MANITOBA ABORIGINAL AND NORTHERN AFFAIRS

Environment Act Proposal
for
Community of Wabowden
Wastewater Treatment Lagoon Expansion

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: MAY 05 2014

Prepared by:

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Issued: May 2014

ENGINEERING CONSULTANTS

ACKNOWLEDGMENTS

To prepare this report various sources of information were investigated and researched. JR Cousin Consultants Ltd. (JRCC) wishes to thank Manitoba Aboriginal and Northern Affairs (MANA) and the community of Wabowden who contributed to the data and content of this study. In addition, we wish to commend MANA for their fortitude in addressing the need for a long-term solution to wastewater treatment for the community of Wabowden.

REMARKS

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

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Environment Act Proposal Form

Manitoba
Conservation and Water Stewardship

Name of the development:
Community of Wabowden, Wastewater Treatment Lagoon

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):
Class 2 Development

Legal name of the applicant:
Manitoba Aboriginal and Northern Affairs

Mailing address of the applicant: 59 Elizabeth Drive, Box 27

Contact Person: Mr. Prasid Bhattarai

City: Thompson Province: Manitoba Postal Code: R8N 1X4

Phone Number: (204) 679-2443 Fax: (204) 677-6525 email:

Location of the development: Wabowden, Manitoba

Contact Person: Mr. Prasid Bhattarai

Street Address:

Legal Description: NW and SW 20-68-8 WPM

City/Town: Wabowden Province: Manitoba Postal Code: R8N 1X4

Phone Number: (204) 689-2362 Fax: (204) 689-2355 email:

Name of proponent contact person for purposes of the environmental assessment:
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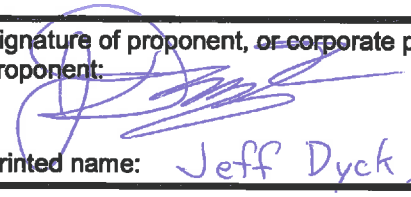
Date: May 5, 2014	Signature of proponent, or corporate principal of corporate proponent:  Printed name: Jeff Dyck, P. Eng.

EXECUTIVE SUMMARY

General

The community of Wabowden and Manitoba Aboriginal and Northern Affairs is proposing to expand the existing wastewater treatment lagoon for the community of Wabowden. An Environment Act Licence will be required from Manitoba Conservation for the construction and operation of the proposed expanded lagoon. JR Cousin Consultants Ltd. (JRCC) was retained for the engineering services.

Description

The existing Wabowden wastewater treatment lagoon is hydraulically overloaded and is in need of expansion due to the projected future growth of the community. The most feasible option considered by the project team to increase the hydraulic capacity of the lagoon was to expand by constructing a new storage cell (Storage Cell #2) to the southeast of the existing cells. Associated works would include construction of a perimeter ditch around Storage Cell #2, and a perimeter fence around the entire lagoon with two lockable gates at each end of the lagoon access road.

Population Contributing Effluent

The projected year 20 population used for sizing the expanded lagoon consists of: the residential population in the community of Wabowden (929 people), the CaNickel mining camp (150 people), the Setting Lake Wayside Park Campground (217 people), and the Ponton Motel (10 people). The residential population in the community is projected to experience an annual population growth of approximately 1.8%, and the campground is expected to grow by approximately 10 campsites, while the remaining populations are not expecting future growth. Therefore, the total population projected to be contributing effluent in year 20 from the piped collection system in the community and from the surrounding holding tank system is 1,306 people.

Lagoon Loading

The total projected year 20 organic loading to the lagoon primary cell would be approximately 103.4 kg BOD_5/day, which considers average daily loading from the community, surrounding commercial population and a peak daily load of holding tank waste from the campground (two tank pump outs per day). The total projected year 20 hydraulic load to the lagoon would be approximately 357 m^3/day.

Lagoon Capacity

Based on a review of the Wabowden lagoon assessment report and design drawings, the existing lagoon primary cell has an organic loading capacity of 103.5 kg BOD_5/day, which would be sufficient for the projected peak organic loadings in design year 20. The expanded lagoon would have a total hydraulic storage capacity of 82,125 m^3, which would be sufficient, for a 230 day storage period in design year 20, based on the projected hydraulic loadings.

Topographical Survey and Geotechnical Investigation

The general area of the proposed lagoon expansion is a partially cleared forested section of land. The land generally slopes towards the east and an elevation difference of approximately 4.4 m was recorded across the expansion area from west to east, at a slope of approximately 0.9%.

The general soil profile at the expansion site consisted of surfical peat and topsoil followed by a layer of high plastic clay, overlying silt till. The peat was observed in test holes 3, 4 and 5, and varied in thickness from 0.3 m to 1.7 m. Test hole 3 was located in a low lying area, and had a saturated peat depth of 1.7 m. The high plastic clay layer also varied in elevation and thickness across the site. The top of this clay layer varied in elevation across the site by approximately 4.3 m, and varied in thickness across the site from 0.3 m to 2.8 m. The silt till material observed onsite was low plastic, and was wet to saturated. This material extended to the bottom of each test hole.

Refusal was encountered in two of the test holes at depths of 1.8 m (bedrock) and 4.5 m (boulder) below the surface. Standing water was not recorded in any of the test holes, however the silt till layer observed onsite was consistently wet, which is an indication of groundwater.

Based on the laboratory analysis, the layer of high plastic clay would be able to achieve a hydraulic conductivity value of 1×10^{-7} cm/sec or less both in-situ and after reworking, which is within the Manitoba Conservation requirements for hydraulic conductivity in a lagoon liner.

Lagoon Liner

Based on the on-site geotechnical investigation and laboratory analysis, it is recommended that the lagoon liner in Storage Cell #3 be constructed of reworked clay soils from the site excavation. It is expected that the high plastic clay soils observed in the expansion area would consistently achieve a hydraulic conductivity value less than 1×10^{-7} cm/sec after reworking, as required by Manitoba Conservation for clay lined lagoons. The lagoon liner will be constructed to a thickness of 1.0 m in the cell floor and 3.0 m in the vertical cut-off walls.

Nutrient Management Plan

Based on the 2011 *Manitoba Water Quality Standards, Objectives and Guidelines*, the Municipal wastewater effluent discharge requirement is a limit of 1.0 mg/L of phosphorus. The exception being small wastewater treatment facilities that serve less than 2,000 equivalent people, which have the option of implementing a nutrient reduction strategy instead of the 1.0 mg/L phosphorus limit.

