

**Application for an  
Environmental Act Licence for  
an Additional Secondary Cell  
to the Existing Adam Lake  
Campground Wastewater  
Treatment Lagoon in Turtle  
Mountain Provincial Park**



To:  
Manitoba Conservation and  
Water Stewardship  
Environmental Assessment and  
Licencing Branch  
Suite 160, 123 Main Street  
Winnipeg MB R3C 1A5

Proponent:  
Manitoba Conservation and  
Water Stewardship  
Parks and Protected Spaces

Prepared by:  
Stantec Consulting Ltd.  
500-311 Portage Avenue,  
Winnipeg MB R3B 2B9

Project No. 111217030



February 2016



**Stantec Consulting Ltd.**  
500-311 Portage Avenue, Winnipeg MB R3B 2B9

February 23, 2016  
File: 111217030

**Attention: Ms. Tracey Braun, M.Sc., Director**  
Environmental Assessment and Licencing Branch  
Manitoba Conservation & Water Stewardship  
Suite 160, 123 Main Street  
Winnipeg, MB R3C 1A5

Dear Ms. Braun,

**Reference: Application for an Environmental Act Licence for an Additional Cell and Upgrades to the Existing Adam Lake Campground Wastewater Treatment Lagoon in Turtle Mountain Provincial Park**

On behalf of Manitoba Conservation and Water Stewardship, Parks and Protected Spaces, we are submitting five (5) paper copies and one (1) electronic copy (CD) of the Application for a new Environmental Act Licence for an Alteration to existing Licence No. 1135 for the existing Adam Lake Campground Wastewater Lagoon in Turtle Mountain Provincial Park. The Alteration will include the construction of a new secondary cell, and upgrades to the existing two cells.

The \$7,500 Licence Application Fee is enclosed and being sent by Stantec on behalf of Parks and Protected Spaces, Manitoba Conservation and Water Stewardship. The undersigned is to be contacted regarding any question that may arise.

Regards,

**STANTEC CONSULTING LTD.**

A handwritten signature in black ink, appearing to read "T Stratton", written over a faint circular stamp.

Tim Stratton, P.Eng., FEC  
Senior Engineer, Associate  
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tim.stratton@stantec.com


Attachment: five paper copies and one CD of the Application for a new Environmental Act Licence

c. JP Perreault, Parks and Protected Spaces  
Cory Vitt, P.Eng., MWSB

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# Environment Act Proposal Form



Name of the development:		
Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):		
Legal name of the applicant:		
Mailing address of the applicant:		
Contact Person:		
City:	Province:	Postal Code:
Phone Number:	Fax:	email:
Location of the development:		
Contact Person:		
Street Address:		
Legal Description:		
City/Town:	Province:	Postal Code:
Phone Number:	Fax:	email:
Name of proponent contact person for purposes of the environmental assessment:		
Phone:	Mailing address:	
Fax:		
Email address:		
Webpage address:		
Date:	Signature of proponent, or corporate principal of corporate proponent: 	
	Printed name: Tim Stratton, P.Eng. - Stantec	

A complete **Environment Act Proposal (EAP)** consists of the following components:

- **Cover letter**
- **Environment Act Proposal Form**
- **Reports/plans supporting the EAP** (see "Information Bulletin - Environment Act Proposal Report Guidelines" for required information and number of copies)
- **Application fee** (Cheque, payable to Minister of Finance, for the appropriate fee)

Per Environment Act Fees Regulation (Manitoba Regulation 168/96):	
Class 1 Developments .....	\$1,000
Class 2 Developments .....	\$7,500
Class 3 Developments:	
Transportation and Transmission Lines ..	\$10,000
Water Developments .....	\$60,000
Energy and Mining.....	\$120,000

**Submit the complete EAP to:**

Director  
Environmental Approvals Branch  
Manitoba Conservation and Water Stewardship  
Suite 160, 123 Main Street  
Winnipeg, Manitoba R3C 1A5

**For more information:**

Phone: (204) 945-8321

Fax: (204) 945-5229

<http://www.gov.mb.ca/conservation/eal>

APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

Development Information  
February 2016

## 1.0 DEVELOPMENT INFORMATION

Stantec was retained in August 2015 by Manitoba Water Services Board on behalf of Manitoba Conservation, Parks and Protected Spaces, to undertake the Adam Lake Lagoon Upgrading Study and subsequent Licence Application if required. The existing two cell lagoon, primary cell and secondary cell, has experienced hydraulic, and probably organic, overloading in recent years and requires expansion. The existing lagoon operates under Environment Act Licence No. 1135 issued January 15, 1988.

The Adam Lake Campground has 113 campsites of which 44 have water service, 2 shower buildings, 5 washrooms, 3 pit privies, 1 RV/trailer dump station and 1 wastewater truck dump. Wastewater from these sources is directed to the lagoon.

The campground has a 150 mm gravity sewer collection system with approximately 10 manholes. There is a lift station which pumps wastewater from the beach washroom to the gravity sewer. The last manhole in the sewer system, which is adjacent to the primary cell, is used as a truck dump. The Parks wastewater truck dumps wastewater from William Lake and Max lake campsite into the manhole. A private hauler also dumps wastewater from Bower Lake, George Lake, and possibly other locations. Pit privies from all Parks campsites are also dumped into the manhole.

The "Adam Lake Campground in Turtle Mountain Provincial Park Wastewater Lagoon Upgrading Study" is attached in Appendix 1. This Study recommends construction of a new 0.23 hectare clay lined secondary cell, and removal of the existing interconnecting dike to provide a 0.50 primary cell. These upgrading works will provide the anticipated capacity for the 20 year design period.

Stantec's opinion of capital cost is 2016 dollars is \$635,000 which includes engineering and construction cost contingency. The estimated annual operation and maintenance cost is \$22,000 which includes phosphorus control with alum.

The proposed new secondary cell location is shown in Figure C-101, Site Plan in the Study Appendix 1.

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Description of Development  
February 2016

## 2.0 DESCRIPTION OF DEVELOPMENT

### 2.1 CERTIFICATE OF THE TITLE AND LEGAL DESCRIPTION

The existing lagoon, and proposed secondary cell addition are located in Section 22, TWP1, RGE 20W, in the Adam Lake Campground, Turtle Mountain Provincial Park, Province of Manitoba. The legal Certificate is "Administrative Plan – Turtle Mountain Provincial Park; Director of Surveys Plan 19826", which is attached in Appendix 2.

### 2.2 OWNER

The land is owned by the Province of Manitoba as registered in Manitoba Land Titles Office of the Property Registry. No formal Title could be found. The Administrative Plan is attached in Appendix 2.

### 2.3 MINERAL RIGHTS

The Province of Manitoba is the owner of all mineral rights.

### 2.4 EXISTING LAND USE

The proposed expansion site is adjacent to an existing two cell wastewater lagoon. The proposed new secondary cell is directly south of the existing cells.

### 2.5 LAND USE DESIGNATION

The land is zoned RD, Recreational Development.

### 2.6 PUBLIC MEETINGS OR HEARINGS

Public meetings or hearings have not been held for this project.

### 2.7 DESCRIPTION OF THE PROPOSED DEVELOPMENT

A complete engineering description of the design and operation of the proposed development is contained in Appendix 1 "Adam Lake Campground in Turtle Lake Provincial Park Wastewater Lagoon Upgrading Study".



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Description of Development  
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## 2.8 AGRICULTURAL OF INDUSTRIAL WASTES

No agricultural or industrial wastes, including petroleum products, will be put in the lagoon or stored on site.

## 2.9 DOMESTIC WATER SUPPLY

The Adam Lake Campground is groundwater sourced, chlorinated, and distributed to the campground.

The Turtle Mountain Provincial Park operates under the Public Water System Operating Licence No. PWS-08-186-01. The Campground water distribution system is designated as a Small System with Certificate #2006-667.



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Environmental Impact and Management Practices  
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## 3.0 ENVIRONMENTAL IMPACT AND MANAGEMENT PRACTICES

### 3.1 INTRODUCTION AND BACKGROUND

A complete description of existing infrastructure in the area, including a water treatment plant and water distribution system, wastewater collection, existing wastewater lagoons and lift station, and the proposed lagoon expansion site is provided in Appendix 1 "Adam Lake Campground in Turtle Mountain Provincial Park Wastewater Lagoon Upgrading Study".

#### 3.1.1 Legal Description

The existing lagoon and secondary cell are located within Turtle Mountain Provincial Park in the southeast quarter, Section 22, Township 1, Range 20W, in the Province of Manitoba.

#### 3.1.2 Ownership of Land

There is no record of title or deed abstract for land in the southeast quarter, Section 22, Township 1, Range 20W. The land is administered by the province as part of Turtle Mountain Provincial Park as shown on Director of Surveys Plan 19826 registered in the Brandon Land Titles Office of the Property Registry (Brandon Land Titles Office 2016). Mineral rights are expected to be held by the Province of Manitoba.

#### 3.1.3 Existing Land Use and Designation

The Project site is an existing two cell wastewater lagoon. The proposed lagoon upgrade location is directly south of the existing cells in a cleared area. The land for the existing and proposed lagoons is categorized as "RD – Recreational Development" under the Manitoba Provincial Parks System Plan for Turtle Mountain Provincial Park (Manitoba Conservation 2008). This category permits intensive recreational developments and activities and some commercial resource opportunities such as oil and gas exploration and extraction and fuelwood cutting. Commercial forestry is not permitted in the Provincial Park (MC 2008). The nearest cottage subdivision is along the south shore of Bower Lake, approximately 365 metres to the north of the Project site. The Adam Lake Campground nearest site is located approximately 200 m to the southeast of the proposed expansion site.

#### 3.1.4 Public Meetings or Hearings

No public consultation was undertaken for the project.



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## 3.2 DESCRIPTION OF THE ENVIRONMENT

The Project site is located in the Turtle Mountain uplands of the Turtle Mountain Ecodistrict in the Southwest Manitoba Uplands Ecoregion. Surficial deposits in the ecodistrict consist of thick, kettled to hummocky, calcareous, loamy to clayey glacial till. The soils are predominantly well drained Dark Gray Chernozems and weakly developed Gray Luvisols. Vegetation in the Project region consists of deciduous forest and shrubs with an undergrowth of herbs and grasses. The predominant tree species in the ecodistrict is trembling aspen with white birch on higher levels and bur oak on lower levels. Green ash, Manitoba maple and balsam poplar are also apparent. Shrubs include hazel, chokecherry, pin cherry, Saskatoon, raspberry, dogwood and high bush cranberry (Smith et al. 1998).

A variety of wildlife is present in the ecodistrict due to the variety of habitat. White-tailed deer, moose, elk, black bear, furbearers (e.g., beaver, muskrat), and small mammals are common. Trapping of furbearers (i.e., beaver, muskrat) is a commercial resource activity in the park occurring outside of built-up recreation areas. Numerous song birds, upland raptors, game birds (sharp-tailed grouse, Hungarian partridge), colonial nesters and waterfowl are found within the wooded uplands and pothole areas of Turtle Mountain (MNR 1985; Smith et al. 1998; TRCD 2005).

A request was submitted to the Manitoba Conservation Data Centre (MBCDC) for existing records of rare and protected wildlife species located in the Project area. One occurrence of the northern leopard frog was identified (Friesen 2016). According to the MBCDC this species is ranked as S4 – meaning widespread, abundant and apparently secure throughout its range or in the province (> 100 occurrences). Under the federal *Species at Risk Act* (SARA), this species is identified as being of Special Concern (Friesen 2016). This species is not listed under *The Manitoba Endangered Species Act* (MBESA).

A search of the Manitoba Herps Atlas (MHA) database revealed the presence of leopard frog, boreal chorus frog, wood frog and barred tiger salamander in the mixed wooded area and low lying marshy areas south of the existing lagoon site and in the vicinity of Adam Lake (within a 2 km radius of the Project site).

Typical fish species found in the Provincial Park, including Adam and Bower lakes, consist of sportfish such as northern pike, perch and stocked species such as trout (MNR 1985; MCWS 2015a).

The surface of Turtle Mountain Provincial Park includes numerous shallow lakes and wetland depressions. Internal drainage is intermittent and poorly defined and surface run-off from the upland area is minimal (MNR 1985). Several lakes are regionally important recreation water bodies, although many have high nutrient levels. The shallowness of many lakes, including Bower and Adam lakes (less than 15 ft.) results in winter fish kills (MNR 1985). The existing wastewater lagoon's secondary cell discharges to a large wetland area immediately to the north of the



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lagoon (i.e., 12 metres), which ultimately connects to Bower Lake located approximately 380 metres further north.

Groundwater in the region is available from a number of aquifers, including lenses of sand and gravel aquifers and from sandstone and sand bedrock aquifers (TRCD 2005). The depths of the sand and gravel aquifers range from a few metres down to over 100 metres. Well yields are low to moderate (i.e., 1 to 65 l/gpm) with groundwater quality for domestic use ranging from very poor to excellent (TRCD 2005). The depth to sandstone and sand layers is generally less than 40 metres. Groundwater quality for domestic use ranges from fair to good (TRCD 2005). There are no registered provincial observation wells or abandoned wells in the general Project region of the Park. One water supply well is located at the Adam Lake Campground south of the Project site.

Other commercial resource use activities in the Provincial Park have included timber harvesting and oil and gas extraction. Timber harvesting was typically for firewood and fence posts. Lands were also leased in the western area of the Provincial Park for oil and gas production (MNR 1985). Neither of these activities occurred in the Project area between Adam Lake and Bower Lake.

Adam Lake Campground has a public water treatment plant and a water distribution system and is classified as a well source water system (TRCD 2005). The treatment plant at Adam Lake supplies treated metered water to the Provincial Park (approx. 3,000 m<sup>3</sup> per year) under an operating licence for a seasonal public water system (Stantec 2016; MCWS 2015b).

Recreational activities within Turtle Mountain Provincial Park and in the Adam Lake to Bower Lake area occur in summer and winter. In the summer, activities include hiking trails, picnic areas, camping, and boating (Manitoba Conservation 2001). In the winter, activities include fishing on Bower and Adam Lake and cross-country skiing on a network of trails. The Adam Lake Recreation Site, located approximately 200 metres to the northeast at its nearest point from the Project site, has winter facilities used for cross-country skiing, ice skating, hockey, waxing trail and warming hut, and tobogganing (Manitoba Conservation 2009).

Heritage resource features have been documented within Turtle Mountain Provincial Park. In the Provincial Park Management Plan two such features were noted in the Park, the Dunseith Trail (a historic trail across the Park dating to the 1800s) and the Oskar Lake archaeological site (evidence of native hunters circa 400 years ago) (MNR 1985). These sites are located approximately 1.8 km to the northwest and 6.0 km to the southwest (respectively) of the Project site. A review of the provincial Archaeological Sites Inventory Database revealed records for five additional known sites in Turtle Mountain Provincial Park, the closest site (i.e., bison skull) being approximately 1.1 km to the northwest of the Project site on Bower Lake (Heritage Resources Branch 2016).



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## 3.3 ENVIRONMENTAL IMPACTS

The existing two-cell lagoon receives wastewater from campsites, shower buildings, washrooms, pit privies and an RV/trailer dump station. Wastewater is also hauled to the existing lagoon from other Provincial Park campsites at William and Max lakes and private sites from Bower and George lakes. The existing two-celled lagoon has been hydraulically and organically overloaded at times, which has resulted in emergency discharges of presumed low quality effluent in the past from the site. The hydraulic and organic loading on the lagoon was studied to determine the required upgrades to meet a 20 year design loading.

A geotechnical soil assessment of the existing lagoon and south expansion site location indicated a homogeneous black and brown high plasticity moist, stiff clay. A consistent layer of clay is present at the site location at least to a depth of 6 metres below ground. Hydraulic conductivity tests from a typical clay sample in the south expansion area indicated that, based on the hydraulic conductivity, the location would be suitable for a clay lined lagoon.

The following sections address Item VIII – “Description of the Development” of the “Environment Act Proposal Form” .

