use as a lagoon liner. The remaining bagged samples were considered suitable for use as a lagoon liner. Our comments regarding the potential use of the material as a lagoon liner are based upon the soil being homogeneous with no preferential flow paths and being properly placed and compacted to maximum density near its optimum moisture content. It should be noted that estimating the hydraulic conductivity of a soil based upon classification test results (plasticity index and particle size analysis) alone might be misleading if the soil contains layers of sand, silt, or organic material.

The hydraulic conductivity results for the 2 tested samples are less than the specified maximum hydraulic conductivity value of 1.0×10^{-7} cm/s for lagoon liners. It should be noted that sample TH29 2.0 – 2.6 m was a Shelby tube sample, and sample TH36 0.4 – 3.1m was a bagged sample which was remoulded in our laboratory prior to testing for hydraulic conductivity.

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Aron Piamsalee

Aron Piamsalee, B.Sc., EIT
Geotechnical Project Manager

THE NATIONAL TESTING LABORATORIES LIMITED

TABLE 1
SUMMARY OF WATER CONTENT, PARTICLE SIZE, ATTERBERG LIMITS, SOIL CLASSIFICATION TEST DATA
MYSTERY LAKE WASTE DISPOSAL FACILITY

Testhole	Depth (m)	Visual Classification	Water Content (%)	Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification ASTM D2487	Potential Use as a Landfill Liner without being Reworked	Potential Use as a Landfill Liner when re-moulded and re-compacted
					Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm								
TH29	1.3 - 4.7	brown, firm, moist, high plasticity clay, trace silt	33.4	0.1	0.0	0.1	0.4	4.2	95.2	64	24	40	CH(Fat Clay)	Yes	Yes
TH31	1.5 - 5.3	grey, firm, moist, low plasticity clay, some silt	29.4	0.0	0.1	0.0	0.1	11.7	88.1	38	19	19	CL(Lean Clay)	HC testing recommended	
TH34	0 - 1.3	brown, stiff, moist, high plasticity clay, trace silt	30.6	0.0	0.0	0.1	0.2	5.4	94.3	55	22	33	CH(Fat Clay)	Yes	Yes
TH34	1.3 - 4.8	grey, stiff, moist, low plasticity clay, some silt	33.2	0.0	0.0	0.0	0.2	10.8	89.0	46	19	27	CL(Lean Clay)	Yes	Yes
TH35	1.3 - 5.6	brown, stiff, moist, low plasticity clay, trace silt	38.0	0.0	0.0	0.1	0.1	8.3	91.5	45	19	26	CL(Lean Clay)	Yes	Yes
TH36	3.1 - 4.8	grey, firm, moist, high plasticity clay, trace silt	29.9	0.0	0.0	0.1	0.0	2.1	97.8	51	20	31	CH(Fat Clay)	Yes	Yes
TH40	2.2 - 3.5	brown, firm, moist, high plasticity clay, trace silt	35.9	0.5	0.1	0.0	0.4	5.3	93.7	65	25	40	CH(Fat Clay)	Yes	Yes
TH40	3.5 - 4.4	brown, firm, moist, low plasticity clay, some silt	34.3	0.0	0.0	0.1	0.5	10.7	88.7	49	21	28	CL(Lean Clay)	Yes	Yes

Notes:
1.A high speed stirring device was used for 1 minute to disperse the test samples for particle size analysis.
2.Atterberg limits conducted in accordance with ASTM D4318 Method B (one-point liquid limit).
3.The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis.

TABLE 2
HYDRAULIC CONDUCTIVITY SUMMARY
MYSTERY LAKE WASTE DISPOSAL FACILITY

Testhole	Depth (m)	Hydraulic Conductivity, "k_{20}"
TH29	2.0 – 2.6	2.1 x 10^{-8} cm/s
TH36	0.4 – 3.1	2.1 x 10^{-8} cm/s

Note: Sample TH36 0.4 – 3.1 m was lab-remoulded prior to testing.

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

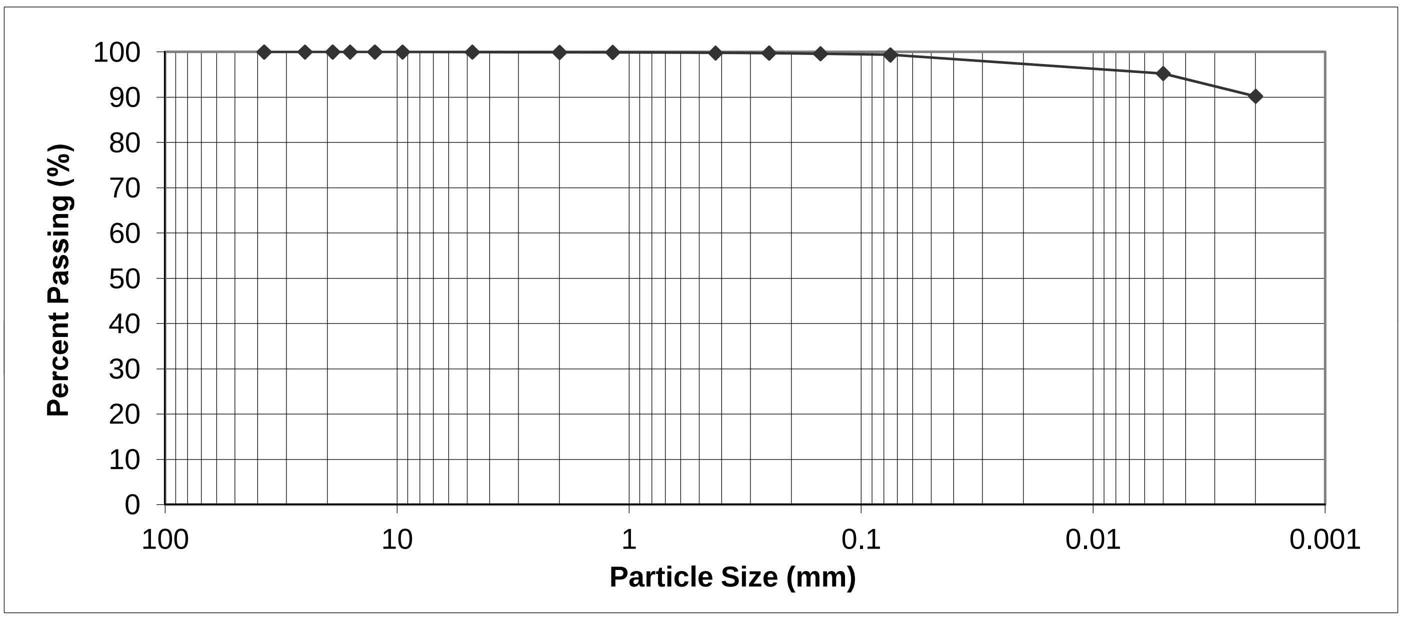
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH29 at 1.3 - 4.7 m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	99.9
2.00 mm	99.9

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.8
0.250 mm	99.7
0.150 mm	99.6
0.075 mm	99.4
0.005 mm	95.2
0.002 mm	90.2
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.1	0.0	0.1	0.4	4.2	95.2	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

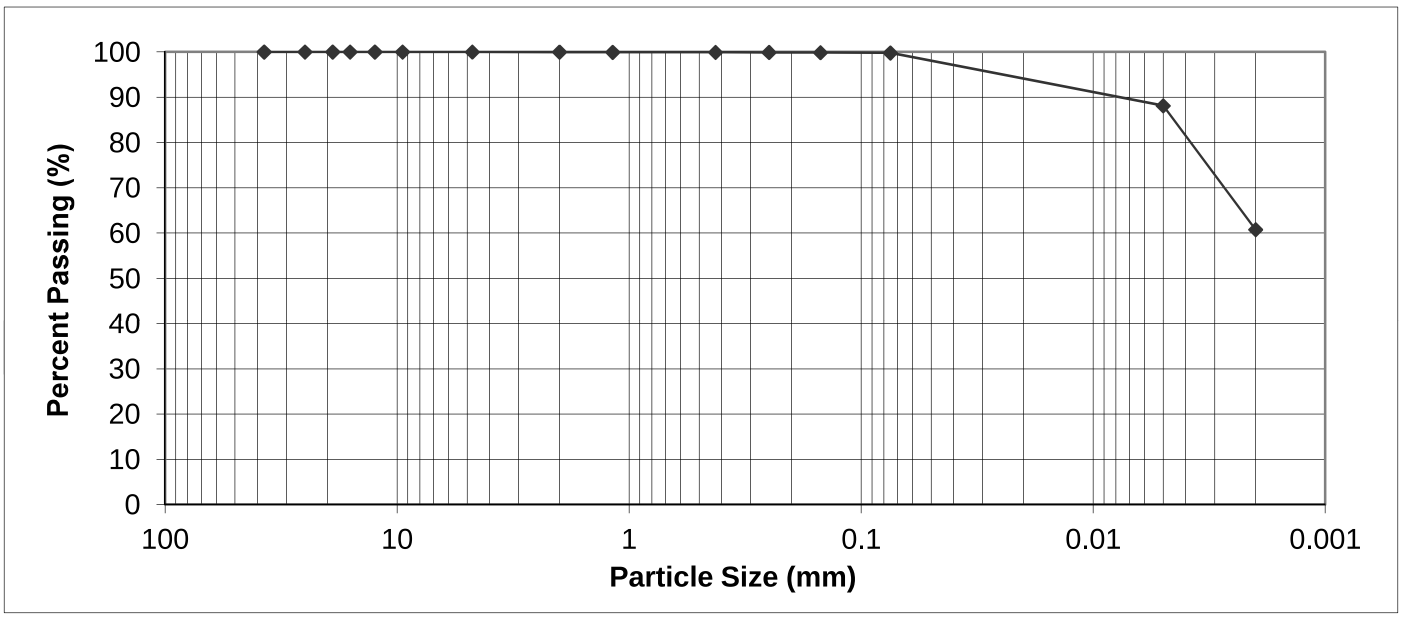
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH31 at 1.5 - 5.3 m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	99.9

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.8
0.005 mm	88.1
0.002 mm	60.8
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.1	0.0	0.1	11.7	88.1	NT

Note: Colloids content not tested

November 30, 2011

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Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

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Winnipeg, Manitoba
R3Y 1G4

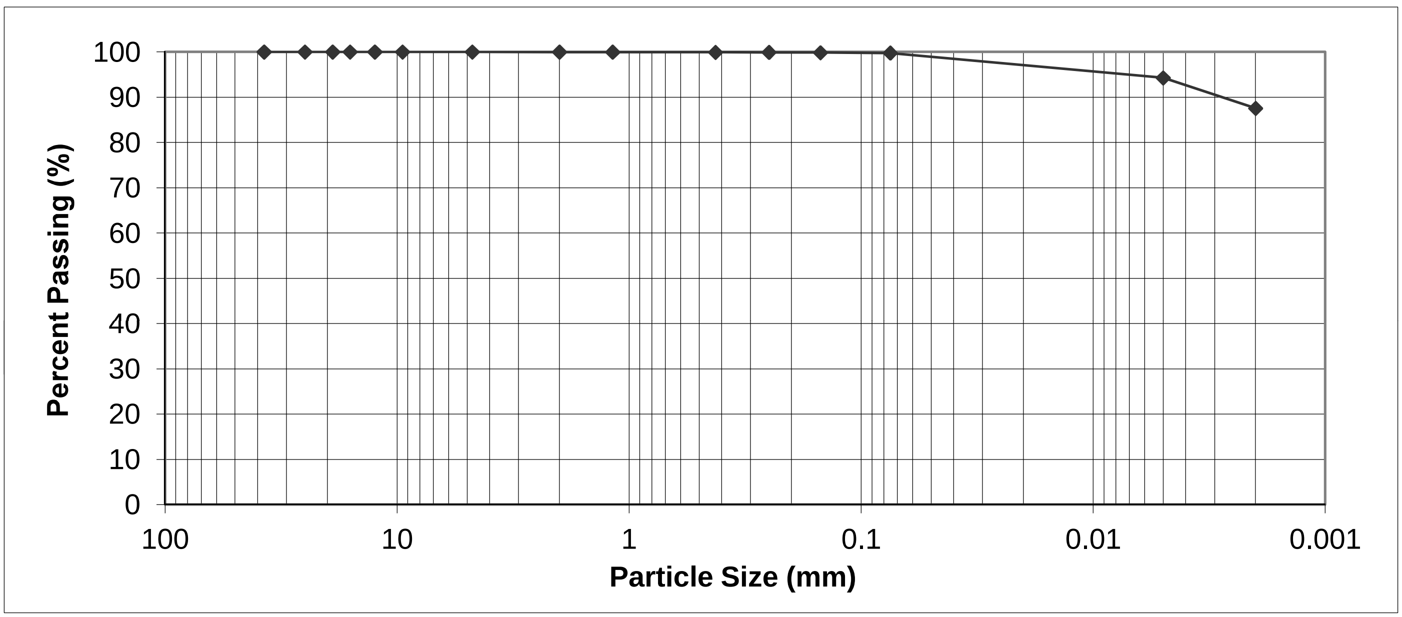
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH34 at 0 - 1.3 m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING	PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0	1.18 mm	99.9
25.00 mm	100.0	0.425 mm	99.9
19.00 mm	100.0	0.250 mm	99.9
16.00 mm	100.0	0.150 mm	99.8
12.50 mm	100.0	0.075 mm	99.7
9.50 mm	100.0	0.005 mm	94.3
4.75 mm	100.0	0.002 mm	87.5
2.00 mm	100.0	0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.2	5.4	94.3	NT

Note: Colloids content not tested

November 30, 2011

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PARTICLE SIZE ANALYSIS
ASTM D422

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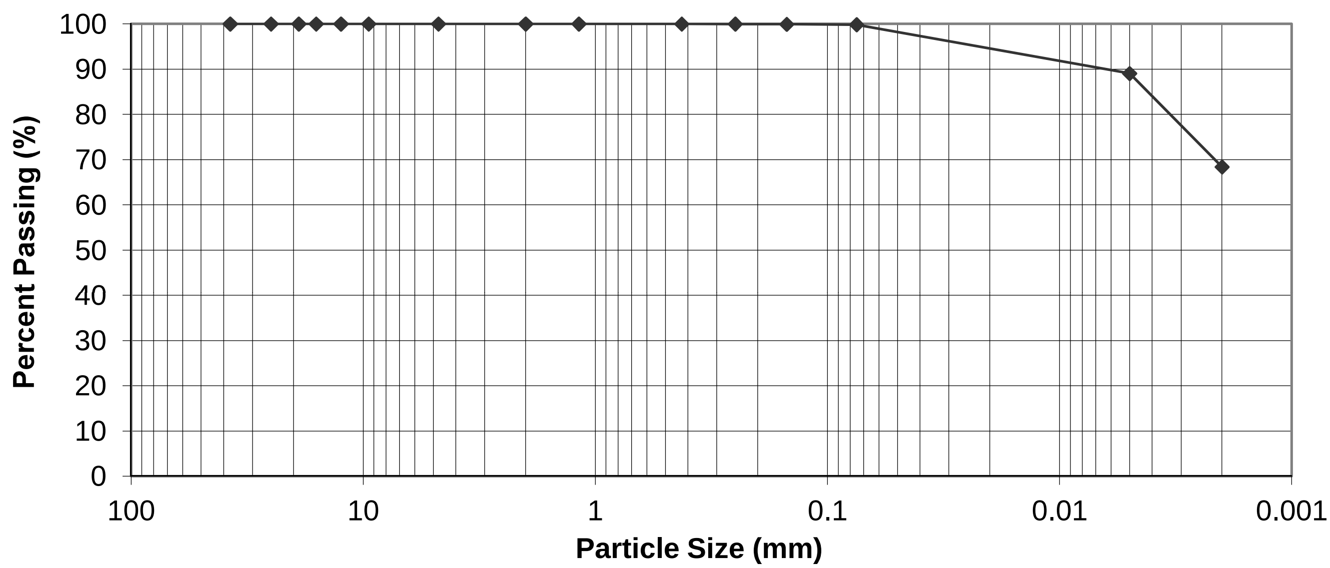
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH34 at 1.3 - 4.8 m
DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING	PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0	1.18 mm	100.0
25.00 mm	100.0	0.425 mm	100.0
19.00 mm	100.0	0.250 mm	100.0
16.00 mm	100.0	0.150 mm	99.9
12.50 mm	100.0	0.075 mm	99.8
9.50 mm	100.0	0.005 mm	89.0
4.75 mm	100.0	0.002 mm	68.4
2.00 mm	100.0	0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.2	10.8	89.0	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

PARTICLE SIZE ANALYSIS
ASTM D422

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91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

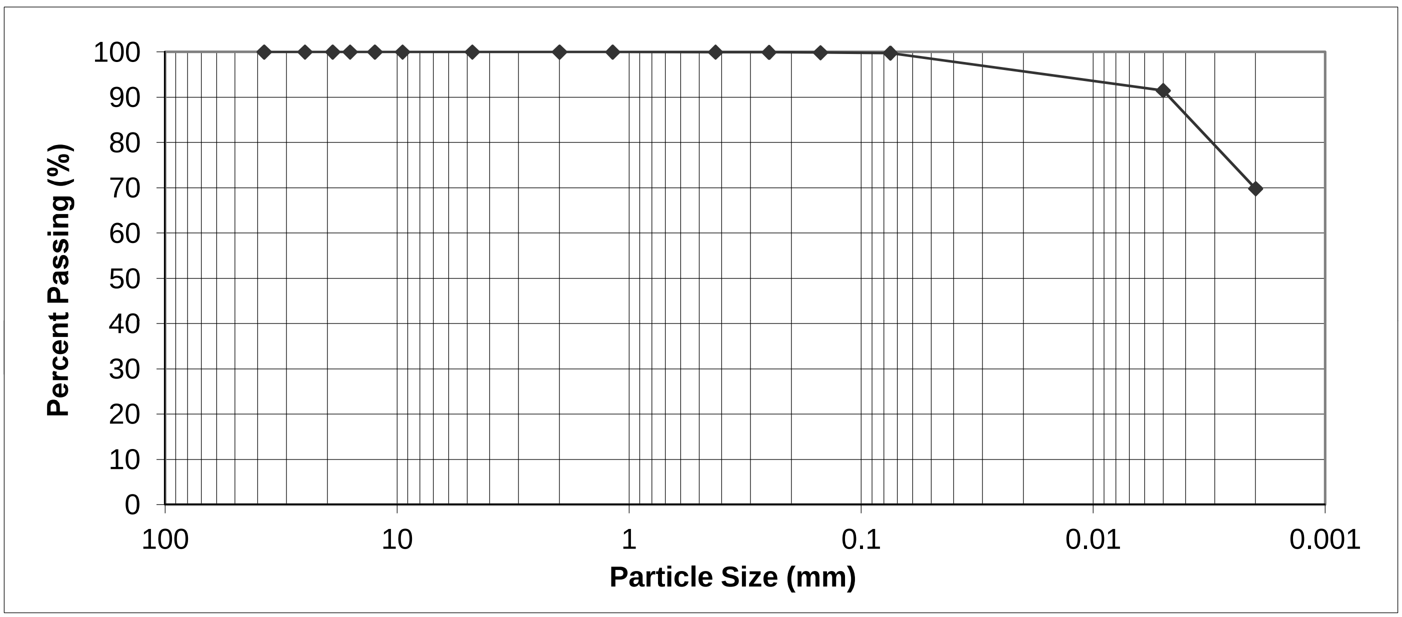
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH35 at 1.3 - 5.6 m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.9
0.075 mm	99.8
0.005 mm	91.5
0.002 mm	69.8
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.1	8.3	91.5	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
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PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

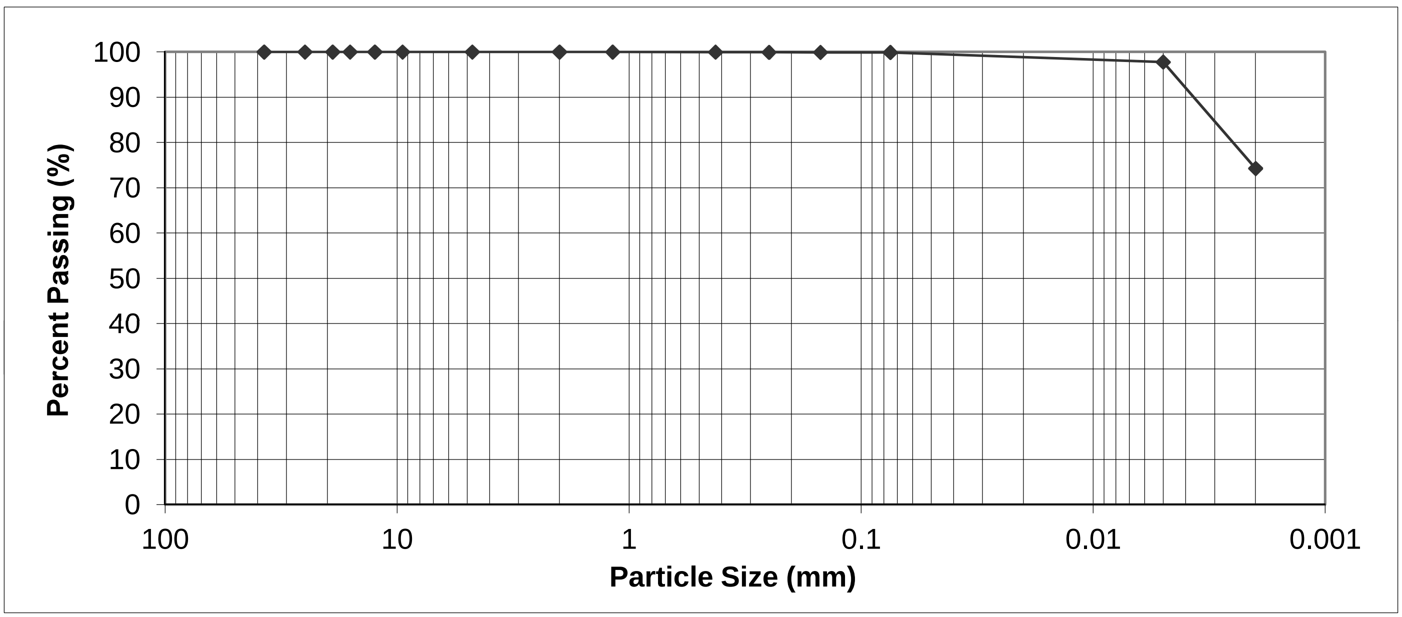
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH36 at 3.1 - 4.8m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	100.0
0.425 mm	99.9
0.250 mm	99.9
0.150 mm	99.9
0.075 mm	99.9
0.005 mm	97.8
0.002 mm	74.3
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.0	2.1	97.8	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

PARTICLE SIZE ANALYSIS
ASTM D422

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

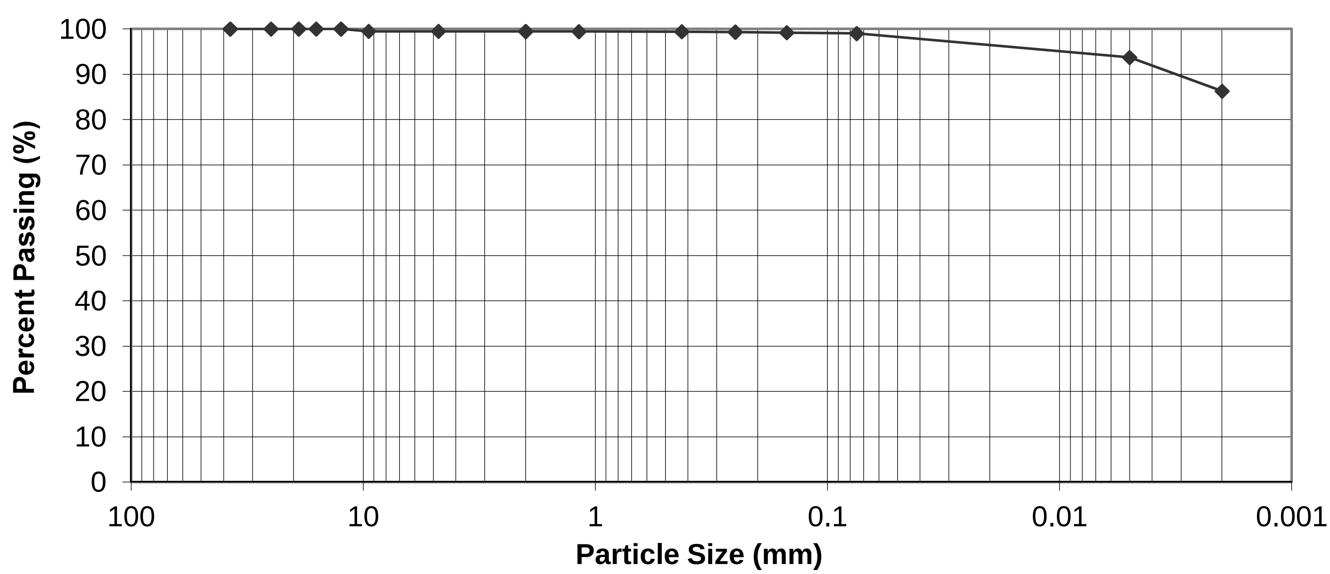
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH40 at 2.2 - 3.5m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING	PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0	1.18 mm	99.4
25.00 mm	100.0	0.425 mm	99.4
19.00 mm	100.0	0.250 mm	99.3
16.00 mm	100.0	0.150 mm	99.2
12.50 mm	100.0	0.075 mm	99.0
9.50 mm	99.5	0.005 mm	93.7
4.75 mm	99.5	0.002 mm	86.3
2.00 mm	99.4	0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.5	0.1	0.0	0.4	5.3	93.7	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

THE NATIONAL TESTING LABORATORIES LIMITED
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PARTICLE SIZE ANALYSIS
ASTM D422

J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

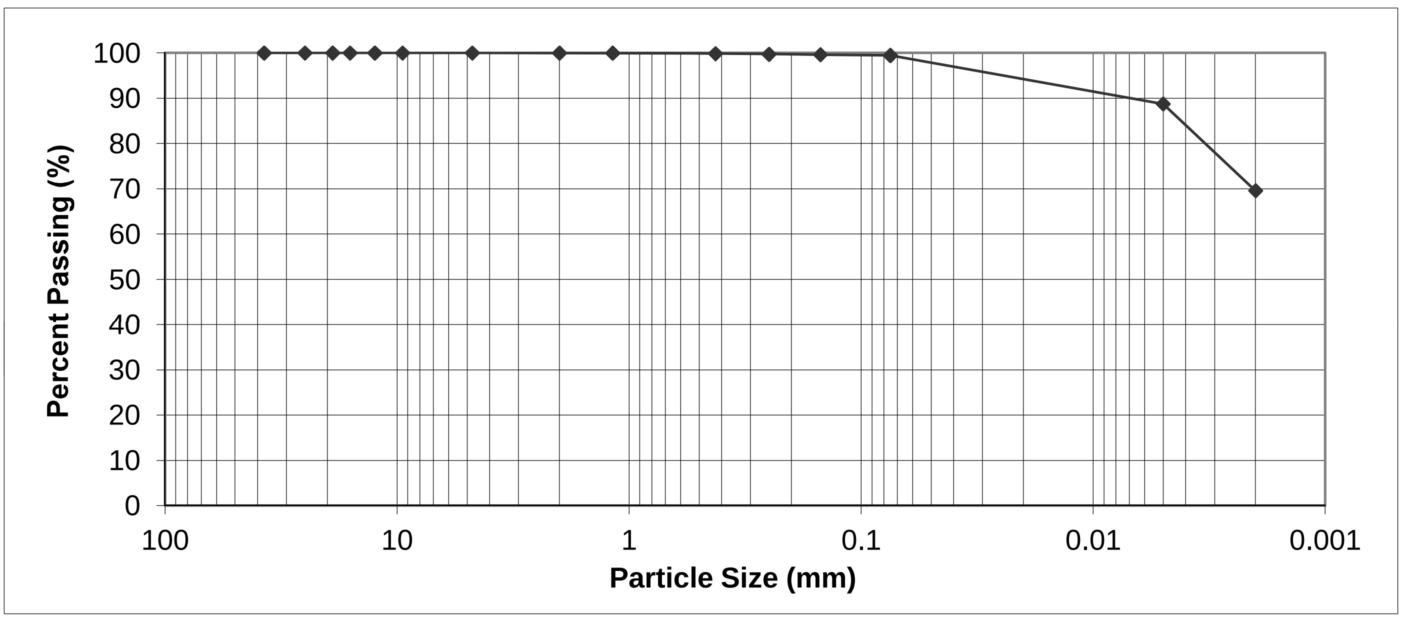
PROJECT: Mystery Lake Disposal Facility

Attention: Brett McCormac

PROJECT NO.: JRC-1102

SAMPLED BY: Client
SAMPLE ID: TH40 at 3.5 - 4.4 m

DATE RECEIVED: November 3, 2011
TESTED BY: Larry Presado



PARTICLE SIZE	PERCENT PASSING
37.50 mm	100.0
25.00 mm	100.0
19.00 mm	100.0
16.00 mm	100.0
12.50 mm	100.0
9.50 mm	100.0
4.75 mm	100.0
2.00 mm	100.0