Various options were considered for meeting the required phosphorus limit, however the most feasible option included utilizing a trickle discharge from the lagoon into the drainage route, to the east to increase nutrient uptake along the discharge route by plants and soils, prior to discharge into the nearest a body of surface water.

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for upgrading the existing Wabowden wastewater treatment lagoon in the community of Wabowden, Manitoba.

1.1 Introduction

Manitoba Aboriginal and Northern Affairs (MANA) is proposing to expand the existing wastewater treatment lagoon for the community of Wabowden, Manitoba. A lagoon expansion is required to accommodate the current population and future proposed growth in the community. An Environment Act Licence is required from Manitoba Conservation for the construction and operation of the expanded lagoon. JR Cousin Consultants Ltd. (JRCC) was retained for the related engineering services.

1.2 Contact Information

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1.3 Background Information

The community of Wabowden is located on Bowden Lake, approximately 111 km southwest of Thompson and approximately 640 km north of Winnipeg, Manitoba along PTH 6. The existing lagoon is located at NW and SW 20-68-8 WPM. The lagoon services residents in the community of Wabowden, the CaNickel Mine operation, the Setting Lake Wayside Park Campground and the Ponton Motel. The lagoon services the residents via a piped wastewater collection system for the community residents and through truck hauling from the remaining population.

The Wabowden lagoon was constructed in 1978, and based on lagoon design drawings, the dikes of the primary and storage cell were constructed of compacted clay soils. The lagoon was constructed with emergency overflow pipe discharges in the primary and storage cells. The lagoon is currently being operated under the Clean Environment Order No. 772. Based on a lagoon assessment conducted in 2012, it was determined that the lagoon is hydraulically overloaded and is in need of upgrading and expansion to accommodate future growth in the community. Therefore a new environmental licence through Manitoba Conservation will be required.

1.4 Description of Previous Studies

Various sources of information for the Wabowden lagoon were reviewed to obtain background information on the site. Design drawings of the lagoon and forcemain (Manitoba Water Resources Branch, 1972) were reviewed, which included test hole logs at the current site of the Wabowden lagoon. Based on the test hole logs, eight test holes were completed at the lagoon site to a maximum depth of approximately 3.0 m. The soils consisted of surficial topsoil (0 m - 0.3 m), followed by clay to the bottom of the test holes. Groundwater levels were noted in three of the test holes at depths ranging from 0.1 m to 2.4 m below the surface.

The Wabowden lagoon assessment prepared by Bearpaw Corporation Inc. in 2012 was reviewed to obtain background information on existing lagoon conditions and concerns relating to lagoon loading. This assessment identified the lagoon as being hydraulically overloaded and has required emergency discharges in the past due to overloading. The report also indicated that the lagoon dikes have undergone erosion and were covered with heavy vegetation. It was recommended that an additional storage cell be constructed to service the community of Wabowden for the 20 year growth projections.

2.0 DESCRIPTION OF THE DEVELOPMENT

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

2.1 Land Title/Location

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

The existing lagoon is located in NW and SW 20-68-8 WPM. The proposed lagoon expansion to the southeast will be located within SW 20-68-8 WPM. There is no land title for the existing and proposed lagoon site, as the land is owned by the Crown (Province of Manitoba), however the land is reserved for the community under Reservation No. SLAG06808W. The land of the existing and proposed lagoon is located on Plan 5712 Lot A (See attached lot plan in Appendix A).

2.2 Owner of Land and Mineral Rights

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

The Crown Lands & Property Agency was contacted regarding the proposed development location. According to the Crown Lands & Property Agency, Parcel "A" Plan 5712 NLTO and Parcel "B" Plan 5712 NLTO have been reserved for the Community Council of Wabowden for maintaining a sewage lagoon. The mines and minerals, and sand and gravel within these two parcels are owned by the Crown (Province of Manitoba) (see email correspondence from the Crown Lands & Property Agency, dated June 13, 2013 in Appendix A).

2.3 Existing Land Use

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

The proposed lagoon expansion site is the land directly southeast of the existing lagoon cells. This land is forested and is not currently being used for a designated purpose. The surrounding lands adjacent consist of forested areas with a community access road approximately 200 m to the southeast of the lagoon cells, and the Canadian National Railway bordering the lagoon cells to the northwest. The community of Wabowden is located approximately 1.1 km to the northeast of the existing lagoon cells (see Plan L1 in Appendix D).

The existing lagoon access road and forcemain piping would continue to be utilized without alteration. The lagoon access road is located to the southeast and southwest of the lagoon cells and connects to the community access road, surrounding the proposed development area.

2.4 Land Use Designation/Zoning Designation

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

The lagoon expansion site is zoned as Limited Development with permitted land use by public utilities and water works, based on the community of Wabowden Zoning By-laws.

2.5 Description of Development

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

2.5.1 Project Schedule

Lagoon design is proposed to begin upon receipt of an Environment Act Licence. Lagoon construction works are proposed to begin in the summer of 2014. Commissioning and operation of the lagoon is proposed to begin upon completion of construction and after approval for use is obtained from Manitoba Conservation. No date for decommissioning has been set for the lagoon, however the lagoon expansion is being designed for a projected year 20 (2034) service population, and a lagoon assessment should be conducted when the lagoon approaches this year 20 design life.

2.5.2 Basis for Proposed Lagoon Expansion Site Selection

The location for the lagoon expansion was chosen based on discussions with the proponent, which takes into account the proximity to the existing community (as discussed below) and property boundaries.

Manitoba Conservation's guidelines for the location of a wastewater treatment lagoon (*Design Objectives for Standard Sewage Lagoons, Province of Manitoba, Environmental Management*, July 1985) are outlined in the following table. A description of the proposed site in relation to each of the guidelines is also provided in the table.

Table A: Location of Proposed Expanded Lagoon Site in Relation to Manitoba Conservation Guidelines

Manitoba Conservation Guideline	Proposed Relation to Site
Lagoons must be located a minimum of 460 m from any community centre.	The proposed expanded lagoon site is located approximately 1.1 km from the community of Wabowden town site.