### **a) Type, Quantity and Concentration of Pollutants to be Released into the Air, Water or on Land.**

Wastewater from the Adam Lake Campground will be retained and treated at the expanded lagoon that will include the original primary cell and former secondary cell converted to a primary cell, and new secondary lagoon cell. Treated wastewater will be tested and will only be discharged once it meets licence requirements. The conversion of the existing secondary cell to a primary cell in combination with the existing primary cell will be of sufficient size to meet the maximum allowable primary cell loading (i.e., 56 kg/day). The addition of a new secondary cell will address the current hydraulic and organic overloading as determined in the Lagoon Upgrade Study. A new discharge pipe, originating from the northwest corner of the new secondary cell, will be routed to the approximate location of the existing effluent discharge in the wetland . The new wastewater treatment system will result in improved effluent quality that meets discharge criteria and addresses historic emergency discharges to the receiving wetland and water bodies.

No winter hydraulic storage is required at the Adam Lake Campground. A design storage equal to 130 days is proposed. It is expected that the discharge of treated effluent would occur between September 16 and October 31 of any given year. Treated effluent will be monitored to ensure the effluent quality meets licence requirements in terms of biological oxygen demand, fecal coliform content and total coliform content and the Province’s total phosphorus loading requirement (i.e., maximum 1 mg/L limit). Phosphorus is currently controlled by the addition of alum to the secondary cell. This practice will be continued in the new secondary cell if required.



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The landscape will be altered by the construction of the new lagoon cell and fencing will be installed around the perimeter of the new cell. Potential effects from the Project on the environment are summarized below.

## **b) Effects on Wildlife**

There is potential for disturbing or displacing wildlife species present in the general Project area via construction activities and noise generated from equipment and vehicles.

A request submitted to MBCDC for existing records of rare and protected wildlife species indicated one occurrence of the northern leopard frog (S4 – apparently secure) in the general Project area. No other mammal or bird species protected under SARA or MBESA were identified in the Project area. Many other bird species potentially occurring in the wooded areas in the vicinity of the general Project area are species listed in the Migratory Birds Convention Act (1994). The Migratory Birds Convention Act provides for the protection of migratory birds by regulating the timing of potentially harmful construction activities so that land alterations occur outside sensitive breeding windows.

Due to the presence of water bodies, low lying marshy areas, mixed-wooded areas and open areas, there is potential for amphibian and reptile species to occur in the general Project area. Species such as the northern leopard frog are known to make seasonal movements between breeding and overwintering habitats in April/May and June, and again in late August and September (late summer or early fall) (COSEWIC 2009; Environment Canada 2013). Construction workers should be aware of the potential for amphibian and reptile species to be present in the general Project area, should report any sightings and take caution to avoid harming sensitive species.

Project-related disturbance activities to wildlife habitat can be reduced by avoiding the sensitive breeding window for migratory bird wildlife species – mid-April to end of August (Environment Canada 2014). To avoid potential disturbance to nesting migratory birds, tree and brush clearing should be conducted prior to mid-April or after August 30. If clearing is to occur during the sensitive nesting period, a pre-construction nest survey to locate and buffer active bird nests would be required.

It is expected that effects on wildlife as a result of the Project will be low given that the proposed site for the lagoon expansion is predominantly a cleared, grassed site with the exception of approximately 2,000 m<sup>2</sup> in the footprint of the new buried pipe and clay waste disposal area.

## **c) Effects on Fisheries**

Concern with respect to potential effects on fish and fish habitat is related to the release of sediments from construction activities (i.e., blown dust, exposed surface run-off) and from untreated lagoon effluent discharges into surface water bodies utilized by fish.



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The nearest water body to the Project site is Bower Lake, some 380 metres to the north. Effects on fish are unlikely in that lagoon effluent will not be directly discharged into a surface water body with known fish species. Effluent will be discharged from the lagoon to the low-lying wetland and forested area surrounding the wastewater lagoons. The likelihood of erosion/deposition from construction activities directly affecting fish bearing water bodies is considered low given the distance between the Project area and Bower Lake and the presence of a low/wetland area between the cells and lake. Prior to construction, silt fences will be installed at the Project site to prevent erosion and deposition.

The proposed lagoon upgrade will provide long-term improvements (i.e., 20 year design loading) at Adam Lake by reducing the hydraulic and organic overloading to the lagoon system, and improving the quality of effluent discharged to the wetland area to the north and ultimately to Bower Lake.

## **d) Effects on Surface and Groundwater**

The construction of a new secondary cell in an area with good clay lining and conversion of the existing secondary cell to a primary cell, working in combination with the existing primary cell, will serve to reduce the existing hydraulic and organic overloading to the lagoon to allow for improved treatment of effluent prior to discharge to the wetland area immediately to the north of the Project site, and to Bower Lake. Erosion/deposition during construction activities at drainage locations will be prevented by the installation of silt fencing. The potential for effect of the Project on surface water is expected to be negligible.

The new lagoon liner will meet Provincial hydraulic conductivity requirements and provide groundwater protection at the site. Based on geotechnical investigations conducted at the site there is a suitable liner of clay present at least to a depth of 6 metres. Effects on groundwater from the lagoon expansion are anticipated to be negligible.

## **e) Effects on Soils**

During Project construction soils could be affected by compaction associated with equipment operating at the site. Any compaction of soils would be limited to the immediate cleared footprint for the Project and activities associated with the trenching of a new drainage ditch. An area for clay waste disposal from lagoon excavation will be established on the west side of the lagoon site. There is also the potential for soils to be contaminated due to accidental spills, leaks or releases of fuels, lubricants or other materials from construction equipment and activities at the Project site.

Disturbance of soils adjacent to the lagoon site, discharge route and existing low-lying wetland area will be minimized during construction by keeping heavy equipment operations limited to the project site to the extent possible and using properly maintained equipment. Potential effects on soil are considered low given the small amount of equipment and quantity of fuel,



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lubricants and materials that would be present at the Project site. An emergency spill kit to remediate accidental spills, leaks or releases will be maintained on the Project site during construction.

## f) Vegetation Effects

While the majority of the Project is located in an existing cleared area the new discharge pipe and clay waste disposal area will require approximately 2,000 m<sup>2</sup> (0.2 ha) of clearing and grubbing. The amount of clearing and disturbance is very small relative to the fairly dense and abundant wooded areas within a 2 km radius surrounding the Project site (an area of approx. 1,200 ha). In addition, a request submitted to MBCDC for existing records of rare and protected plant species indicated no records of such species existed in the Project area (Friesen 2016). As such, effects on vegetation as a result of the Project are expected to be low.

## g) Forestry Related Effects

Project related effects on forestry are anticipated to be negligible. Commercial forestry is not permitted in the Provincial Park (MC 2008). An existing cleared area south of the existing lagoon site will be used for the new lagoon cell and no potential timber harvesting areas (i.e., fuelwood cutting, fence posts) would be affected. No new road access is required for new lagoon construction as the existing road will continue to provide access to the lagoon.

## h) Air Quality Effects

There is potential for emissions, including greenhouse gases (GHGs) and fugitive dust generation, from construction equipment and vehicles during construction works at the site. The Adam Lake Recreation Site, which is used for winter recreation activities, is located approximately 200 metres to the northeast at its nearest point to the Project site. However, the Park campground will be closed for the season when construction takes place. Increased volatile organic carbon (VOC) levels could result from fuels used during construction. Fuel may be transported to the site to fuel equipment. Effects are expected to be low due to the short-term of construction and small construction workforce.

Temporary nuisance odours can occur from lagoons. The lagoons may generate some odours for a short time in spring during the thawing period. The resultant odours could be carried by prevailing winds and cause a temporary nuisance to Park users in the campground which is located approximately 200 metres to the south of the site. However, no prior odour complaints are known to have been registered with MCWS over lagoon operation. In addition, the upgraded lagoon will have expanded organic treatment.

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Tree buffers around the lagoon cell locations will serve to mitigate odours. Any odour release would be short-term in duration and is considered low in magnitude. It is expected that any odour effects on air quality will be improved as a result of new secondary cell construction and conversion of the existing secondary cell to a primary cell in terms of enhanced organic treatment and elimination of organic overload situations.

## i) Noise Effects

There is some potential for noise effects in the immediate area during construction from the operation of construction equipment and vehicles. Noise effects could cause temporary disturbance to wildlife in the area and Park users utilizing recreational facilities in the area during the winter season. The tree buffer around the lagoon cells will mitigate the effect of noise on receptors nearby.

Construction noise effects are expected to be low and short-term in duration. Noise effects from the maintenance vehicles (i.e., wastewater hauling trucks, grass mowers) operating at the site would only be intermittent in nature and limited in duration.

## j) Heritage Resources

Heritage resources, and their associated artifacts and cultural data, are protected under *The Heritage Resources Act*. A desktop screening of the proposed lagoon upgrade revealed one record in the vicinity of the Project area. The site is approximately 1,100 metres to the northwest on Bower Lake, consisting of a bison skull discovered on the lake when it was dry (site is now underwater). Four additional sites were recorded at Max Lake located approximately 5 km west and northwest of the Project area, consisting of hammerstones, a stone axe, and an isolated find of a stone scraper. There are no known heritage resources at the proposed lagoon expansion site.

The Historic Resources Branch (HRB) was contacted to undertake a Heritage Screening for the proposed lagoon upgrade project in Turtle Mountain Provincial Park (Nesbitt 2016). The HRB examined the applicable area proposed for development based on the Branch's records for areas of potential concern and identified no heritage concerns with the Project (Nesbitt 2016). In the event that heritage resources, or objects thought to be heritage resources, are exposed during construction, work at the site will cease until HRB authorities have been notified and the item investigated. The HRB may require that a heritage resource management strategy be implemented to mitigate the effects of development on the heritage resources (Nesbitt 2016).

## k) Socio-economic Effect

Minimal expansion is expected at the Park campground and private cottage sites within the Provincial Park. As such, the proposed upgrade includes an allowance for a 10 percent growth in wastewater discharged to the lagoon system over the 20 year design period.





# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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The proposed sewage lagoon expansion will create temporary construction employment and contribute to the local economy in the surrounding area through the purchase of goods and services during construction. The potential effects are considered positive but negligible.

There will be a general socio-economic benefit as a result of the improvement of treated effluent quality discharged to the northern wetland area and Bower Lake as well as a reduction in organic overload events. These improvements are expected to contribute to the enjoyment of the Provincial Park facilities.

## I) Visual Effects

The lagoon expansion is expected to have a negligible adverse effect on area aesthetics. Construction will occur in an area to the south and adjacent to existing lagoon cells in a cleared area surrounded by tree buffers. The new lagoon cell will be a low profile earthen dike structure, approximately 0.45 metres above ground, with a fence approximately 2 metres high. Grass on the new earthen dike will be mowed regularly during seasonal operation.

The new lagoon cell will be similar in appearance to the existing facility and will generally not be visible to Park users due to the presence of vegetation surrounding the Project site. There are no marked hiking/day use trails or paths within approximately 170 metres or in direct line of sight of the lagoon with the exception of the existing access road.

## 3.4 ENVIRONMENTAL MANAGEMENT PRACTICES

Proposed environmental management practices will be undertaken in accordance with recommended "Operation and Maintenance of Sewage Lagoons" manual and Environment Act Licence, both as issued by Manitoba Conservation.

### 3.4.1 Operation

Manitoba Conservation, Parks and Natural Areas, currently operates a number of wastewater lagoons and have operators trained under the training program for a "Small System" sewage treatment facility. Normally, the lagoon would be discharged once per year, between September 15 and October 31. The maximum water level in the cells is 1.5 m. The following procedure would be followed with respect to discharging the lagoon.

**Step 1:** Close the valves between the primary cells and secondary cell two weeks before sampling.

**Step 2:** Sample the secondary cell after the connecting valve between the primary and secondary cell has been closed for two weeks. Sample bottles and sample preservation and submission procedures can be obtained from accredited laboratories.



# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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## Step 3:

- a) If the samples tested meet criteria, open the discharge valve from the secondary cell and discharge the contents. Discharge would be completed within two weeks.
- b) If the samples tested do not meet criteria, it is necessary to repeat the sampling until bacteriological criteria are met. Once met, discharge can take place.

**Step 4:** When the secondary cell is drained, the discharge valve would be closed.

**Step 5:** Open the valve between the primary cells and the secondary cell and control the water levels in the cells such that there is a minimum of 0.30 m.

## 3.4.2 Maintenance

### Spring, Summer and Fall Maintenance

The majority of maintenance is carried out in the spring, summer and fall of each year as weather permits. Typical maintenance tasks include:

- Grass on the dykes of the lagoon should be cut on a regular basis. The grass should not exceed 0.3 meters in length. Deep rooted weeds should be removed to prevent deterioration of the dykes and liner system.
- Inspect fence and gate for damage and repair as required.
- Gate valves should be operated in spring, summer and fall to ensure they are in proper working order.
- If encountered, animals burrowing on the dykes of the lagoon should be removed and the holes filled. If assistance in animal control is required, contact Manitoba Conservation.
- Check for erosion on the dykes. If erosion is present, erosion repairs should be undertaken. This may include re-grading, grass planting or stone rip-rap.
- Regular road and turn around maintenance should be undertaken to ensure access to the site at all times. Culverts should be cleared of blockage.
- Ensure the discharge valve is closed when not draining.
- Inspect the discharge ditch and repair if necessary.

# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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## Winter Maintenance

There is no wastewater going in to the lagoon in winter. The maintenance task is:

- Ensure gate is locked at all times.

## 3.5 LAGOON DETAILS

Figures C-101 and 1.0 show details of the new lagoon system including:

- Clearing and grubbing area
- Interconnecting pipe structure including gate valve
- Discharge pipe structure including gate valve
- Proposed new cell location
- Lagoon cell bottom elevations
- Clay waste area

## 3.6 MITIGATION OF SILT RUNOFF DURING CONSTRUCTION

Silt fences and/or straw wattles will be placed around the construction area as required to protect the drainage routes during construction and until silt movement has stabilized.

## 3.7 DISTANCE FROM EXISTING STRUCTURES

The existing and expanded proposed lagoon cell is approximately 200 m from the nearest camp site and is separated by forest.

## 3.8 SLUDGE DISPOSAL PLAN

The Sludge Disposal Plan is as follows:

Sludge in the primary cell would be monitored on an annual basis and removed when a significant accumulation occurs (300-400 mm) within the 2.5 m top to bottom range. There is currently an estimated 200 mm of sludge in the primary cell. A reasonable equivalent figure for sludge generation is 50 L per capita per season at the Park. A Manitoba Conservation Licence would be obtained in the future by the Manitoba Conservation, Parks and Protected Spaces, for sludge removal and disposal, if required.



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At removal time, the sludge would be dewatered on site, removed from site, and applied to agricultural land or an appropriate landfill in accordance with disposal methods approved by the Province of Manitoba.

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Schedule  
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## 4.0 SCHEDULE

Construction of the proposed wastewater lagoon is tentatively scheduled to start in September 2016. The completed lagoon upgrade would commence operation, upon approval by Manitoba Conservation, likely in the spring of 2017.

**APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK**

Funding  
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## **5.0 FUNDING**

This project is being funded by The Province of Manitoba.

# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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# APPLICATION FOR AN ENVIRONMENTAL ACT LICENCE FOR AN ADDITIONAL SECONDARY CELL TO THE EXISTING ADAM LAKE CAMPGROUND WASTEWATER TREATMENT LAGOON IN TURTLE MOUNTAIN PROVINCIAL PARK

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## **APPENDIX 1**

# **Adam Lake Campground in Turtle Mountain Provincial Park Wastewater Lagoon Upgrading Study**

**Adam Lake Campground in  
Turtle Mountain Provincial Park  
Wastewater Lagoon  
Upgrading Study**

Final Report



Prepared for:  
The Manitoba Water Services  
Board

- and -

Manitoba Conservation and  
Water Stewardship

Prepared by:  
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Winnipeg, MB R3B 2B9

Stantec Project No. 111217030



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Figure C-101 Site Plan

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## APPENDICES

Appendix A Soil Test Results and Logs



# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Introduction  
February 2016

## 1.0 INTRODUCTION

Adam Lake Campground (Adam Lake) is located within Turtle Mountain Provincial Park 95 km south of Brandon. Adam Lake Campground has a water pumping station where groundwater is chlorinated and distributed to the Campground. It also has a gravity sewer system which flows to a two cell wastewater treatment lagoon. The last manhole at the lagoon serves as a wastewater truck dump for the Park and one outside hauler. There is also a wastewater lift station by the beach which serves the washroom there and delivers wastewater by forcemain to a nearby manhole on the gravity sewer system.