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.9
0.425 mm	99.9
0.250 mm	99.7
0.150 mm	99.6
0.075 mm	99.4
0.005 mm	88.7
0.002 mm	69.6
0.001 mm	NT

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.5	10.7	88.7	NT

Note: Colloids content not tested

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

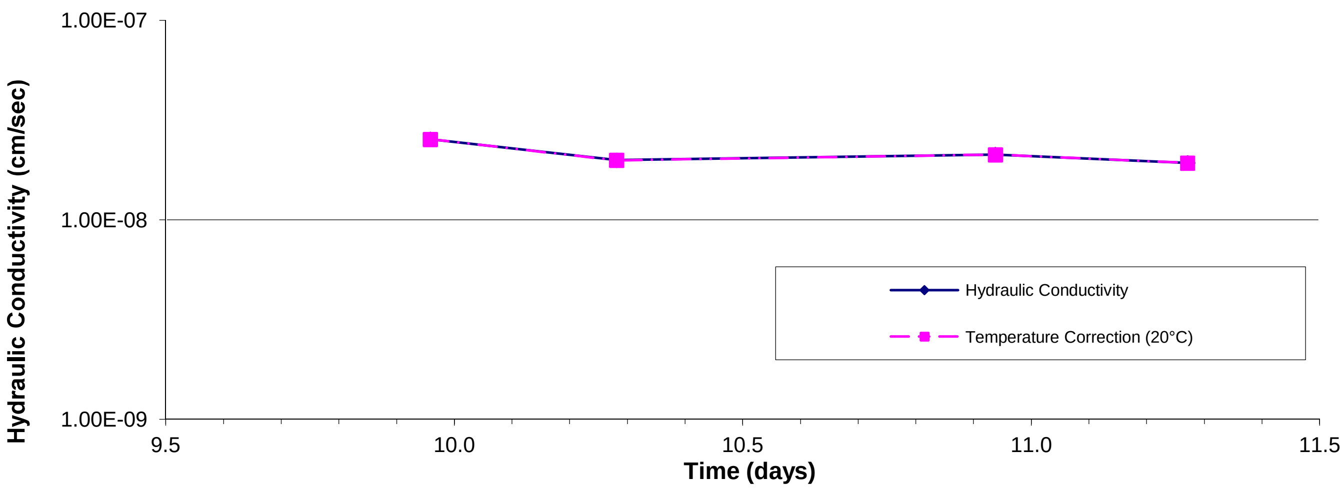
J.R.Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

SAMPLE I.D.:	**TH29 at 2 - 2.6 m**
SOIL TYPE:	Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED:	November 4 to Nov 15
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	18.3
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	2.1E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**2.1E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	81.1	72.4	638.3	1.475	29.6	95.1
Final Reading	81.4	72.6	646.8	1.449	32.5	100.7



November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

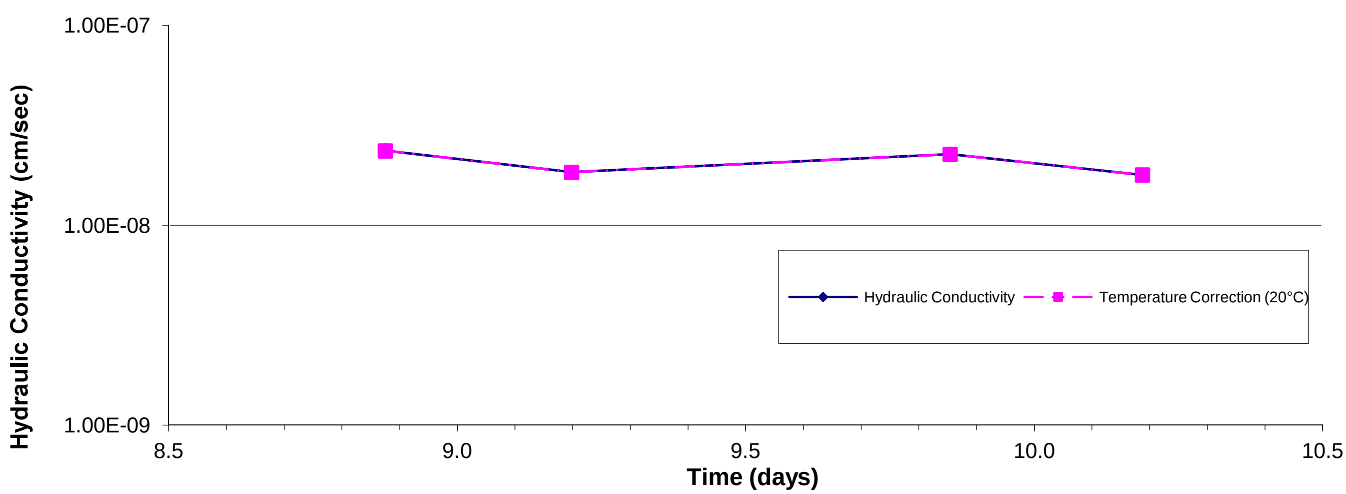
J.R.Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

PROJECT: Mystery Lake Waste Disposal Facility

Attention: Brett McCormac

SAMPLE I.D.:	**TH36 at 0.4 - 3.1 m**
SOIL TYPE:	Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED:	November 5 to November 16
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	19.8
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	2.1E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**2.1E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	74.6	70.5	567.9	1.489	31.1	102.0
Final Reading	74.6	70.6	570.9	1.491	31.0	102.0



Note: Sample was lab-remoulded prior to testing

November 30, 2011

REVIEWED BY: Aron Piamsalee, B.Sc., EIT

Phase I Construction Works – Hydraulic Conductivity Test Results, NTL, September 14, 2012

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

199 Henlow Bay
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Smook Contractors.
101 Hayes Road
Thompson, Manitoba
R8N 1M3

Attention: Peter Paulic

September 14, 2012

Project: LGD of Mystery Lake
Phase I

Soil samples were submitted to our laboratory on September 4, 2012. The samples were tested in accordance with ASTM D5084, Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter. The test results are summarized in the following table and the attached hydraulic conductivity reports.

Sample ID	Sample Depth (m)	Hydraulic Conductivity, "k_{20}"
TH1	1.5-2.1	1.6×10^{-8} cm/s
TH2	0.2-0.8	9.7×10^{-9} cm/s
TH4	4.5-5.1	3.1×10^{-8} cm/s

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Farouk Fourar-Laidi, E.I.T.
Geotechnical Engineering

HYDRAULIC CONDUCTIVITY
ASTM D5084

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

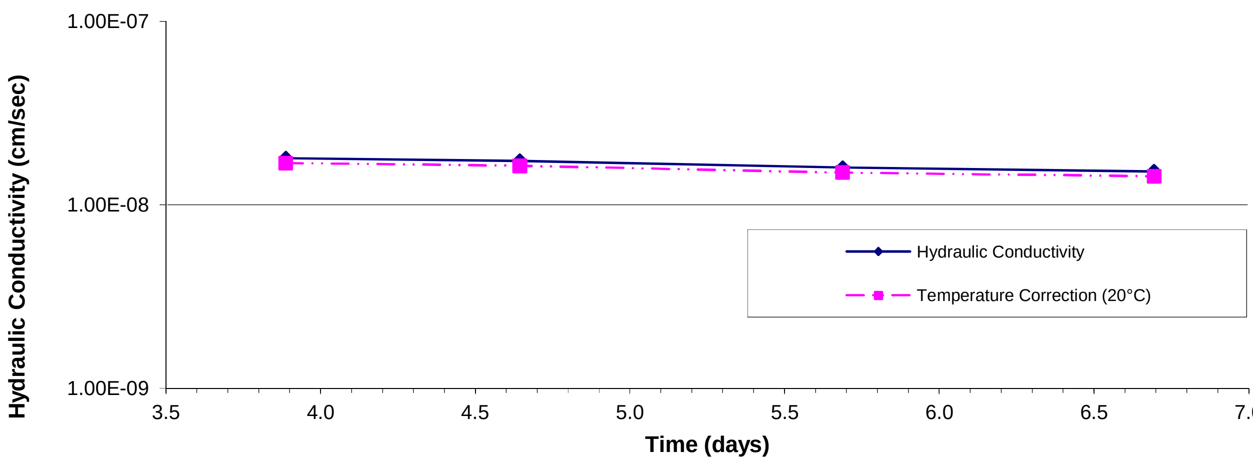
Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

PROJECT: LGD of Mystery Lake, Phase I

Attention: Peter Paulic

SAMPLE I.D.: **TH1 at 1.5-2.1 m**
SOIL TYPE: Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED: September 4th to 11th, 2012
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
HYDRAULIC GRADIENT: 19.0
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.7E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **1.6E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	77.4	72.5	632.5	1.530	29.4	103.2
Final Reading	78.1	72.8	640.2	1.510	30.5	104.1



September 14, 2012

REVIEWED BY: Farouk Fourar-Laidi, EIT

HYDRAULIC CONDUCTIVITY
ASTM D5084

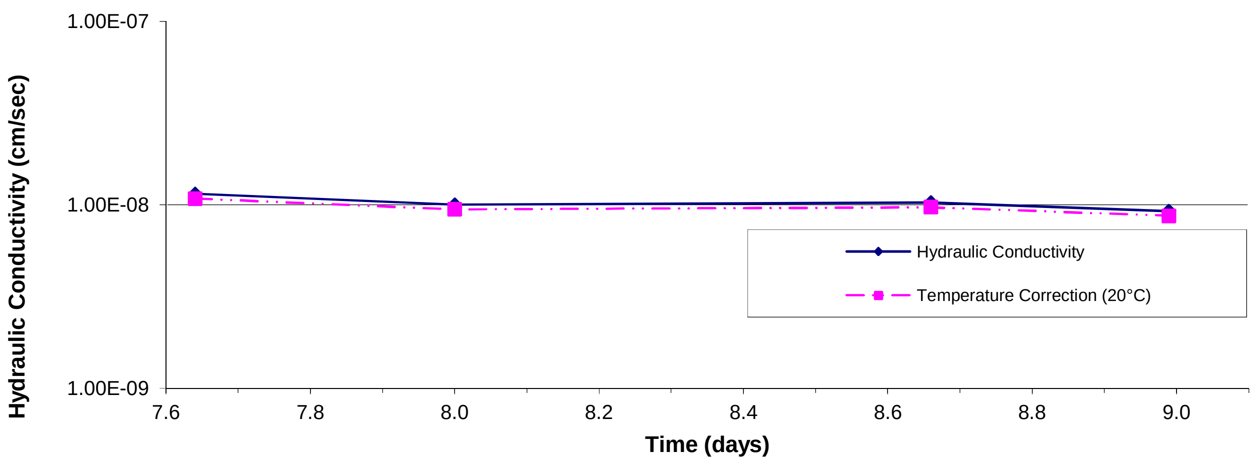
Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

PROJECT: LGD of Mystery Lake, Phase I

Attention: Peter Paulic

SAMPLE I.D.: **TH2 at 0.2-0.8 m**
SOIL TYPE: Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED: September 4th to 13 th, 2012
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
HYDRAULIC GRADIENT: 20.1
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.0E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **9.7E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	74.2	72.6	580.6	1.440	31.2	94.3
Final Reading	73.4	72.6	586.1	1.452	32.9	101.3



September 14, 2012

REVIEWED BY: Farouk Fourar-Laidi, EIT

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HYDRAULIC CONDUCTIVITY
ASTM D5084

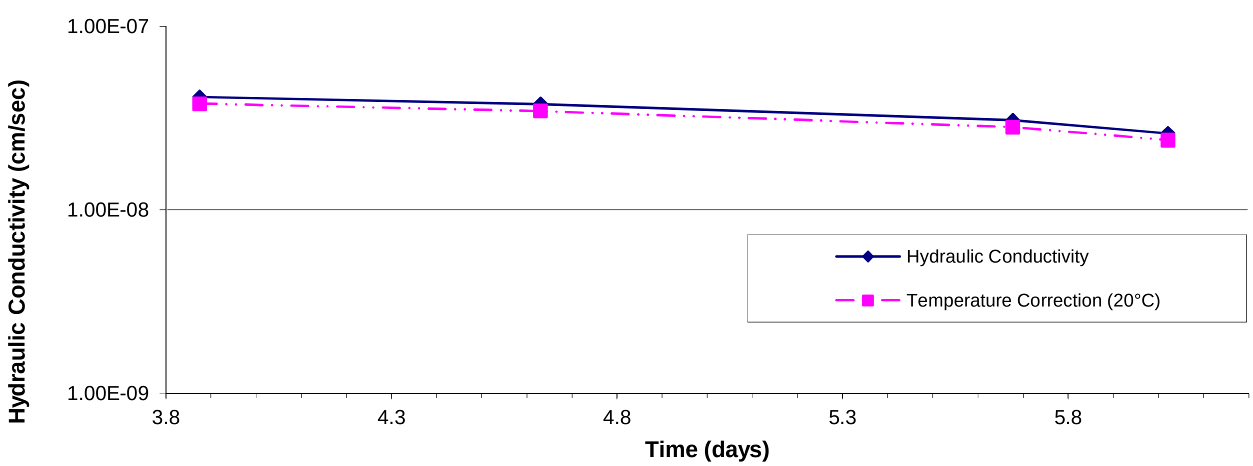
Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

PROJECT: LGD of Mystery Lake, Phase I

Attention: Peter Paulic

SAMPLE I.D.:	**TH4 at 4.5-5.1m**
SOIL TYPE:	Brown, stiff, moist, high plasticity clay trace silt
DATE TESTED:	September 4th to 10th, 2012
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
HYDRAULIC GRADIENT:	20.2
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	3.4E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**3.1E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	73.3	72.5	601.9	1.567	27.2	101.0
Final Reading	73.4	72.6	607.8	1.565	27.8	102.9



September 14, 2012

REVIEWED BY: Farouk Fourar-Laidi, EIT

Phase II Construction Works – Hydraulic Conductivity Test Results, NTL, October 29, 2013

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

199 Henlow Bay
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www.nationaltestlabs.com

CELEBRATING 90 Years 1923 - 2013

Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

October 29, 2013

Project: LGD of Mystery Lake Landfill

Attention: Peter Paulic

Seven Shelby tube samples were submitted to our laboratory on October 4, 2013. The samples were extruded from the Shelby tubes on October 17, 2013 in the presence of Manitoba Conservation Officer and a representative from J.R. Cousin Consultants Ltd. Selected soil samples from the Shelby tubes were tested in accordance with ASTM D5084, Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.

The test results for the soil samples tested are summarized in the following table and in the attached Hydraulic Conductivity Reports.

Testhole	Depth (ft)	Hydraulic Conductivity, "k_{20}"
TH5	1-3	3.6×10^{-8} cm/s
TH7	1-3	9.5×10^{-9} cm/s
TH8	1-3	1.9×10^{-8} cm/s

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Farouk Fourar-Laidi, B.Sc., EIT
Geotechnical Engineering

HYDRAULIC CONDUCTIVITY
ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

PROJECT: LGD of Mystery Lake Landfill

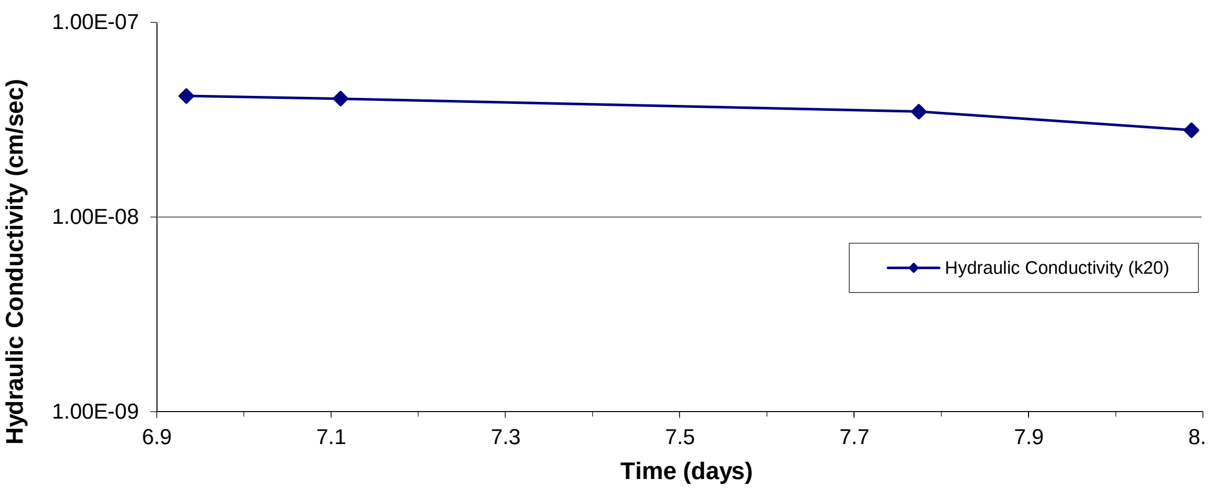
Attention: Peter Paulic

PROJECT NO.: SMO-1304

SAMPLE I.D.: **TH5 at 1'-3'**
SOIL DESCRIPTION: Brown,stiff, moist, high plasticity silty clay

DATE TESTED: October 17th to October 25th, 2013
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
ASSUMED SPECIFIC GRAVITY: 2.71
HYDRAULIC GRADIENT: 20.3
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 4.0E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **3.6E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	73.5	72.1	585.7	1.540	26.8	95.4
Final Reading	73.0	72.0	593.5	1.548	29.0	104.5



October 29, 2013

REVIEWED BY: Farouk Fourar-Laidi, B.Sc., EIT

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

PROJECT: LGD of Mystery Lake Landfill

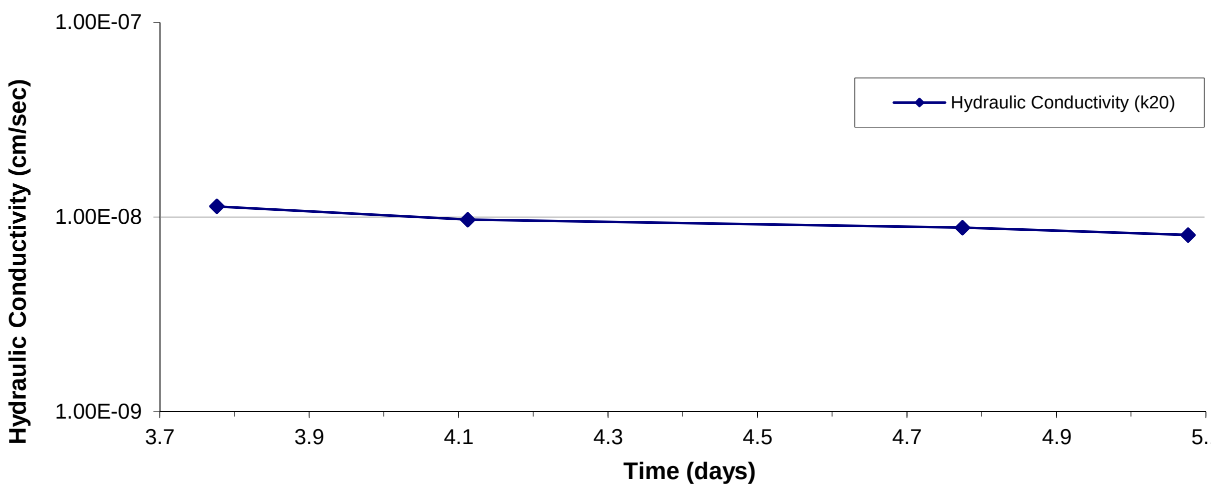
Attention: Peter Paulic

PROJECT NO.: SMO-1304

SAMPLE I.D.: **TH7 at 1'-3'**
SOIL DESCRIPTION: Brown, stiff, moist, high plasticity silty clay

DATE TESTED: October 17th to October 22nd, 2013
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
ASSUMED SPECIFIC GRAVITY: 2.71
HYDRAULIC GRADIENT: 19.6
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.0E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **9.5E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	76.5	71.7	592.9	1.477	30.1	97.6
Final Reading	75.5	71.5	593.7	1.531	28.2	99.1



October 29, 2013

REVIEWED BY: Farouk Fourar-Laidi, B.Sc., EIT

199 Henlow Bay, Winnipeg, Manitoba R3Y 1G4 Phone (204) 488-6999 Fax (204) 488-6947 Email info@nationaltestlabs.com

THE NATIONAL TESTING LABORATORIES LIMITED
Established in 1923

HYDRAULIC CONDUCTIVITY
ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, MB
R8N 1M3

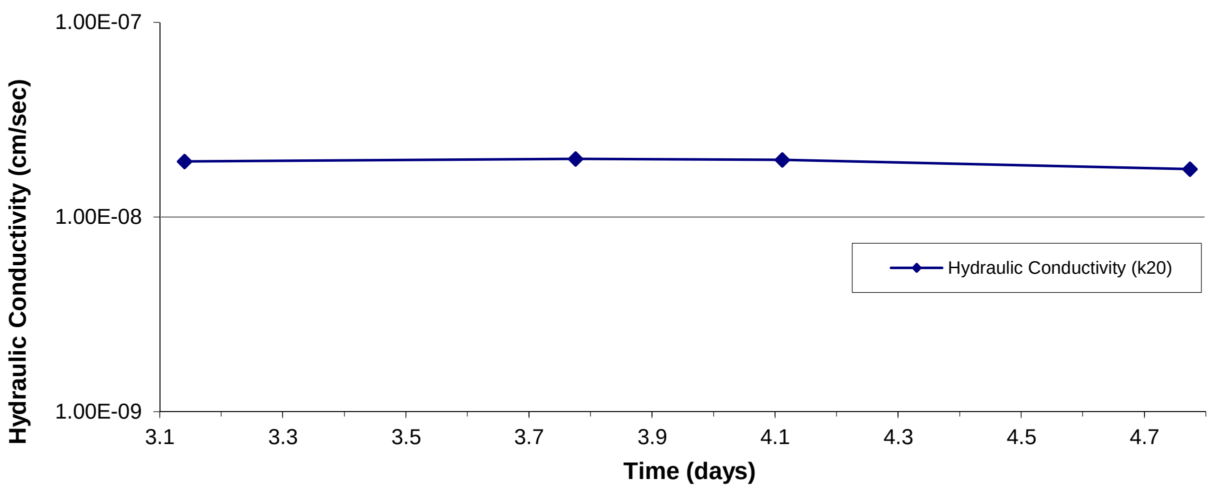
PROJECT: LGD of Mystery Lake Landfill

Attention: Peter Paulic

PROJECT NO.: SMO-1304

SAMPLE I.D.:	**TH8 at 1'-3'**
SOIL DESCRIPTION:	Brown, firm, moist, high plasticity silty clay
DATE TESTED:	October 17th to October 22nd, 2013
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
ASSUMED SPECIFIC GRAVITY:	2.71
HYDRAULIC GRADIENT:	20.2
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	2.1E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**1.9E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	73.8	72.6	594.0	1.478	31.6	102.8
Final Reading	73.4	72.3	594.6	1.523	29.6	102.8



October 29, 2013

REVIEWED BY: Farouk Fourar-Laidi, B.Sc., EIT

Phase III Construction Works – Hydraulic Conductivity Test Results, Stantec, October 23, 2014

Stantec Consulting Ltd.
905 Waverley Street, Winnipeg MB R3T 5P4

October 23, 2014
File: 123311511

Attention: Ken Allard
Smook Contractors
101 Hayes Road
Thompson, MB, R8N 1M3

Dear Ken,

Reference: Soils Testing for LGD Mystery Lake

Three soil samples, identified as Sample #2, Sample #5 and Sample #6 were submitted to our laboratory on October 3, 2014. The samples were tested in accordance with ASTM D5084, Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter. The test results are provided in the attached hydraulic conductivity reports and are summarized in the following table:

Sample ID	Hydraulic Conductivity, "k_{20}"
Sample #2	7.5×10^{-9} cm/s
Sample # 5	2.0×10^{-8} cm/s
Sample # 6	1.2×10^{-8} cm/s

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Regards,

STANTEC CONSULTING LTD.

Jason Thompson, C.E.T.
Associate - Manager, Materials Testing Services
Phone: (204) 928-4004
Fax: (204) 488-6947
Jason.Thompson@stantec.com

Attachment: 3x – Hydraulic Conductivity Test Report.

LABORATORY
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999

HYDRAULIC CONDUCTIVITY
ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, Manitoba
R8N 1M3

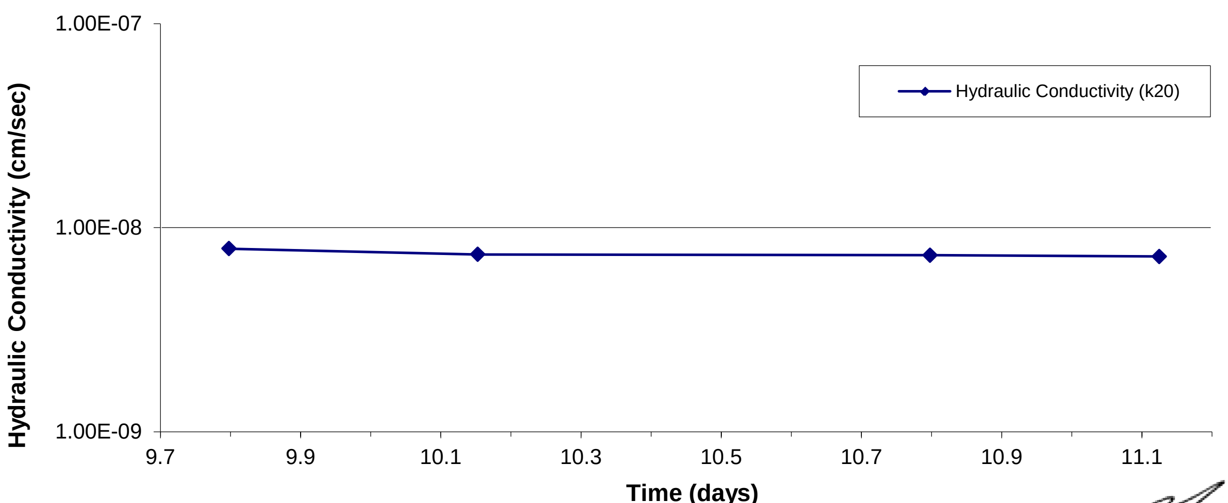
PROJECT: LGD of Mystery Lake

Attention: Ken Allard

PROJECT NO.: 123311511

SAMPLE I.D.:	**Sample #2**
SOIL DESCRIPTION:	Brown, stiff, moist, high plasticity silty clay trace fine gravel
DATE TESTED:	October 6 to October 17, 2014
CONFINING PRESSURE (kPa):	137.9
EFFECTIVE SATURATION STRESS (kPa):	34.5
ASSUMED SPECIFIC GRAVITY:	2.71
HYDRAULIC GRADIENT:	19.9
TYPE OF PERMEANT LIQUID:	De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s):	8.0E-09
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s):	**7.5E-09**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	74.3	72.4	605.8	1.544	28.3	101.6
Final Reading	74.4	72.7	609.7	1.519	29.8	102.9



October 23, 2014

REVIEWED BY: Jason Thompson, C.E.T.