Manitoba Conservation Guideline	Proposed Relation to Site
Lagoons must be located a minimum of 300 m from any residence. (The distance is to be measured from the centreline of the nearest dike).	The proposed expanded lagoon site is located approximately 990 m from the nearest resident.
Consideration should be given to sites in which prevailing winds are in the direction of uninhabited areas.	The prevailing winds typically blow from the north and west. The proposed lagoon expansion site is located southwest of the community, however the site is separated from the community by forested land which will act as a wind barrier and limit the travel of potential odours.
Sites with an unobstructed wind sweep across the lagoon are preferred.	The land surrounding the expanded lagoon is forested, which creates a natural windbreak.
Areas that are habitually flooded shall be avoided.	The lagoon is situated approximately 850 m from Bucko Lake and flooding is not expected in the expansion area. The top of dikes of the proposed lagoon expansion cell would be constructed at the same elevation as the existing lagoon dikes, which is approximately 1.5 m higher than the existing ground. There have been no reports of flooding around the existing lagoon cells.
Areas of porous soils and fissured rock formations should be critically evaluated to avoid creation of health hazards or other undesirable conditions.	A liner will be utilized in the lagoon expansion cell construction according to Provincial guidelines, thus reducing the possibility of groundwater contamination.

The lagoon expansion area is located beyond all setback distances required by Manitoba Conservation, therefore there are no expected concerns for the location of the expansion cell. The advantage of a lagoon having a wind sweep across the surface is the ability to generate wave action which creates turbulence and aeration within the cells, which aids in wastewater treatment. As the site is surrounded by forest land, the wind sweep across the lagoon will be limited. Plan L2 in Appendix D, shows the minimum setback distance requirements for the expanded lagoon to the local residents and the community.

2.5.3 Existing Lagoon Drainage Route

The Wabowden lagoon effluent discharge is currently to the east, through access road ditches and to a creek which flows to Rock Island Lake. The length of the discharge route is approximately 3.3 km (522 m in the ditch and 2.8 km in the creek). The design of the lagoon expansion will continue to utilize this drainage path for lagoon effluent discharge. The new storage cell will include an independent discharge valve to the east, which will enter the existing discharge ditch and follow the existing discharge route (see Plan L4 in Appendix D).

2.5.3.1 Water Quality Information

Manitoba Conservation and Water Stewardship were contacted for water quality data in Rock Island Lake. From correspondence with the Water Science and Management Branch, no water quality data was available in the provincial data base for Rock Island Lake.

2.5.4 Access Road

The lagoon site would continue to be accessed by an existing all weather access road from the southeast and southwest of the lagoon cells, surrounding the proposed expansion cell. This lagoon access road connects with the community access road approximately 200 m to the south. The existing lagoon access road has a granular base which appeared to be in suitable condition for continued use. This access road utilizes the south lagoon dike to access the existing truck turnaround and spillway.

2.5.5 Population Contributing Effluent

Population data was obtained from Statistics Canada and from the population assessment conducted during the lagoon assessment by Bearpaw Corporation Inc. (2012). The service population utilizing the Wabowden lagoon includes residents within the community of Wabowden, the CaNickel Mine operation, the Setting Lake Wayside Park Campground, the Ponton Motel, and commercial contributions (My's Restaurant and Penner Oil).

2.5.5.1 Community of Wabowden

The community of Wabowden consists of residential, institutional, commercial and industrial populations. Based on information obtained from Statistics Canada, and from correspondence with the community council, the population in the community in 2011 was 650 people. Based on discussions with the proponent it is estimated that the community will experience an annual projected growth rate of 1.8%. Therefore, the community would have a projected year 20 population of approximately 929 people.

2.5.5.2 CaNickel Mine

The CaNickel Mine operates a mining camp which has a reported population of approximately 150 people. The population of the mining camp fluctuates based on the degree of mining activity. Due to these fluctuations, no projected population growth (0% growth) was estimated, therefore the year 20 population is also estimated to be 150 people.

2.5.5.3 Setting Lake Wayside Park Campground

The Setting Lake Wayside Park Campground is a seasonal campground which has an operating season of approximately 140 days (Victoria Day to Thanksgiving). Based on discussions with the Wabowden Community Council, the campground has 52 sites and is serviced with non-modern washrooms (no showers or flush toilets). Council

reported that the campground is typically filled to capacity during the operating season and the average population is approximately 3.5 people per campsite. Therefore the current population of the campground during the operating season is estimated to be 182 people. From discussion with Council, there are some preliminary plans on expanding the campground by approximately 10 sites within the next 5 years. No further expansion plans beyond this have been considered. This would represent an increase in population of 35 people after design year 5 and no population growth afterwards, for an overall projected population of 217 people in year 20.

2.5.5.4 Ponton Motel

The Ponton Motel was reported to have 5 rooms with an average population of two people per room. The current population of the motel would be 10 people. No expansion of the motel was expected over the next 20 years, therefore a population growth of 0% was utilized and the year 20 population is projected to be 10 people. The Wabowden lagoon is not currently receiving wastewater from Ponton, but is expected to in the future, therefore this population will be considered in the proposed lagoon upgrade.

2.5.5.5 Commercial Sources

Commercial sources of wastewater identified by the community Council included Penner Oil and My's Restaurant. These businesses were included in the wastewater loading to the lagoon from the community, as no specific populations were available for these sites, since they are used by both residents and non-residents in the community.

2.5.5.6 Population Summary Table

The current and projected populations for the service area have been included in the summary table below and in the attached Table 1 of Appendix B.

Contributing Population	Current Population	Year 20 Population
Community of Wabowden	650	929
CaNickel Mine	150	150
Setting Lake Wayside Park Campground	182	217
Ponton Motel	10	10

2.5.6 Wastewater Production

The expanded wastewater treatment lagoon is to service the projected year 20 populations as stated above, for the community, mining camp, campground, motel and commercial businesses.

2.5.6.1 Organic Loading

The organic loading calculation is based upon the organics in typical residential wastewater and septage. A typical value of 0.076 kg BOD_5/person/day was utilized to estimate the organic loading from the residents connected to the piped sewer system (community population). The service populations from the mining camp, motel and commercial businesses utilize holding tanks, which are considered to have similar organic loading rates as that in the piped sewer system (0.076 kg BOD_5/person/day). A typical BOD concentration of 174 mg/L was utilized for the organic loading of the commercial businesses.