The two cell (primary and secondary cells) lagoon receives wastewater from the following:

1. Adam Lake
  - 113 campsites contributing (44 with water service)
  - 2 shower buildings
  - 5 washrooms
  - 3 pit privies
  - 1 RV/trailer dump station (manhole on the sewer system)

There are 13 water supply standpipes in the campground.

Wastewater is hauled to the lagoon from other Park campsites at William Lake and Max Lake by a Parks sewage truck. One private sewage hauling contractor trucks sewage from Bower Lake, George Lake and possibly other locations. There are haul records of the trucked sewage.

The sewage trucks also haul septage from 8 known pit privies as well as approximately 25 cottage septic tanks.

The two celled lagoon is hydraulically overloaded at times and liquid can overtop the interconnecting dike which is only 1.5 m above the primary cell bottom and 1.9 m above the secondary cell bottom. Emergency discharges have taken place in the past due to hydraulic overloading.

The purpose of this Study is to determine the hydraulic and organic loading on the lagoon and to determine upgrading required to meet the 20 year design loading.

The existing lagoon operates under Environment Act Licence No. 1135 issued January 15, 1988.

The Park has been placing alum in the secondary cell prior to discharge to meet the 1.0 mg/L phosphorus discharge limit.



# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Scope of Work  
February 2016

## 2.0 SCOPE OF WORK

The scope of work included the following tasks:

- Project initiation meeting with the MWSB & Parks.
- Site investigation by Stantec Project Team.
- Review of project issues.
- Test hole drilling and soils identification program on the existing lagoon cells and the expected cleared expansion site directly to the south. A secondary expansion area would be in a treed area to the east. Stantec would be on site to log test holes.
- Assess 20 year design wastewater loading.
- Topographic survey of existing lagoon site and potential adjacent new site.
- Measurement of sludge in both cells.
- Desktop assessment of environmental issues with Manitoba Conservation including fisheries, navigable waters, water rights, soil contamination, heritage resources, construction constraints, and rare and endangered species.
- Determine design hydraulic and organic loading.
- Assess sizing of existing lagoon with respect to estimated wastewater loading.
- DFO considerations with respect to Licence Application, if required.
- Liaise with Manitoba Conservation Environmental Licencing and other stakeholders, as appropriate.
- Assess treated effluent drainage route.
- Assess ground water conditions on site.
- Develop alternatives as appropriate.
- Prepare preliminary construction quantities.
- Prepare preliminary cost estimates.
- Prepare preliminary design and plan(s) of project components for Licence Proposal.
- Prepare and submit draft report.



## ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Scope of Work  
February 2016

- Receive comments on draft report from stakeholders.
- Prepare and submit Final Report, incorporating comments.
- Prepare and submit Environmental Act Licence Proposal (5 hardcopies and 1 electronic copy) to Manitoba Conservation, if required.
- Respond to questions of TAC on Environment Act Licence Proposal.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Existing Systems  
February 2016

## 3.0 EXISTING SYSTEMS

### 3.1 PARK WATER USE

The Adam Lake water pumping station supplies metered chlorinated water to the Campground. The station distributes approximately 3000 m<sup>3</sup> to the Campground annually. Based on an average of 130 days operation per year, this equates to approximately 23,000 L/day.

Chlorinated water that does not reach the lagoon is difficult to assess. An approximate annual estimate is as follows:

1. Standpipes (13);		
5 uses per day x 13 standpipes x 10 L / use x 130 days	=	85,000 L
2. Flushing Wastewater Collection Lines;		
250 L x 2 standpipes x 20 weeks	=	10,000 L
3. Miscellaneous cleaning, vehicle washing, plant watering, other	=	<u>50,000 L</u>
	<b>Subtotal</b>	<b>- 145,000 L</b>

Water / Wastewater added to the lagoon;

1. RV dump, other; estimate	=	<u>5,000 L</u>
	<b>Subtotal</b>	<b>+ 5,000 L</b>

Therefore, the net estimated water removed from system and not reaching the lagoon = 145,000 – 5,000 = 140,000 L annually which is approximately 5% of the water supplied.

Therefore the current estimated wastewater, excluding infiltration, currently going to the lagoon from the site gravity wastewater system is 95% x 3,000 m<sup>3</sup> = approximately 2,850 m<sup>3</sup> annually.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Existing Systems  
February 2016

## 3.2 WASTEWATER TRUCKED TO THE LAGOON

The Park provided the following data on wastewater trucked to the lagoon and discharged into the last downstream manhole on the gravity sewer system:

1. Park Wastewater Truck	290 m <sup>3</sup> /year
2. Private Hauler	<u>230 m<sup>3</sup>/year</u>
<b>Total</b>	<b>520 m<sup>3</sup> year</b>
Pit Privy and Septic Tank Septage Loads	30 loads/year
These loads are included in 1. and 2. above.	

## 3.3 WASTEWATER COLLECTION SYSTEM

The Park has a gravity wastewater collection system consisting of 150 mm SDR 35 PVC pipe and approximately 10 manholes. The Park replaced 3 sections of sewer line in recent years. A number of manholes were inspected during the site visit and the majority are generally high. However, there are low manholes which may collect surface runoff. There may also be cracks/breaks in the buried sewer pipe. A CCTV analysis would have to be done to determine the condition of the sewer line.

## 3.4 EXISTING WASTEWATER LAGOON

The Adam Lake clay lined lagoon was constructed in the mid-1970's and consists of a 0.26 hectare primary cell and 0.21 hectare secondary cell at full supply level (FSL). The secondary cell discharges into a large swampy area to the north which is connected to Bower Lake.

The lagoon has the following characteristics:

- Lagoon constructed of site clay.
- A 150 mm gravity inlet pipe.
- 200 mm clay tile gravity discharge pipe to the swamp.
- 4 / 1 interior side slopes.
- 200 mm interconnecting pipe and valve.
- Grassed dikes which are mowed regularly.
- Gate and fence.

The wastewater lagoon appears to be in reasonable physical condition. The lagoon has a history of hydraulic overloading which is an indicator that it is holding liquid. The lagoon is





# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Existing Systems  
February 2016

regularly operated above stipulated Licence levels. The operators advised that they were not aware of any visual leakage through the dikes. The swamp discharge area appears to be suitable as a receiving water. The interconnecting and discharge valves operate satisfactorily. The outside berms are high and wide, presumably to take excess construction excavation.

In summary, the lagoon appears to function reasonably well except that it is hydraulically overloaded.

## 3.5 LAGOON EXPANSION SITES

There is a cleared area directly south of the existing lagoon which appears to be a suitable expansion site. There is a second site directly east of the lagoon which is not as suitable as it is higher and treed. Further, the first test hole drilling program determined that the second site to the east does not have suitable soil.

## 3.6 LIFT STATION

The lift station at the beach area pumps wastewater from the beach washroom up to the adjacent gravity sewer system. The lift station apparently is in satisfactory operating condition except for a minor float control problem.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Topographic Survey of Site  
February 2016

## 4.0 TOPOGRAPHIC SURVEY OF SITE

A topographic survey was undertaken on October 15, 2015 which included the existing lagoon, the preferred expansion site to the south and a few shots on the expansion site to the east.

At that time, shots were also taken in the bottom of the primary and secondary cells to measure sludge accumulation.

Test holes were marked out, and elevations shot, for the first test drilling which occurred on October 28, 2015.

A second survey was conducted on November 4, 2015 to pick up additional information.

The average primary cell geodetic bottom elevation was determined to be 689.61m and the average secondary cell elevation 689.10 m.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Test Hole Drilling  
February 2016

## 5.0 TEST HOLE DRILLING

Paddock Drilling (Paddock) drilled 15 test holes on October 28, 2015, at the existing lagoon and the expansion sites, to a depth of 3 m each. All test holes were backfilled with bentonite pellets.

Soil samples were taken at all holes and Shelby tubes at 4 holes for possible hydraulic conductivity test.

A second drilling was undertaken by Paddock on December 14, 2015 to determine if clay was present at a deeper depth. Four 6 meter deep holes were drilled and soil samples taken.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Geotechnical Assessment  
February 2016

## 6.0 GEOTECHNICAL ASSESSMENT

### 6.1 SOIL TYPE

In the initial drilling, all test holes showed homogeneous black and brown predominantly high plasticity moist, stiff clay overlain by 50 to 200 mm of topsoil. There were traces of sand, silt and gravel. Three of the holes reached the elevation of 1 m below the existing secondary cell elevation and clay was found at this elevation. It was decided that additional deeper test holes should be drilled to confirm that clay is consistently present as a cell floor liner. The second drilling confirmed that suitable liner clay is present at least to a depth of 6 m below ground.

### 6.2 HYDRAULIC CONDUCTIVITY TESTS

Hydraulic conductivity tests were undertaken on two Shelby tube samples, one from the existing lagoon and one from a typical clay sample in the south expansion area. The results were:

Test Hole 4 – Existing Lagoon                       $6.8 \times 10^{-9}$  cm/sec

Test Hole 12 – Expansion Area                       $1.3 \times 10^{-8}$  cm/sec

Both samples meet the required lagoon hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec for a clay liner.

### 6.3 GEOTECHNICAL CONCLUSION

The clay in both the existing lagoon and the south expansion site are suitable for a clay lined lagoon.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Lagoon Hydraulic and Organic Loadings  
February 2016

## 7.0 LAGOON HYDRAULIC AND ORGANIC LOADINGS

### 7.1 STORAGE PERIOD

As there is no winter hydraulic storage required, the recommended design storage is from May 15 to October 15, equal to 153 days. However, since design storage days exceed annual loading, design storage is the annual summer loading of 130 days. We expect discharge of treated effluent in a new Licence would be allowed between September 16 and October 31 of any year.

### 7.2 DESIGN ANNUAL HYDRAULIC LOADING

From Park water treatment plant generated wastewater	2,850 m <sup>3</sup> /year
From trucked wastewater	<u>530 m<sup>3</sup>/year</u>
	3,370 m <sup>3</sup> /year

There is minimal expansion expected at the Park campsites and private cottages. A 10% increase in wastewater to the lagoon should be more than adequate for the 20 year design period. Therefore the design hydraulic wastewater loading for the lagoon has been set at  $3,370 \text{ m}^3 + 10\% = 3,700 \text{ m}^3$  annually assuming 130 days operation per year which excludes infiltration.

### 7.3 EXISTING STORAGE

The existing allowable storage is 1,080 m<sup>3</sup> in the primary cell and 1,970 m<sup>3</sup> in the secondary cell for a total of 3,050 m<sup>3</sup>. However, the lagoon is occasionally hydraulically overloaded which indicates there is infiltration.

### 7.4 INFILTRATION

The infiltration cannot be accurately assessed without a CCTV analysis, which is currently not planned. Although most manhole tops are high, low manhole tops, especially on the flat area near the lagoon, should be raised. The design infiltration rate has been set at 50% of wastewater flow which is an average rate for a gravity sewer system. This equates to 1,425 m<sup>3</sup> annually.

### 7.5 TOTAL HYDRAULIC LOADING AND REQUIRED STORAGE

Therefore, the total design annual hydraulic loading, and required hydraulic storage, is  $3,700 + 1,425 \text{ infiltration} = 5,125 \text{ m}^3$ .



# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Lagoon Hydraulic and Organic Loadings  
February 2016

## 7.6 REQUIRED ADDITIONAL STORAGE

The required additional design storage is  $5,125 - 3,050 = 2,075 \text{ m}^3$ .

## 7.7 20 YEAR DESIGN ORGANIC LOADING - WITH OUTHOUSE WASTE

Domestic sewage organic loading is hydraulically based and has been set at 250 mg/L BOD<sub>5</sub>. Manitoba Conservation Environmental Approvals has advised that outhouse waste is considered septage. Septage organic loading is set at 7000 mg/L BOD<sub>5</sub>. The infiltration / extraneous flow organic loading has been set at 25 mg/L BOD<sub>5</sub>.

### a) Domestic Wastewater Hydraulic Loading (infiltration excluded)

Average Annual Loading	=	3,700 m <sup>3</sup>	
Average Daily Loading	=	$3,700 \text{ m}^3 \div 130 \text{ days}$ $= 28,500 \text{ L/day}$	
Estimated Maximum Daily Loading	=	$1.75 \times 28,500 \text{ L/day}$	= 50,000 L/day

### b) Organic Loading

The estimated maximum organic daily loading is:

Maximum Day Organic Domestic Loading	=	50,000 L @ 250 mg/L	=	12.5 kg / day BOD <sub>5</sub>
Trucked Pit Privy or Septic Tank Waste; (only one privy maximum per day allowed)	=	1,000 L @ 7000 mg/L	=	7.0 kg / day BOD <sub>5</sub>
Daily Infiltration / Extraneous Flow Loading $1,425 \text{ m}^3 \div 130$	=	11,000 L @ 25 mg/L	=	0.27 kg / day BOD <sub>5</sub>
<b>Total Maximum Day Organic Loading</b>	=		=	<b>19.8 kg/day BOD<sub>5</sub></b>

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Lagoon Hydraulic and Organic Loadings  
February 2016

## 7.8 REQUIRED PRIMARY CELL SIZE – WITH PRIVY WASTE

The maximum allowable primary cell loading is 56 kg/day/hectare. Therefore, the minimum required primary cell size is  $19.8 \div 56 = 0.35$  hectare area at 1.5 m full supply level (F.S.L). The existing lagoon primary cell has an area of 0.23 hectare at FSL. Therefore, the existing primary cell is inadequate to meet the required organic loading requirements. The existing secondary cell should be converted to a primary cell by the removal of the clay interconnecting dike. The interconnecting dike clay would be disposed of in the clay waste area. Any potential sludge on the clay would be removed prior to placement in the waste area. The combined two existing cells would have approximately 0.50 hectare surface area with the interconnecting dike removal and would meet the Provincial organic loading requirements as a primary cell.