Stantec

LABORATORY
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999

HYDRAULIC CONDUCTIVITY ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, Manitoba
R8N 1M3

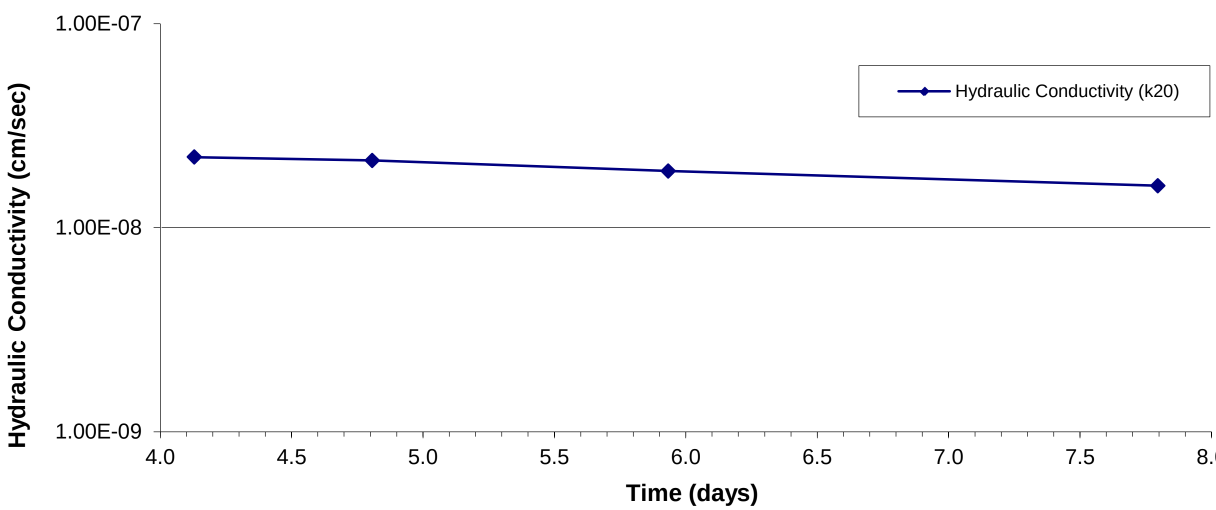
PROJECT: LGD of Mystery Lake

Attention: Ken Allard

PROJECT NO.: 123311511

SAMPLE I.D.: **Sample #5**
SOIL DESCRIPTION: Brown, stiff, moist, high plasticity silty clay trace fine gravel
DATE TESTED: October 6 to October 14, 2014
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
ASSUMED SPECIFIC GRAVITY: 2.71
HYDRAULIC GRADIENT: 20.4
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 2.0E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **2.0E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	72.4	72.5	572.8	1.454	31.9	100.1
Final Reading	72.4	72.1	575.6	1.464	33.1	105.4



October 23, 2014

REVIEWED BY: Jason Thompson, C.E.T.

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of the test results is provided only on written request. The data presented above is for the sole use of the client stipulated above. Stantec is not responsible, nor can be held liable, for the use of this report by any other party, with or without the knowledge of Stantec.

LABORATORY
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999

HYDRAULIC CONDUCTIVITY
ASTM D5084

Smook Contractors
101 Hayes Road
Thompson, Manitoba
R8N 1M3

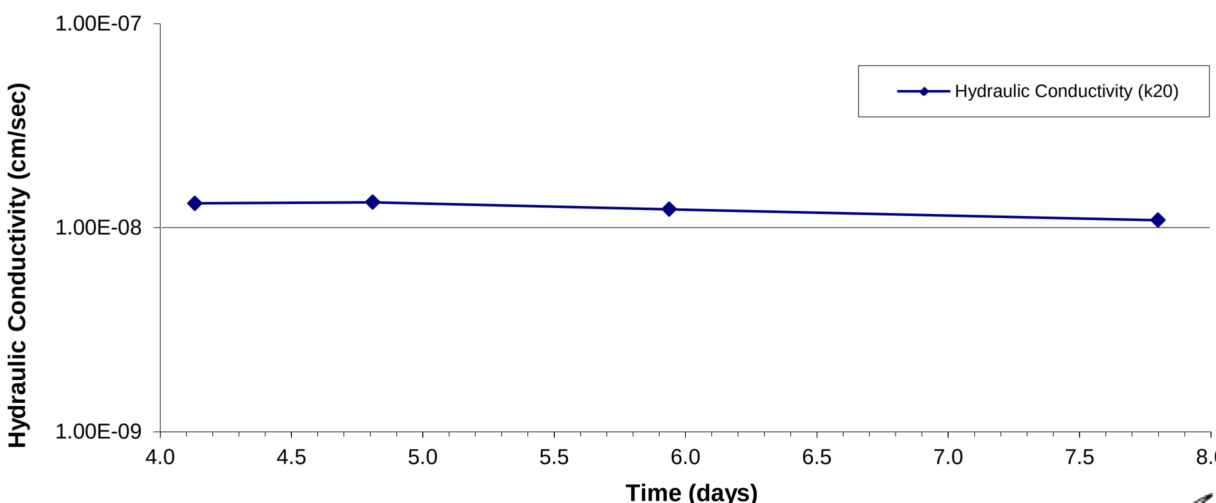
PROJECT: LGD of Mystery Lake

Attention: Ken Allard

PROJECT NO.: 123311511

SAMPLE I.D.: **Sample #6**
SOIL DESCRIPTION: Brown, stiff, moist, high plasticity silty clay trace fine gravel
DATE TESTED: October 6 to October 14, 2014
CONFINING PRESSURE (kPa): 137.9
EFFECTIVE SATURATION STRESS (kPa): 34.5
ASSUMED SPECIFIC GRAVITY: 2.71
HYDRAULIC GRADIENT: 20.6
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.3E-08
HYDRAULIC CONDUCTIVITY, "k_{20}" (cm/s): **1.2E-08**

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (%)	Saturation (%)
Initial Reading	71.9	72.5	578.5	1.506	29.4	99.8
Final Reading	71.9	72.1	579.8	1.522	29.8	103.2



October 23, 2014

REVIEWED BY: Jason Thompson, C.E.T.

Appendix C

Plan 1: Site Layout with Approximate Location of Property Line

Plan 2: Final Cover Grading Contours and Final Drainage Plan

Phase I Works – Record Drawing Plan Set

Phase II Works – Record Drawing Plan Set

Phase III Works – Record Drawing Plan Set

Phase IV Works – Design Drawing Plan Set

Plan 1:	Site Layout with Approximate Location of Property Line
Plan 2:	Final Cover Grading Contours and Final Drainage Plan

SCALE BAR
(IN METRES)
40 0 20 40 80 120 160 200
1:2000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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ENGINEER'S SEAL

PRELIMINARY

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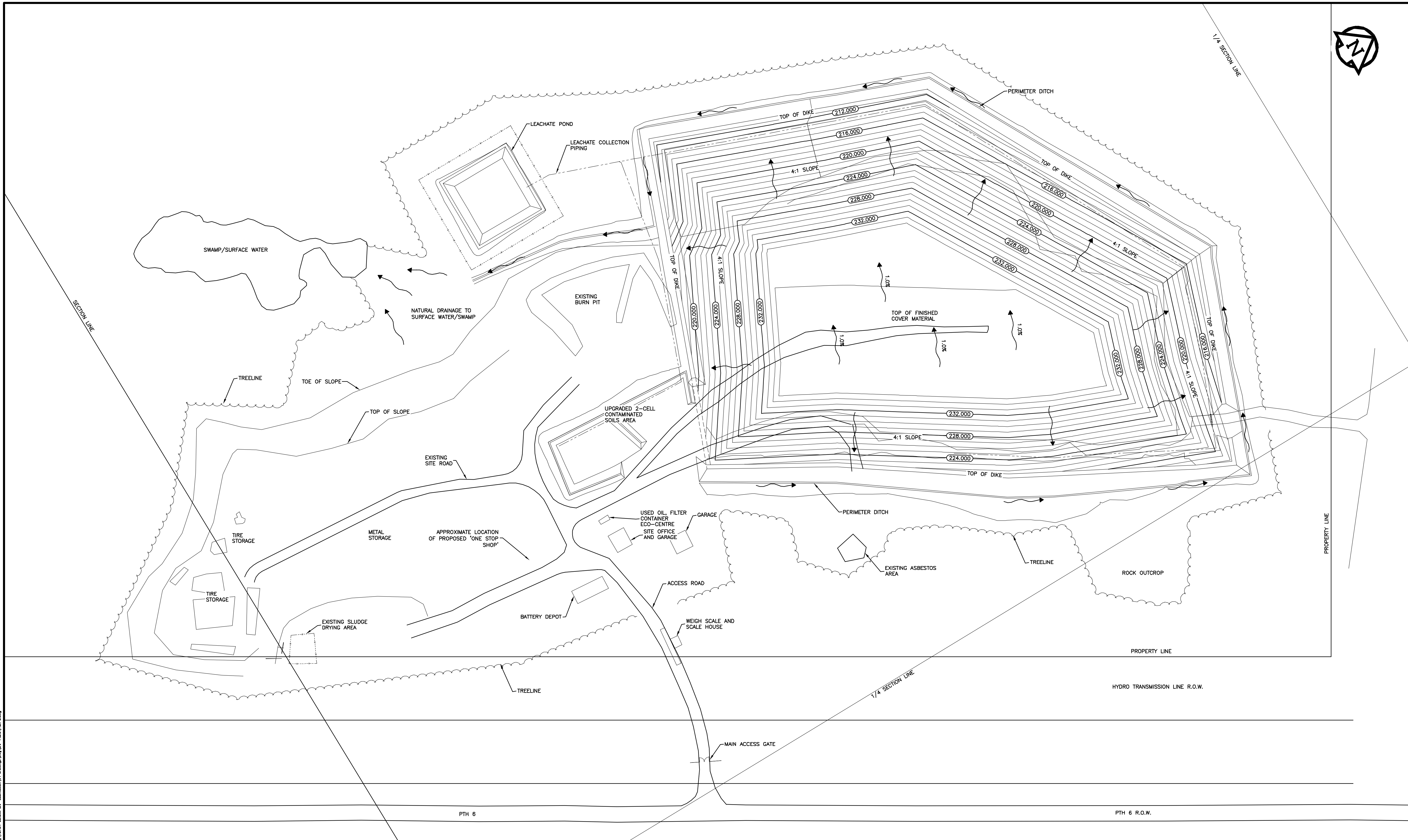
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE: T-727.01
DESIGNED BY: BM
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: CITY OF THOMPSON WASTE DISPOSAL GROUND EAP SUBMISSION

TITLE: SITE LAYOUT WITH APPROXIMATE LOCATION OF PROPERTY LINE

SCALE:	DATE:	PLAN:	SHEET:
1:2000	16/05/26	1	1 of 2



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(IN METRES)
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1:1250

No.	REVISIONS	DATE	INITIALS

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ENGINEERING EXCELLENCE SINCE 1981

CODE: T-727.01
DESIGNED BY: BM
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
CITY OF THOMPSON
WASTE DISPOSAL GROUND EAP SUBMISSION

TITLE:
FINAL COVER GRADING CONTOURS AND FINAL DRAINAGE PLAN

SCALE:	DATE:	PLAN:	SHEET:
1:1250	16/05/26	2	2 of 2

Phase I Works – Record Drawing Plan Set

LGD of MYSTERY LAKE

WASTE DISPOSAL GROUND PHASE I WORKS

PLAN INDEX

J.R. Cousin Consultants Ltd.
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Record Drawing

Drawing compiled from visual observations of various parts of construction and/or from information by others. Accuracy not warranted. Independent verification required before application.

DRAWING LEGEND:

PIPING:

- EXISTING WATERMAIN
- PROPOSED WATERMAIN
- FUTURE WATERMAIN
- EXISTING SEWERMAIN
- PROPOSED SEWERMAIN
- FUTURE SEWERMAIN
- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- FUTURE FORCEMAIN
- EXISTING RAW WATERMAIN
- PROPOSED RAW WATERMAIN
- FUTURE RAW WATERMAIN
- EXISTING LAND DRAINAGE SEWER
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER
- FH EXISTING FIRE HYDRANT
- FH PROPOSED FIRE HYDRANT
- EXISTING VALVE
- PROPOSED VALVE
- CO EXISTING CLEANOUT
- CO PROPOSED CLEANOUT
- MH EXISTING MANHOLE
- MH PROPOSED MANHOLE
- EXISTING CURBSTOP
- PROPOSED CURBSTOP
- CB EXISTING CATCH BASIN
- CB PROPOSED CATCH BASIN

ROADS AND DRAINAGE:

- EXISTING ROAD CENTERLINE
- PROPOSED ROAD CENTERLINE
- FUTURE ROAD CENTERLINE
- EXISTING ROAD SHOULDER
- PROPOSED ROAD SHOULDER
- EXISTING ROAD EDGE
- PROPOSED ROAD EDGE
- FUTURE ROAD EDGE
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- EXISTING DITCH
- PROPOSED DITCH
- EXISTING CULVERT
- PROPOSED CULVERT
- EXISTING DRAINAGE DIRECTION
- PROPOSED DRAINAGE DIRECTION
- 100 CONTOURS – MAJOR INTERVALS
- 100.5 CONTOURS – MINOR INTERVALS
- ×100.00 EXISTING GROUND ELEVATION
- (100.00) PROPOSED GROUND ELEVATION
- (100.00) EXISTING ROAD ELEVATION
- (100.00) PROPOSED ROAD ELEVATION
- TOP / BOTTOM EXISTING SLOPE
- TOP / BOTTOM PROPOSED SLOPE

MISCELLANEOUS:

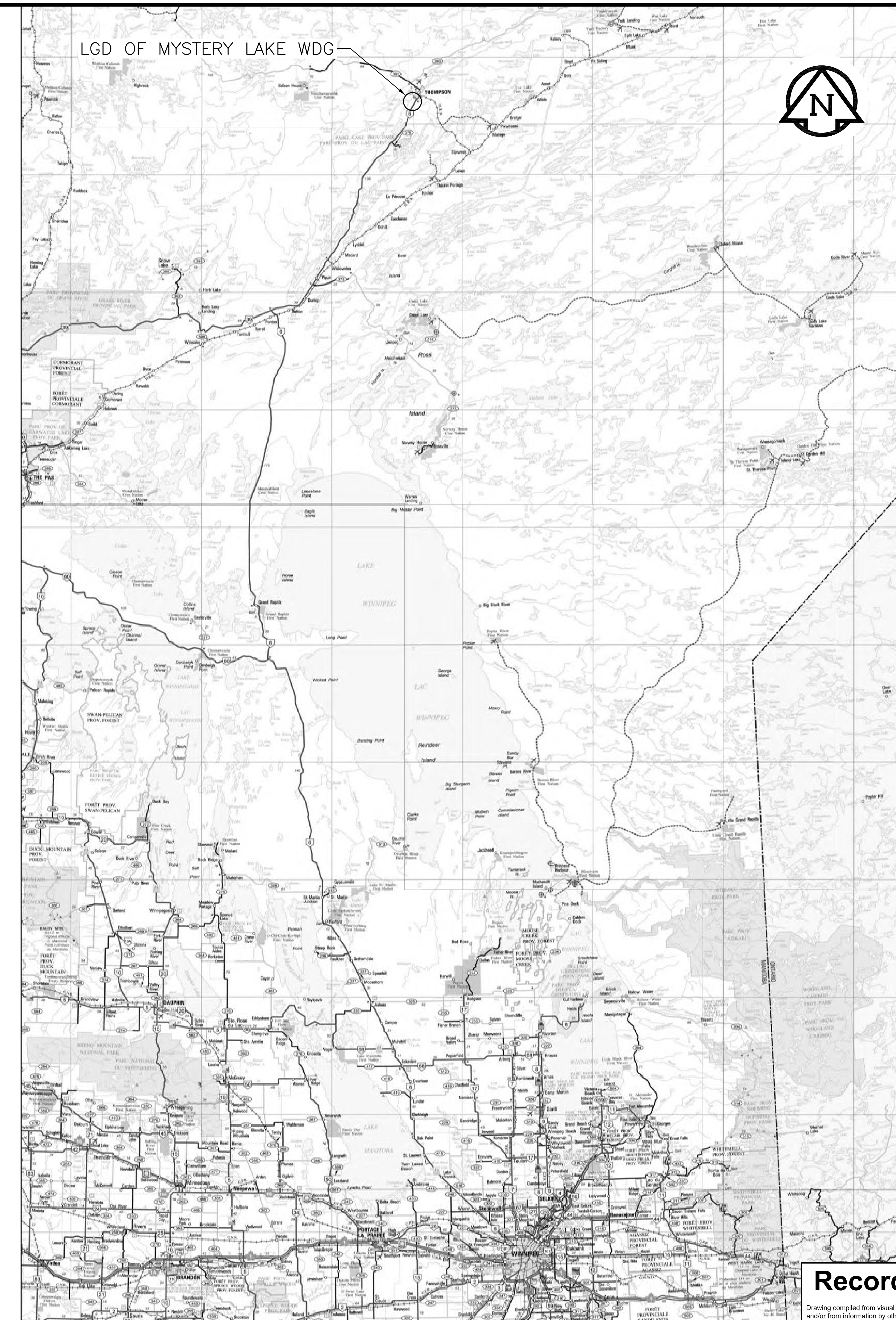
- EXISTING FENCE LINE
- PROPOSED FENCE LINE
- EXISTING HYDRO LINE
- PROPOSED HYDRO LINE
- EXISTING GAS LINE
- MTS EXISTING MTS LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- LEGAL/LOT LINE
- RAILWAY LINE
- MATCH LINE
- HP HYDRO POLE
- W WATER HOLDING TANK
- S SEPTIC TANK
- H SEWAGE HOLDING TANK
- SURVEY BAR
- SURVEY MONUMENT/BENCHMARK
- EXISTING VEGETATION
- PROPOSED VEGETATION
- D1 DOOR CONSTRUCTION TYPE
- W1 WALL CONSTRUCTION TYPE
- EASEMENT
- N NORTH ARROW

ABBREVIATIONS:

@	AT
A/C	AIR CONDITIONING
ALUM	ALUMINUM
ASPH	ASPHALT
AVE	AVENUE
AVG	AVERAGE
BD	BOTTOM OF DITCH
BLDG	BUILDING
BLVD	BOULEVARD
BM	BENCHMARK
BOT	BOTTOM
BP	BACKWASH PUMP
B/W	BOTHWAYS
CB	CATCH BASIN
CI	CAST IRON
CHKD	CHECKED
CNR	CANADIAN NATIONAL RAILWAY
CO	CLEANOUT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
COORD	COORDINATE
CPR	CANADIAN PACIFIC RAILWAY
C/W	COMPLETE WITH
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DHW	DOMESTIC HOT WATER
DIA	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DP	DUTY PUMP
DR	DRIVE
DWG	DRAWING
E	EAST
EC	END OF CURVE
EL	ELEVATION
ELEC	ELECTRICAL
EP	EDGE OF PAVEMENT
ER	EDGE OF ROAD
E/W	EACHWAY
EXT	EXTERIOR
FAX	FAX MACHINE STAND
FC	FILE CABINET
FD	FLOOR DRAIN
F/F	FACE TO FACE
FH	FIRE HYDRANT
FM	FORCEMAIN
FP	FIRE PUMP
FT	FOOT, FEET
GA	GAUGE
GALV	GALVANIZED
HA	HECTARE
HB	HOSE BIBB
HI	HEIGHT OF INSTRUMENT
HLF	HIGH LEVEL FLOAT
HPW	HIGH PRESSURE WATER LINE
HORIZ	HORIZONTAL
HP	HYDRO POLE
HST	HYDROSTATIC TRANSDUCER
HR	HOUR
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HW	HOT WATER TANK
HWL	HIGH WATER LEVEL
ID	INSIDE DIAMETER
IL	ICE LEVEL
INCL	INCLUDE
INT	INTERIOR
INV	INVERT
JCT	JUNCTION
JP	JOCKEY PUMP
LAB	LABORATORY
LAM	LAMINATE
LAT	LATITUDE
LDS	LAND DRAINAGE SEWER
LF	LEVEL FLOAT
LLF	LOW LEVEL FLOAT
LONG	LONGITUDE
LWL	LOW WATER LEVEL
M	METRE
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEMB	MEMBRANE
MH	MANHOLE
MIN	MINIMUM
MM	MILLIMETRE
N	NORTH
NAT	NATURAL
NBC	NATIONAL BUILDING CODE
NS	NORTH SHORE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O/C	ON CENTRE
O/D	OUTSIDE DIAMETER
O/F	OUTSIDE FACE
O/H	OVER HEAD
OD	OUTSIDE DIAMETER
ORIG	ORIGINAL
OWSJ	OPEN WEB STEEL JOIST
PLYWD	PLYWOOD
PS	PRESSURE SEWER
POLY	POLYETHYLENE
PROP	PROPERTY
PVC	POLY VINYL CHLORIDE
RAD	RADIUS
RD	ROAD
REV	REVISION
ROW	RIGHT OF WAY
RM	ROOM
S	SOUTH
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIB	STEEL IRON BAR
SPEC	SPECIFICATION
SQ	SQUARE
SS	SOUTH SHORE
ST	STREET
STD	STANDARD
SUSP	SUSPENDED
SW	SIDEWALK
TEL	TELEPHONE
TEMP	TEMPORARY
TP	TRUCKFILL PUMP
TYP	TYPICAL
VERT	VERTICAL
VOL	VOLUME
US	ULTRASONICS TRANSDUCER
VAR	VARIES
VB	VAPOUR BARRIER
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
W	WEST
W/O	WITHOUT
WL	WATER LEVEL
WM	WATERMAIN
WWS	WASTEWATER SEWER
WT	WEIGHT

A – DETAIL NUMBER
B – PLAN WHERE DETAIL EXPANDED
C – PLAN WHERE DETAIL ORIGINATES

NOTE:
–WHOLE NUMBERS INDICATE MILLIMETERS
–DECIMALIZED NUMBERS REPRESENT METERS



Record Drawing

Drawing compiled from visual observations of various parts of construction and/or from information by others. Accuracy not warranted. Independent verification required before application.

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

B.M. ELEV.

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APEGM STAMP

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 11/10/20

ENGINEER'S SEAL

ORIGINAL DRAWING SIGNED AND SEALED BY G.R. COUSIN 11/10/20

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS

CODE: M–617.01

TITLE: DRAWING LEGEND, ABBREVIATION INDEX AND KEY PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	NTS	11/10/12	1	1 of 8

Record Drawing

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SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

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PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS
CODE: M–617.01
TITLE: EXISTING SITE LAYOUT WITH TEST HOLE LOCATIONS

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/10/12	2	2 of 8

Sep 20, 2012 – 9:46am F:\600\617 Mystery Lake LGD\617.01 Waste Disposal

Record Drawing

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No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

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PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS

CODE: M–617.01

TITLE: EXISTING SITE LAYOUT WITH CONTOUR LINES

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:1250	11/10/12	3	3 of 8

LEGEND

TH # – TEST HOLES BY AECOM IN 2005
MW # – MONITORING WELLS BY AECOM IN 2005
TH # – TEST HOLES BY JRCC IN 2011
EXISTING
PROPOSED – PHASE 1
PROPOSED – PHASE 1 LEACHATE PIPING
PROPOSED – FUTURE PHASES
PROPOSED – FUTURE LEACHATE PIPING

PHASE I WORKS

EXPANSION CELL WITH PERIMETER DIKING AND DITCHING
PORTABLE LITTER CONTROL FENCING IN ACTIVE PORTION OF THE ACTIVE CELL
LEACHATE COLLECTION PIPING
LEACHATE COLLECTION POND
PERIMETER FENCE AROUND LEACHATE POND

FUTURE PHASE WORKS

DIKING AROUND THE ENTIRE FORMER AND ACTIVE CELL AREA WITH A PERIMETER FENCE
REMAINDER OF THE LEACHATE COLLECTION SYSTEM
PERIMETER DITCHING
COVERED AND LINED SHELTER FOR HAZARDOUS WASTE
DESIGNATED AREAS FOR MATERIALS COLLECTION
TWO CELL BURN AREA WITH FENCING ON THE TOP OF THE DIKES
UPGRADED DIKES AROUND THE CONTAMINATED SOILS AREA

Record Drawing

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SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

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No. 234 Date: 11/10/20

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J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

DESIGNED BY: JC | DRAWN BY: BM | REVIEWED BY: JC

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS
CODE: M-617.01
TITLE: OVERALL MASTER PLAN SHOWING ALL DEVELOPMENT PHASES
SCALE: 1:1250 | DATE: 11/10/12 | PLAN: 4 | SHEET: 4 of 8

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
2	REVISED ELEVATIONS	12/06/01	BM
1	ISSUED FOR TENDER	11/10/20	BM

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No. 234 Date: 11/10/20

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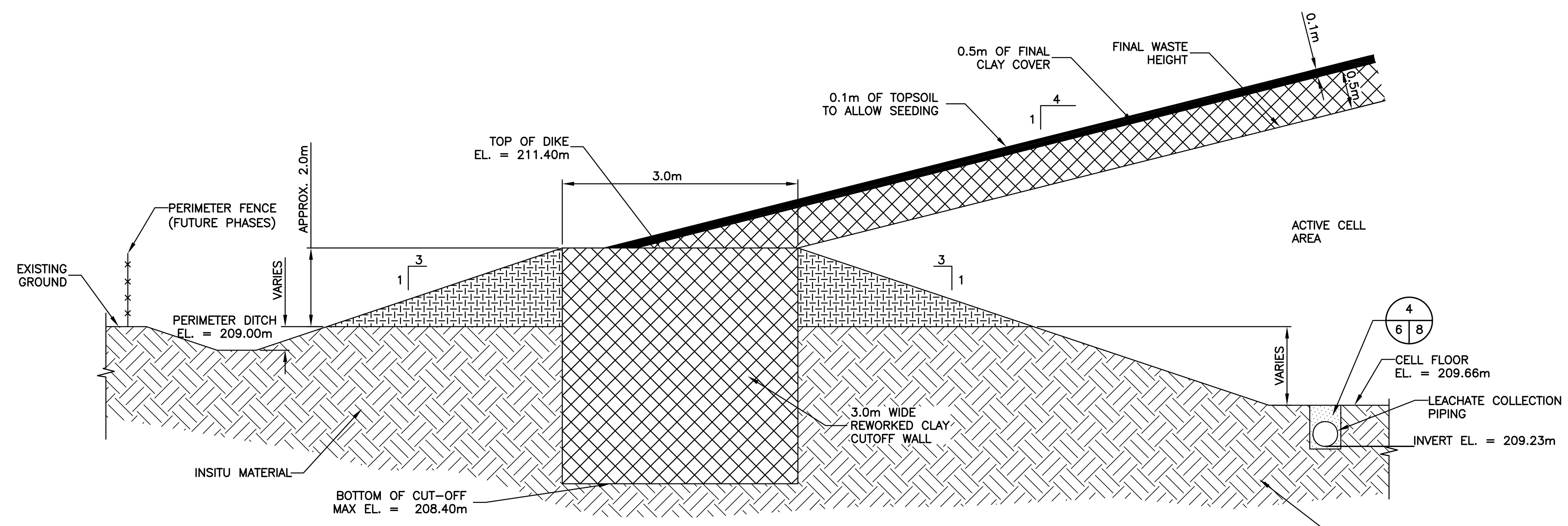
PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS

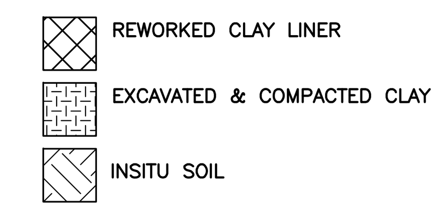
CODE: M-617.01

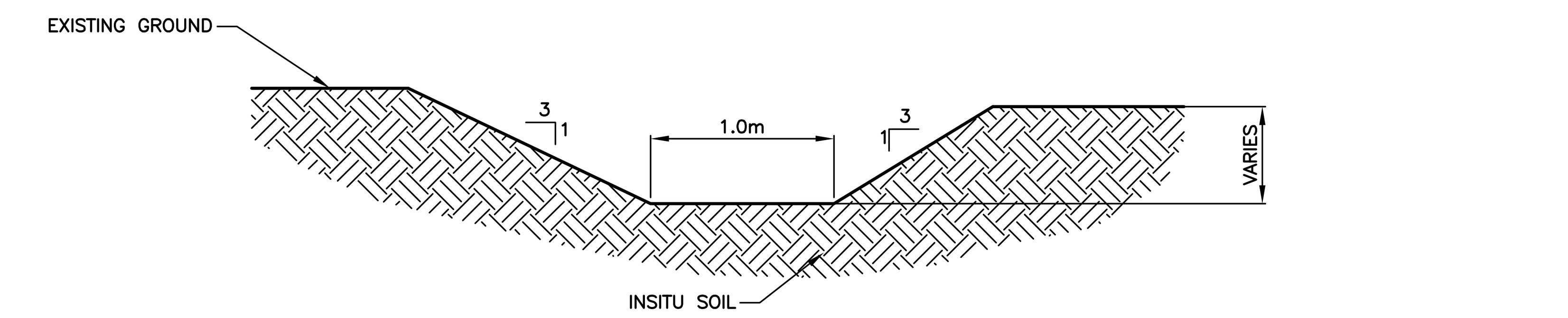
TITLE: PHASE 1 WORKS

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	1:750	11/10/12	5	5 of 8



1 4,5 6 ACTIVE CELL DIKE DETAIL
SCALE = 1:50





4 4,5 6 TYPICAL DITCH DETAIL
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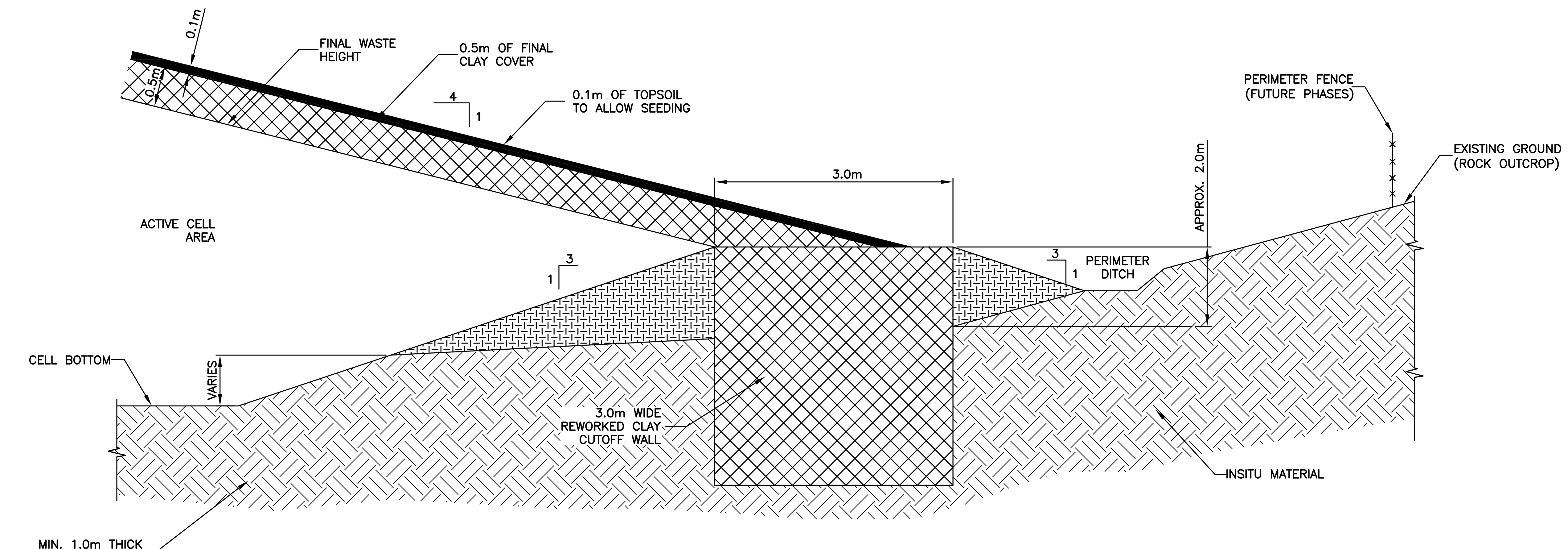
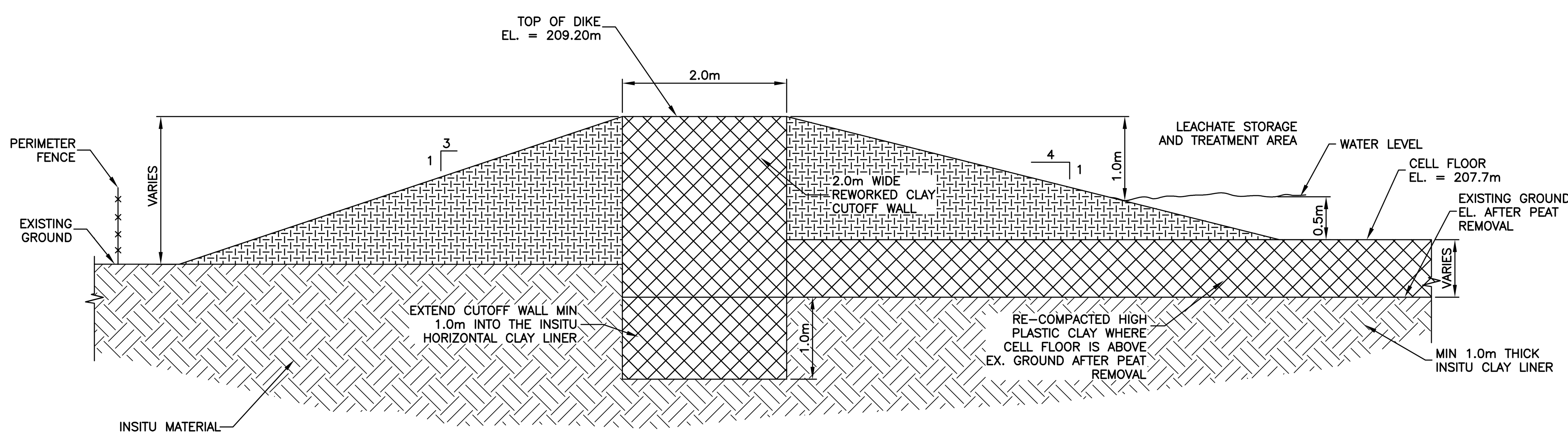
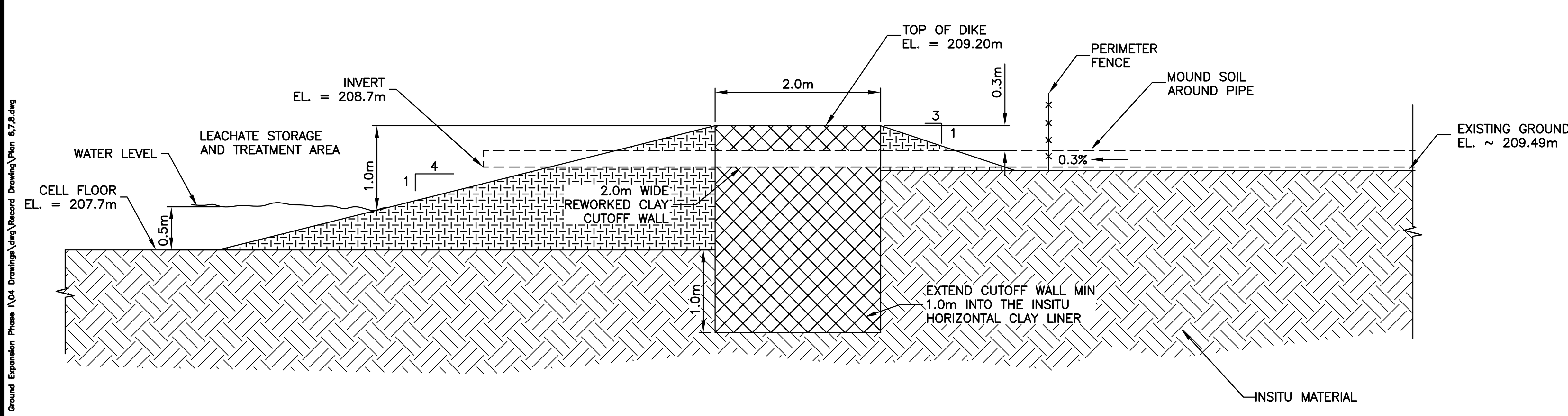


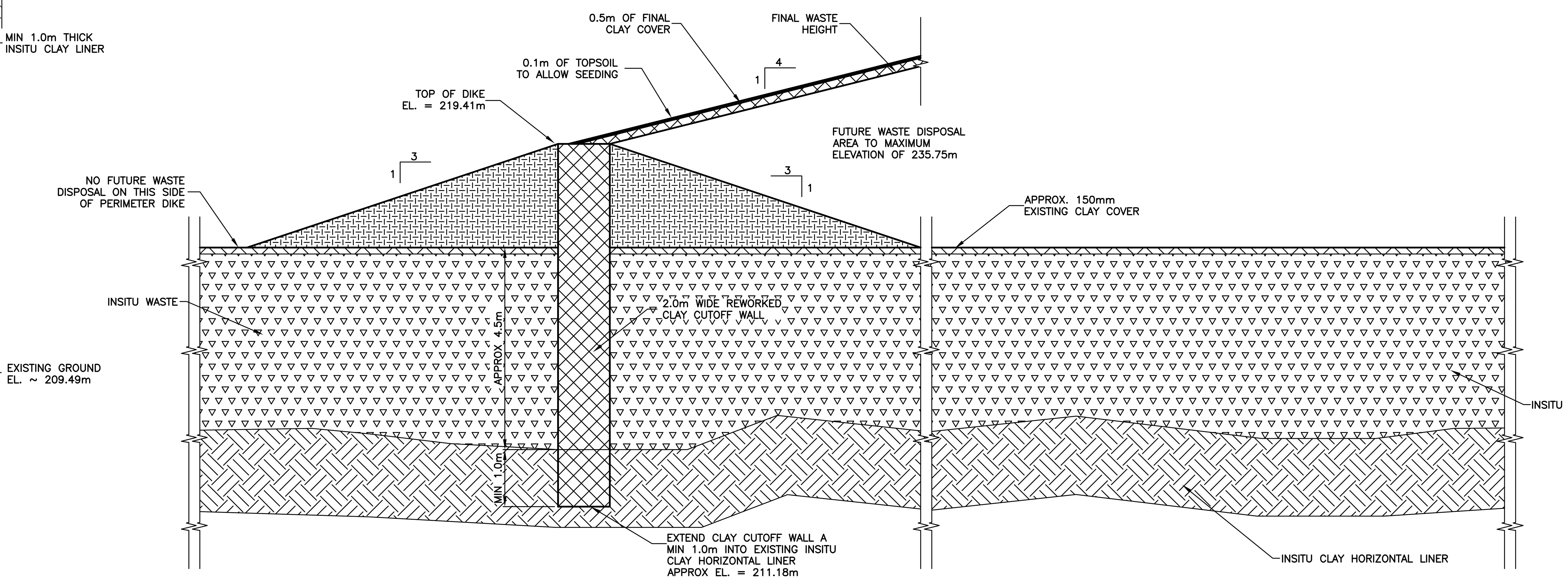
5 4 6 ACTIVE CELL DIKE DETAIL
SCALE = 1:50



2 4,5 6 LEACHATE POND DIKE DETAIL
SCALE = 1:50



3 4,5 6 LEACHATE POND AT PIPE DIKE DETAIL
SCALE = 1:50



6 4,5 6 DIKE ON EXISTING WASTE CROSS-SECTION
SCALE = NTS

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No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

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APEGM STAMP

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No. 234 Date: 11/10/20

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PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE 1 WORKS

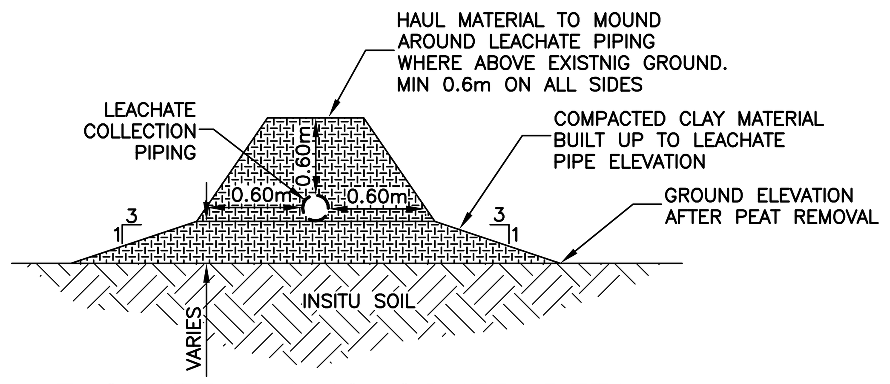
CODE: M-617.01

TITLE: ACTIVE CELL AND LEACHATE POND DIKE DETAILS, LEACHATE COLLECTION PIPING AND DITCH DETAILS

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	AS NOTED	11/10/12	6	6 of 8

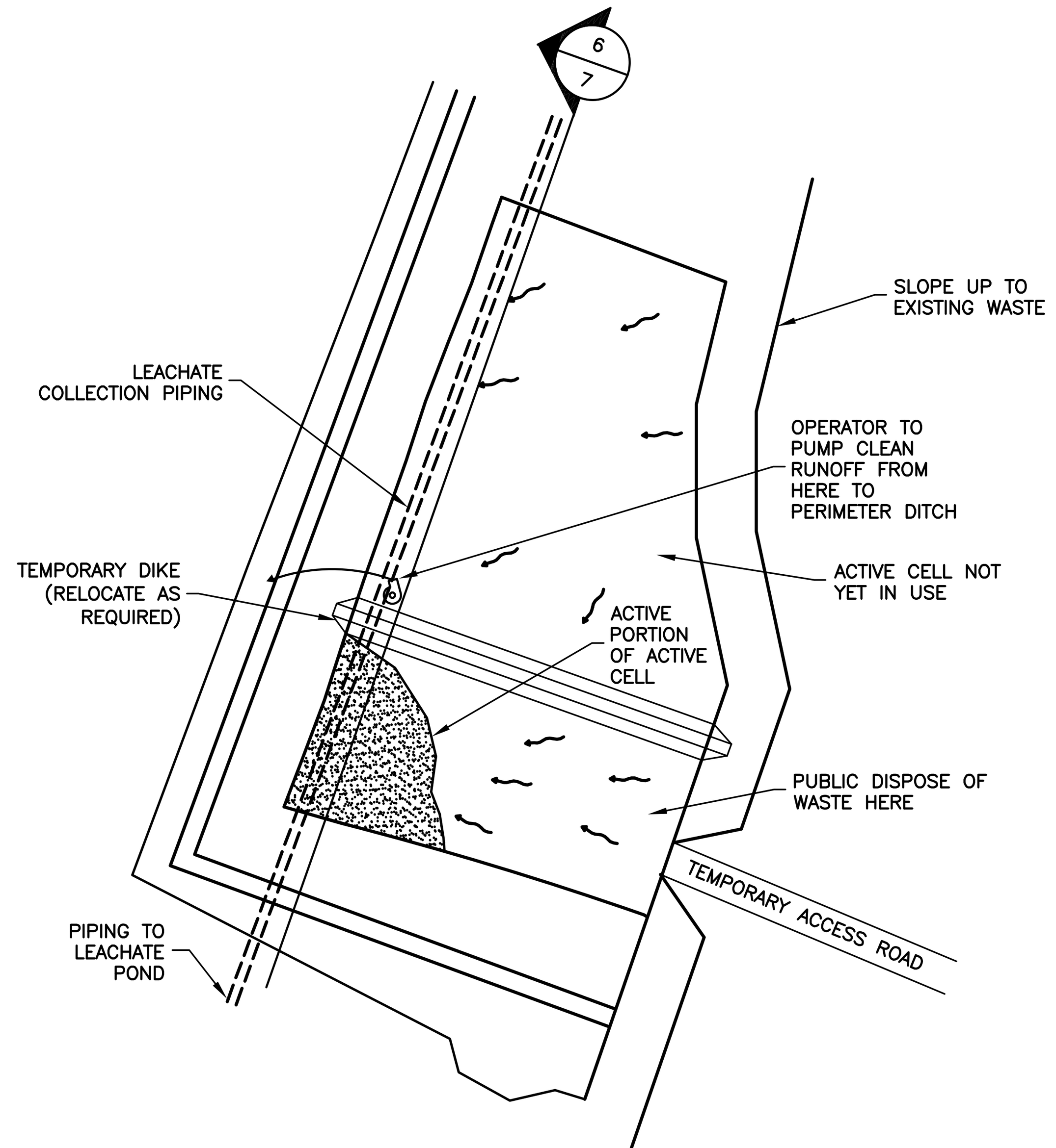
Sep 20, 2012 - 9:42am F:\600\617 Mystery Lake LUD\617.01 Waste Disposal Ground Expansion Phase 1\04 Drawings\dwg\Record Drawings\Plan 6,7,8.dwg

- REWORKED CLAY LINER
- EXCAVATED & COMPACTED CLAY
- INSITU SOIL
- FINAL COVER MATERIAL
- FINAL TOPSOIL COVER
- ACTIVE PORTION OF ACTIVE CELL
- COVERED WASTE (FORMER ACTIVE PORTION OF ACTIVE CELL)

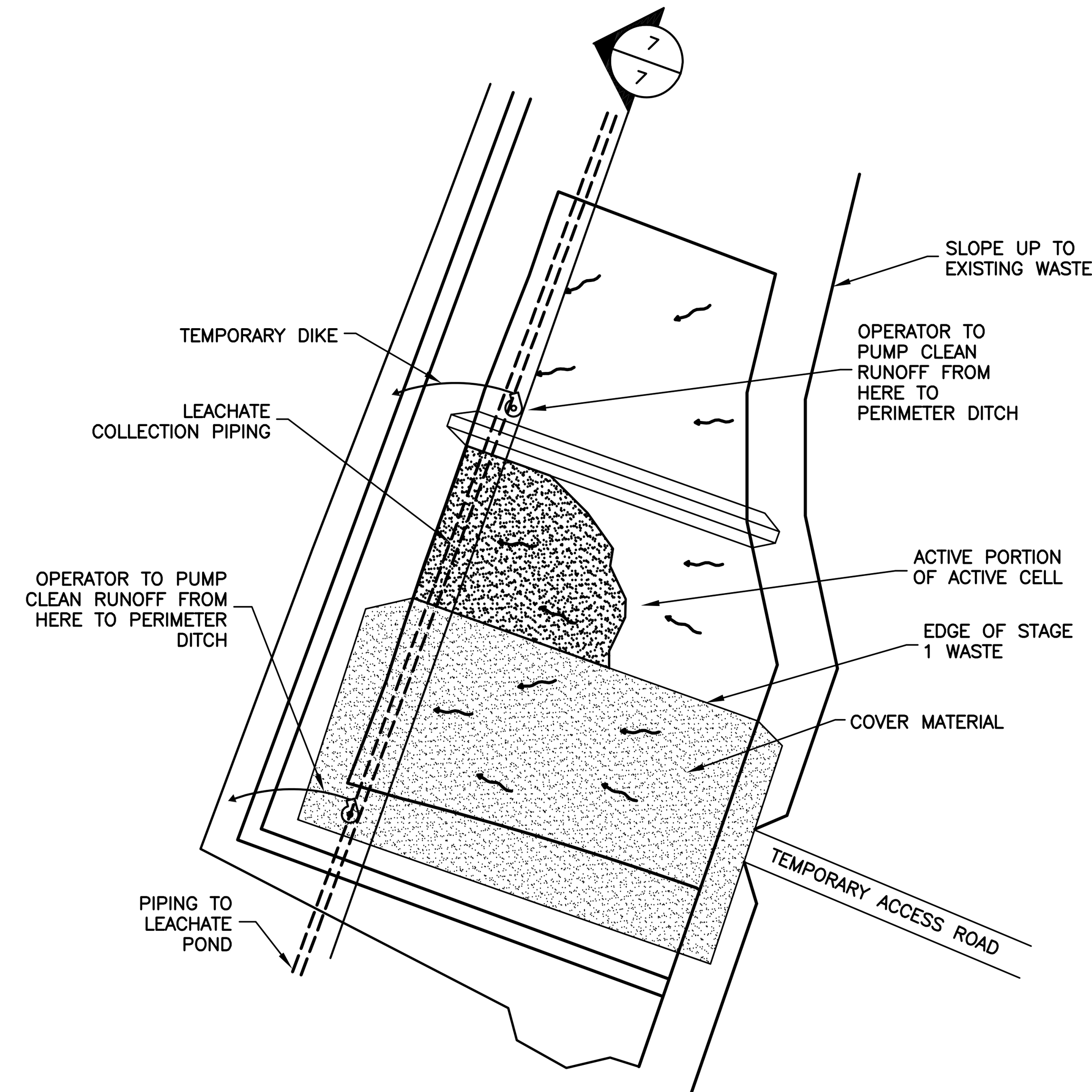


LEACHATE PIPING COVER DETAIL
SCALE = N.T.S.

1 / 5 7 PHASE I EXPANSION CELL DISPOSAL OPERATION STAGES AND LEACHATE PIPING DETAILS
SCALE = NTS



2 / 7 STAGE 1
SCALE = N.T.S



3 / 7 STAGE 2
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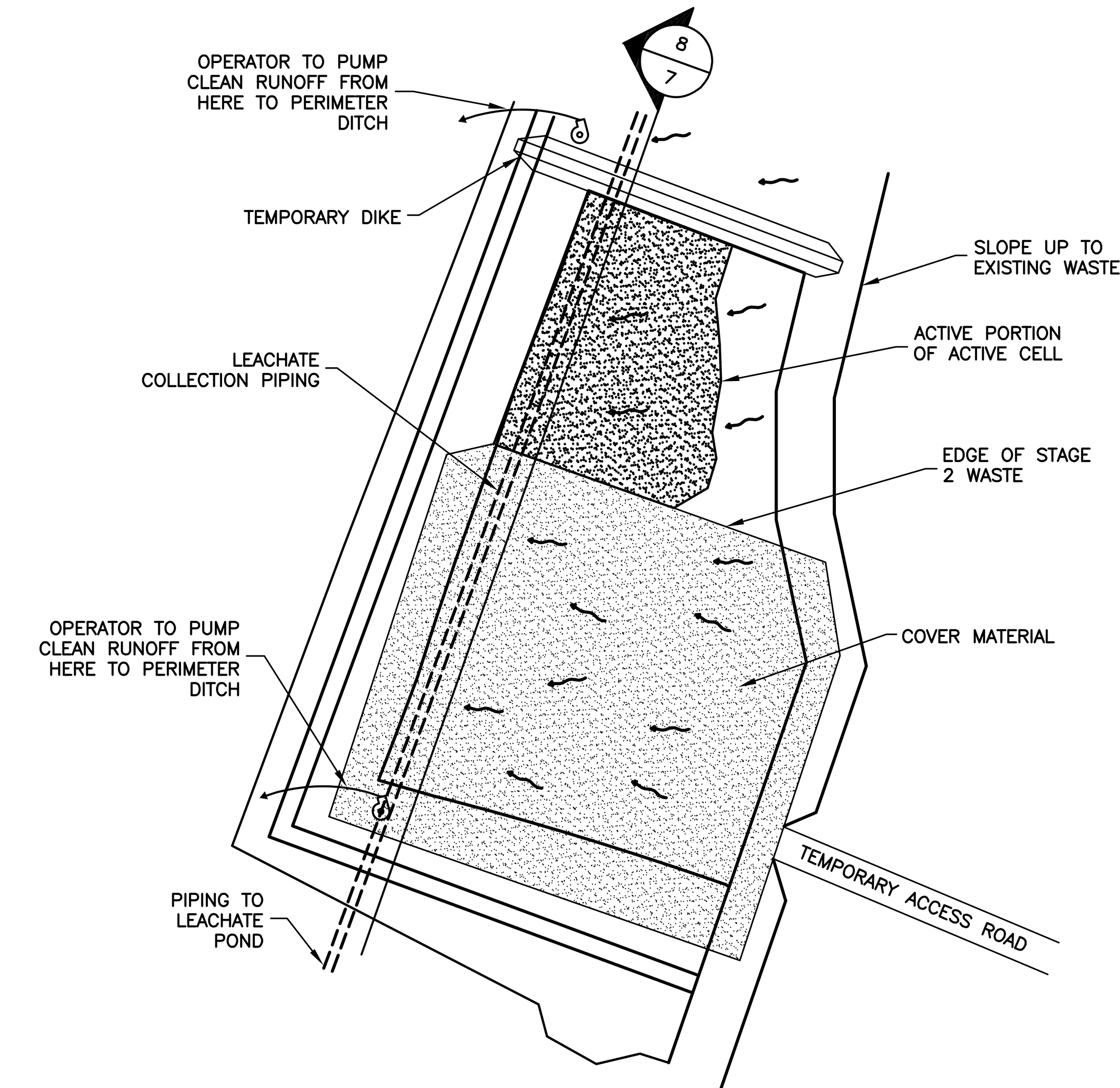

4 / 7 STAGE 3
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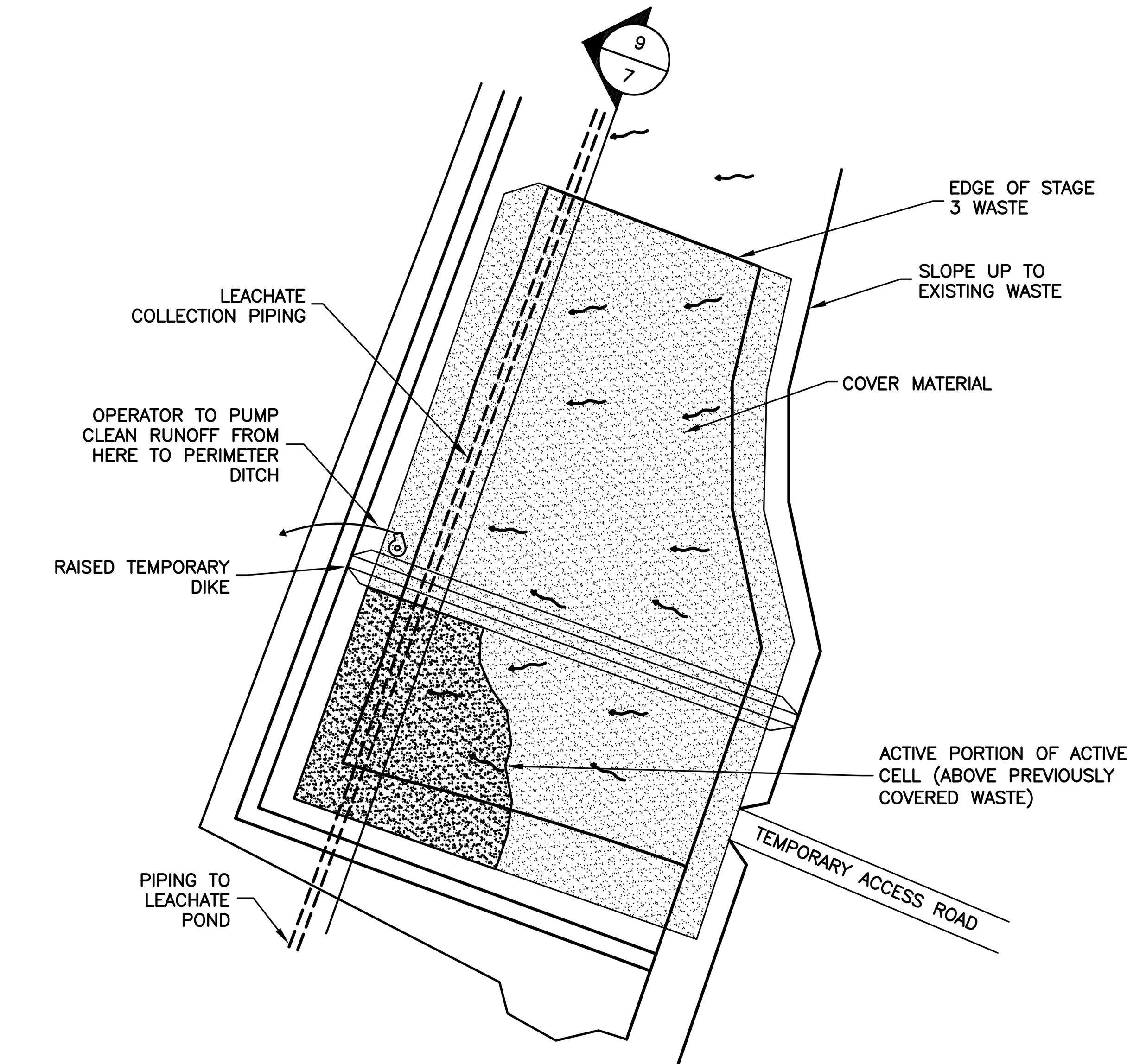