The campground also utilizes holding tanks for their privies, however as there is no running water entering the holding tanks, therefore the organic loading strength is more similar to that of septic tank sludge (septage) as opposed to a residential holding tank. The campground currently has 3 holding tanks with a capacity of approximately 3,000 L per tank. The typical concentration used for the organic strength of septage is 0.007 kg BOD_5/L, while the estimated volume of accumulated sludge in a tank is 600 L and the remaining volume of 2,400 L would be considered septage effluent.

The truck hauled septage from the campground holding tanks, is considered for a peak daily BOD loading, as this affects the odours generated at the lagoon during disposal. At a typical strength for septage sludge of 0.007 kg BOD_5/L, and a typical strength of septage effluent of 0.00253 kg BOD_5/L, the organic loading for one holding tank load (3,000 L) of septage from the campground would be 10.3 kg BOD_5.

From discussions with Manitoba Conservation, the peak organic loading to the primary cell of the lagoon is limited to 56 kg BOD_5/ha/day, due to organic treatment rates and potential odour concerns. Based on the size of the existing Wabowden lagoon primary cell and the estimated organic loading from the community piped and holding tank systems, the additional truck hauled septage to the lagoon from the campground will need to be limited by the community of Wabowden to two holding tank loads (6,000 L) per day.

The current total daily organic loading from piped sources in the community and from two holding tank loads of septage from the campground (considered peak day loading), is approximately 82.2 kg BOD_5/day. The daily loading is expected to increase to 103.4 kg BOD_5/day (peak day) in year 20, due to the projected increase in the population. Table 1 attached shows the current and projected year 20, organic loadings to the lagoon.

An agreement would be required between the community and local septic hauler that not more than two holding tank loads from the campground could be dumped into the primary cell per day, to remain within the required organic loading limits of the

primary cell. If additional loads are permitted to be dumped per day, then expansion of the primary cell would be required.

2.5.6.2 Hydraulic Loading

The hydraulic loading to the wastewater treatment lagoon is comprised of three waste streams: water usage, infiltration and truck hauled septage. The wastewater conveyed by the wastewater collection system includes both water usage and infiltration. The per capita wastewater production identified for the community was 360 L/person/day, as provided by MANA.

Based on the report by Bearpaw Corporation, the CaNickel Mine has an estimated hydraulic loading rate of 46 L/person/day, which was utilized in the proposed lagoon hydraulic loading.

Based on a review of the US EPA guidelines, typical wastewater flow rates for a hotel are 190 L/person/day, which were utilized for the population from the Ponton Motel.

The Manitoba Conservation and US EPA guidelines were reviewed to determine typical wastewater flow rates for campgrounds, however there were no typical values given which matched the exact conditions in the Setting Lake Wayside Park Campground (no-flush toilets, no showers). From EPA documentation, the typical flow rates for a picnic park with flush toilets would be 19 - 38 L/person/day, with a typical value of 30 L/person/day, which would most closely match the conditions in the existing campground. Therefore a hydraulic loading of 30 L/person/day was utilized for the campground residents.

While trailer camping is permitted at the campground, trailer wastewater dumping is not permitted or available, and seasonal residents or visitors are required to deposit their wastewater at a location in the community, which ties directly into the sewer system. Therefore no consideration for trailer dumping wastewater was considered at the campground.

The Community Council indicated that commercial businesses (Penner Oil and My's Restaurant) contribute approximately 390 litres of wastewater to the lagoon per day, which was considered in the hydraulic loading design.

An additional loading from the water treatment plant (WTP) backwash was considered in the hydraulic loading to the lagoon. It was discussed that the WTP backwash contributes approximately 13,500 litres to the lagoon per day.

The total hydraulic loading to the lagoon from all sources would currently be 257 m^3/day. The total hydraulic loading in design year 20 would be 357 m^3/day, based on the increase in population. As discussed in Section 2.5.7.2 below, the existing and proposed lagoon cells would be sized for the projected year 20 hydraulic

loading. Table 1 attached in Appendix B, shows the current and projected year 20 hydraulic loadings to the lagoon.

Manitoba Conservation currently requires a lagoon to have sufficient storage for a 230 day period over the winter and spring months. The original lagoon Clean Environment Order required a storage period of 197 days, however upon upgrade to the lagoon, a new Environment Act Licence will be required and the current Manitoba Conservation requirements will be in effect.

2.5.7 Existing Lagoon Assessment and Capacity

The organic and hydraulic storage capacities of the existing Wabowden Lagoon were determined from a review of the 2012 lagoon assessment by Bearpaw Corporation Inc. The requirements for lagoon loading and sizing were based on the Manitoba Conservation *Design Objectives for Standard Sewage Lagoons* (July, 1985). An assessment of the existing lagoon cells was not conducted during the 2014 site investigation due to the snow cover, however design drawings of the lagoon cells were reviewed to determine the construction details.

2.5.7.1 Lagoon Assessment

The existing primary cell was designed with a total depth of 2.44 m, an operating depth of 1.22 m, and a freeboard of 1.22 m. Manitoba Conservation requires a maximum operating level of 1.5 m and a freeboard of 1.0 m in a facultative lagoon primary cell. A lagoon emergency overflow pipe was installed in the intercell dike from the primary cell to the secondary cell at an invert height of 1.23 m from the cell floor. The intercell pipe between the primary cell and secondary cell was installed at an invert height of 0.09 m from the cell floor.

The existing storage cell was constructed with a total depth of 2.43 m from the cell floor to top of dike. This cell was designed for an operating depth of 1.52 m and a freeboard of 0.91 m. An emergency overflow pipe was installed in the perimeter dike of the secondary cell at an invert height of 1.53 m from the cell floor. The storage cell floor was constructed with an elevation of 0.3 m below the elevation of the primary cell floor. The discharge pipe was installed in the perimeter dike at an invert height of 0.09 m from the cell floor.

The lagoon dikes were constructed of compacted clay soils with inside slopes of 4H:1V. Manitoba Conservation requires a lagoon clay liner to have a minimum thickness of 1.0 m and to achieve a permeability of 1×10^{-7} cm/sec or less. Based on an email from MANA in 2011, the community had been required to perform emergency discharges annually for several years, and as a result Manitoba Conservation did not allow the community to perform an emergency discharge in 2011. This required the community to increase the dike height to prevent overflow. It was reported that the emergency overflow pipe from the primary to secondary cell was plugged to maximize the primary cell volume, as per an Environmental Order, to

reduce the frequency of emergency discharges to the receiving environment. Based on a survey of a portion of the existing lagoon cells during the 2014 site investigation, the cell dike height was raised a minimum of 0.5 m in both cells.