## 7.9 REQUIRED NEW SECONDARY CELL

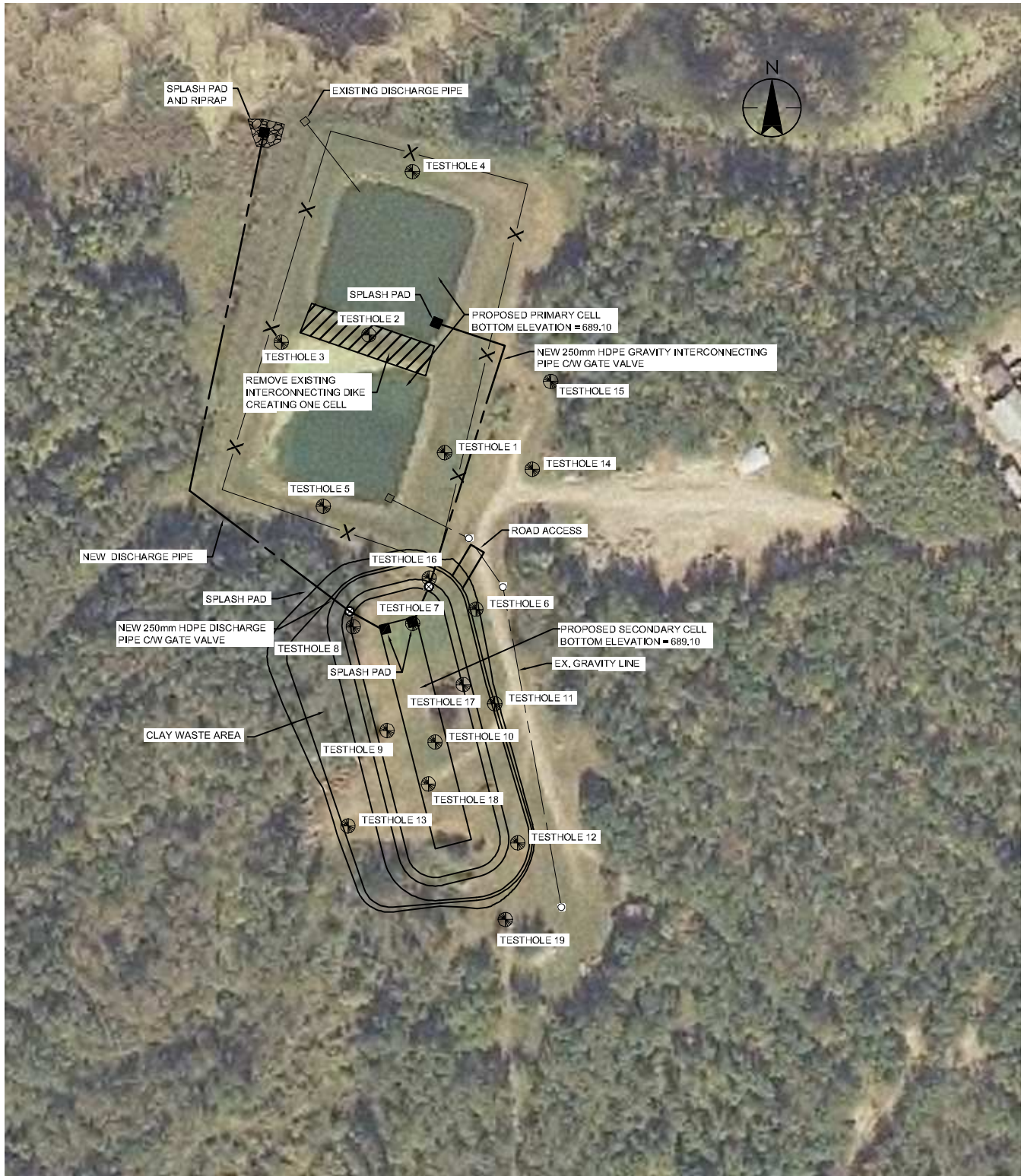
A new 0.23 hectare secondary cell at full supply level would be required to meet the design summer hydraulic loading storage of 2,075 m<sup>3</sup>. The location of the proposed cell is shown on Figure C-101 and a typical dike cross section shown on Figure 1.0, which follow.

## 7.10 SLUDGE ACCUMULATION

The bottom of the primary cell is essentially level with no apparent accumulations of sludge. However, we have assumed a 200 mm overall sludge accumulation which is reasonable considering the lower elevation of the secondary cell, the height of the dikes, and the design elevations (no as-constructed drawings were made available). This would represent approximately 600 m<sup>3</sup> of sludge.

The secondary cell appears to have minimal sludge accumulation.

The sludge in the primary cell should be monitored each year and likely removed when there is an accumulation of 300 to 400 mm.



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 2016/02/23 8:53 AM By: Redman, Steve

February, 2016  
111217030

ORIGINAL SHEET - ISO LETTER - v14.06



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THE MANITOBA WATER SERVICES BOARD  
 ADAM LAKE CAMPGROUND WASTEWATER  
 LAGOON UPGRADING STUDY

Figure No.

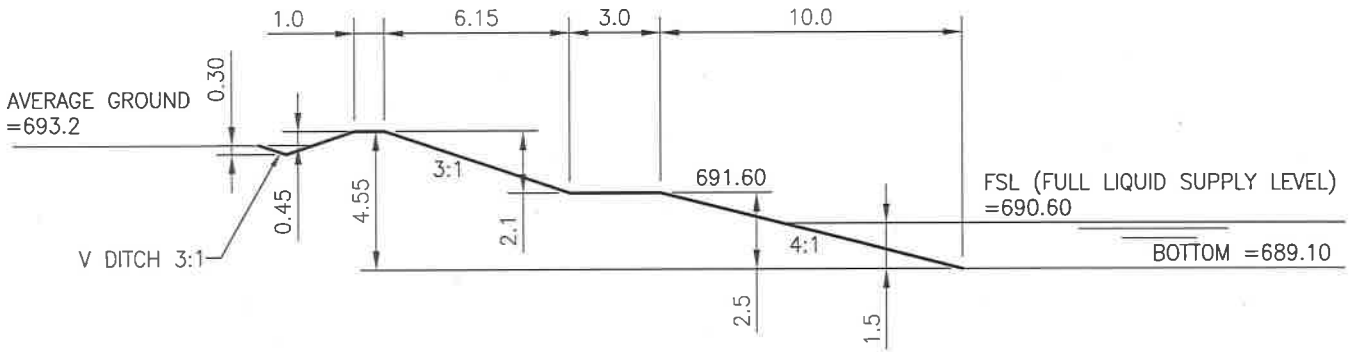
C-101

Title

SITE PLAN



V:\112\active\111217030\0300\_drawing\0301\_sketches\17030-fig1.0.dwg ISO\_Bx11\_VERT  
2016/02/22 4:01 PM By: Ramnarace, Keith



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Figure No.  
1.0

Title  
TYPICAL DIKE  
CROSS SECTION

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Lagoon Secondary Cell Addition Estimated Costs  
February 2016

## 8.0 LAGOON SECONDARY CELL ADDITION ESTIMATED COSTS

A new clay secondary cell could be constructed which would allow the lagoon system to meet the overall 20 year design hydraulic and organic loading requirements.

Our preliminary opinion of capital cost is as follows:

### Preliminary Quantities and Capital Cost Estimate for New Clay Lined Secondary Cell (Item totals to the nearest \$5,000)

	Unit	Quantity	Unit Price	Amount
1 Clearing & Grubbing	L.S.	1	\$ 30,000	\$ 30,000
2 Topsoil Stripping, Stockpiling and Replacement	C.M.	2,500	\$ 15	\$ 40,000
3 Common Excavation	C.M.	10,000	\$ 15	\$ 150,000
4 Remove Interconnecting Dike between Existing Cells	L.S.	1	\$ 30,000	\$ 30,000
5 Interconnecting Pipe System	L.S.	1	\$ 45,000	\$ 45,000
6 Discharge Structure and Pipe	L.S.	1	\$ 40,000	\$ 40,000
7 Granular Material for Road	C.M.	100	\$ 50	\$ 5,000
8 Culvert	L.S.	1	\$ 5,000	\$ 5,000
9 Ditching	L.S.	1	\$ 20,000	\$ 20,000
10 Seeding	L.S.	1	\$ 15,000	\$ 15,000
11 Fence and Gate	L.S.	1	\$ 40,000	\$ 40,000
12 Post Construction Testing	L.S.	1	\$ 5,000	\$ 5,000
13 Raise Manholes Tops	L.S.	1	\$ 15,000	\$ 15,000
14 Extra Work Allowance	L.S.	1	\$ 30,000	\$ 30,000
<b>Sub-Total Construction Cost</b>				<b>\$470,000</b>
<b>Engineering and Construction Cost Contingency (35%)</b>				<b>\$165,000</b>
<b>TOTAL ESTIMATED OPINION OF CAPITAL COST (not including GST or land costs)</b>				<b>\$635,000</b>

The cost estimate does not include the cost of sludge removal and disposal. Sludge can be removed at a future time if necessary.

# ADAM LAKE CAMPGROUND IN TURTLE MOUNTAIN PROVINCIAL PARK WASTEWATER LAGOON UPGRADING STUDY – FINAL REPORT

Conclusions and Recommendations  
February 2016

## 9.0 CONCLUSIONS AND RECOMMENDATIONS

A new 0.23 hectare clay lined secondary cell could be constructed which would allow the lagoon system to meet the required 20 year design hydraulic and organic loadings. The interconnecting dike between the existing cells would be removed to provide one larger 0.50 hectare primary cell.

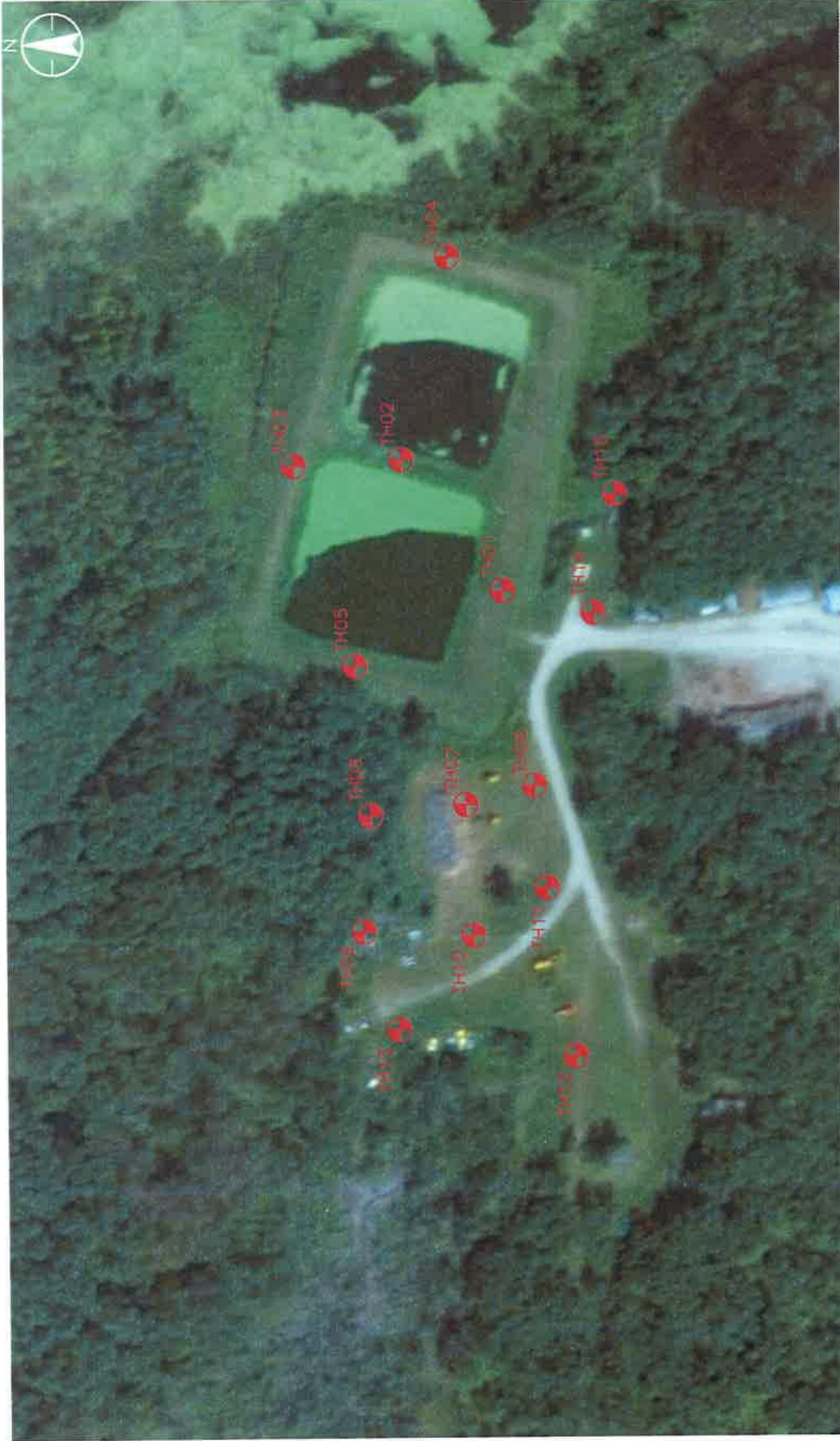
The proposed location of the new secondary cell is south of the existing primary cell as shown on Figure C-101, Site Plan.

Our opinion of estimated capital cost for the new secondary cell and related works is \$635,000, which includes engineering and construction contingency.

Sludge could be removed in the future when accumulations warrant.

**APPENDIX A**  
**Soil Test Results and Logs**

**October 28, 2015**  
**Test Holes**



November, 2015  
11/21/2015

ORIGINAL SHEET - ISO 8.5x11 H - v1.4.06



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Legend



TESTHOLE

Notes

IMAGE SOURCE:  
GOOGLE EARTH

Client/Project

MANITOBA WATER SERVICES BOARD  
ADAM LAKE LAGOON ASSESSMENT  
TURTLE MOUNTAIN PROVINCIAL PARK

Figure No.

1

Title

TESTHOLE LOCATION PLAN



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PROJECT: Adam Lake Lagoon Assessment

REPORT NO.: 1

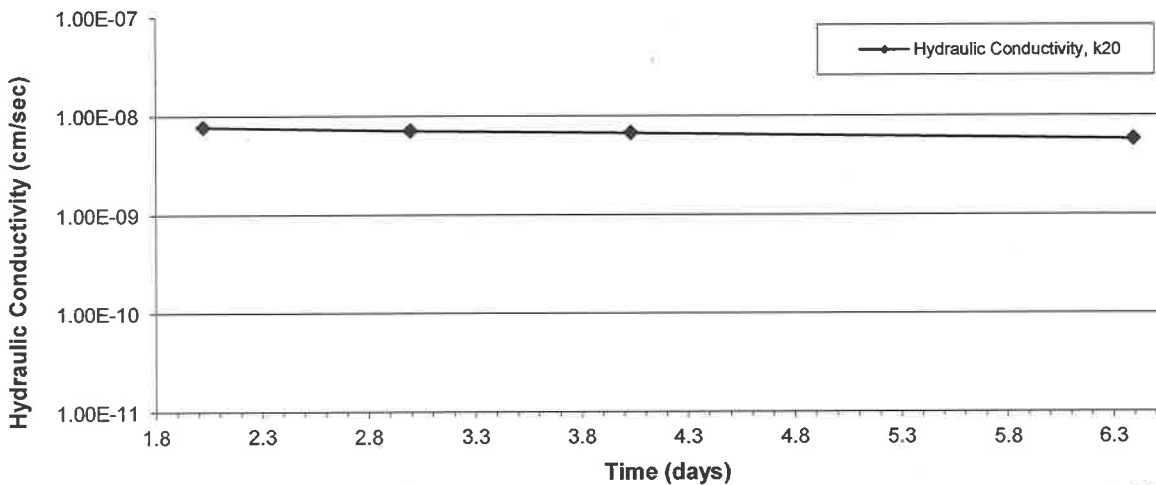
Attention: Tim Stratton

PROJECT NO.: 111217030

**SAMPLE FIELD I.D.:** TH4 @ 5' - 7.5'  
**SOIL DESCRIPTION:** Clay, brown, stiff, moist, high plasticity, trace silt

**DATE TESTED:** November 2 to November 13, 2015  
**CONFINING PRESSURE (kPa):** 102.0  
**EFFECTIVE SATURATION STRESS (kPa):** 34.5  
**ASSUMED SPECIFIC GRAVITY:** 2.71  
**HYDRAULIC GRADIENT:** 19.0  
**TYPE OF PERMEANT LIQUID:** De-aired Water  
**HYDRAULIC CONDUCTIVITY, "k" (cm/s):** 7.0E-09  
**HYDRAULIC CONDUCTIVITY, "k<sub>20</sub>" (cm/s):** 6.8E-09

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm <sup>3</sup> )	Water Content (%)	Saturation (%)
<b>Initial Reading</b>	77.2	72.7	590.1	1.327	38.5	100.3
<b>Final Reading</b>	78.0	73.2	597.2	1.309	39.1	99.0



REPORT DATE: November 16, 2015

REVIEWED BY:  Jason Thompson, C.E.T.