5 / 7 STAGE 4
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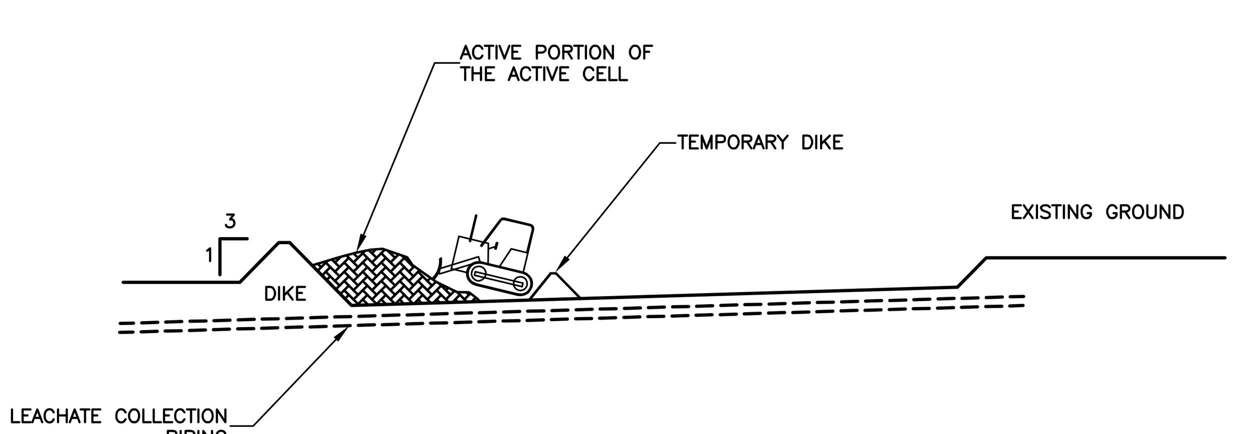

6 / 7 STAGE 1 – CROSS SECTION
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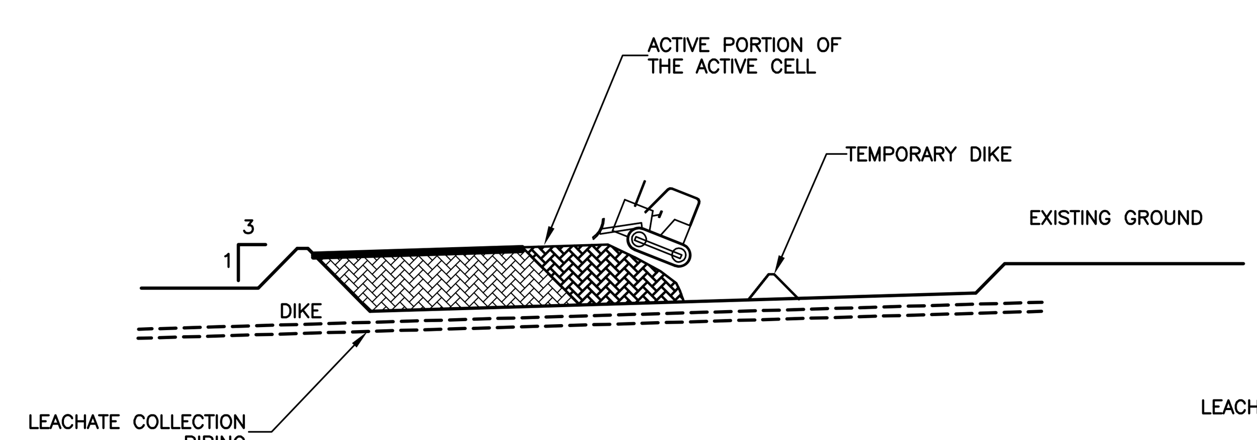
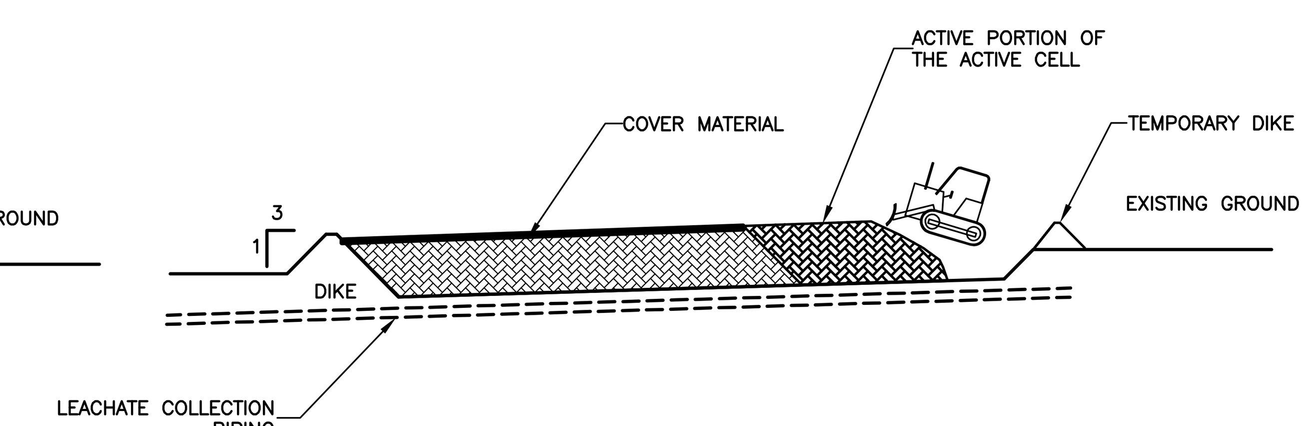
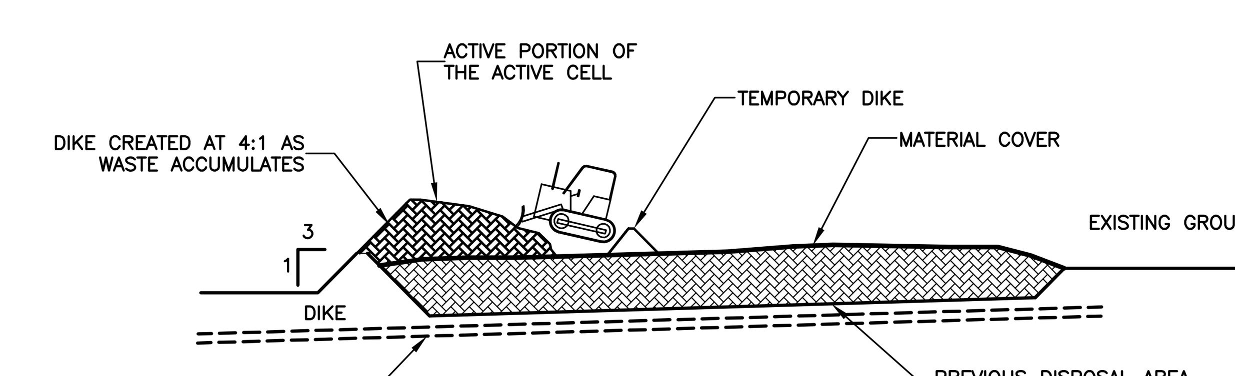


7 / 7 STAGE 2 – CROSS SECTION
SCALE = N.T.S.



8 / 7 STAGE 3 – CROSS SECTION
SCALE = N.T.S.



9 / 7 STAGE 4 – CROSS SECTION
SCALE = N.T.S.

Record Drawing

Drawing compiled from visual observations of various parts of construction and/or from information by others. Accuracy not warranted. Independent verification required before application.

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

B.M. ELEV.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM STAMP
APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 11/10/20

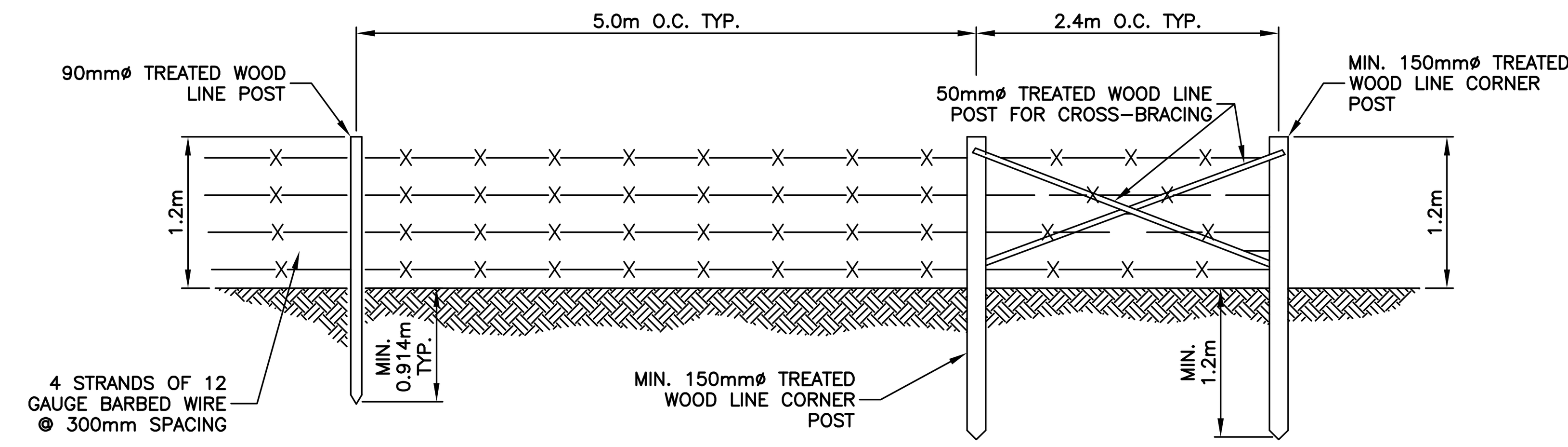
ENGINEER'S SEAL
ORIGINAL DRAWING SIGNED AND SEALED BY G.R. COUSIN 11/10/20

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS
CODE: M-617.01
TITLE: WDG OPERATIONS PLAN

DESIGNED BY:	DRAWN BY:	REVIEWED BY:	SCALE:	DATE:	PLAN:	SHEET:
JC	BM	JC	NTS	11/10/12	7	7 of 8

Sep 20, 2012 - 8:41am F:\600\617 Mystery Lake LGD\617.01 Waste Disposal Ground Expansion Phase I\04 Drawings\dwg\Record Drawing\Plan 6,7,8.dwg



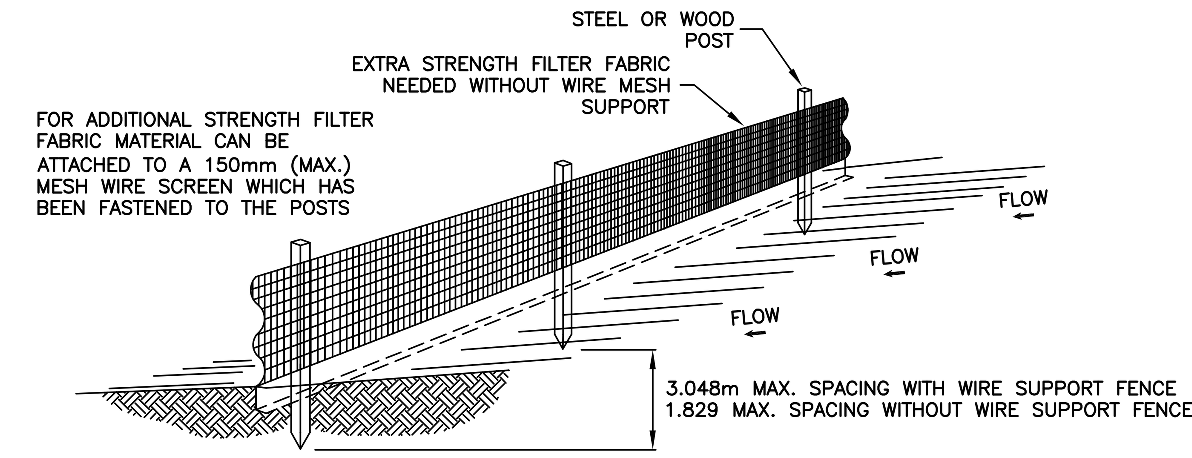
NOTE:

- PROVIDE CROSS BRACING AT CORNERS POSTS IN BOTH DIRECTIONS.
- SHOWN DIAMETER REFERS TO SMALLEST END OF POST.

1/8 LEACHATE POND FENCE DETAIL
SCALE = 1:50

NOTE:
- LITTER FENCE TO BE PLACED AROUND ACTIVE CELL

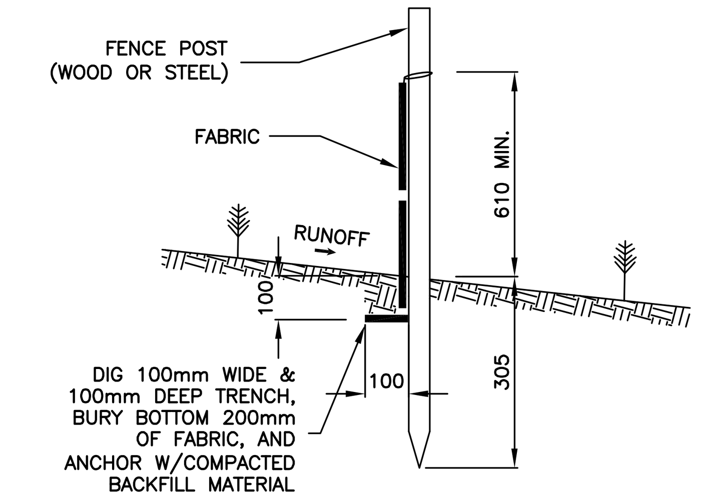
2/8 LITTER FENCE
Scale = NTS



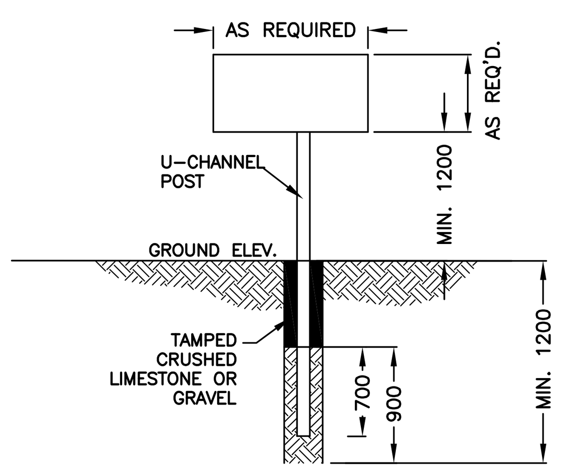
NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 25mm LONG, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 50mm AND SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 200mm OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
7. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

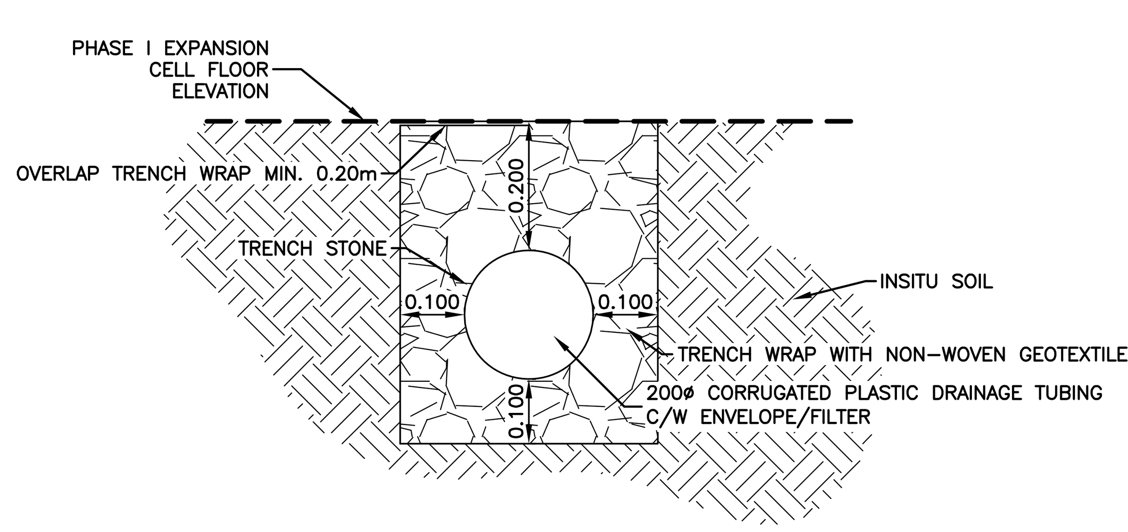
7/8 SILT FENCE DETAIL
SCALE = NTS



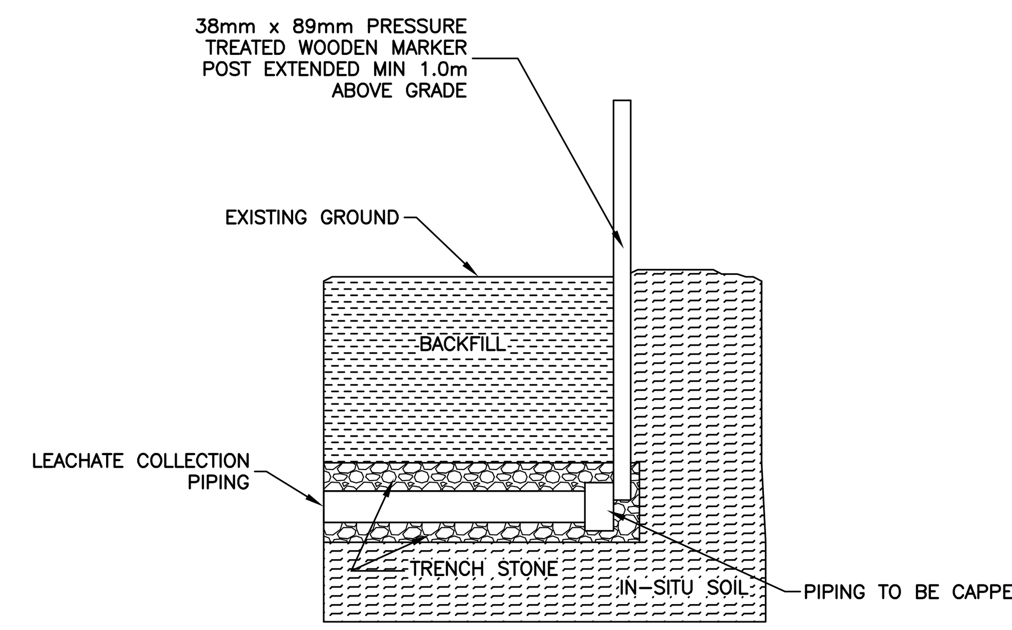
8/8 SILT FENCE SECTION
SCALE = NTS



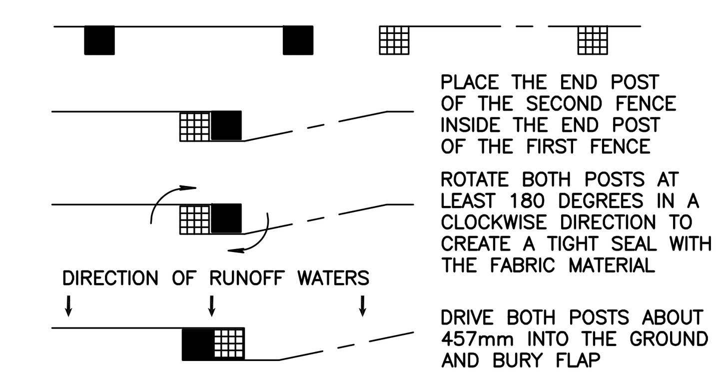
3/8 SIGN DETAIL
Scale = NTS



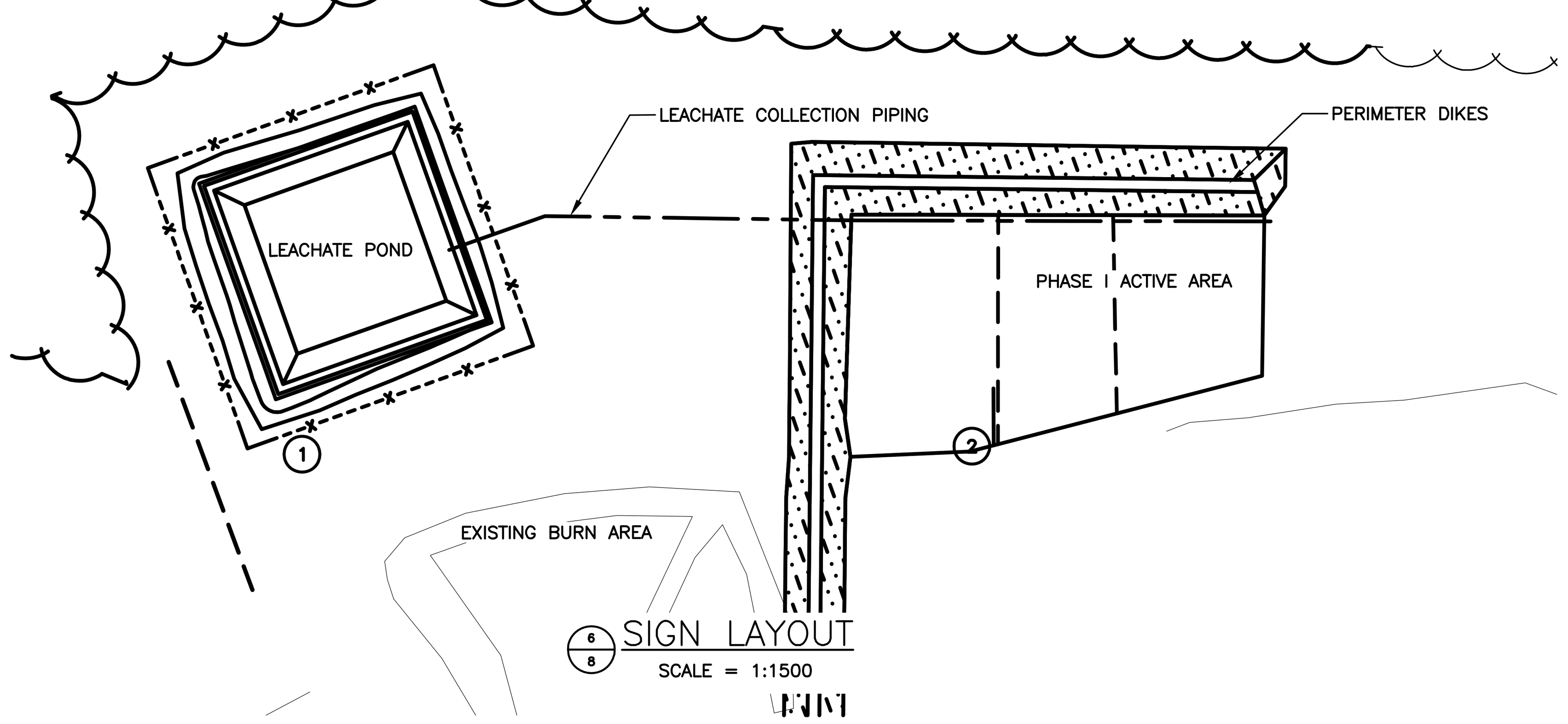
4/6 8 LEACHATE COLLECTION PIPING DETAIL
SCALE: 1:10



5/4,5 8 PIPE END MARKER DETAIL
SCALE = NTS



9/8 ATTACHING TWO SILT FENCES
SCALE = NTS



6/8 SIGN LAYOUT
SCALE = 1:1500

LEACHATE COLLECTION POND

NO LIQUID WASTE DUMPING

1

ACTIVE AREA

2

Record Drawing

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No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	12/08/24	RH
1	ISSUED FOR TENDER	11/10/20	BM

B.M. ELEV.