Based on the 2012 lagoon assessment, the lagoon dikes were heavily covered with vegetation on the inside and outside slopes. The majority of the lagoon perimeter fencing was damaged and missing. The lagoon access road, truck turnaround and spillway were reported to be in suitable condition for continued use.

The following sections summarize the current organic and hydraulic capacities of the existing lagoon, based on the lagoon design information available. The information utilized for determining future capacity included the inside slope of the primary and secondary cell dikes; the operating depth of the lagoon cells; and the invert of the discharge pipe in the secondary cell.

2.5.7.2 Existing Organic Capacity

Provincial guidelines stipulate that the organic loading rate of a lagoon must not exceed 56 kg BOD_5/ha/day in the primary cell. The effluent surface area at a 0.75 m depth in the primary cell is used to determine the treatment surface area. The existing lagoon primary cell currently has a surface area of 18,250 m^2 at a depth of 0.75 m, resulting in a total organic loading capacity of 102.2 kg BOD_5/day. This is based on the original operating depth of 1.22 m in the primary cell, however, as the emergency overflow pipe between the two cell has been plugged, the operating depth of the primary can be increased to 1.44 m, which maintains the 1.0 m freeboard requirement. This would then increase the surface area in the primary cell to 18,491 m^2, resulting in a total organic loading capacity of 103.5 kg BOD_5/day. Based on the estimated organic loading rate discussed above, the primary cell requires a minimum surface area of 18,466 m^2 at a depth of 0.75 m, in design year 20 for a total organic loading rate of 103.4 kg BOD_5/day. The existing lagoon organic capacity in the primary cell would be sufficient for the projected population in design year 20 and will not require expansion.

2.5.7.3 Existing Hydraulic Storage Capacity

Provincial guidelines stipulate that the hydraulic storage capacity of a lagoon is determined from the volume of the top half of the primary cell and the secondary (storage) cell(s) volume, between the discharge pipe invert and the maximum liquid level (1.5 m depth). The existing lagoon primary cell has a storage capacity of 11,544 m^3, and the existing secondary cell has a capacity of 30,844 m^3, resulting in an overall lagoon storage capacity of 42,388 m^3. This is based on the original operating depth of 1.22 m in the primary cell, and 1.52 m in the secondary cell, as designed. However, as the emergency overflow pipe between the two cells has been plugged, the operating depth of the primary can be increased to 1.44 m, which maintains the 1.0 m freeboard requirement. This would then increase the hydraulic storage

capacity in the primary cell to 13,891 m^3. In addition, the secondary cell was designed with a freeboard height of 0.91 m, however Manitoba Conservation requires a freeboard height of 1.0 m and therefore if the freeboard was increased to 1.0 m, the operating depth would decrease to 1.43 m. This would decrease the hydraulic storage capacity of the secondary cell to 28,759 m^3. These changes in operation would change the overall hydraulic storage capacity to 42,650 m^3. Based on the estimated year 20 hydraulic loading from the service population, the lagoon requires a total storage volume of 82,125 m^3 over the 230 day storage period. Therefore, the existing lagoon does not have sufficient hydraulic storage for the projected hydraulic loading from the service population and will require expansion.

2.5.8 Lagoon Sizing Requirements

As discussed above, the existing lagoon will not have sufficient capacity to meet the year 20 hydraulic design loadings. Therefore, expansion of the secondary cell is required to meet the future hydraulic loading requirements. The most feasible option considered for the expansion of the secondary cell would be the construction of a new storage cell to the southeast of the existing lagoon cells, and connecting the flow from the existing secondary cell.

The expanded lagoon will be sized to handle the year 20 organic and hydraulic loadings from the piped system in the community and the truck hauled system from the remaining commercial populations, as discussed above.

The expanded lagoon would consist of one primary cell and two storage cells, each with 4H:1V inner and outer side slopes. The operating depth, freeboard and discharge invert of the expansion storage cell is described below.

2.5.8.1 Primary Cell

Based on the provincial organic loading rate limits (as described in Section 2.5.7.2 above), and the estimated year 20 organic loading rate from the service population, the minimum required surface area in the primary cell would be approximately 18,466 m^2, for a daily permitted organic loading rate of approximately 103.4 kg BOD_5/day. Currently the lagoon primary cell has a surface area at 0.75 m from the cell floor of 18,491 m^2, for a daily permitted organic loading rate of 103.5 kg BOD_5/day.

2.5.8.2 Storage Cells

Based on the provincial hydraulic storage requirements (as described in Section 2.5.7.3 above), and the estimated year 20 hydraulic loading rate from the service population, the required hydraulic storage requirement during the 230 day period would be approximately 82,125 m^3. As discussed, the hydraulic storage capacity of existing Storage Cell #1 and the primary cell would be approximately 42,650 m^3. The remainder of the required hydraulic storage capacity would come from the proposed Storage Cell #2.

The proposed operating depth of the proposed Storage Cell #2 would be 1.5 m, with the invert of the discharge pipe located at a height of 0.3 m above the cell floor. The existing discharge pipe in Storage Cell #1, will flow into Storage Cell #2, based on the configuration of the cells, and will act an intercell pipe between the two storage cells. The expanded lagoon will be sized for a 230 day hydraulic storage capacity.

2.5.8.3 Lagoon Capacity and Loading Requirements Summary Table

Lagoon Loading	Existing Capacity	Capacity Needed	Shortfall
Organic	18,491 m^2	18,466 m^2	**0 m^2**
Hydraulic	42,650 m^3	82,125 m^3	**39,475 m^3**

Table 1, attached in Appendix B, shows the current and projected year 20 wastewater (hydraulic and organic) loadings.

2.5.9 Topography and Geotechnical Review

2.5.9.1 Past Geotechnical Investigations

Groundwater Driller Well Logs

The nearest driller well log reports available from the Manitoba Water Stewardship database, were from the community of Wabowden (28-68-8 WPM). These reports indicated that the subsoils in the area consist of surficial clay, followed by till or gravel down to the granite bedrock (ranging from 1.5 m to 8.2 m below the surface). Groundwater was reported at depths ranging from 0.9 m to 1.8 m below the surface.