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PROJECT: Adam Lake Lagoon Assessment

REPORT NO.: 2

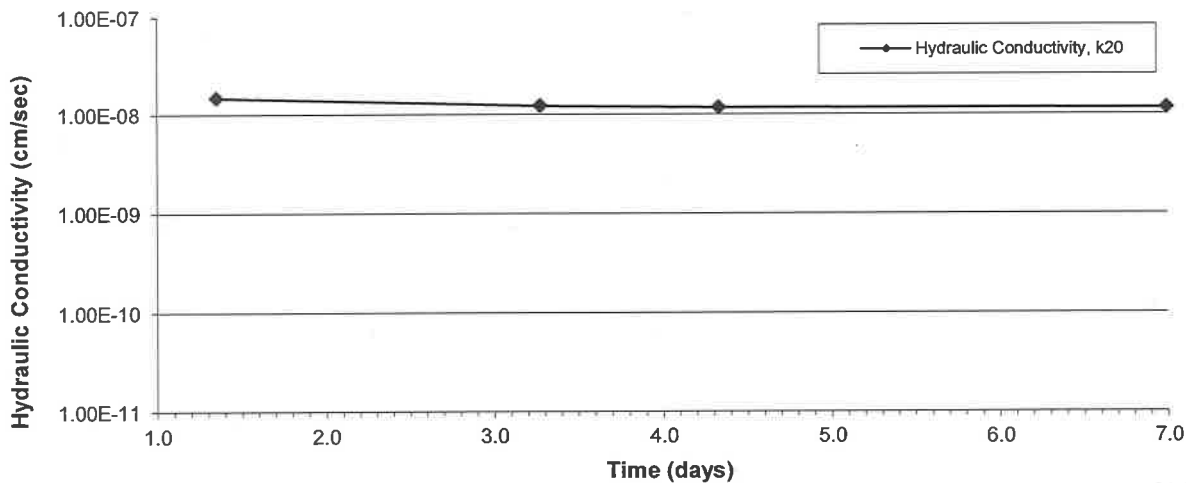
Attention: Tim Stratton

PROJECT NO.: 111217030

**SAMPLE FIELD I.D.:** TH12 @ 5' - 7.5'  
**SOIL DESCRIPTION:** Clay, brown, stiff, moist, high plasticity, trace silt inclusions

**DATE TESTED:** November 2 to November 13, 2015  
**CONFINING PRESSURE (kPa):** 102.0  
**EFFECTIVE SATURATION STRESS (kPa):** 34.5  
**ASSUMED SPECIFIC GRAVITY:** 2.71  
**HYDRAULIC GRADIENT:** 18.9  
**TYPE OF PERMEANT LIQUID:** De-aired Water  
**HYDRAULIC CONDUCTIVITY, "k" (cm/s):** 1.3E-08  
**HYDRAULIC CONDUCTIVITY, "k<sub>20</sub>" (cm/s):** 1.3E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm <sup>3</sup> )	Water Content (%)	Saturation (%)
<b>Initial Reading</b>	77.7	72.8	618.2	1.460	30.9	97.7
<b>Final Reading</b>	78.7	73.2	630.9	1.436	32.6	99.5



REPORT DATE: November 16, 2015

REVIEWED BY: Jason Thompson, C.E.T.

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199 Henlow Bay, Winnipeg MB R3Y 1G4

November 17, 2015  
File: 111217030

**Attention: Tim Stratton**  
Stantec  
500-311 Portage Avenue  
Winnipeg, Manitoba R3B 2B9

Dear Tim,

**Reference: Adam Lake Lagoon Assessment**

Soil samples were submitted to our laboratory on October 28, 2015. The following tests were conducted on selected soil samples:

- Water content (ASTM D2216)
- Particle-Size Analysis (ASTM D422)
- Liquid Limit (multi-point), plastic limit, and plasticity index (ASTM D4318)
- Hydraulic Conductivity (ASTM D5084)

We appreciate the opportunity to assist you in this project. Please call if you have any questions regarding this report.

Regards,

**STANTEC CONSULTING LTD.**

A handwritten signature in black ink, appearing to read "J. Thompson".

Jason Thompson, C.E.T.  
Senior Associate – Team Lead  
Manager, Materials Testing Services  
Phone: (204) 928-4004  
Fax: (204) 488-6947  
Jason.Thompson@stantec.com

Attachment: Table 1 - Water Content Test Data  
Table 2 – Particle Size Analysis and Atterberg Limits Test Data  
11 x Particle Size Analysis Reports  
9 x Atterberg Limits Reports  
2 x Hydraulic Conductivity Reports



November 13, 2015  
 Tim Stratton  
 Page 2 of 2

Reference: Adam Lake Lagoon Assessment

**TABLE 1  
 WATER CONTENT TEST DATA**

Testhole	Depth (ft.)	Water Content (%)
TH2	2.5	37.0
TH5	5	41.9
TH7	2.5	39.1
TH12	2.5	30.4
TH13	5	56.8

**TABLE 2  
 PARTICLE SIZE AND ATTERBERG LIMITS TEST DATA**

Testhole	Depth Range (ft.)	Particle Size Analysis							Atterberg Limits		
		Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.002 mm	Clay (%) <0.002 mm	Colloids (%) < 0.001 mm	Liquid Limit	Plastic Limit	Plasticity Index
			Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm						
TH2	2.5	0.3	0.0	0.1	1.3	37.9	60.4	53.7	79	25	54
TH5	5	0.0	0.1	0.8	3.3	33.2	62.6	55.3	NT	NT	NT
TH7	2.5	0.0	0.0	0.1	1.3	33.6	65.0	58.1	88	30	58
TH12	2.5	0.0	0.0	0.1	2.9	41.7	55.3	48.9	NT	NT	NT
TH13	5	0.0	0.0	0.5	2.7	41.0	55.8	49.7	NT	NT	NT

**Notes:**

1. A high speed stirring device was used for 1 minute to disperse the test sample for particle size analysis
2. The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis
3. NT\* sample not tested



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**PARTICLE SIZE ANALYSIS  
 ASTM D422**

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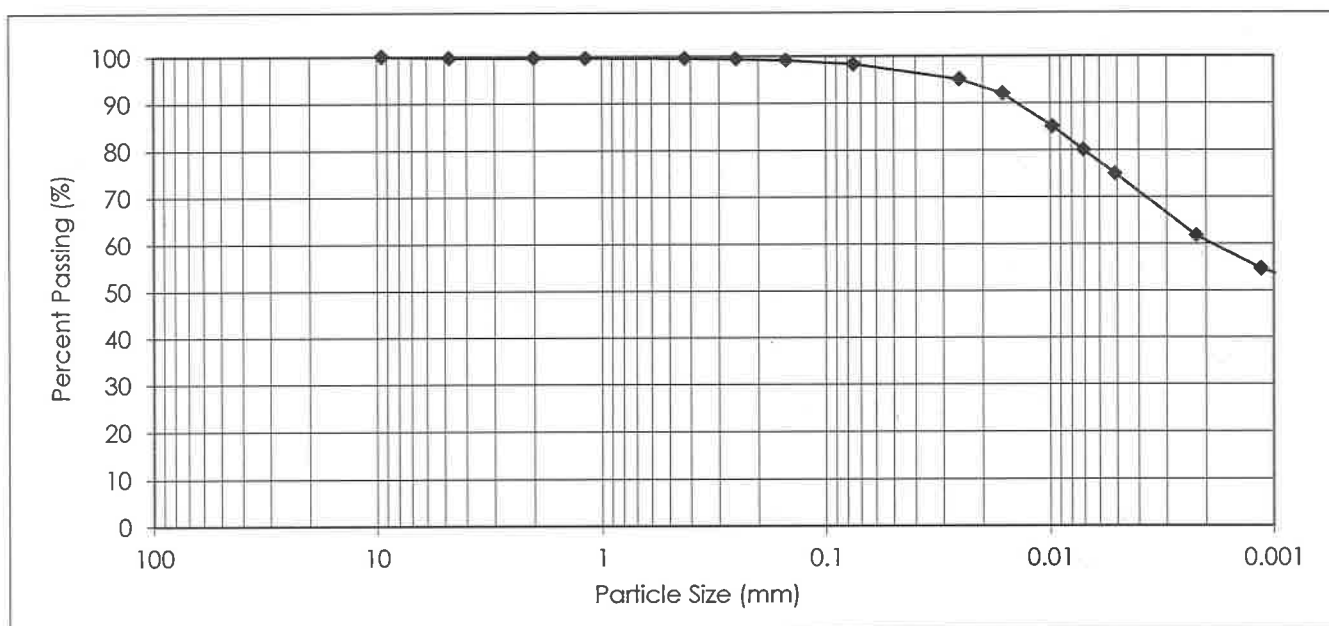
PROJECT: Adam Lake Lagoon Assessment

Attention: Tim Stratton

PROJECT NO.: 111217030

SAMPLED BY: Larry Presado, C.Tech.  
 SAMPLE ID: TH2 @ 2.5'

DATE RECEIVED: October 28, 2015  
 TESTED BY: Nestor Abarca



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	99.7
2.00 mm	99.7

PARTICLE SIZE	PERCENT PASSING
1.18 mm	99.6
0.425 mm	99.6
0.250 mm	99.4
0.150 mm	99.1
0.075 mm	98.3
0.005 mm	74.4
0.002 mm	60.4
0.001 mm	53.7

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.002 mm	Clay, % <0.002 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			
0.3	0.0	0.1	1.3	37.9	60.4	53.7

REPORT DATE: November 6, 2015



REVIEWED BY: *Jason Thompson*, C.E.T.

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**PARTICLE SIZE ANALYSIS  
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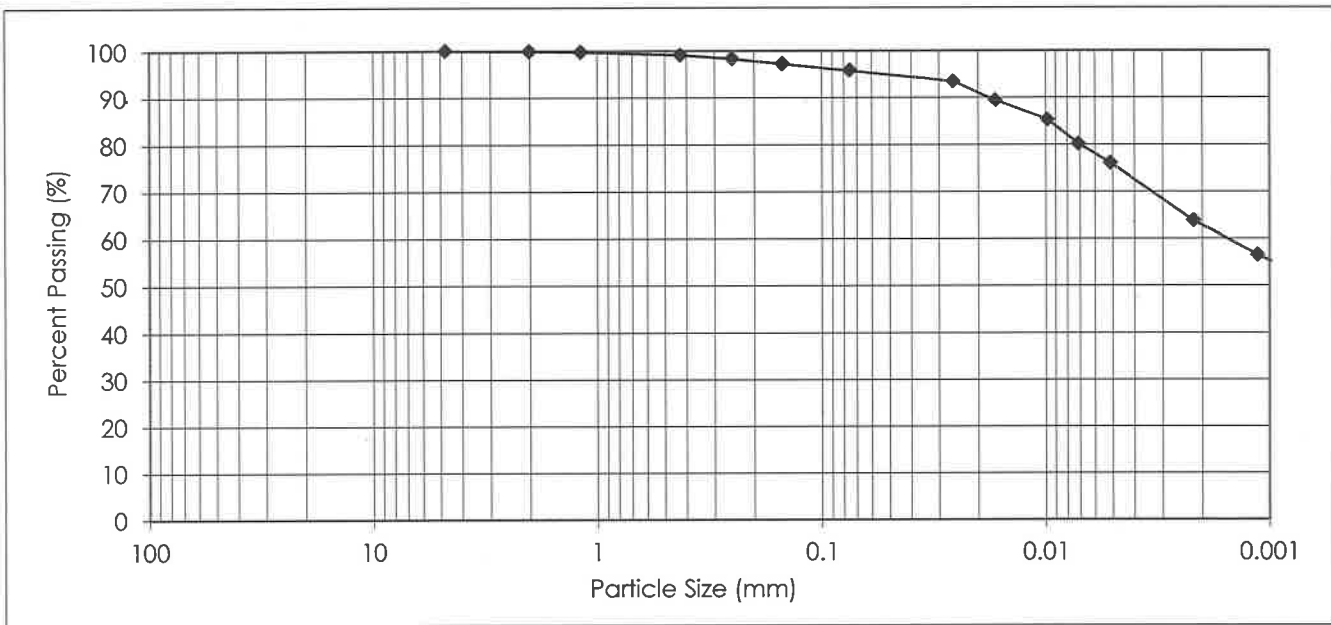
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Attention: Tim Stratton

PROJECT NO.: 111217030

SAMPLED BY: Larry Presado, C.Tech.  
 SAMPLE ID: TH5 @ 5'

DATE RECEIVED: October 28, 2015  
 TESTED BY: Nestor Abarca



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	99.8
0.425 mm	99.1
0.250 mm	98.3
0.150 mm	97.2
0.075 mm	95.8
0.005 mm	75.6
0.002 mm	62.6
0.001 mm	55.3

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.002 mm	Clay, % <0.002 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	0.8	3.3	33.2	62.6	55.3

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**PARTICLE SIZE ANALYSIS  
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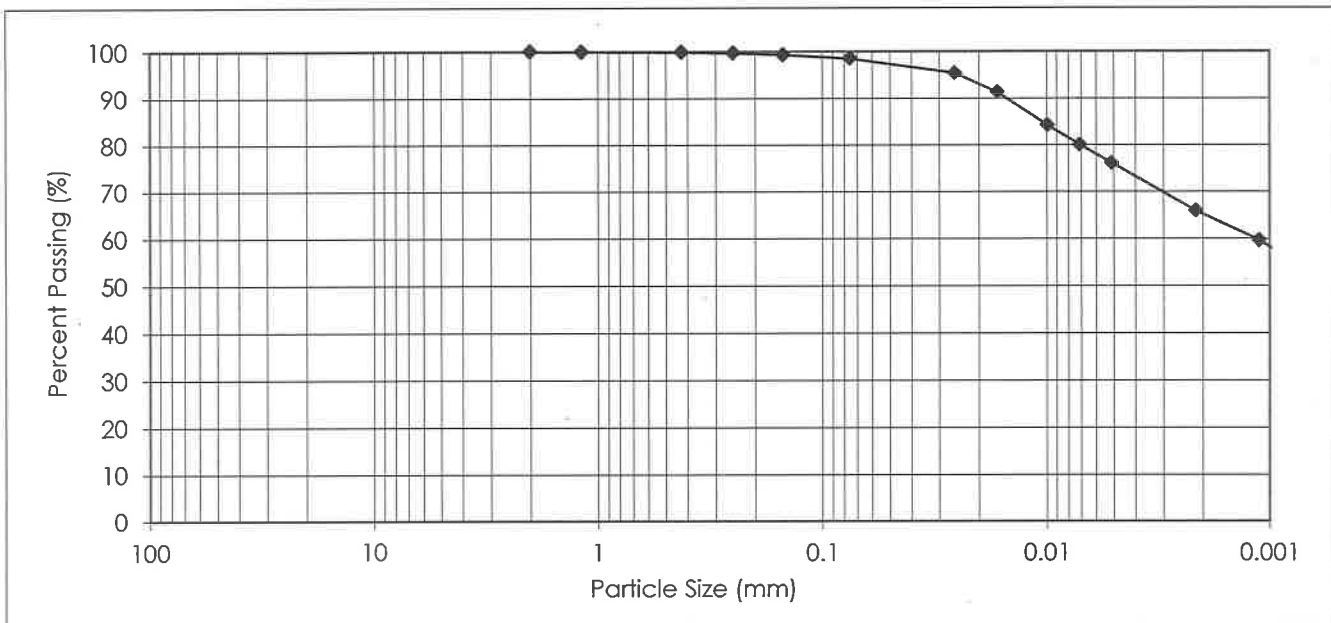
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Attention: Tim Stratton

PROJECT NO.: 111217030

SAMPLED BY: Larry Presado, C.Tech.  
 SAMPLE ID: TH7 @ 2.5'

DATE RECEIVED: October 28, 2015  
 TESTED BY: Nestor Abarca



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	99.7
0.150 mm	99.3
0.075 mm	98.6
0.005 mm	75.7
0.002 mm	65.0
0.001 mm	58.1

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.002 mm	Clay, % <0.002 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	1.3	33.6	65.0	58.1