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APEGM STAMP
APEGM
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J.R. Cousin Consultants Ltd.
No. 234 Date: 11/10/20

ENGINEER'S SEAL
ORIGINAL DRAWING SIGNED AND SEALED BY G.R. COUSIN 11/10/20

J.R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
Ph (204) 489-0474 Fax (204) 489-0487 www.jrcc.ca

DESIGNED BY: JC | DRAWN BY: BM | REVIEWED BY: JC

PROJECT: LDG OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE I WORKS
CODE: M-617.01
TITLE: FENCE, SIGN LEACHATE COLLECTION PIPING AND EROSION CONTROL DETAILS
SCALE: AS NOTED | DATE: 11/10/12 | PLAN: 8 | SHEET: 8 of 8

Phase II Works – Record Drawing Plan Set

LGD of MYSTERY LAKE

WASTE DISPOSAL GROUND PHASE II WORKS

PLAN INDEX

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Engineering Excellence since 1981

Record Drawing

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DRAWING LEGEND:

PIPING:

- EXISTING WATERMAIN
- PROPOSED WATERMAIN
- FUTURE WATERMAIN
- EXISTING SEWERMAIN
- PROPOSED SEWERMAIN
- FUTURE SEWERMAIN
- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- FUTURE FORCEMAIN
- EXISTING RAW WATERMAIN
- PROPOSED RAW WATERMAIN
- FUTURE RAW WATERMAIN
- EXISTING LAND DRAINAGE SEWER
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER
- FH EXISTING FIRE HYDRANT
- FH PROPOSED FIRE HYDRANT
- EXISTING VALVE
- PROPOSED VALVE
- CO EXISTING CLEANOUT
- CO PROPOSED CLEANOUT
- MH EXISTING MANHOLE
- MH PROPOSED MANHOLE
- EXISTING CURBSTOP
- PROPOSED CURBSTOP
- CB EXISTING CATCH BASIN
- CB PROPOSED CATCH BASIN

ROADS AND DRAINAGE:

- EXISTING ROAD CENTERLINE
- PROPOSED ROAD CENTERLINE
- FUTURE ROAD CENTERLINE
- EXISTING ROAD SHOULDER
- PROPOSED ROAD SHOULDER
- EXISTING ROAD EDGE
- PROPOSED ROAD EDGE
- FUTURE ROAD EDGE
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- EXISTING DITCH
- PROPOSED DITCH
- EXISTING CULVERT
- PROPOSED CULVERT
- EXISTING DRAINAGE DIRECTION
- PROPOSED DRAINAGE DIRECTION
- 100 CONTOURS – MAJOR INTERVALS
- 100.5 CONTOURS – MINOR INTERVALS
- ×100.00 EXISTING GROUND ELEVATION
- (100.00) PROPOSED GROUND ELEVATION
- (100.00) EXISTING ROAD ELEVATION
- (100.00) PROPOSED ROAD ELEVATION
- TOP / BOTTOM EXISTING SLOPE
- TOP / BOTTOM PROPOSED SLOPE
- ASPHALT
- GRAVEL

MISCELLANEOUS:

- —X— EXISTING FENCE LINE
- —X— PROPOSED FENCE LINE
- —P— EXISTING PROPANE LINE
- —P— PROPOSED PROPANE LINE
- —H— EXISTING HYDRO LINE
- —H— PROPOSED HYDRO LINE
- —G— EXISTING GAS LINE
- —MTS— EXISTING MTS LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- LEGAL/LOT LINE
- RAILWAY LINE
- MATCH LINE
- HP EXISTING HYDRO POLE
- HP PROPOSED HYDRO POLE
- W WATER HOLDING TANK
- S SEPTIC TANK
- H SEWAGE HOLDING TANK
- SURVEY BAR
- SURVEY MONUMENT/BENCHMARK
- EXISTING VEGETATION
- PROPOSED VEGETATION
- D1 DOOR CONSTRUCTION TYPE
- W1 WALL CONSTRUCTION TYPE
- EASEMENT
- N NORTH ARROW

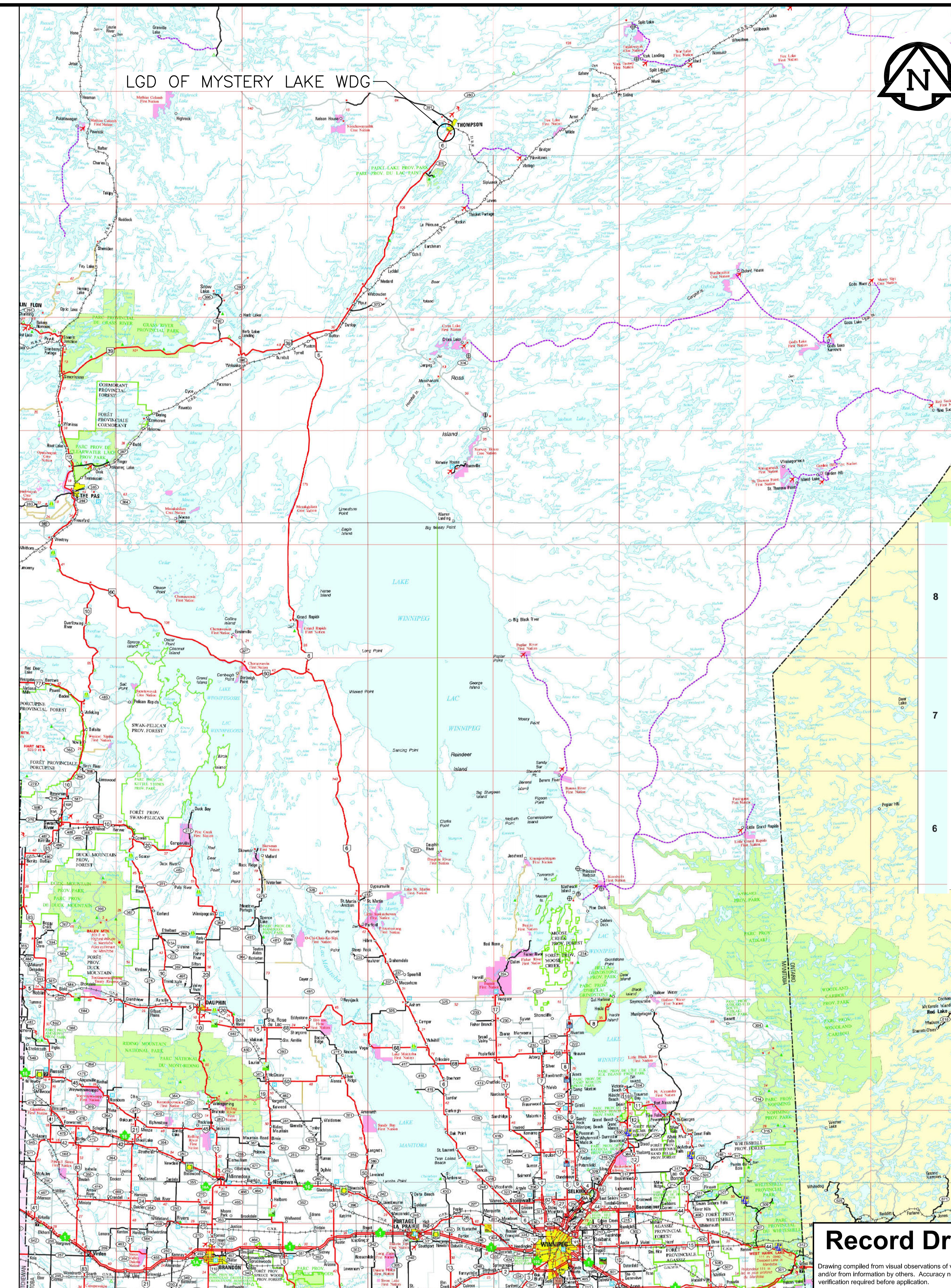
ABBREVIATIONS:

@	AT
A/C	AIR CONDITIONING
ALUM	ALUMINUM
ASPH	ASPHALT
AVE	AVENUE
AVG	AVERAGE
BD	BOTTOM OF DITCH
BLDG	BUILDING
BLVD	BOULEVARD
BM	BENCHMARK
BOT	BOTTOM
BP	BACKWASH PUMP
B/W	BOTHWAYS
CB	CATCH BASIN
CI	CAST IRON
CHKD	CHECKED
CNR	CANADIAN NATIONAL RAILWAY
CO	CLEANOUT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
COORD	COORDINATE
CPR	CANADIAN PACIFIC RAILWAY
C/W	COMPLETE WITH
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DHW	DOMESTIC HOT WATER
DIA	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DP	DUTY PUMP
DR	DRIVE
DWG	DRAWING
E	EAST
EC	END OF CURVE
EL	ELEVATION
ELEC	ELECTRICAL
EP	EDGE OF PAVEMENT
ER	EDGE OF ROAD
E/W	EACHWAY
EXT	EXTERIOR
FAX	FAX MACHINE STAND
FC	FILE CABINET
FD	FLOOR DRAIN
F/F	FACE TO FACE
FH	FIRE HYDRANT
FM	FORCEMAIN
FP	FIRE PUMP
FT	FOOT, FEET
GA	GAUGE
GALV	GALVANIZED
HA	HECTARE
HB	HOSE BIBB
HDPE	HIGH DENSITY POLYETHYLENE
HI	HEIGHT OF INSTRUMENT
HPW	HIGH PRESSURE WATER LINE
HORIZ	HORIZONTAL
HP	HYDRO POLE
HR	HOUR
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HW	HOT WATER TANK
HWL	HIGH WATER LEVEL
ID	INSIDE DIAMETER
IL	ICE LEVEL
INCL	INCLUDE
INT	INTERIOR
INV	INVERT
JCT	JUNCTION
JP	JOCKEY PUMP
LAB	LABORATORY
LAM	LAMINATE
LAT	LATITUDE
LDS	LAND DRAINAGE SEWER
LFS	LEVEL FLOAT SWITCH
LONG	LONGITUDE
LWL	LOW WATER LEVEL
M	METRE
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEMB	MEMBRANE
MH	MANHOLE
MIN	MINIMUM
MM	MILLIMETRE
N	NORTH
NAT	NATURAL
NBC	NATIONAL BUILDING CODE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O/C	ON CENTRE
O/D	OUTSIDE DIAMETER
O/F	OUTSIDE FACE
O/H	OVER HEAD
OD	OUTSIDE DIAMETER
ORIG	ORIGINAL
OWSJ	OPEN WEB STEEL JOIST
PLYWD	PLYWOOD
POLY	POLYETHYLENE
PROP	PROPERTY
PVC	POLY VINYL CHLORIDE
RAD	RADIUS
RD	ROAD
REV	REVISION
ROW	RIGHT OF WAY
RM	ROOM
S	SOUTH
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIB	STEEL IRON BAR
SPEC	SPECIFICATION
SQ	SQUARE
SSL	SEWER SERVICE LINE
ST	STREET
STD	STANDARD
SUSP	SUSPENDED
SW	SIDEWALK
TEL	TELEPHONE
TEMP	TEMPORARY
TP	TRUCKFILL PUMP
TYP	TYPICAL
VERT	VERTICAL
VOL	VOLUME
US	ULTRASONICS TRANSDUCER
VAR	VARIES
VB	VAPOUR BARRIER
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
W	WEST
W/O	WITHOUT
WL	WATER LEVEL
WM	WATERMAIN
WSL	WATER SERVICE LINE
WWS	WASTEWATER SEWER
WT	WEIGHT

NOTE:

DECIMALIZED NUMBERS INDICATE METRES.
WHOLE NUMBERS INDICATE MILLIMETRES.

A – DETAIL NUMBER
B – PLAN WHERE DETAIL EXPANDED
C – PLAN WHERE DETAIL ORIGINATES



Record Drawing

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No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	13/10/16	OT

B.M. EL.

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APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 13/07/02

ENGINEER'S SEAL

ORIGINAL DRAWING SIGNED AND SEALED BY G.R. COUSIN 13/07/02

J. R. Cousin Consultants Ltd.
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email: info@jrcc.ca website: www.jrcc.ca
Engineering Excellence since 1981

CODE: M–617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE II WORKS

TITLE: DRAWING LEGEND, ABBREVIATION INDEX AND KEY PLAN

SCALE: NTS | DATE: 13/06/12 | PLAN: 1 | SHEET: 1 of 7

Record Drawing

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Oct 31, 2013 – 8:55am F:\600\617 Mystery Lake LGD\617.02 Waste Disposal Ground Expansion Phase II\04 Drawings\dwg\Record Drawings\Plan 2.dwg

SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	13/10/16	OT

B.M. EL.
JRCC TEMPORARY BENCHMARK
#10 REBAR
COORDINATES 6171041.984N 568049.899E
ELEVATION 224.966m
BEHIND BATTERY DEPOT

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

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No. 234 Date: 13/07/02

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Engineering Excellence since 1981

CODE: M–617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE II WORKS

TITLE:
EXISTING WDG LAYOUT AFTER PHASE I WORKS WITH TEST HOLE LOCATIONS

SCALE:	DATE:	PLAN:	SHEET:
1:1250	13/06/12	2	2 of 7

Record Drawing

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No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	13/10/16	OT

B.M. EL.

REFER TO PLAN 2 FOR BENCHMARK LOCATION

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No. 234 Date: 13/07/02

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Engineering Excellence since 1981

CODE: M–617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE II WORKS

TITLE: OVERALL WASTE DISPOSAL GROUND LAYOUT SHOWING PROPOSED PHASE II WORKS

SCALE: 1:1250 | DATE: 13/06/12 | PLAN: 3 | SHEET: 3 of 7

SCALE BAR
(IN METRES)
10 0 5 10 20 30 40 50
1:500

No.	REVISIONS	DATE	INITIALS
2	RECORD DRAWING	13/10/16	OT
1	ADDED EXISTING CONTOUR LINES	13/07/15	BM

B.M. EL.
REFER TO PLAN 2 FOR BENCHMARK LOCATION

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CODE: M–617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE II WORKS

TITLE: PHASE II ACTIVE CELL DIKES

SCALE: 1:500 | DATE: 13/06/12 | PLAN: 4 | SHEET: 4 of 7

Record Drawing

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SCALE BAR
(IN METRES)
10 0 5 10 20 30 40 50
1:500

No.	REVISIONS	DATE	INITIALS
3	RECORD DRAWING	13/10/16	OT
2	REVISED CONTAMINATED SOILS AREA	13/08/26	BM
1	ADDED EXISTING CONTOUR LINES	13/07/15	BM

B.M. EL.

REFER TO PLAN 2 FOR BENCHMARK LOCATION

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 13/07/02

ENGINEER'S SEAL

ORIGINAL DRAWING
SIGNED AND SEALED
BY
G.R. COUSIN
13/07/02

J. R. Cousin Consultants Ltd.
Consulting Engineers and Project Managers
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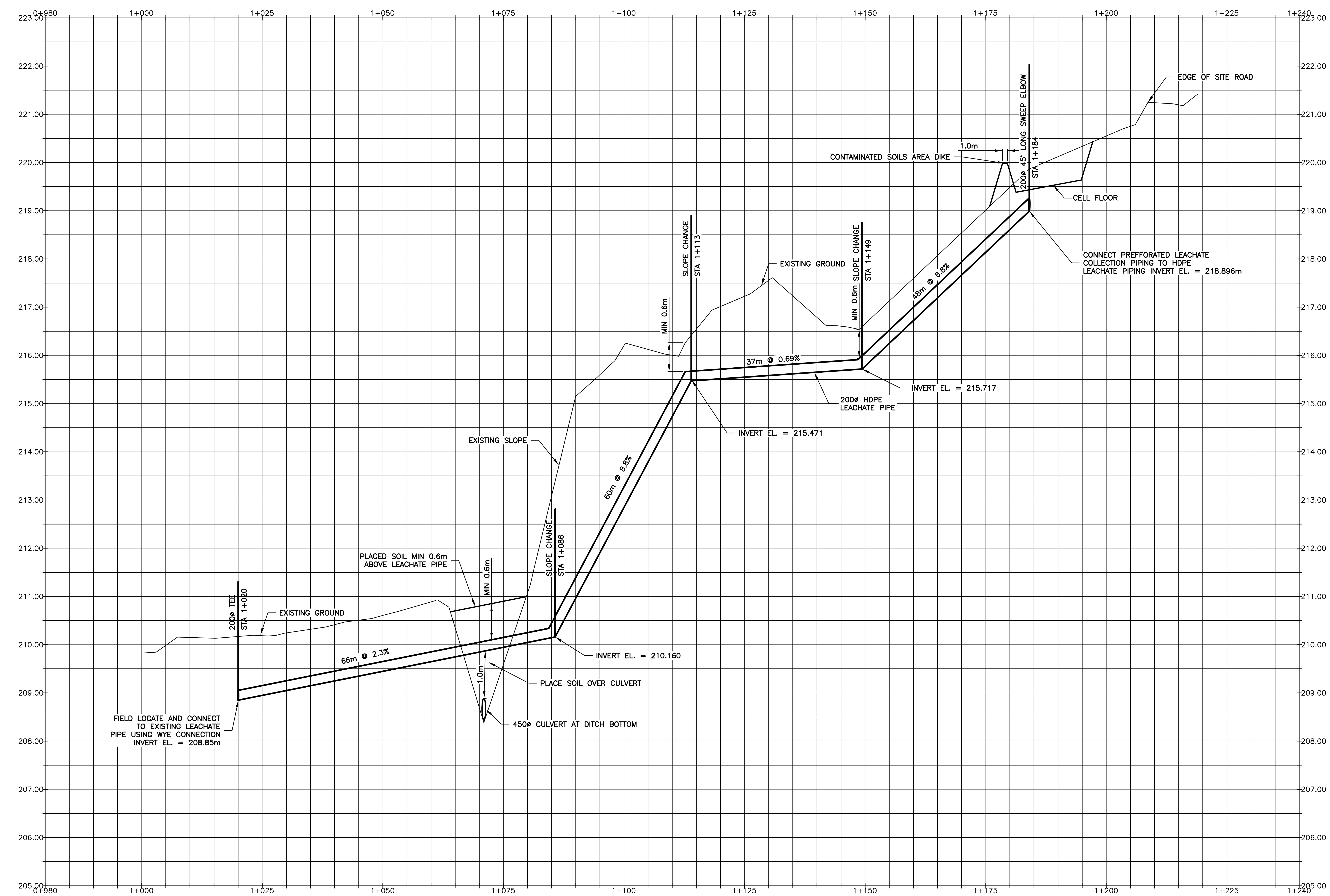
email: info@jrcc.ca website: www.jrcc.ca
Engineering Excellence since 1981

CODE: M–617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE II WORKS

TITLE:
CONTAMINATED SOILS AREA AND
LEACHATE COLLECTION PIPE LAYOUT

SCALE: 1:500
DATE: 13/06/12
PLAN: 5
SHEET: 5 of 7



Record Drawing

Drawing compiled from visual observations of various parts of construction and/or from information by others. Accuracy not warranted. Independent verification required before application.

SCALE BAR
(IN METRES)

10 0 5 10 20 30 40 50

1:500

No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	13/10/16	OT

B.M. EL.

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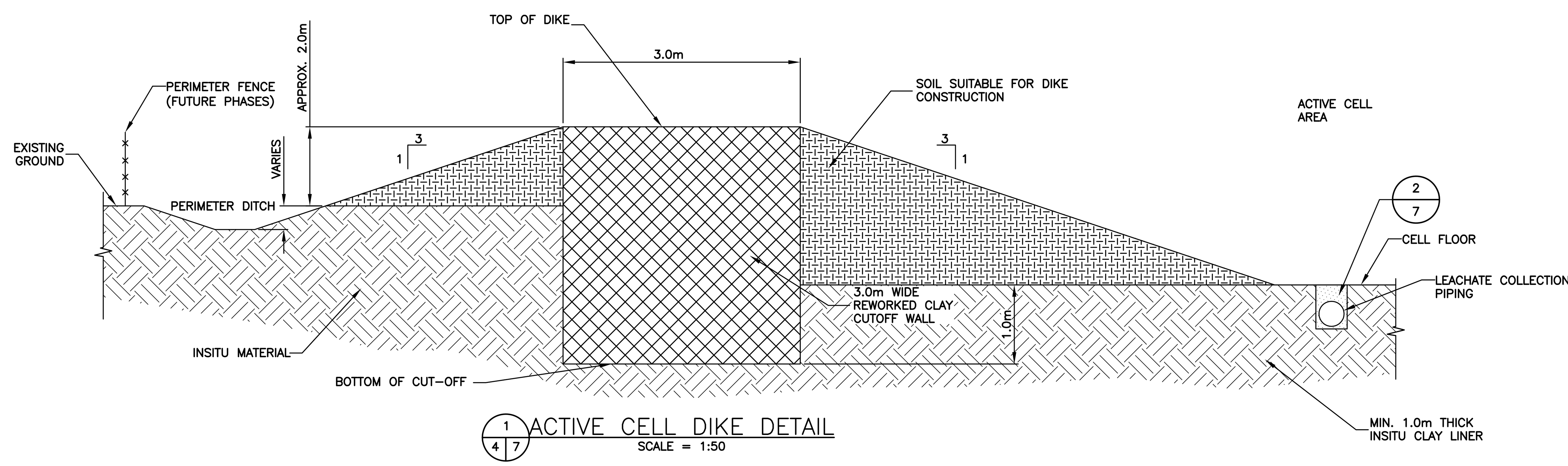
CODE: M-617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

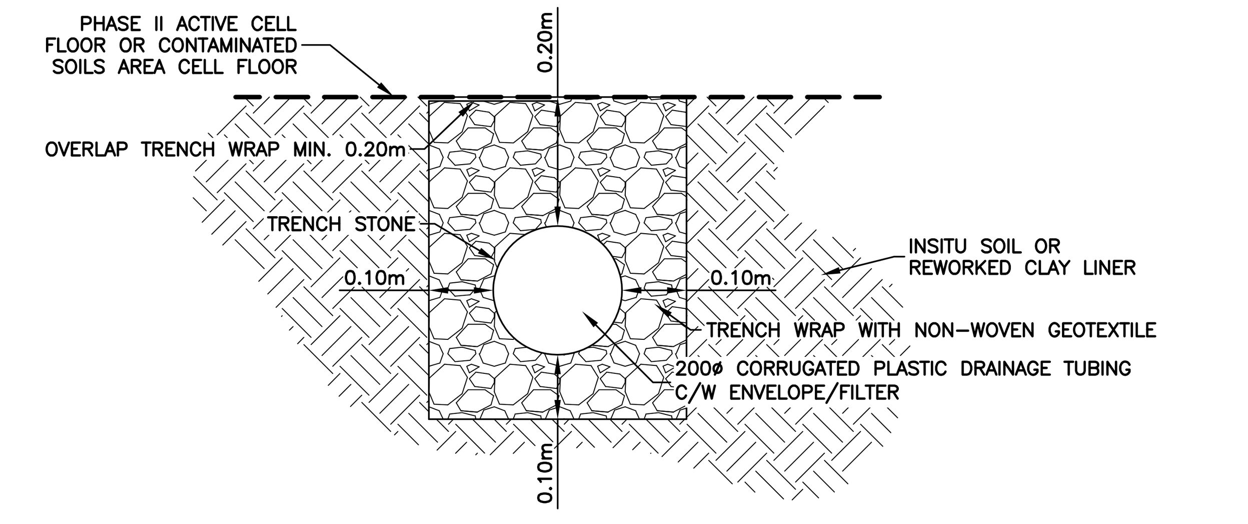
PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE II WORKS

TITLE:
LEACHATE COLLECTION PIPE PROFILE

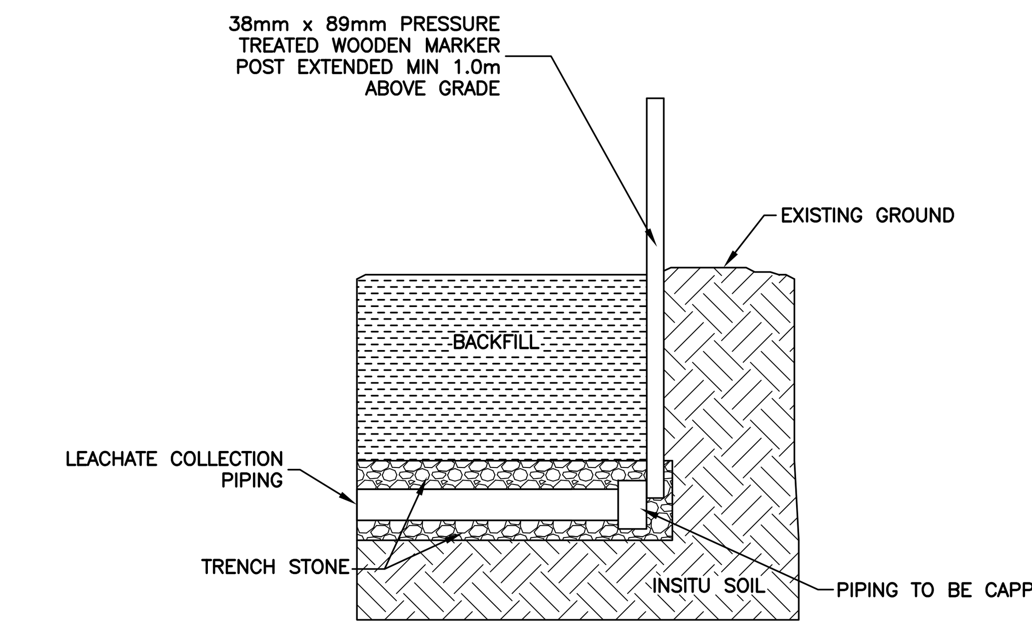
SCALE:	DATE:	PLAN:	SHEET:
H 1:500 V 1:50	13/06/12	6	6 of 7



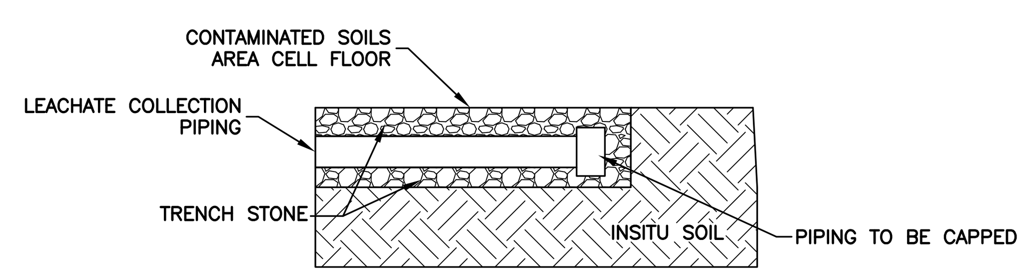
1 | 4 | 7 ACTIVE CELL DIKE DETAIL
SCALE = 1:50



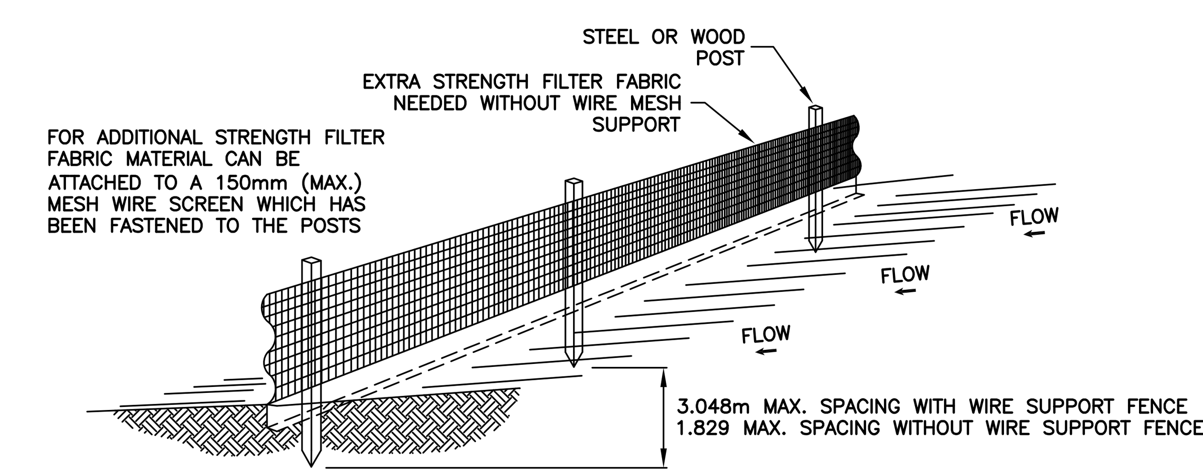
2 | 7 LEACHATE COLLECTION PIPING DETAIL
SCALE: 1:50



3 | 4 | 7 PIPE END MARKER DETAIL
SCALE = NTS



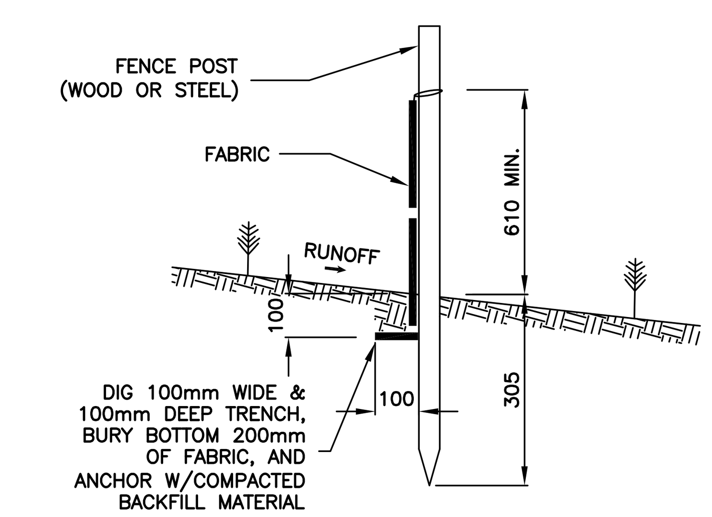
4 | 5 | 7 PIPE END DETAIL
SCALE = NTS



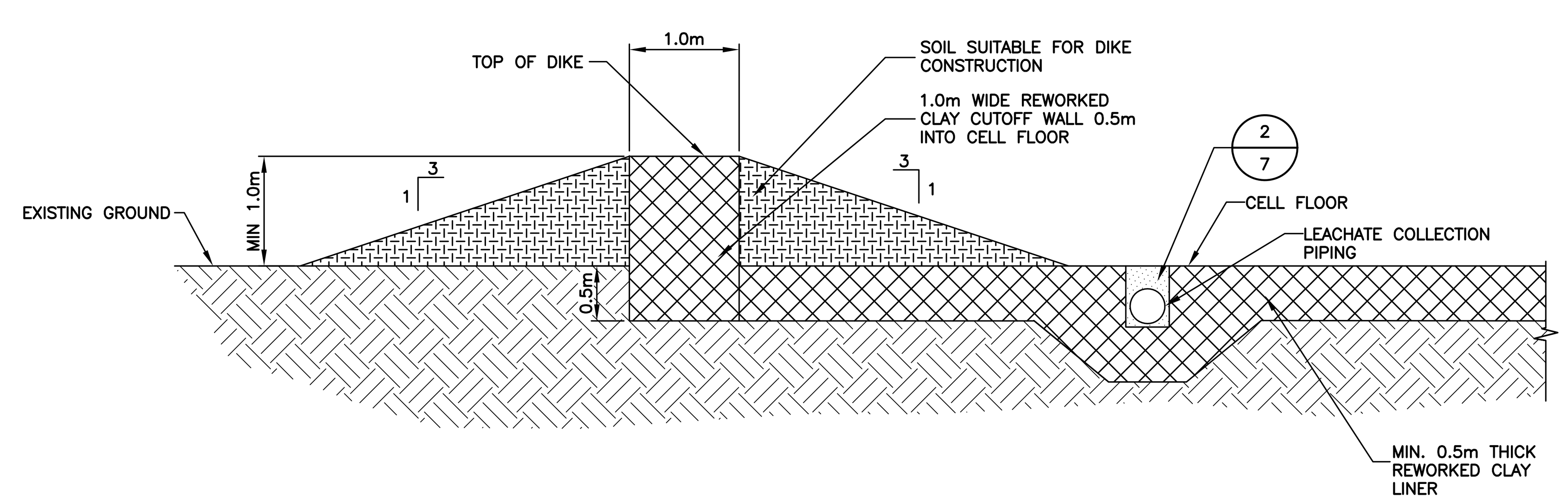
NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 25mm LONG, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 50mm AND SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 200mm OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
7. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