Canada-Manitoba Soil Survey

Reconnaissance Soils Survey data of the area indicated that the soils consist of:

- Rock Outcrops – consists of rubble over limestone and Precambrian bedrock.
- Atik Complex – consists of poorly drained Terric Mesisols developed on forest peat, overlying clayey lacustrine sediments. Soils occur on veneer bogs, have moderately slow permeability and a very high water table.
- Wabowden Series – consists of well drained Solonetzic Gray Luvisol soils developed on deep, uniform clayey lacustrine deposits. Soils occur on mid slope positions of undulating to hummocky landscapes and have slow permeability and moderate surface runoff.

Detailed soil survey information was not available for the project area.

2.5.9.2 Current Geotechnical Investigation

An on-site geotechnical and topographic investigation was completed by JRCC on February 19, 2014 to determine the suitability of the site and soils for the proposed

lagoon expansion. A local backhoe was utilized to excavate the test holes to maximum depth of 4.7 m. There were seven test holes located to the southeast of the existing lagoon cells. The area tested was a recently cleared forested section of land. The soils were examined and tested to determine whether they were suitable for use as a clay lagoon liner in an undisturbed state (in-situ) or after reworking, and whether soils could be used for potential borrow material. Test hole locations are shown on Plan L1, attached in Appendix D.

The subsurface soil profile within each test hole was logged, water conditions were noted and representative soil samples were collected as the soils varied along the profile. The samples were visually field-classified and confirmed through laboratory analysis. Shelby tubes of undisturbed in-situ soil were collected in various test holes and at depths appropriate for a lagoon liner. Bulk samples were also collected in at a representative test hole, for utilization if testing of a reworked soil sample was deemed necessary. Following completion of drilling, an assessment of the short term groundwater conditions was completed by measuring the level of standing water in the test holes. All test holes were then backfilled with excavated material.

Soil Profile

From the seven test holes excavated around the existing lagoon cells, the soil profile was fairly consistent across the site. The typical soil profile consisted of surficial peat and topsoil, followed by a layer of high plastic clay, overlying silt till.

The peat was observed in test holes 3, 4 and 5, and varied in thickness from 0.3 m to 1.7 m. Test hole 3 was located in a low lying area, and had a saturated peat depth of 1.7 m.

The high plastic clay layer also varied in elevation and thickness across the site. The top of this clay layer varied in elevation from 223.5 m to 227.8 m; a difference in elevation of 4.3 m. The thickness of this clay layer also varied from 0.3 m to 2.8 m.

The silt till material observed onsite was low plastic, and was wet to saturated. This material extended to the bottom of each test hole.

Details of the soil profile in each test hole can be found in the test hole logs, attached in Appendix C.

Groundwater and Bedrock

Groundwater was encountered in all of the test holes to varying degrees. The silt till material was observed to be wet to saturated, which is an indication of the presence of groundwater, however the majority of the test holes did not have standing water upon backfilling, which is an indication of slow infiltration. Cold conditions at the surface, which were present during the site investigation, can also affect flow of groundwater. Static water level at the surface was observed in TH3, which was a low

lying area with saturated peat at the surface. Groundwater in the test holes depends on high static groundwater conditions and on seasonal conditions, i.e. snowmelt and rainy seasons. Other assumptions relating to the groundwater elevation cannot be made at this time, as water levels will normally fluctuate seasonally.

Bedrock was encountered in one of the test holes TH7, which was located furthest from the existing lagoon cells, just off of the community access road. The bedrock in TH7 was recorded at a depth of 1.8 m below the surface. Rock refusal was also encountered in TH5 at a depth of 4.5 m below the surface, due to the presence of a large boulder.

Contractors should be made aware of the geotechnical conditions encountered onsite, as dewatering may be required during construction, depending on the depth of excavation determined during final design. Details of the groundwater and refusal depth for each test hole can be found in the attached test hole logs, in Appendix C.

Laboratory Analysis

Representative bagged soil samples from the proposed lagoon expansion area were submitted to Stantec Consulting Ltd. for testing and analysis. The following is a summary of the testing results, while details of soil analysis and testing results are attached in Appendix C.

Three bagged samples were analyzed for the following:

- Atterberg Limits (plastic limit, liquid limit, and plasticity index, ASTM D4318)
- Soil Classification (ASTM D2487)
- Moisture Content (ASTM D2216)
- Particle Size Analysis (Hydrometer test, ASTM D422)
- Visual Classification.

The three bagged soil samples analyzed were from the following test holes:

- TH2 2.0 m – 3.2 m
- TH5 0.3 m – 2.2 m
- TH5 2.2 m – 4.5 m.

JRCC requested that the laboratory also provide a professional assessment, based on the analysis and the testing, as to whether the soil samples could achieve a permeability of 1×10^{-7} cm/sec or less in their in-situ and reworked states. A summary of the laboratory results are as follows:

> The laboratory analysis of the bagged samples indicated that the soils consisted of CH – high plastic clay to ML - low plastic silt. The laboratory

indicated that in general, homogeneous soils with a Plasticity Index greater than 25 and a clay content greater than 50% would typically be expected to achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. The Plasticity Index in the bagged samples ranged from 37 (CH) to non-plastic (ML), and the percentage of clay ranged from 89% (CH) to 15% (ML). Based on these results it is expected that the high plastic clay soils observed would be able to achieve a hydraulic conductivity of 1 x 10^{-7} cm/sec both in-situ or when reworked and re-compacted. The lab indicated that the high plastic clay soils would likely be suitable for use as a lagoon liner in-situ or when reworked and re-compacted, while the silt soils would not. The lab also noted that comments regarding the potential use of the material as a liner are based upon the soil being homogeneous with no preferential flow paths.

Based on the results of the laboratory testing on the bagged samples and observations made during the site investigation, no further permeability analysis was deemed to be necessary. Details of the Stantec Consulting Ltd. soil analysis report, dated March 4, 2014 have been included in Appendix C.

Discussion

Manitoba Conservation guidelines require a standard wastewater lagoon clay liner to be a minimum of 1.0 m in thickness and have a maximum hydraulic conductivity (i.e. the potential rate of fluid movement through the soil) of 1 x 10^{-7} cm/sec or less. This low rate is to protect the underlying groundwater from lagoon seepage.