REPORT DATE: November 6, 2015



REVIEWED BY: *Jason Thompson*  
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**PARTICLE SIZE ANALYSIS  
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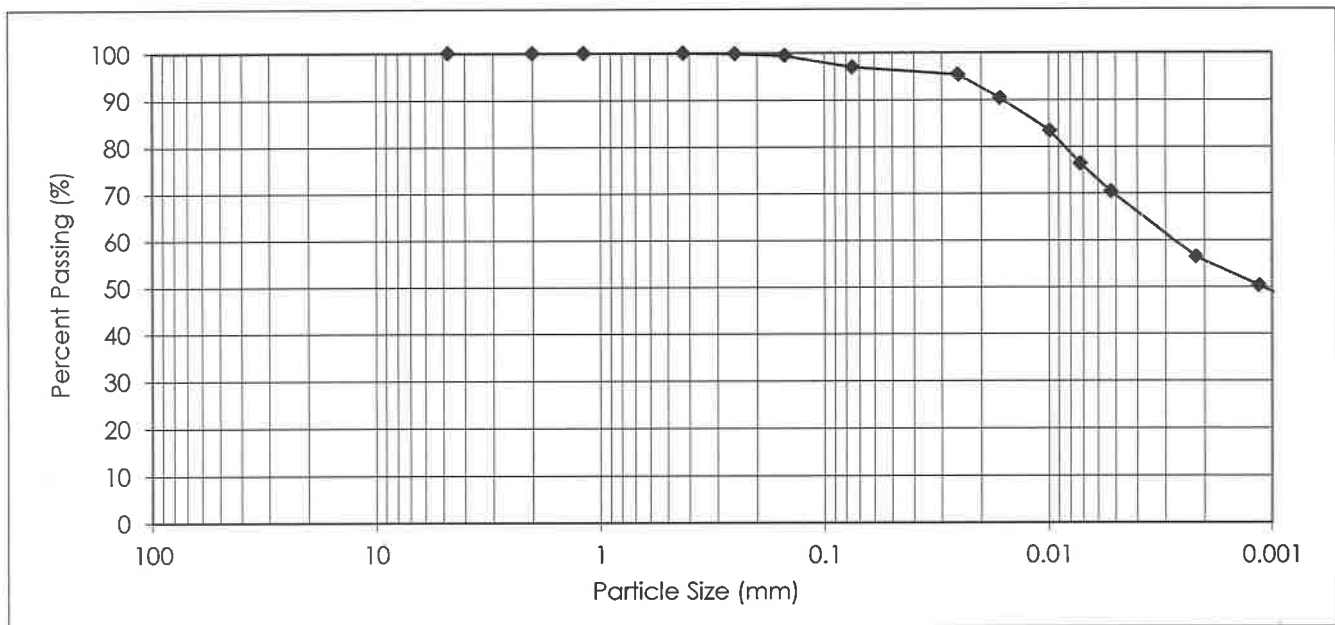
PROJECT: Adam Lake Lagoon Assessment

Attention: Tim Stratton

PROJECT NO.: 111217030

SAMPLED BY: Larry Presado, C.Tech.  
 SAMPLE ID: TH12@2.5'

DATE RECEIVED: October 28, 2015  
 TESTED BY: Nestor Abarca



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	99.8
0.150 mm	99.4
0.075 mm	97.0
0.005 mm	69.3
0.002 mm	55.3
0.001 mm	48.9

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.002 mm	Clay, % <0.002 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	2.9	41.7	55.3	48.9

REPORT DATE: November 6, 2015



REVIEWED BY: *Jason Thompson*  
 Jason Thompson, C.E.T.

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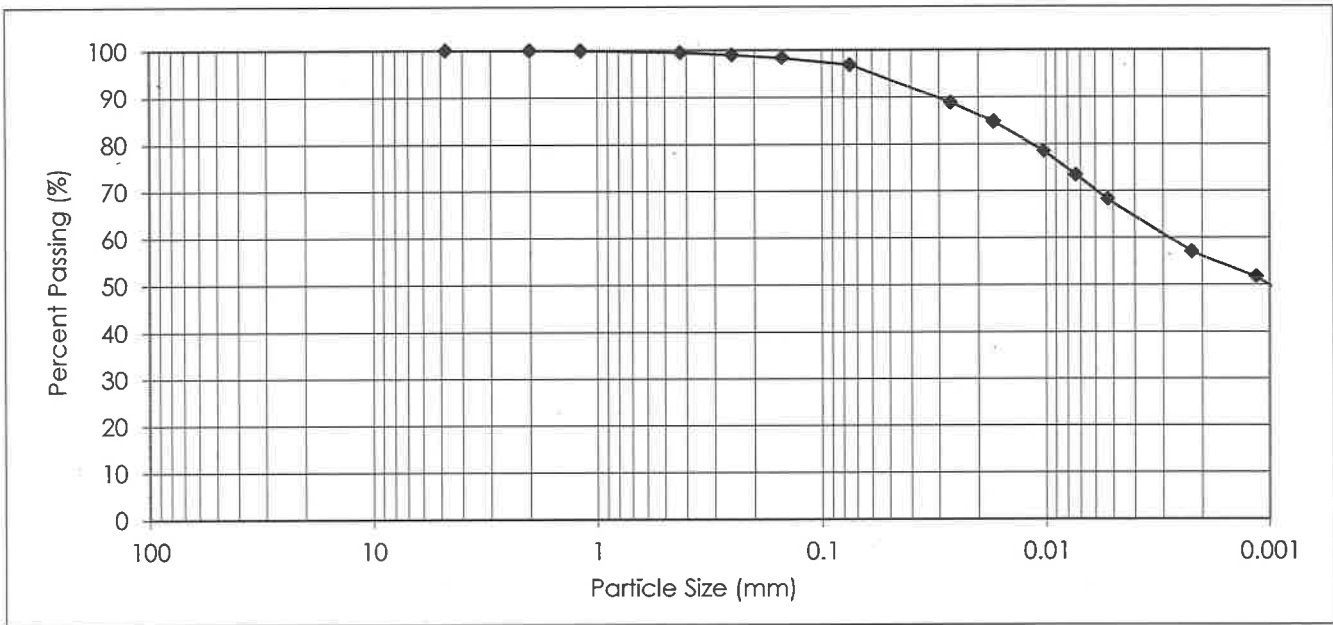
PROJECT: Adam Lake Lagoon Assessment

Attention: Tim Stratton

PROJECT NO.: 111217030

SAMPLED BY: Larry Presado, C.Tech.  
 SAMPLE ID: TH13 @ 5'

DATE RECEIVED: October 28, 2015  
 TESTED BY: Nestor Abarca



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		99.5	
19.00 mm		100.0		0.250 mm		99.0	
16.00 mm		100.0		0.150 mm		98.3	
12.50 mm		100.0		0.075 mm		96.8	
9.50 mm		100.0		0.005 mm		67.1	
4.75 mm		100.0		0.002 mm		55.8	
2.00 mm		100.0		0.001 mm		49.7	
Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.002 mm	Clay, % <0.002 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	0.5	2.7	41.0	55.8	49.7	

REPORT DATE: November 6, 2015



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.



**Afterberg Limits**  
 ASTM D4318  
 Method A - Multi-Point

Client: MWSB and Parks  
 Project Name: Adam Lake Lagoon Assessment  
 Project No: 111217030  
 Date Received: October 28, 2015  
 Date Tested: November 4, 2015  
 Tested By: Nestor Abarca

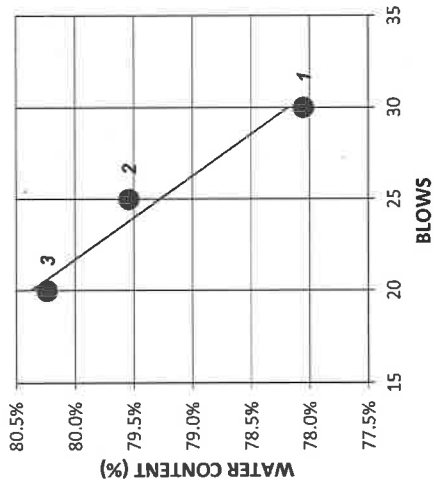
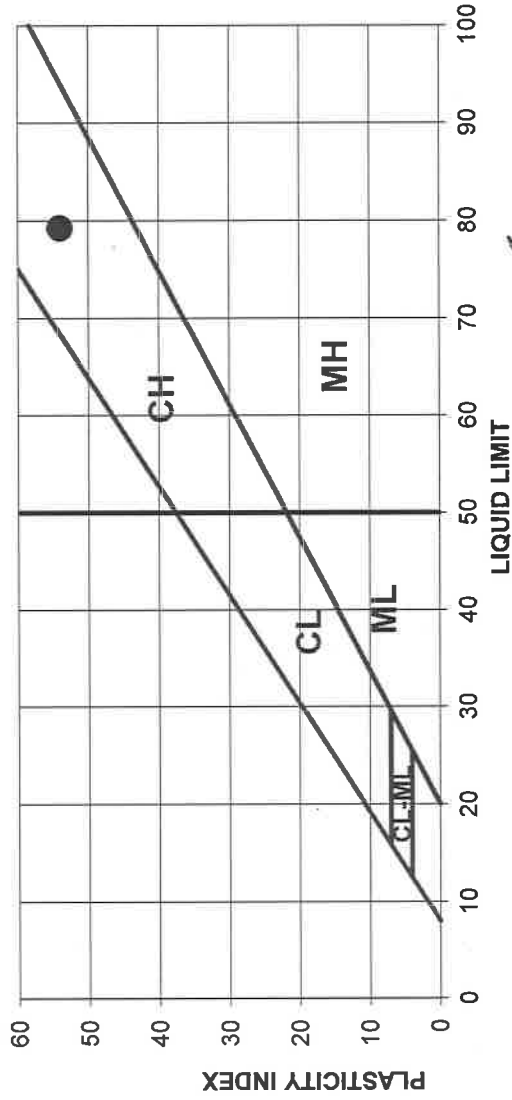
**LABORATORY**  
 199 Henlow Bay  
 Winnipeg, Manitoba  
 Canada R3Y 1G4

Tel: (204) 488-6999

Sample: TH2 @ 2.5'

Trial	LIQUID LIMIT			PLASTIC LIMIT		
	1	2	3	1	2	3
No. of Blows	30	25	20	297	318	318
Tare No.	249	277	287	34.16	33.11	33.11
Wt. Sa. (wet+tare) (g)	39	38	39	31.47	30.6	30.6
Wt. Sa. (dry+tare) (g)	31	31	31	20.91	20.64	20.64
Wt. Tare (g)	20	21	21	10.6	10.0	10.0
Wt. Dry Soil (g)	10.6	9.6	10.1	2.7	2.5	2.5
Wt. Water (g)	8.3	7.6	8.1	25.5%	25.2%	25.2%
Water Content (%)	78.1%	79.5%	80.2%			

RESULTS	
LL	79
PL	25
PI	54



Reviewed By: Jason Thompson, C.E.T.

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**Atterberg Limits**  
 ASTM D4318  
 Method A- Multi-Point

Client: MWSB and Parks  
 Project Name: Adam Lake Lagoon Assessment  
 Project No: 111217030  
 Date Received: October 28, 2015  
 Date Tested: November 4, 2015  
 Tested By: Larry Presado, C. Tech.

**LABORATORY**  
 199 Hentlow Bay  
 Winnipeg, Manitoba  
 Canada R3Y 1G4

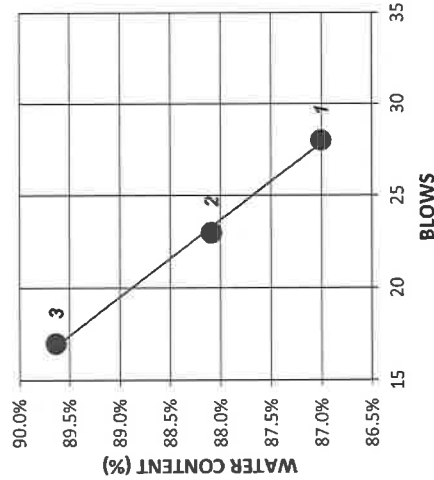
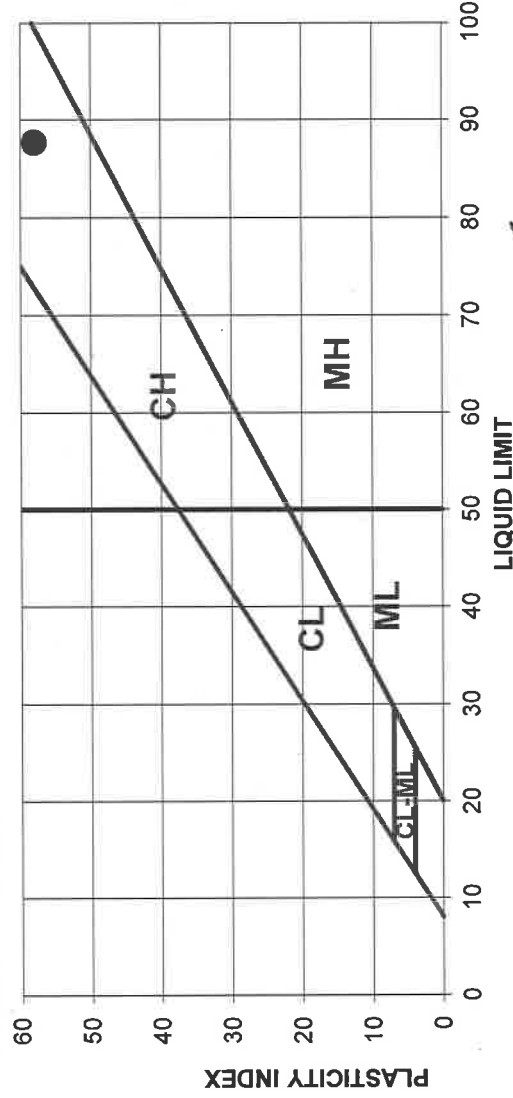
Tel: (204) 488-6999

Sample: TH7 @ 2.5'

**LIQUID LIMIT**

Trial	LIQUID LIMIT			PLASTIC LIMIT		
	1	2	3	1	2	3
No. of Blows	28	23	17			
Tare No.	283	314	308	268	267	267
Wt. Sa. (wet+tare)(g)	39	38	37	32.86	29.23	29.23
Wt. Sa. (dry+tare)(g)	30	30	29	30.08	27.25	27.25
Wt. Tare (g)	21	21	21	20.97	20.74	20.74
Wt. Dry Soil (g)	9.6	9.3	8.5	9.1	6.5	6.5
Wt. Water (g)	8.4	8.2	7.6	2.8	2.0	2.0
Water Content (%)	87.0%	88.1%	89.6%	30.5%	30.4%	30.4%

RESULTS	
LL	88
PL	30
PI	58



Reviewed By: Jason Thompson, C.E.T.

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# TH02 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433314.307  
 LOCATION Turtle Mountain Provincial Park ELEVATION 690.964 m EASTING 421929.434  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input checked="" type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		TOPSOIL								0	
			Stiff brown fat CLAY (CH) with trace silt		X	GS						
			Particle Size Analysis at 0.8 m: 0.3% GRAVEL, 1.4% SAND, 37.9% SILT, 60.4% CLAY		X	GS	37					
			- trace gravel									
			- trace fine to coarse sand									
			- silty									
		CH			X	GS						
2						ST						
					X	GS						
3					X	GS						
			<ul style="list-style-type: none"> <li>• Minor groundwater seepage was observed at a depth of 1.8 m.</li> <li>• No soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>									

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH03 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433311.75  
 LOCATION Turtle Mountain Provincial Park ELEVATION 691.343 m EASTING 421898.945  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			Moisture Content & Atterberg Limits				DEPTH (ft)	
				TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa		
0	TP		TOPSOIL Stiff brown fat CLAY (CH) with trace silt								0	
			- grey below 0.8 m - trace gravel - trace fine to coarse sand - silty	X	GS						2	
1				X	GS						4	
	CH		- brown below 1.5 m	X	GS						6	
2				X	GS						8	
3				X	GS						10	
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>									12

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH04 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433371.153  
 LOCATION Turtle Mountain Provincial Park ELEVATION 690.897 m EASTING 421944.562  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		TOPSOIL									0
			Stiff brown fat CLAY (CH) with trace silt		X	GS						
			- silty below 0.8 m		X	GS						
1												
	CH		- trace coarse sand below 1.5 m		X	GS						
2			- some fine to coarse sand below 2.0 m									
			- trace fine gravel below 2.4 m		X	GS						
3					X	GS						
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>									

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH05 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433254.651  
 LOCATION Turtle Mountain Provincial Park ELEVATION 691.519 m EASTING 421913.568  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	In situ Shear Vane (kPa)	Torvane on Samples (kPa)	Pocket Penetrometer (kPa)	Standard Penetration Test, blows/0.3m	
0	TP		TOPSOIL Stiff brown fat CLAY (CH) with trace silt								0
				X	GS						2
				X	GS						4
1											6
	CH		Particle Size Analysis at 1.5 m: 0.0% GRAVEL, 4.2% SAND, 33.2% SILT, 62.6% CLAY - trace fine to coarse sand - silty	X	GS	42					8
2				X	GS						10
3				X	GS						12

• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.  
 • Testhole terminated at a depth of 3.0 m.