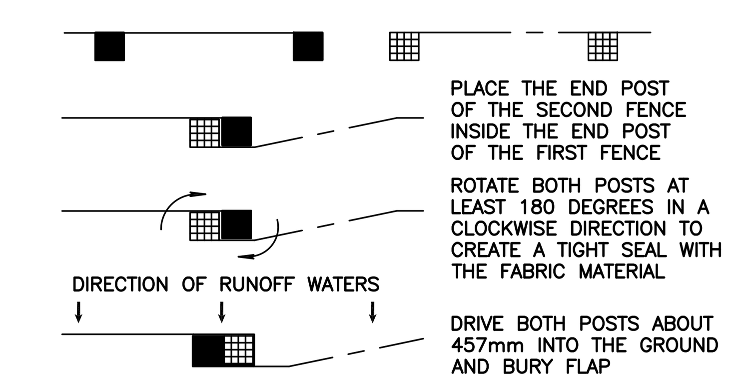
6 | 7 SILT FENCE DETAIL
SCALE = NTS



7 | 7 SILT FENCE SECTION
SCALE = NTS



5 | 5 | 7 CONTAMINATED SOILS AREA DIKE DETAIL
SCALE = 1:50



ATTACHING TWO
8 | 7 SILT FENCES
SCALE = NTS

Record Drawing

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1	RECORD DRAWING	13/10/16	OT

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CODE: M-617.02
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE II WORKS

TITLE:
ACTIVE CELL DIKES, CONTAMINATED SOIL DIKES LEACHATE COLLECTION PIPING, PIPE END MARKER AND SILT FENCE DETAILS

SCALE:	DATE:	PLAN:	SHEET:
AS NOTED	13/06/12	7	7 of 7

Phase III Works – Record Drawing Plan Set

LGD OF MYSTERY LAKE

WASTE DISPOSAL GROUND

REVISED PHASE III WORKS

Record Drawing

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PLAN INDEX

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ENGINEERING EXCELLENCE SINCE 1981

REDUCED DRAWING SET
DO NOT SCALE

DRAWING LEGEND:

PIPING:

- EXISTING WATERMAIN
- PROPOSED WATERMAIN
- FUTURE WATERMAIN
- EXISTING SEWERMAIN
- PROPOSED SEWERMAIN
- FUTURE SEWERMAIN
- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- FUTURE FORCEMAIN
- EXISTING RAW WATERMAIN
- PROPOSED RAW WATERMAIN
- FUTURE RAW WATERMAIN
- EXISTING LAND DRAINAGE SEWER
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER
- FH EXISTING FIRE HYDRANT
- FH PROPOSED FIRE HYDRANT
- EXISTING VALVE
- PROPOSED VALVE
- CO EXISTING CLEANOUT
- CO PROPOSED CLEANOUT
- MH EXISTING MANHOLE
- MH PROPOSED MANHOLE
- EXISTING CURBSTOP
- PROPOSED CURBSTOP
- CB EXISTING CATCH BASIN
- CB PROPOSED CATCH BASIN

ROADS AND DRAINAGE:

- EXISTING ROAD CENTERLINE
- PROPOSED ROAD CENTERLINE
- FUTURE ROAD CENTERLINE
- EXISTING ROAD SHOULDER
- PROPOSED ROAD SHOULDER
- EXISTING ROAD EDGE
- PROPOSED ROAD EDGE
- FUTURE ROAD EDGE
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- EXISTING DITCH
- PROPOSED DITCH
- EXISTING CULVERT
- PROPOSED CULVERT
- EXISTING DRAINAGE DIRECTION
- PROPOSED DRAINAGE DIRECTION
- 100 CONTOURS – MAJOR INTERVALS
- 100.5 CONTOURS – MINOR INTERVALS
- ×100.00 EXISTING GROUND ELEVATION
- 100.00 PROPOSED GROUND ELEVATION
- 100.00 EXISTING ROAD ELEVATION
- 100.00 PROPOSED ROAD ELEVATION
- TOP / BOTTOM EXISTING SLOPE
- TOP / BOTTOM PROPOSED SLOPE
- ASPHALT
- GRAVEL

MISCELLANEOUS:

- —X— EXISTING FENCE LINE
- —X— PROPOSED FENCE LINE
- —P— EXISTING PROPANE LINE
- —P— PROPOSED PROPANE LINE
- —H— EXISTING HYDRO LINE
- —H— PROPOSED HYDRO LINE
- —G— EXISTING GAS LINE
- —MTS— EXISTING MTS LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- LEGAL/LOT LINE
- RAILWAY LINE
- MATCH LINE
- HP EXISTING HYDRO POLE
- HP PROPOSED HYDRO POLE
- W WATER HOLDING TANK
- S SEPTIC TANK
- H SEWAGE HOLDING TANK
- SURVEY BAR
- SURVEY MONUMENT/BENCHMARK
- EXISTING VEGETATION
- PROPOSED VEGETATION
- D1 DOOR CONSTRUCTION TYPE
- W1 WALL CONSTRUCTION TYPE
- EASEMENT
- N NORTH ARROW

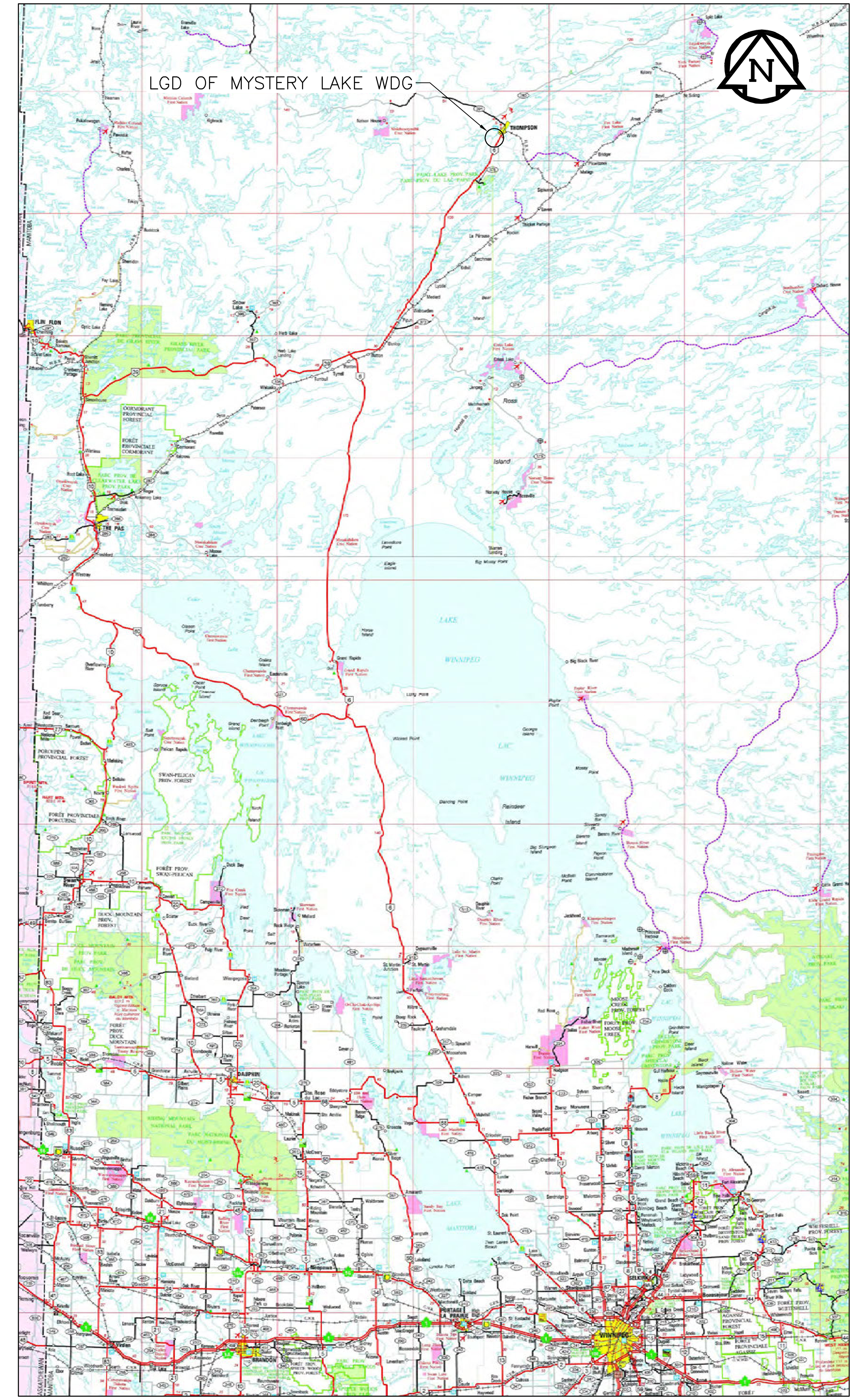
ABBREVIATIONS:

@	AT
A/C	AIR CONDITIONING
ALUM	ALUMINUM
ASPH	ASPHALT
AVE	AVENUE
AVG	AVERAGE
BD	BOTTOM OF DITCH
BLDG	BUILDING
BLVD	BOULEVARD
BM	BENCHMARK
BOT	BOTTOM
BP	BACKWASH PUMP
B/W	BOTHWAYS
CB	CATCH BASIN
CI	CAST IRON
CHKD	CHECKED
CNR	CANADIAN NATIONAL RAILWAY
CO	CLEANOUT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
COORD	COORDINATE
CPR	CANADIAN PACIFIC RAILWAY
C/W	COMPLETE WITH
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DHW	DOMESTIC HOT WATER
DIA	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DP	DUTY PUMP
DR	DRIVE
DWG	DRAWING
E	EAST
EC	END OF CURVE
EL	ELEVATION
ELEC	ELECTRICAL
EP	EDGE OF PAVEMENT
ER	EDGE OF ROAD
E/W	EACHWAY
EXT	EXTERIOR
FAX	FAX MACHINE STAND
FC	FILE CABINET
FD	FLOOR DRAIN
F/F	FACE TO FACE
FH	FIRE HYDRANT
FM	FORCEMAIN
FP	FIRE PUMP
FT	FOOT, FEET
GA	GAUGE
GALV	GALVANIZED
HA	HECTARE
HB	HOSE BIBB
HDPE	HIGH DENSITY POLYETHYLENE
HI	HEIGHT OF INSTRUMENT
HPW	HIGH PRESSURE WATER LINE
HORIZ	HORIZONTAL
HP	HYDRO POLE
HR	HOUR
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HW	HOT WATER TANK
HWL	HIGH WATER LEVEL
ID	INSIDE DIAMETER
IL	ICE LEVEL
INCL	INCLUDE
INT	INTERIOR
INV	INVERT
JCT	JUNCTION
JP	JOCKEY PUMP
LAB	LABORATORY
LAM	LAMINATE
LAT	LATITUDE
LDS	LAND DRAINAGE SEWER
LFS	LEVEL FLOAT SWITCH
LONG	LONGITUDE
LWL	LOW WATER LEVEL
M	METRE
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEMB	MEMBRANE
MH	MANHOLE
MIN	MINIMUM
MM	MILLIMETRE
N	NORTH
NAT	NATURAL
NBC	NATIONAL BUILDING CODE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O/C	ON CENTRE
O/D	OUTSIDE DIAMETER
O/F	OUTSIDE FACE
O/H	OVER HEAD
OD	OUTSIDE DIAMETER
ORIG	ORIGINAL
OWSJ	OPEN WEB STEEL JOIST
PLYWD	PLYWOOD
POLY	POLYETHYLENE
PROP	PROPERTY
PS	PRESSURE SEWER
PVC	POLY VINYL CHLORIDE
RAD	RADIUS
RD	ROAD
REV	REVISION
ROW	RIGHT OF WAY
RM	ROOM
S	SOUTH
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIB	STEEL IRON BAR
SPEC	SPECIFICATION
SQ	SQUARE
SSL	SEWER SERVICE LINE
ST	STREET
STD	STANDARD
SUSP	SUSPENDED
SW	SIDEWALK
TEL	TELEPHONE
TEMP	TEMPORARY
TP	TRUCKFILL PUMP
TYP	TYPICAL
VERT	VERTICAL
VOL	VOLUME
US	ULTRASONICS TRANSDUCER
VAR	VARIES
VB	VAPOUR BARRIER
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
W	WEST
W/O	WITHOUT
WL	WATER LEVEL
WM	WATERMAIN
WSL	WATER SERVICE LINE
WWS	WASTEWATER SEWER
WT	WEIGHT

NOTE:

DECIMALIZED NUMBERS INDICATE METRES.
WHOLE NUMBERS INDICATE MILLIMETRES.

A/B — A – DETAIL NUMBER
B – PLAN WHERE DETAIL EXPANDED
C – PLAN WHERE DETAIL ORIGINATES — A/C B



Record Drawing

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No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	OCT/14	DN

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No. 234 **Date:** 14/08/18

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ENGINEERING EXCELLENCE SINCE 1981

CODE: M–617.03
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND REVISED PHASE III WORKS

TITLE: DRAWING LEGEND, ABBREVIATION INDEX AND KEY PLAN

SCALE: NTS | DATE: 14/08/18 | PLAN: 1 | SHEET: 1 of 5

Oct 22, 2014 – 4:05pm F:\600\617 Mystery Lake LGD\617.03 Waste Disposal Ground Expansion Phase III\04 Drawings\dwg\Record Drawings\Plan 1 – Key Plan.dwg

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SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

1	RECORD DRAWING	OCT/14	DN
No.	REVISIONS	DATE	INITIALS

B.M. EL.
TBM – REBAR
NORTHING: 6171041.947
EASTING: 568049.915
ELEVATION: 224.978m

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DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND REVISED PHASE III WORKS

TITLE: EXISTING WDG LAYOUT AFTER PHASE II WORKS WITH TEST HOLE LOCATIONS

SCALE: 1:1250 | DATE: 14/08/18 | PLAN: 2 | SHEET: 2 of 5

SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	OCT/14	DN

B.M. EL.
SEE PLAN 2

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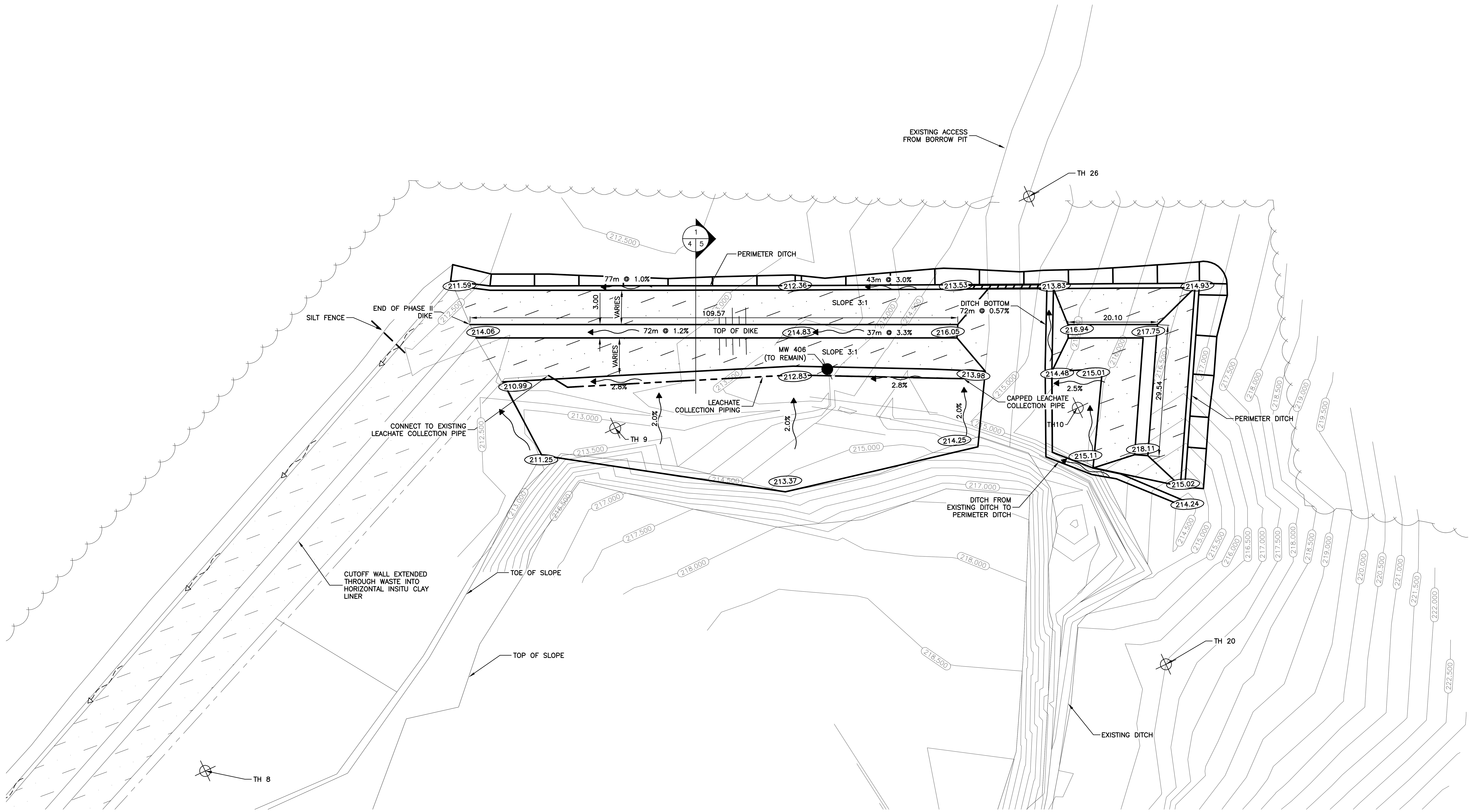
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND REVISED PHASE III WORKS

TITLE:
OVERALL WDG LAYOUT
SHOWING PROPOSED PHASE III WORKS

SCALE:	DATE:	PLAN:	SHEET:
1:1250	14/08/18	3	3 of 5



LEGEND

- TH # – TEST HOLES BY AECOM IN 2005
- MW # – MONITORING WELLS BY AECOM IN 2005
- TH # – TEST HOLES BY JRCC IN 2011
- EXISTING
- PROPOSED – PHASE III WORKS
- PROPOSED – PHASE III LEACHATE PIPING

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SCALE BAR
(IN METRES)
10 0 5 10 20 30 40 50
1:500

No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	OCT/14	DN

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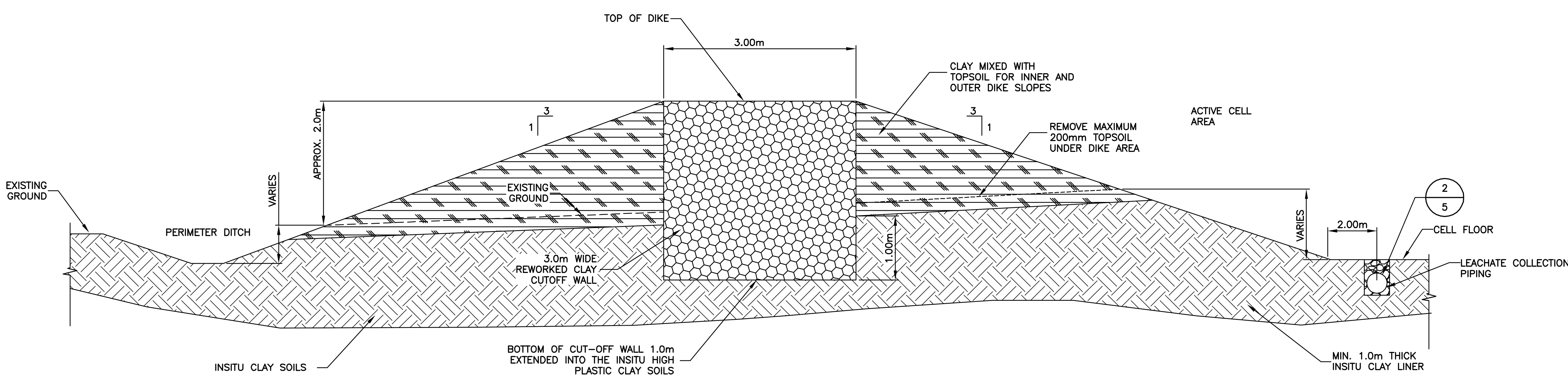
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND REVISED PHASE III WORKS
TITLE: PHASE III ACTIVE CELL AREA LAYOUT

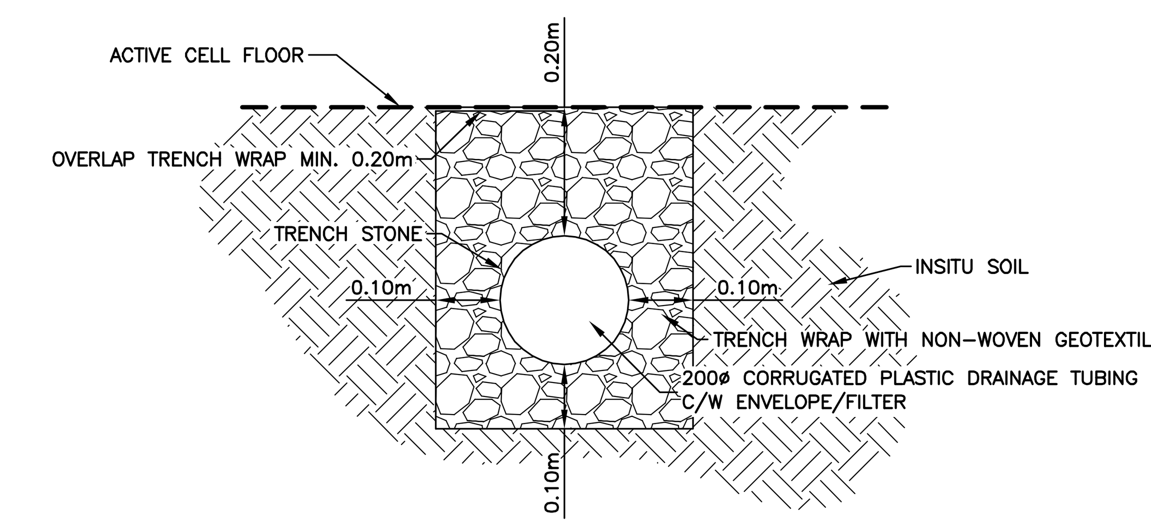
SCALE:	DATE:	PLAN:	SHEET:
1:500	14/08/18	4	4 of 5

LEGEND:

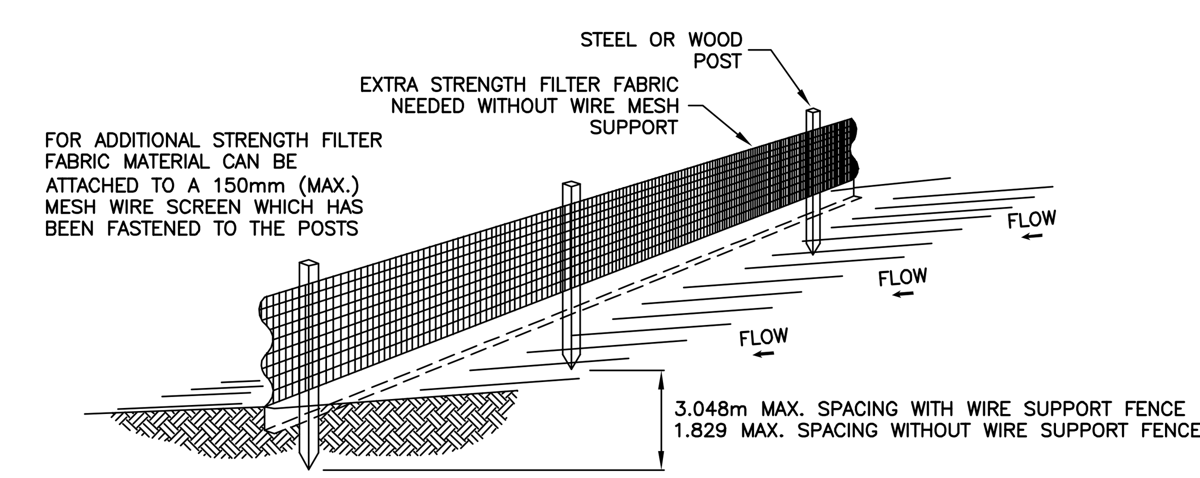
- EXCAVATED AND COMPACTED MEDIUM–HIGH PLASTIC CLAY
- CLAY MIXED WITH CLEAN TOPSOIL/PEAT
- INSITU SOIL
- STONE



1 / 4 5 ACTIVE CELL DIKE DETAIL
SCALE = 1:50



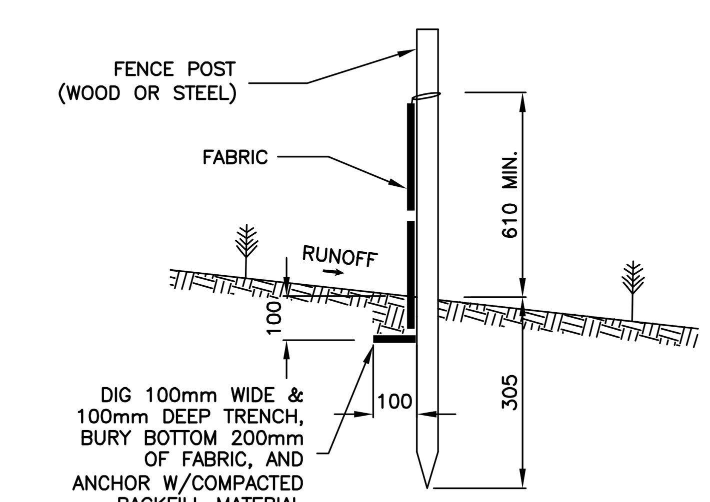
2 / 5 LEACHATE COLLECTION PIPING DETAIL
SCALE: 1:50



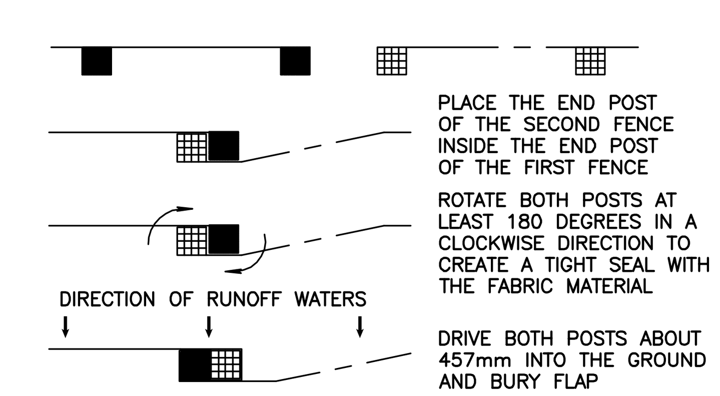
NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 25mm LONG, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 50mm AND SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 200mm OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
7. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

3 / 5 SILT FENCE DETAIL
SCALE = NTS



4 / 5 SILT FENCE SECTION
SCALE = NTS



5 / 5 ATTACHING TWO SILT FENCES
SCALE = NTS

Record Drawing

Drawing compiled from visual observations of various parts of construction and/or from information by others. Accuracy not warranted. Independent verification required before application.

No.	REVISIONS	DATE	INITIALS
1	RECORD DRAWING	OCT/14	DN

B.M. EL.