Based on the results of the onsite investigation and laboratory analysis, there is a layer of high plastic soils throughout the lagoon expansion area which would be suitable for use as a lagoon liner both in-situ and when reworked. As indicated above, this layer of high plastic clay varies in both elevation and thickness throughout the expansion area, with unsuitable silty soil material underlying it. Therefore, based on the high risk of encountering unsuitable soils, this layer of high plastic clay could not reliably be utilized as an in-situ clay liner. However, this layer could be utilized for a reworked clay liner once a design elevation has been established. Reworking the soils would significantly reduce the potential for preferential flow paths in the liner due to the presence of rocks or unsuitable soil material (silt and sand). If a pocket or seam of unsuitable material was discovered during construction, this unsuitable soil would be removed and replaced with re-compacted suitable clay soil.

2.5.9.3 Topography

The general topography of the proposed expansion area to the southeast of the existing lagoon cells was obtained through a GPS survey during the site investigation. Based on the survey data obtained, the site is gently sloping from west to east. A maximum elevation difference of approximately 4.4 m was recorded across the expansion area from west to east, at a slope of approximately 0.9%. As described

above, a low lying area was observed in the expansion area, which is likely wet at the surface, due to the presence of surficial, saturated peat. Due to the site being covered in snow, no surface water was observed. From a survey of a portion of the perimeter ditching to the southeast of the lagoon cells, the ditch is sloped to the east and flow appears to be under the lagoon access road through an existing culvert and into a natural drainage course.

2.5.10 Lagoon Regulatory Requirements

2.5.10.1 Province of Manitoba Design Objectives

The Province of Manitoba *Design Objectives for Standard Sewage Lagoons (1985)* were used as a guideline in the layout and design of the lagoon expansion.

Organic Loading

Although a facultative lagoon operates at various organic efficiencies throughout the year, an average organic treatment capacity of 56 kg BOD_5/ha/day at a depth of 0.75 m in the primary cell has been established by Manitoba Conservation for facultative lagoon design purposes.

Hydraulic Loading

According to current guidelines a facultative lagoon cannot be discharged between November 1 and June 15 (230 day winter storage period). Therefore, the lagoon must have the storage capacity for this time period based upon half the volume of the primary cell and the storage cell(s) volume from the invert of the discharge pipe to the maximum liquid level.

Lagoon Liner

Sewage lagoons are to be designed and constructed such that the interior surface of the proposed lagoon is underlain by soil with a thickness of at least 1.0 metre and having a hydraulic conductivity of 1×10^{-7} cm/sec or less. In the absence of soils with a hydraulic conductivity of 1×10^{-7} cm/sec or less, the interior surfaces of a lagoon could be lined with a synthetic liner.

Effluent Quality Requirements

Any new or expanding wastewater treatment lagoons are required to meet the Manitoba *Water Quality Standards, Objectives and Guidelines - Tier 1 Water Quality Standards* at a minimum, along with the Federal *Wastewater Systems Effluent Regulations*, for discharged effluent. The effluent requirements for the Wabowden wastewater treatment lagoon, at a minimum, would be:

- fecal coliforms of 200/100 ml or less, or E. coli of 200/100 ml or less
- BOD of 25 mg/L or less
- CBOD of 25 mg/L or less

- TSS of 25 mg/L or less
- Total residual chlorine of 0.02 mg/L or less
- Un-ionized ammonia (as N) of 1.25 mg/L or less, at 15˚C
- 1 mg/L Total Phosphorus or demonstrated nutrient reduction strategy.

Additional effluent parameters may be required as part of the Environment Act Licence, to be determined by Manitoba Conservation.

2.5.10.2 Nutrient Management Plan

The *Manitoba Water Quality Standards, Objectives, and Guidelines*, 2011, outline the nutrient reduction requirements for effluent in all new, expanding or modified wastewater treatment facilities. The regulations include province wide standards for biological reduction, suspended solids reduction, phosphorus reduction and where site-specific conditions warrant, nitrogen reduction. The Federal *Wastewater Systems Effluent Regulations*, 2012, outline the limits on un-ionized ammonia concentration in the effluent.

A 1.0 mg/L phosphorus limit applies for effluent upon discharge, with the exception being small wastewater treatment facilities that serve less than 2,000 equivalent people, which have the option of implementing a nutrient reduction strategy instead of the 1.0 mg/L phosphorus limit. Nitrogen reduction to 15 mg/L is required on a site-specific basis depending on the receiving environment for new and expanding wastewater treatment facilities serving more than 10,000 equivalent people. The Wabowden lagoon would not be required to adhere to a nitrogen limit of 15 mg/L, based on the service population. A limit of 1.25 mg/L of un-ionized ammonia applies to all lagoons, however the un-ionized portion of ammonia is pH and temperature dependent, and will increase with higher temperatures and pH. Typically this ammonia limit can be met by regular lagoon operations such as discharging effluent in the spring and fall and not during the warmest period of the summer. Algae blooms in a lagoon can trigger an increase in pH and un-ionized ammonia, however these algae blooms also typically occur during the warmest period of the summer, and so the most simple solution would be to wait until the water temperatures drop in the fall before discharging.

Nutrient reduction strategies include, but are not limited to, effluent irrigation, trickle discharge or constructed wetlands. The guidelines also set the discharge requirements for fecal coliform at 200 organisms/100 ml sample, Total Suspended Solids at 25 mg/L and the Biochemical Oxygen Demand at 25 mg/L (facilities with ammonia or total nitrogen limits have a Carbonaceous Biochemical Oxygen Demand limit of 25 mg/L).

As the original lagoon was designed prior to these guidelines being instituted, the following options were considered to address nutrient management in the design of the Wabowden lagoon expansion, with particular emphasis on phosphorus reduction.

Phosphorus Reduction by Filtration

Sewage treatment plant technology, such as chemical addition and filtration systems could be utilized to reduce the phosphorus concentration in the lagoon. The effluent could be pumped through a filtration system prior to discharge. A chemical flocculent such as alum would have to be added to the wastewater prior to filtration. Backwash containing the phosphorus would be sent back to the primary cell where it would settle out into the sludge blanket at the bottom. The sludge will accumulate in the lagoon for approximately 20 - 25 years before requiring removal.