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH06 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433218.801  
 LOCATION Turtle Mountain Provincial Park ELEVATION 692.915 m EASTING 421966.678  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)							
				TYPE	NUMBER	MOISTURE CONTENT (%)	□ Insitu Shear Vane (kPa)	■ Torvane on Samples (kPa)	△ Pocket Penetrometer (kPa)	● Standard Penetration Test, blows/0.3m								
								50kPa	100kPa	150kPa	200kPa							
								W <sub>p</sub>	W	W <sub>L</sub>	Moisture Content & Atterberg Limits							
									○									
								10	20	30	40	50	60	70	80	90		
0	TP	TP	<b>TOPSOIL</b> - Firm black fat CLAY (CH) with trace silt - brown below 0.3 m	X	GS													0
1			- trace fine to coarse sand below 0.8 m - silty	X	GS													4
2		CH		X	GS													6
3				X	GS													10
			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.													12		

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type: ■ Bentonite ☒ Drill Cuttings □ Sand ☒ Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH07 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433213.889  
 LOCATION Turtle Mountain Provincial Park ELEVATION 692.751 m EASTING 421944.603  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	□ Insitu Shear Vane (kPa)	■ Torvane on Samples (kPa)	△ Pocket Penetrometer (kPa)	○	
0	TP		<b>TOPSOIL</b> Firm black fat CLAY (CH) with trace silt								0
			- brown, some fine to coarse sand below 0.6 m								2
			Particle Size Analysis at 0.8 m: 0.0% GRAVEL, 1.4% SAND, 33.6% SILT, 65.0% CLAY - silty								4
1				X	GS	39					6
		CH		X	GS						8
2					ST						10
				X	GS						12
3				X	GS						12
			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.								

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton





# TH08 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433212.1  
 LOCATION Turtle Mountain Provincial Park ELEVATION 691.823 m EASTING 421919.307  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP	TP	<b>TOPSOIL</b> Firm to stiff black fat CLAY (CH) with trace silt									0
			- trace fine to coarse sand below 0.8 m		X	GS						2
			- silty		X	GS						4
			- brown below 1.2 m									6
	CH	CH			X	GS						8
			- some fine to coarse sand below 2.1 m		X	GS						10
3			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.		X	GS						12

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH09 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433173.121  
 LOCATION Turtle Mountain Provincial Park ELEVATION 690.780 m EASTING 421917.911  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	Insitu Shear Vane (kPa)	Torvane on Samples (kPa)	Pocket Penetrometer (kPa)	Moisture Content & Atterberg Limits	
0	TP	CH	<b>TOPSOIL</b> Firm black fat CLAY (CH) with trace silt  - soft below 0.6 m - brown, silty below 0.8 m - trace fine to coarse sand	X	GS						0
1				X	GS						4
2				X	GS						8
3			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.	X	GS						12

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH10 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433172.532  
 LOCATION Turtle Mountain Provincial Park ELEVATION 692.865 m EASTING 421952.464  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP	VT	<b>TOPSOIL</b> Firm to stiff black fat CLAY (CH) with trace silt									0
			- brown, silty below 0.8 m		X	GS						2
			- trace fine to coarse sand		X	GS						4
1												6
		CH			X	GS						8
2												10
					X	GS						12
3												
			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.									

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH11 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433185.877  
 LOCATION Turtle Mountain Provincial Park ELEVATION 693.586 m EASTING 421973.223  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)
				TYPE	NUMBER	MOISTURE CONTENT (%)	Insitu Shear Vane (kPa)	Torvane on Samples (kPa)	Pocket Penetrometer (kPa)	Moisture Content & Atterberg Limits	
0	TP		TOPSOIL								0
			Firm brown fat CLAY (CH) with trace silt								
			- silty below 0.8 m	X	GS						2
			- trace fine to coarse sand	X	GS						4
1											6
	CH			X	GS						8
2											10
				X	GS						12
3				X	GS						12
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>								

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH12 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433137.433  
 LOCATION Turtle Mountain Provincial Park ELEVATION 694.149 m EASTING 421981.219  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		<b>TOPSOIL</b> Firm to stiff brown fat CLAY (CH) with trace silt									0
			Particle Size Analysis at 0.8 m: 0.0% GRAVEL, 3.0% SAND, 41.7% SILT, 55.3% CLAY - trace fine to coarse sand - silty		X GS	30						2
1					X GS							4
2	CH				X GS							6
					X GS							8
3					X GS							10
			• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole terminated at a depth of 3.0 m.									12

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH13 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433143.304  
 LOCATION Turtle Mountain Provincial Park ELEVATION 693.112 m EASTING 421922.143  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES					DEPTH (ft)	
				TYPE	NUMBER	MOISTURE CONTENT (%)	□ Insitu Shear Vane (kPa)	■ Torvane on Samples (kPa)	△ Pocket Penetrometer (kPa)	50kPa	100kPa		150kPa
0	TP		<b>TOPSOIL</b> Firm black fat CLAY (CH) with trace silt										0
			- trace wood chips below 0.8 m										
			- brown below 0.9 m										
1													2
													4
	CH		Particle Size Analysis at 1.5 m: 0.0% GRAVEL, 3.2% SAND, 41.0% SILT, 55.8% CLAY - trace fine to coarse sand - silty	X	GS	57							6
2													8
													10
3													12
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>										

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH14 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433267.533  
 LOCATION Turtle Mountain Provincial Park ELEVATION 693.222 m EASTING 421986.337  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA	SAMPLES			<input type="checkbox"/> Insitu Shear Vane (kPa) <input type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa)				DEPTH (ft)
					TYPE	NUMBER	MOISTURE CONTENT (%)	50kPa	100kPa	150kPa	200kPa	
0	TP		TOPSOIL									0
			Firm black fat CLAY (CH) with trace silt									
			- brown, trace to some silt below 0.5 m		X	GS						2
			- trace fine to coarse sand below 0.8 m		X	GS						4
			- silty		X	GS						6
1		CH			X	GS						8
2					X	GS						10
3					X	GS						12
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>									

Sample Type: GS - Grab Sample    SPT - Standard Penetration Test  
 ST - Shelby Tube    PT - Piston Tube    VT - Shear Vane Test  
 Piezometer Backfill Type:  Bentonite     Drill Cuttings     Sand     Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton



# TH15 TESTHOLE RECORD

CLIENT Manitoba Water Services Board PROJECT No. 111217030  
 PROJECT Adam Lake Lagoon Assessment DATUM NAD83 NORTHING 5433298.108  
 LOCATION Turtle Mountain Provincial Park ELEVATION 693.106 m EASTING 421992.692  
 DRILLING DATE October 28, 2015 DRILLING CO. Paddock Drilling Ltd DRILLING METHOD 125 mm SSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA			SAMPLES				DEPTH (ft)	
				TYPE	NUMBER	MOISTURE CONTENT (%)	□ Insitu Shear Vane (kPa)	■ Torvane on Samples (kPa)	△ Pocket Penetrometer (kPa)	50kPa		100kPa
0	TP		TOPSOIL									0
			Firm black fat CLAY (CH) with trace silt									
			- brown below 0.3 m	X	GS							
			- some fine to coarse sand below 0.5 m									
			- silty below 0.8 m	X	GS							
1												4
	CH			X	GS							6
2												8
				X	GS							
3				X	GS							10
			<ul style="list-style-type: none"> <li>• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.</li> <li>• Testhole terminated at a depth of 3.0 m.</li> </ul>									
												12

Sample Type: GS - Grab Sample SPT - Standard Penetration Test  
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test  
 Piezometer Backfill Type: ■ Bentonite ⊗ Drill Cuttings □ Sand ⊠ Slough

Logged by: Larry Presado  
 Reviewed by: Tim Stratton

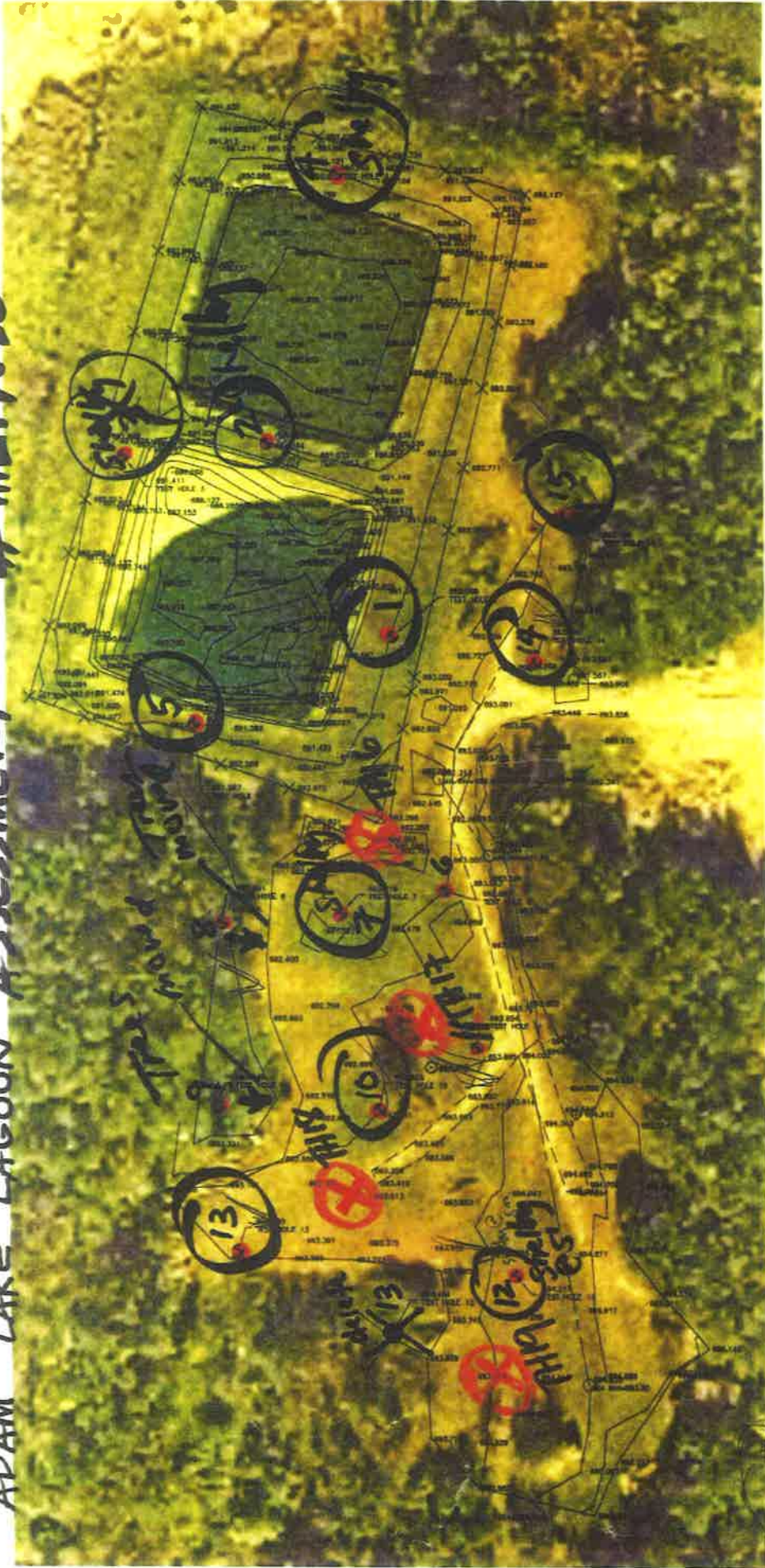




**December 14, 2015**  
**Test Holes**

# N1217030

ADAM LAKE LAGOON ASSESSMENT



Additional TH16, TH17, TH18 & TH19  
Drilled: Dec. 14, 2015

## Stratton, Tim

---

**From:** Presado, Larry  
**Sent:** Tuesday, December 15, 2015 11:00 AM  
**To:** Stratton, Tim  
**Cc:** Leal, German; Thompson, Jason; Ransom, Brett  
**Subject:** RE: Adam Lake Lagoon Assessment - Project No. 111217030  
**Attachments:** record\_soil\_profile\_dec\_14\_lp.pdf; addtl\_testholes\_lp\_dec\_14\_lp.pdf

Hi Tim,

Please find attached test holes location plan and record of soil profile of test holes drilled in Adam Lake Lagoon, Turtle Mountain Provincial Park on December 14, 2015.

- Test holes identification as TH16 to TH19 with GPS coordinates. Since we had test holes marked as TH1 to TH15 from the previous drilling done in October 28.
- Secured grabbed soil samples from each test holes in case we need them for moisture contents and other lab testing.
- No soil sloughing and groundwater observed during and upon completion of drilling with Paddock Drilling.
- Test holes were terminated to a depth of 6 meter (20 feet) as instructed.

File located here: [V:\1233\active\111217030\field\\_data\record\\_soil\\_profile\\_dec\\_14\\_lp.pdf](V:\1233\active\111217030\field_data\record_soil_profile_dec_14_lp.pdf) ;  
[V:\1233\active\111217030\drawing\addtl\\_testholes\\_lp\\_dec\\_14\\_lp.pdf](V:\1233\active\111217030\drawing\addtl_testholes_lp_dec_14_lp.pdf)

Please let me know if you have any questions.

Thank you,

**Larry Presado, C.Tech.**

Geotechnical Technologist

Stantec

199 Henlow Bay Winnipeg MB R3Y 1G4

Phone: 204-488-6999

Cell: 204-470-7264

Fax: 204-488-6947

[larry.presado@stantec.com](mailto:larry.presado@stantec.com)



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Please consider the environment before printing this email.

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**From:** Stratton, Tim  
**Sent:** Tuesday, December 08, 2015 4:05 PM  
**To:** Leal, German; Presado, Larry  
**Subject:** FW: Rivers Lagoon Analysis

FYI

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**From:** Lockie, James (CWS) [<mailto:James.Lockie@gov.mb.ca>]  
**Sent:** Tuesday, December 08, 2015 3:52 PM  
**To:** Stratton, Tim  
**Subject:** RE: Rivers Lagoon Analysis

Thanks for letting me know, shouldn't be a problem.