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APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/08/18

ENGINEER'S SEAL
ORIGINAL DRAWING SIGNED AND SEALED BY G. R. COUSIN 14/08/18

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ENGINEERING EXCELLENCE SINCE 1981

CODE: M–617.03
DESIGNED BY: JC
DRAWN BY: OT
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND REVISED PHASE III WORKS

TITLE: ACTIVE CELL DIKES, LECHATE COLLECTION PIPING AND SILT FENCE DETAILS

SCALE:	DATE:	PLAN:	SHEET:
AS NOTED	14/08/18	5	5 of 5

Oct 22, 2014 - 4:11pm F:\600\617 Mystery Lake LGD\617.03 Waste Disposal Ground Expansion Phase III\04 Drawings\dwg\Record Drawings\Plan 5 - Details.dwg

Phase IV Works – Design Drawing Plan Set

LGD OF MYSTERY LAKE

WASTE DISPOSAL GROUND

PHASE IV WORKS

ISSUED FOR TENDER

PLAN INDEX

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REDUCED DRAWING SET
DO NOT SCALE

DRAWING LEGEND:

PIPING:

- EXISTING WATERMAIN
- PROPOSED WATERMAIN
- FUTURE WATERMAIN
- EXISTING SEWERMAIN
- PROPOSED SEWERMAIN
- FUTURE SEWERMAIN
- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- FUTURE FORCEMAIN
- EXISTING RAW WATERMAIN
- PROPOSED RAW WATERMAIN
- FUTURE RAW WATERMAIN
- EXISTING LAND DRAINAGE SEWER
- PROPOSED LAND DRAINAGE SEWER
- FUTURE LAND DRAINAGE SEWER
- FH EXISTING FIRE HYDRANT
- FH PROPOSED FIRE HYDRANT
- EXISTING VALVE
- PROPOSED VALVE
- CO EXISTING CLEANOUT
- CO PROPOSED CLEANOUT
- MH EXISTING MANHOLE
- MH PROPOSED MANHOLE
- EXISTING CURBSTOP
- PROPOSED CURBSTOP
- CB EXISTING CATCH BASIN
- CB PROPOSED CATCH BASIN

ROADS AND DRAINAGE:

- EXISTING ROAD CENTERLINE
- PROPOSED ROAD CENTERLINE
- FUTURE ROAD CENTERLINE
- EXISTING ROAD SHOULDER
- PROPOSED ROAD SHOULDER
- EXISTING ROAD EDGE
- PROPOSED ROAD EDGE
- FUTURE ROAD EDGE
- EXISTING SIDEWALK
- PROPOSED SIDEWALK
- EXISTING DITCH
- PROPOSED DITCH
- EXISTING CULVERT
- PROPOSED CULVERT
- EXISTING DRAINAGE DIRECTION
- PROPOSED DRAINAGE DIRECTION
- 100 CONTOURS – MAJOR INTERVALS
- 100.5 CONTOURS – MINOR INTERVALS
- ×100.00 EXISTING GROUND ELEVATION
- 100.00 PROPOSED GROUND ELEVATION
- 100.00 EXISTING ROAD ELEVATION
- 100.00 PROPOSED ROAD ELEVATION
- TOP / BOTTOM EXISTING SLOPE
- TOP / BOTTOM PROPOSED SLOPE
- ASPHALT
- GRAVEL

MISCELLANEOUS:

- X EXISTING FENCE LINE
- X PROPOSED FENCE LINE
- P EXISTING PROPANE LINE
- P PROPOSED PROPANE LINE
- H EXISTING HYDRO LINE
- H PROPOSED HYDRO LINE
- G EXISTING GAS LINE
- MTS EXISTING MTS LINE
- EXISTING BUILDING
- PROPOSED BUILDING
- LEGAL/LOT LINE
- RAILWAY LINE
- MATCH LINE
- HP EXISTING HYDRO POLE
- HP PROPOSED HYDRO POLE
- W WATER HOLDING TANK
- S SEPTIC TANK
- H SEWAGE HOLDING TANK
- SURVEY BAR
- SURVEY MONUMENT/BENCHMARK
- EXISTING VEGETATION
- PROPOSED VEGETATION
- D1 DOOR CONSTRUCTION TYPE
- W1 WALL CONSTRUCTION TYPE
- EASEMENT
- N NORTH ARROW

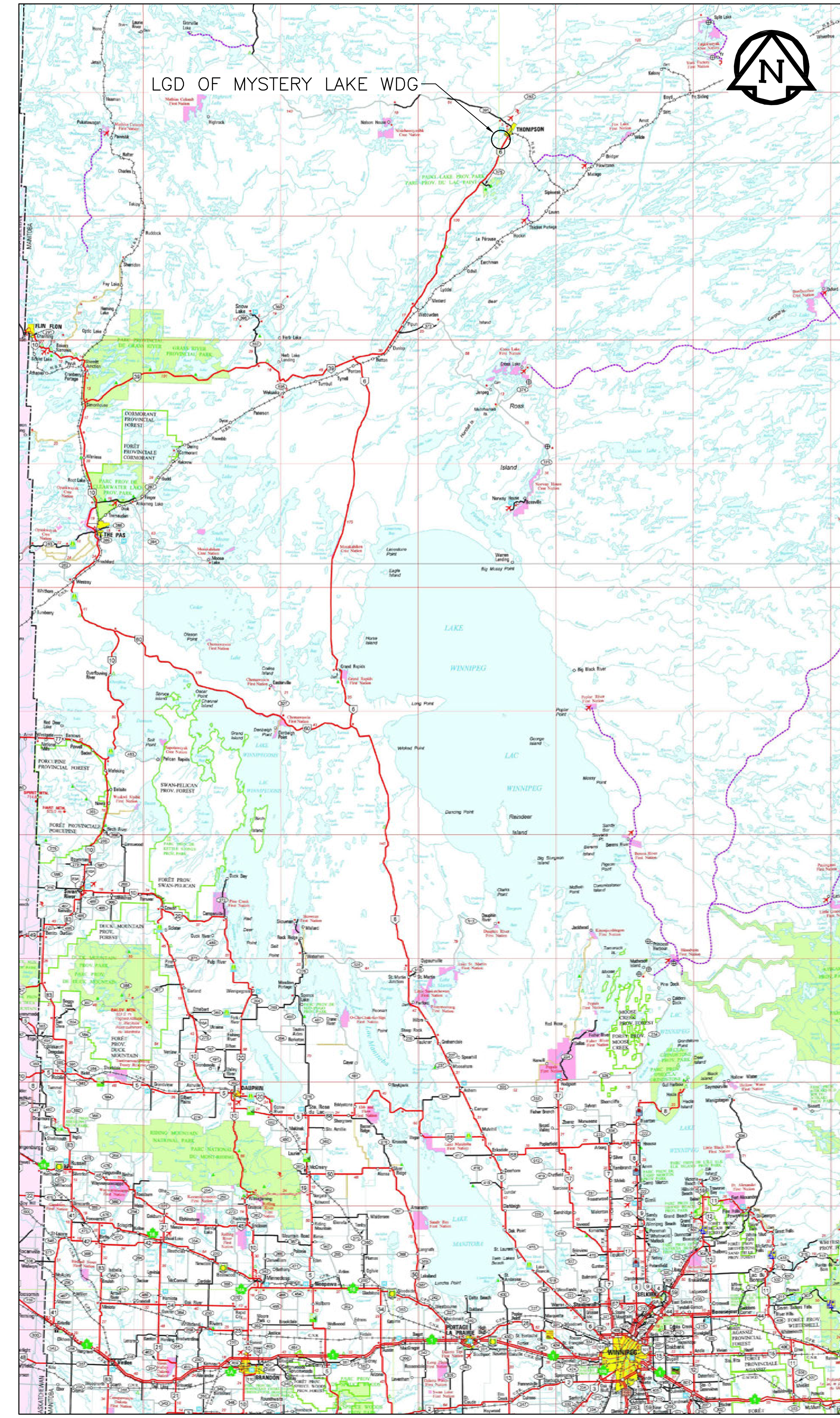
ABBREVIATIONS:

@	AT
A/C	AIR CONDITIONING
ALUM	ALUMINUM
ASPH	ASPHALT
AVE	AVENUE
AVG	AVERAGE
BD	BOTTOM OF DITCH
BLDG	BUILDING
BLVD	BOULEVARD
BM	BENCHMARK
BOT	BOTTOM
BP	BACKWASH PUMP
B/W	BOTHWAYS
CB	CATCH BASIN
CI	CAST IRON
CHKD	CHECKED
CNR	CANADIAN NATIONAL RAILWAY
CO	CLEANOUT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
COORD	COORDINATE
CPR	CANADIAN PACIFIC RAILWAY
C/W	COMPLETE WITH
DCW	DOMESTIC COLD WATER
DEG	DEGREE
DHW	DOMESTIC HOT WATER
DIA	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DP	DUTY PUMP
DR	DRIVE
DWG	DRAWING
E	EAST
EC	END OF CURVE
EL	ELEVATION
ELEC	ELECTRICAL
EP	EDGE OF PAVEMENT
ER	EDGE OF ROAD
E/W	EACHWAY
EXT	EXTERIOR
FAX	FAX MACHINE STAND
FC	FILE CABINET
FD	FLOOR DRAIN
F/F	FACE TO FACE
FH	FIRE HYDRANT
FM	FORCEMAIN
FP	FIRE PUMP
FT	FOOT, FEET
GA	GAUGE
GALV	GALVANIZED
HA	HECTARE
HB	HOSE BIBB
HDPE	HIGH DENSITY POLYETHYLENE
HI	HEIGHT OF INSTRUMENT
HPW	HIGH PRESSURE WATER LINE
HORIZ	HORIZONTAL
HP	HYDRO POLE
HR	HOUR
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HW	HOT WATER TANK
HWL	HIGH WATER LEVEL
ID	INSIDE DIAMETER
IL	ICE LEVEL
INCL	INCLUDE
INT	INTERIOR
INV	INVERT
JCT	JUNCTION
JP	JOCKEY PUMP
LAB	LABORATORY
LAM	LAMINATE
LAT	LATITUDE
LDS	LAND DRAINAGE SEWER
LFS	LEVEL FLOAT SWITCH
LONG	LONGITUDE
LWL	LOW WATER LEVEL
M	METRE
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MEMB	MEMBRANE
MH	MANHOLE
MIN	MINIMUM
MM	MILLIMETRE
N	NORTH
NAT	NATURAL
NBC	NATIONAL BUILDING CODE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O/C	ON CENTRE
O/D	OUTSIDE DIAMETER
O/F	OUTSIDE FACE
O/H	OVER HEAD
OD	OUTSIDE DIAMETER
ORIG	ORIGINAL
OWSJ	OPEN WEB STEEL JOIST
PLYWD	PLYWOOD
POLY	POLYETHYLENE
PROP	PROPERTY
PS	PRESSURE SEWER
PVC	POLY VINYL CHLORIDE
RAD	RADIUS
RD	ROAD
REV	REVISION
ROW	RIGHT OF WAY
RM	ROOM
S	SOUTH
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIB	STEEL IRON BAR
SPEC	SPECIFICATION
SQ	SQUARE
SSL	SEWER SERVICE LINE
ST	STREET
STD	STANDARD
SUSP	SUSPENDED
SW	SIDEWALK
TEL	TELEPHONE
TEMP	TEMPORARY
TP	TRUCKFILL PUMP
TYP	TYPICAL
VERT	VERTICAL
VOL	VOLUME
US	ULTRASONICS TRANSDUCER
VAR	VARIES
VB	VAPOUR BARRIER
VERT	VERTICAL
VFD	VARIABLE FREQUENCY DRIVE
W	WEST
W/O	WITHOUT
WL	WATER LEVEL
WM	WATERMAIN
WSL	WATER SERVICE LINE
WWS	WASTEWATER SEWER
WT	WEIGHT

NOTE:

DECIMALIZED NUMBERS INDICATE METRES.
WHOLE NUMBERS INDICATE MILLIMETRES.

A – DETAIL NUMBER
B – PLAN WHERE DETAIL EXPANDED
C – PLAN WHERE DETAIL ORIGINATES



No.	REVISIONS	DATE	INITIALS

B.M. EL.

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APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 15/07/27

ENGINEER'S SEAL

PROVINCE OF MANITOBA
15/07/27 M-617.04
B.J.D. McCORMAC
Member
31648
REGISTERED PROFESSIONAL ENGINEER

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ENGINEERING EXCELLENCE SINCE 1981

CODE: M–617.04
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE IV WORKS

TITLE: DRAWING LEGEND, ABBREVIATION INDEX AND KEY PLAN

SCALE: NTS
DATE: 15/07/07
PLAN: 1
SHEET: 1 of 5

Jul 27, 2015 – 2:03pm F:\600\617 Mystery Lake LGD\617.04 Waste Disposal Ground Expansion Phase IV\04 Drawings\Dwg\Design Plans\Plan 1 – Key Plan.dwg

SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. EL.
TBM – REBAR
NORTHING: 6171041.947
EASTING: 568049.915
ELEVATION: 224.978m

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CODE: M–617.04
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE IV WORKS

TITLE:
EXISTING WDG LAYOUT AFTER PHASE III WORKS
WITH TEST HOLE LOCATIONS

SCALE: 1:1250
DATE: 15/07/07
PLAN: 2
SHEET: 2 of 5

SCALE BAR
(IN METRES)
25 0 12.5 25 50 75 100 125
1:1250

No.	REVISIONS	DATE	INITIALS

B.M. EL.
SEE PLAN 2

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

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No. 234 Date: 15/07/27

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15/07/27

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ENGINEERING EXCELLENCE SINCE 1981

CODE: M-617.04
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE IV WORKS

TITLE:
OVERALL WDG LAYOUT
SHOWING PROPOSED PHASE IV WORKS

SCALE:	DATE:	PLAN:	SHEET:
1:1250	15/07/07	3	3 of 5

NOTE: DIKE LAYOUT IS BASED ON INTERPOLATION OF DATA FROM PAST TEST HOLES. IF SUITABLE CLAY FOR A WDG LINER IS NOT PRESENT AT THE CUT-OFF WALL LOCATION AS SHOWN ON THE PLAN THE DIKE LAYOUT WILL HAVE TO BE ALTERED AS DIRECTED BY THE ENGINEER

SCALE BAR
(IN METRES)
15 0 7.5 15 30 45 60 75
1:750

No.	REVISIONS	DATE	INITIALS

B.M. EL.
SEE PLAN 2

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

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No. 234 Date: 15/07/27

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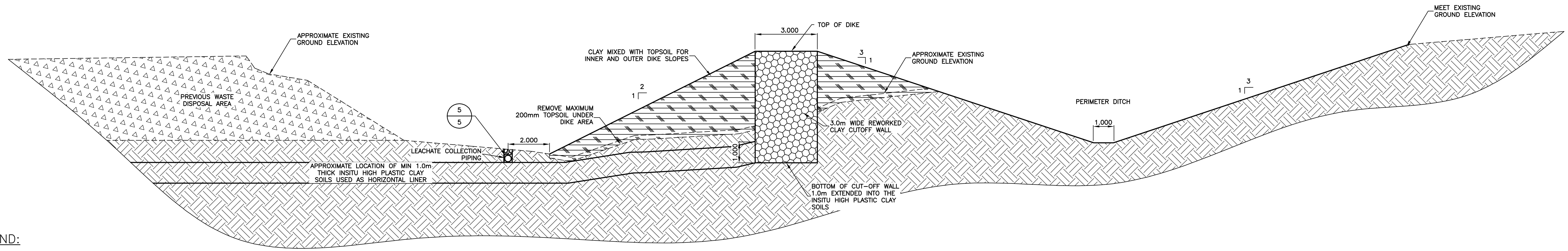
CODE: M–617.04
DESIGNED BY: JC
DRAWN BY: BM
REVIEWED BY: JC

PROJECT:
LGD OF MYSTERY LAKE
WASTE DISPOSAL GROUND PHASE IV WORKS

TITLE:
PHASE IV PERIMETER DIKE LAYOUT

SCALE: 1:750
DATE: 15/07/07
PLAN: 4
SHEET: 4 of 5

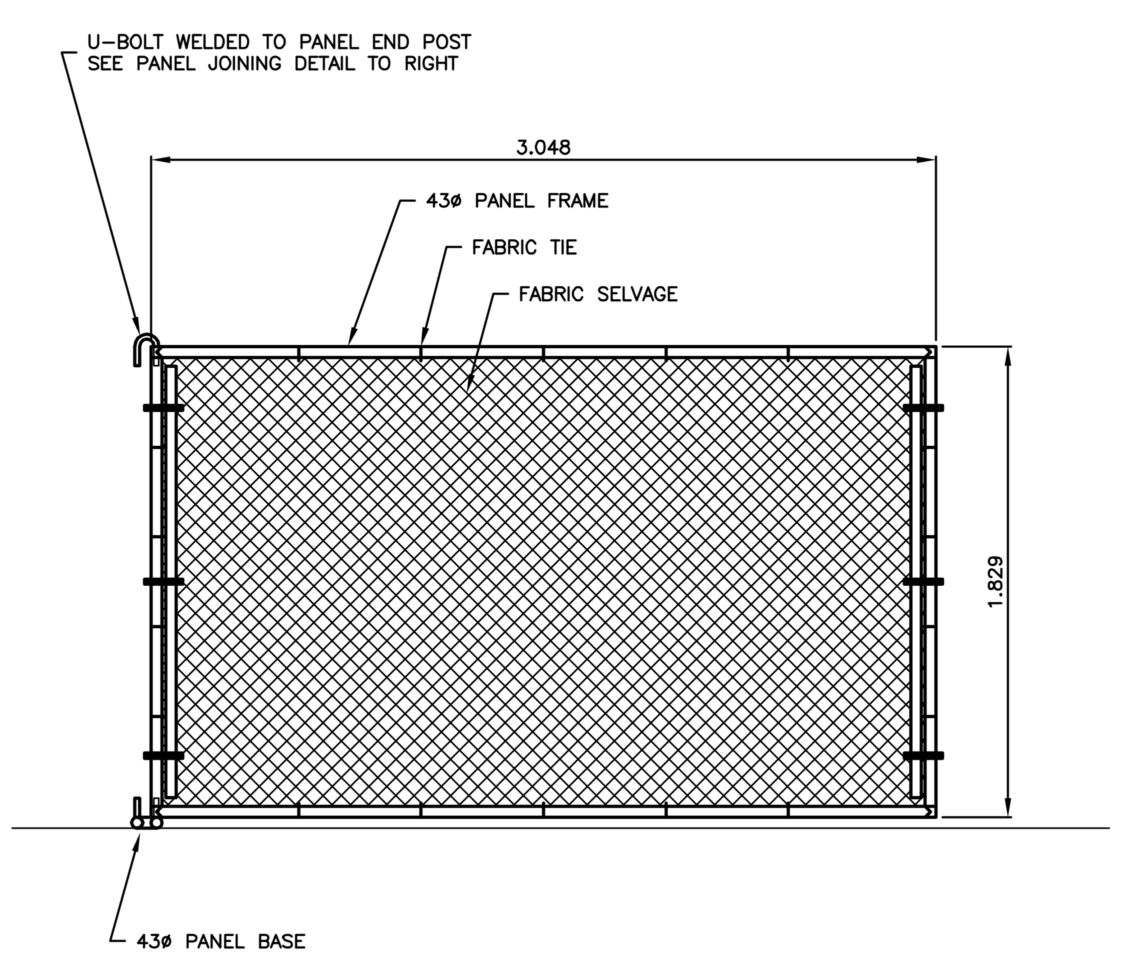
Jul 27, 2015 – 2:25pm F:\600\617 Mystery Lake LGD\617.04 Waste Disposal Ground Expansion Phase IV\04 Drawings\Dwg\Design Plans\Plan 4 – Phase IV Active Cell Dikes.dwg



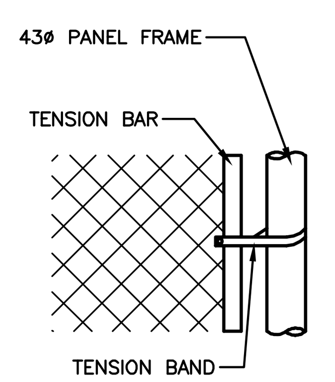
1 / 4 | 5 PERIMETER DIKE DETAIL
SCALE = 1:100

LEGEND:

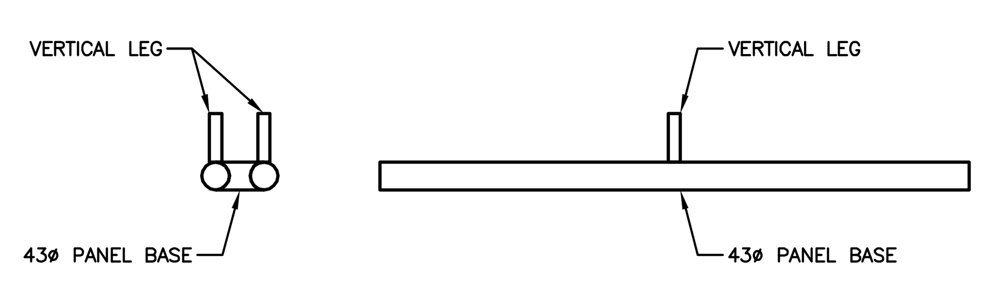
- EXCAVATED AND COMPACTED MEDIUM-HIGH PLASTIC CLAY
- CLAY MIXED WITH CLEAN TOPSOIL/PEAT
- INSITU SOIL
- EXISTING WASTE
- STONE



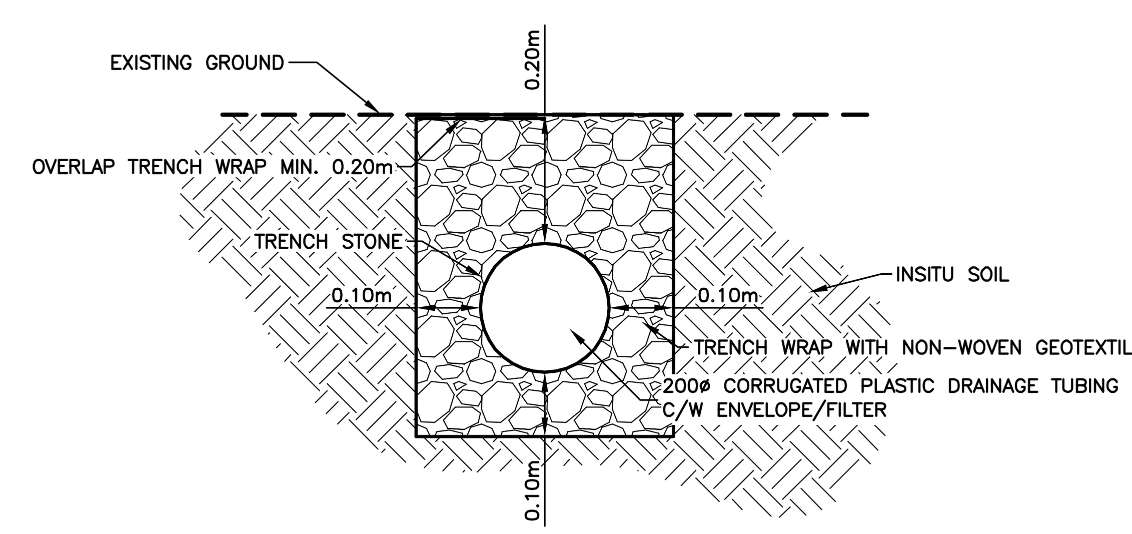
MOVEABLE CHAIN LINK FENCE PANEL DETAIL
2 / 5
SCALE = 1:25



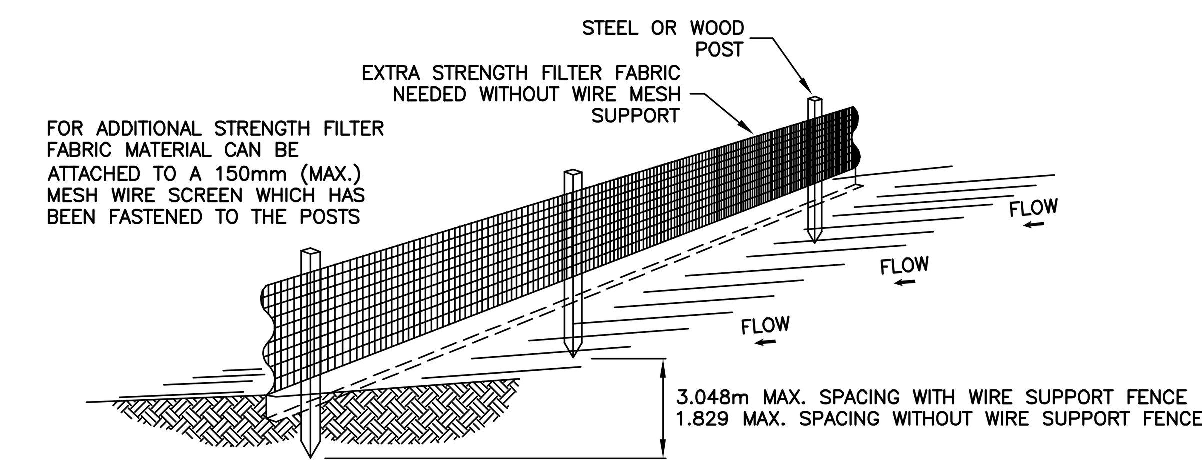
3 / 5 TENSION BAR
SCALE = 1:15



4 / 5 BASE DETAIL
SCALE = 1:10



5 / 5 LEACHATE COLLECTION PIPING DETAIL
SCALE: 1:50



NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
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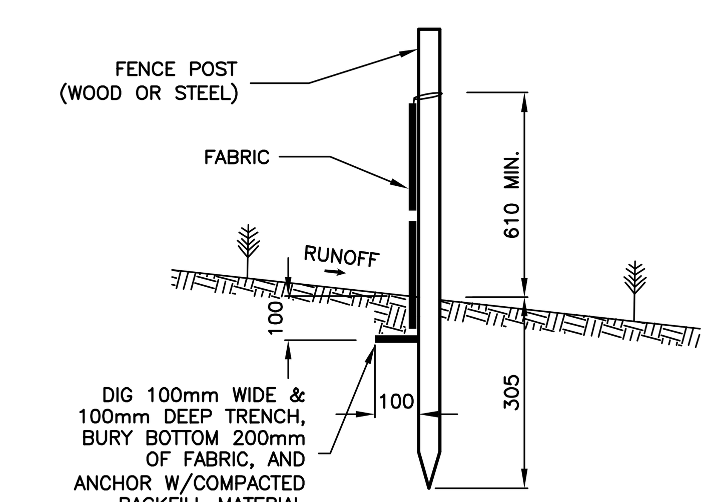
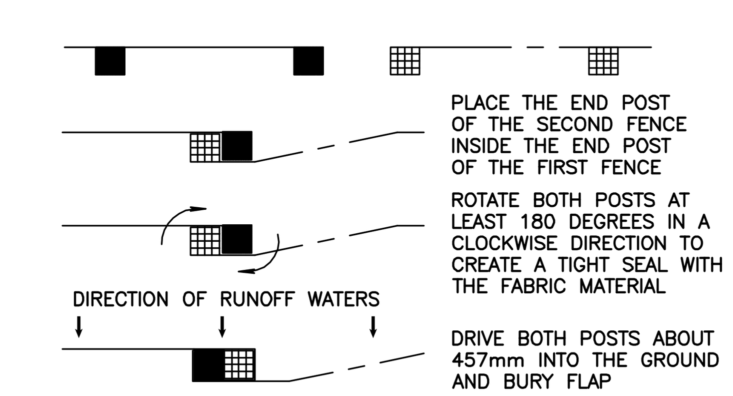
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

6 / 5 SILT FENCE DETAIL
SCALE = NTS



7 / 5 SILT FENCE SECTION
SCALE = NTS



ATTACHING TWO SILT FENCES
8 / 5
SCALE = NTS

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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APEGM
Certificate of Authorization
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No. 234 Date: 15/07/27

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DRAWN BY: BM
REVIEWED BY: JC

PROJECT: LGD OF MYSTERY LAKE WASTE DISPOSAL GROUND PHASE IV WORKS

TITLE: PERIMETER DIKE, MOVEABLE CHAIN LINK FENCE, LECHATE COLLECTION PIPING AND SILT FENCE DETAILS

SCALE:	DATE:	PLAN:	SHEET:
AS NOTED	15/07/07	5	5 of 5