# RECORD OF SOIL PROFILE

TH No.: TA16      Logged by: Larry Presado      Drill Date: December 14, 2015  
 Client: STANTEC      Project: Adam Lake Lagoon Assessment      Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_  
 Drill Contractor: Paddock Drilling      Drill Rig: RM30      Drilling Method: 125 mm Ø Solid Stem Auger  
 Location: Turtle Mountain Provincial Park      GPS Coordinates: 421956 <sup>144</sup> E, 5433225 N, Elevation: \_\_\_\_\_ m Sheet 1 of 1

Typical Soil Classifications: Clay / Clay Fill / Silt / Sand / Gravel / Glacial Till / Granular Base or Fill / Topsoil / Peat or Organics / Bedrock

Colour	Consistency	Compactness	Water Content	Plasticity	Particle Size	Quantity
Black Grey Brown Tan	<b>Torvane</b> Hard >200 kPa Very Stiff 100-200 kPa Stiff 50-100 kPa Firm 25-50 kPa Soft 12-25 kPa Very Soft <12 kPa	<b>SPT</b> Very loose 0-4 Loose 4-10 Compact 10-30 Dense 30-50 Very Dense >50	Dry Moist Saturated	Non Plastic (NP) Low Plasticity (LP) Int. Plasticity (IP) High Plasticity (HP)	Fine Sand 0.075 - 0.425 mm Medium Sand 0.425 - 2.0 mm Coarse Sand 2.0 - 4.75 mm Fine Gravel 4.75 - 19 mm Coarse Gravel 19 - 75 mm Cobbles 75 - 300 mm Boulders >300 mm	Trace 0-10% Some 10-20% Adjective 20-35% (silty/clayey/sandy) And 35-50%

Depth		Soil Type	Soil Description	Soil Samples		Field Tests			
from	to			Type	Depth		Test	Depth	Test Result
					from	to			
0	4"	Topsoil	black	TC		1			
4"	1.5'	Clay	black, firm to stiff, moist high plasticity	"		2.5'			
				"		5'			
1.5'	14'	Silty Clay	brown, firm, moist, med. to high plasticity	"		7.5'			
			some fine to coarse-grained sand below 7.5'	"		10'			
			stiff below 7.5'	"		15'			
				"		20'			
14'	20'	Clay	brown, firm, moist, high plasticity trace fine sand some silt						

<b>Soil Sloughing</b> <input checked="" type="radio"/> None • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____	<b>Groundwater Seepage</b> <input checked="" type="radio"/> None <input type="radio"/> Minor <input type="radio"/> Moderate <input type="radio"/> Heavy Depth of Seepage: _____ Final Groundwater depth: _____	<b>Auger Refusal</b> <input type="checkbox"/> Bedrock <input type="checkbox"/> Dense Till <input type="checkbox"/> Boulders <input type="checkbox"/> Other Refusal Depth: <u>20'</u> <u>Terminated</u>	<b>Sample Types</b> AC - Auger Cutting ST - Shelby Tube SS - Split Spoon C - Core JS - Water Sample for Sulphate Content	<b>Field Tests</b> SPT - Standard Penetration Test PP - Pocket Penetrometer TV - Torvane Note: record correction factor for torvane tests Note: if sloughing, use hollow stems
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Comments: Backfilled with auger cuttings & bentonite chips bottom & top of testhole

# RECORD OF SOIL PROFILE

TH No.: TH17      Logged by: Larry Presado      Drill Date: December 14, 2015  
 Client: STANTEC      Project: Adam Lake Lagoon Assessment      Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_  
 Drill Contractor: Paddock Drilling      Drill Rig: RM30      Drilling Method: 125 mm Ø Solid Stem Auger  
 Location: Turtle Mountain Provincial Park      GPS Coordinates: N41 42 19.73 E. 54 38 18.84 N, Elevation: — m Sheet 1 of 1

Typical Soil Classifications: Clay / Clay Fill / Silt / Sand / Gravel / Glacial Till / Granular Base or Fill / Topsoil / Peat or Organics / Bedrock

Colour	Consistency	Compactness	Water Content	Plasticity	Particle Size	Quantity
Black Grey Brown Tan	Torvane Hard >200 kPa Very Stiff 100-200 kPa Stiff 50-100 kPa Firm 25-50 kPa Soft 12-25 kPa Very Soft <12 kPa	SPT Very loose 0-4 Loose 4-10 Compact 10-30 Dense 30-50 Very Dense >50	Dry Moist Saturated	Non Plastic (NP) Low Plasticity (LP) Int. Plasticity (IP) High Plasticity (HP)	Fine Sand 0.075 - 0.425 mm Medium Sand 0.425 - 2.0 mm Coarse Sand 2.0 - 4.75 mm Fine Gravel 4.75 - 19 mm Coarse Gravel 19 - 75 mm Cobbles 75 - 300 mm Boulders >300 mm	Trace 0-10% Some 10-20% Adjective 20-35% (silty/clayey/sandy) And 35-50%

Depth		Soil Type	Soil Description	Soil Samples		Field Tests			
from	to			Type	Depth		Test	Depth	Test Result
					from	to			
0	6"	Topsoil	black	AC		1			
6"	2.5'	Clay	brown/black, stiff, moist high plasticity	"		2.5'			
				"		5'			
2.5'	12.5'	Silty Clay	brown, firm, moist, med. to high plasticity	"		7.5'			
				"		10'			
			stiff below 10", trace sand	"		12.5'			
12.5'	20'	Clay	brown, firm, moist, high plasticity	"		15'			
				"		20'			

**Soil Sloughing**

None  
 • Yes → Source (soil type): \_\_\_\_\_  
           → Source (depth): \_\_\_\_\_  
 • Yes → Source (soil type): \_\_\_\_\_  
           → Source (depth): \_\_\_\_\_  
 • Yes → Source (soil type): \_\_\_\_\_  
           → Source (depth): \_\_\_\_\_

**Groundwater Seepage**

None  
 Minor  
 Moderate  
 Heavy  
 Depth of Seepage: \_\_\_\_\_  
 Final Groundwater depth: \_\_\_\_\_

**Auger Refusal**

Bedrock  
 Dense Till  
 Boulders  
 Other  
 Refusal Depth: 20'  
Terminated

**Sample Types**

AC - Auger Cutting  
 ST - Shelby Tube  
 SS - Split Spoon  
 C - Core  
 JS - Water Sample for Sulphate Content

**Field Tests**

SPT - Standard Penetration Test  
 PP - Pocket Penetrometer  
 TV - Torvane  
 Note: record correction factor for torvane tests  
 Note: If sloughing, use hollow stems

Comments: Backfilled with auger cuttings & bentonite chips bottom & top of testhole.

# RECORD OF SOIL PROFILE



TH No.: TH18      Logged by: Larry Plesada      Drill Date: December 14, 2015  
 Client: STANTEC      Project: Adam Lake Lagoon Assessment      Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_  
 Drill Contractor: Paddock Drilling      Drill Rig: RM30      Drilling Method: 125 mm Ø Solid SPM Auger  
 Location: Turtle Mountain Provincial Park      GPS Coordinates: 421935 E, 5433153 N, Elevation: — m Sheet 1 of 1

Typical Soil Classifications: Clay / Clay Fill / Silt / Sand / Gravel / Glacial Till / Granular Base or Fill / Topsoil / Peat or Organics / Bedrock

Colour	Consistency	Compactness	Water Content	Plasticity	Particle Size	Quantity
Black Grey Brown Tan	<b>Torvane</b> Hard >200 kPa Very Stiff 100-200 kPa Stiff 50-100 kPa Firm 25-50 kPa Soft 12-25 kPa Very Soft <12 kPa	SPT Very loose 0-4 Loose 4-10 Compact 10-30 Dense 30-50 Very Dense >50	Dry Moist Saturated	Non Plastic (NP) Low Plasticity (LP) Int. Plasticity (IP) High Plasticity (HP)	Fine Sand 0.075 - 0.425 mm Medium Sand 0.425 - 2.0 mm Coarse Sand 2.0 - 4.75 mm Fine Gravel 4.75 - 19 mm Coarse Gravel 19 - 75 mm Cobbles 75 - 300 mm Boulders >300 mm	Trace 0-10% Some 10-20% Adjective 20-35% (silty/clayey/sandy) And 35-50%

Depth		Soil Type	Soil Description	Soil Samples		Field Tests			
from	to			Type	Depth		Test	Depth	Test Result
					from	to			
0	8"	Topsoil	black	AC		1			
8"	6'	<del>Silt</del> clay	black, stiff, moist, med. high plasticity	"		2.5'			
			brown below 5'	"		5'			
			Silty	"		7.5'			
	10.5'			"		10'			
6'	10.5'	Silty clay	brown, firm, moist, med. to high plasticity. trace fine sand.	"		12.5'			
				"		15'			
				"		20'			
10.5'	20'	clay	brown, stiff, moist high plasticity greyish (streaks) below 15'						
			trace silt						

<b>Soil Sloughing</b> <input checked="" type="radio"/> None • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____	<b>Groundwater Seepage</b> <input checked="" type="radio"/> None <input type="radio"/> Minor <input type="radio"/> Moderate <input type="radio"/> Heavy Depth of Seepage: _____ Final Groundwater depth: _____	<b>Auger Refusal</b> <input type="checkbox"/> Bedrock <input type="checkbox"/> Dense Till <input type="checkbox"/> Boulders <input type="checkbox"/> Other Refusal Depth: <u>20'</u> Terminated	<b>Sample Types</b> <input checked="" type="radio"/> AC - Auger Cutting <input type="radio"/> ST - Shelby Tube <input type="radio"/> SS - Split Spoon <input type="radio"/> C - Core <input type="radio"/> JS - Water Sample for Sulphate Content	<b>Field Tests</b> SPT - Standard Penetration Test PP - Pocket Penetrometer TV - Torvane Note: record correction factor for torvane tests Note: If sloughing, use hollow stems
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Comments: Backfilled with auger cuttings & bentonite chips bottom & top of testhole.

# RECORD OF SOIL PROFILE

TH No.: TH19      Logged by: Larry Presado      Drill Date: December 14, 2015  
 Client: STANTEC      Project: Adam Lake Lagoon Assessment      Start Time: \_\_\_\_\_ End Time: \_\_\_\_\_  
 Drill Contractor: Paddock Drilling      Drill Rig: RM30      Drilling Method: 125 mm Ø Solid SPM Auger  
 Location: Turtle Mountain Provincial Park      GPS Coordinates: 42 19 77 E, 143 31 35 N      Elevation: \_\_\_\_\_ m Sheet 1 of 1

Typical Soil Classifications: Clay / Clay Fill / Silt / Sand / Gravel / Glacial Till / Granular Base or Fill / Topsoil / Peat or Organics / Bedrock

Colour	Consistency	Compactness	Water Content	Plasticity	Particle Size	Quantity
Black Grey Brown Tan	<b>Torvane</b> Hard >200 kPa Very Stiff 100-200 kPa Stiff 50-100 kPa Firm 25-50 kPa Soft 12-25 kPa Very Soft <12 kPa	SPT Very loose 0-4 Loose 4-10 Compact 10-30 Dense 30-50 Very Dense >50	Dry Moist Saturated	Non Plastic (NP) Low Plasticity (LP) Int. Plasticity (IP) High Plasticity (HP)	Fine Sand 0.075 - 0.425 mm Medium Sand 0.425 - 2.0 mm Coarse Sand 2.0 - 4.75 mm Fine Gravel 4.75 - 19 mm Coarse Gravel 19 - 75 mm Cobbles 75 - 300 mm Boulders >300 mm	Trace 0-10% Some 10-20% Adjective 20-35% (silty/clayey/sandy) And 35-50%

Depth		Soil Type	Soil Description	Soil Samples		Field Tests			
from	to			Type	Depth		Test	Depth	Test Result
					from	to			
0	4"	Topsoil	black	TC		1			
4"	25'	Clay	black, stiff, moist, high plasticity	"		25'			
				"		5'			
25'	10'	Silty Clay	brown, stiff, moist, medium to high plasticity	"		7.5'			
			trace fine sand	"		10'			
10'	20'	Clay	brown, stiff, moist, high plasticity	"		15'			
			firm below 12.5'	"		20'			
			some silt below 15'						
			trace fine sand						

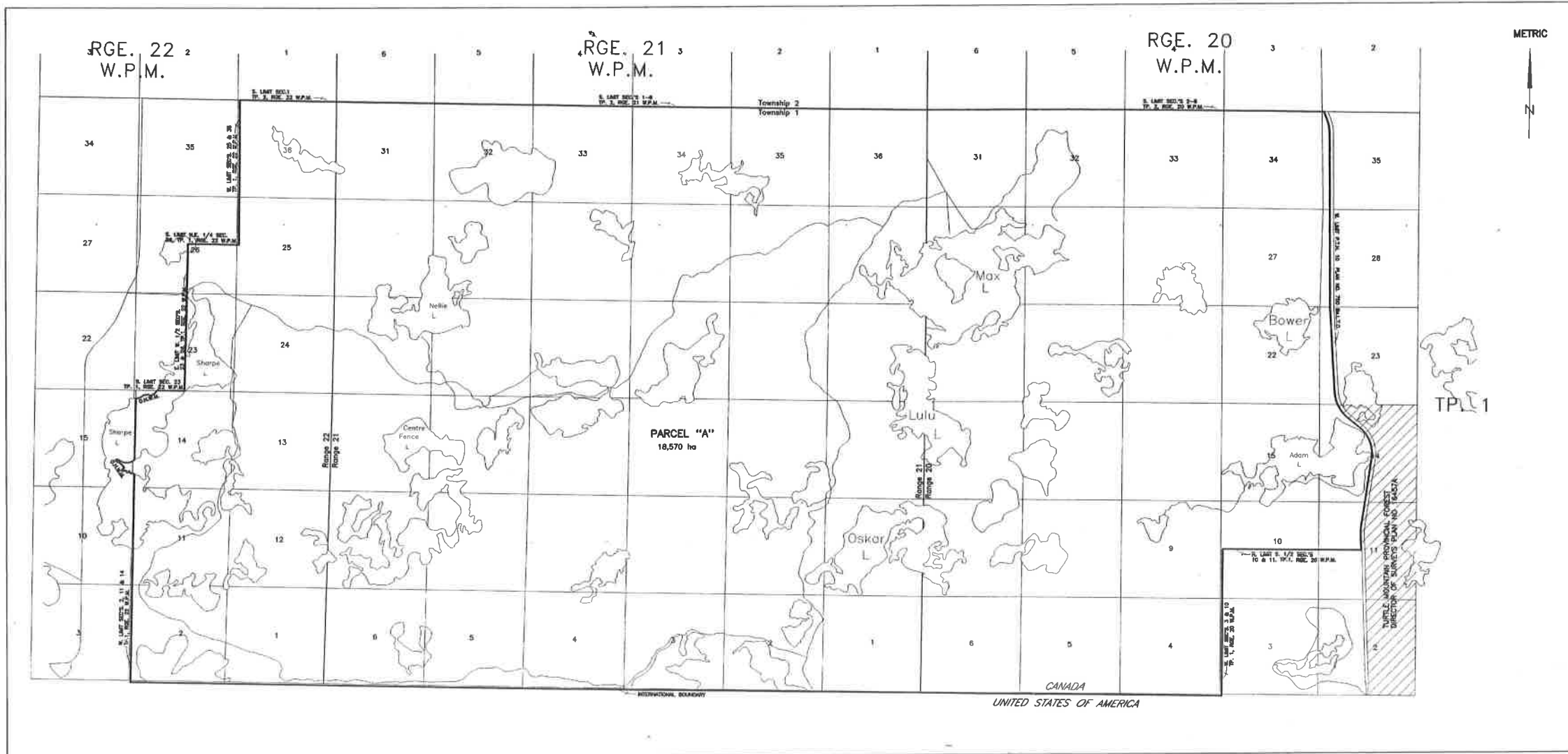
<b>Soil Sloughing</b> <input checked="" type="radio"/> None • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____ • Yes → Source (soil type): _____ → Source (depth): _____	<b>Groundwater Seepage</b> <input checked="" type="radio"/> None <input type="radio"/> Minor <input type="radio"/> Moderate <input type="radio"/> Heavy Depth of Seepage: _____ Final Groundwater depth: _____	<b>Auger Refusal</b> <input type="checkbox"/> Bedrock <input type="checkbox"/> Dense Till <input type="checkbox"/> Boulders <input type="checkbox"/> Other Refusal Depth: <u>20'</u> <u>Terminated</u>	<b>Sample Types</b> <input checked="" type="radio"/> AC - Auger Cutting <input type="radio"/> ST - Shelby Tube <input type="radio"/> SS - Split Spoon <input type="radio"/> C - Core <input type="radio"/> JS - Water Sample for Sulphate Content	<b>Field Tests</b> SPT - Standard Penetration Test PP - Pocket Penetrometer TV - Torvane Note: record correction factor for torvane tests Note: if sloughing, use hollow stems
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Comments: Backfilled with auger cuttings & bentonite chips bottom & top of testhole.

## **APPENDIX 2**

# **Administrative Plan**





**ADMINISTRATIVE PLAN  
 OF  
 TURTLE MOUNTAIN PROVINCIAL PARK  
 IN  
 TOWNSHIP 1, RANGES 20, 21 & 22 W.P.M.  
 R.M.'s OF MORTON AND WINCHESTER**

**MANITOBA**

Scale 1:23,000

This plan is for administrative purposes only; no survey has been made.

**NOTES:**

Portions affected by this plan are shown bordered blue.  
 All plans referred to are in record in the Department of Land Title Office unless otherwise shown.  
 Area shown in red on this map may be corrected by adding the following to 2.37152:

**CERTIFICATE:**

Certified correct  
 this 17th day of January A.D. 1987  
*E. Hoop*  
 Director of Survey

**APPROVALS:**

Approved  
 this 6th day of March A.D. 1987  
*C. D. Hawk*  
 Director of Parks and Natural Areas

Approved  
 this 17th day of January A.D. 1987  
*E. Hoop*  
 Director of Survey