This level of treatment is costly as equipment and housing is required as well as annual operating costs and chemical costs. An electrical power source is also required, such as a hydro line to the lagoon. It is therefore not a feasible option for the Wabowden lagoon due to the higher capital cost and associated operating and maintenance costs.

Phosphorus Reduction by Surface Chemical Treatment

This option involves application of chemicals such as alum to wastewater in the storage cell(s) to reduce the level of phosphorus in the treated effluent. The alum is broadcast onto the surface of the storage cell(s) utilizing a gas driven pump and spray system from the top of the dike, or from a boat on the surface of the cell(s). The alum produces a chemical reaction with the phosphorus causing a pin floc. The pin floc of phosphorus and the turbidity settle to the bottom. The effluent can then be discharged from the storage cells with a reduced level of phosphorus. This option requires higher operation and maintenance costs and is complicated for the lagoon operator, therefore it is not the preferred option for the Wabowden lagoon.

Constructed or Natural Wetlands

Constructed wetlands or natural wetlands can be used to polish treated effluent from a lagoon, and have the potential to provide nutrient reduction. However, constructing engineered wetlands can require large land areas and add significant construction costs to a project, making the option unfeasible. However, if natural wetlands exist in the vicinity of the lagoon discharge, they can potentially be utilized for enhanced biological and nutrient reduction in the discharge route. The effectiveness of wetlands for polishing lagoon effluent under cold climatic conditions, as experienced in northern Manitoba, has not been established and requires further research. As a natural wetland area is not present near the lagoon discharge route, a constructed/engineered wetland would be required for this option. Due to the uncertain effectiveness of the system and the increased cost, the use of

constructed/engineered wetlands for the Wabowden lagoon was not considered feasible.

Trickle Discharge

A slower discharge of effluent is expected to increase opportunity for nutrients to be taken up by growing plants along the discharge route, which is a means of reducing phosphorus concentration in the treated effluent. The existing drainage route is being proposed for continued used for the expanded lagoon. This drainage route is to the east, from the perimeter ditch to a creek which flows to Rock Island Lake. The total length of the discharge route is approximately 3.3 km (522 m in the ditch and 2.8 km in the creek).

The maximum discharge volume from the lagoon would be approximately 68,586 m^3 (the total available volume in the storage cells). Typically the hydraulic storage volume of the primary cell is not included in the discharge volume, as the intercell valve between the primary and storage cells is closed during lagoon discharge, to prevent untreated effluent in the primary cell from being discharged. If the entire volume of the storage cells was discharged over a 4 week period, the average discharge rate would be approximately 28.4 L/sec.

Based on the trickle discharge rate from the lagoon and the length of drainage route, it is expected that natural uptake of nutrients by the plants and soils will occur prior to the effluent reaching Rock Island Lake.

Public Awareness

In conjunction with the nutrient reduction methods described above, preventative measures can also be taken to reduce nutrients in the wastewater influent. As the majority of the influent to the Wabowden lagoon would be residential in nature, the Community Council is encouraged to inform residents and schools in the community of nutrient reducing strategies, such as using non-phosphate based soap and cleaning products for domestic use. This would reduce the amount of phosphorus being released into the lagoon and reduce the level of treatment required.

Proposed Option

As the population being serviced by the Wabowden lagoon is less than 2,000 people, a nutrient reduction strategy would be recommended, as opposed to a phosphorus limit of 1.0 mg/L prior to discharge. The proposed option to meet the nutrient reduction requirements in a new environmental licence, would be to utilize a trickle discharge from the storage cells (as described above), and continue to utilize the existing drainage route. In addition, the community of Wabowden will be encouraged to notify and educate residents about the importance of nutrient source reduction in their homes.

2.5.11 Expanded Lagoon Layout

The expanded lagoon would consist of the existing primary cell and Storage Cell #1, and the proposed Storage Cell #2 constructed to the southeast of the existing cells. The proposed lagoon layout is shown on Plan L3 in Appendix D.

2.5.12 Expanded Lagoon Design and Construction Details

2.5.12.1 Conceptual Liner Design and Construction Details

Conceptual design plans (Plans L1 to L6) for the lagoon expansion are provided in Appendix D.

Storage Cell #2 would be constructed by excavating to 1.0 m below the cell floor elevation and constructing the horizontal liner of reworked high plastic clay soils. Based on information obtained during the site investigation, the elevations of the high plastic clay soils will need to be field identified during construction, as the elevations varied across the site. Any unsuitable soil material (silt, sand, peat) excavated will be stockpiled and not utilized in the construction of the lagoon liner.

A 3.0 m wide vertical cut-off wall would be extended 1.0 m below the top of the horizontal liner, and constructed of reworked high plastic clay soils from the site excavation. The inner and outer dike slopes would be constructed by compacting a mixture of excavated soil material (clay, silt, topsoil) at slopes of 4H:1V. Storage Cell #2 would have a proposed height of 2.5 m from the cell floor to the top of dike.

A discharge pipe would be installed through the east perimeter dike of Storage Cell #2, with rip rap stone placed around the pipe end to prevent erosion. A valve box would be located on the top of the dike to open and close the discharge pipe, when required. A perimeter ditch around Storage Cell #2 would be constructed and connected to the existing perimeter ditch. The outer slope and perimeter drainage system would prevent surface drainage from entering into the lagoon and prevent ponding of surface water around the perimeter of the lagoon.

The specifications should state that the outer dikes, interior dikes from the high water mark to the top of dike, top of dikes and ditch embankments are to be seeded with a grass such as brome, to prevent soil erosion. A barbed wire fence would be installed along the outside toe of the lagoon cells (existing and proposed), due to the need for existing fence replacement. In addition, two lockable gates would need to be installed, one at either end of the existing lagoon access road, to prevent unauthorized entry.

2.5.12.2 Construction Techniques

All topsoil would be removed to a minimum depth of 0.3 m from the cell construction area including the lagoon cell floor area. All peat would be excavated and removed from the lagoon expansion area prior to construction of the cell liner.

The cell liner is to be compacted to a minimum Standard Proctor Density of 98% in lifts of 150 mm. Embankment and liner material, should be compacted with a minimum of eight passes of a sheepsfoot roller on each 150 mm compacted lift. The cell bottom will be graded to a tolerance of ± 50 mm.

The lagoon construction specifications should indicate that the sheepsfoot roller shall have a minimum foot pressure of no less than 1,700 kPa (250 psi). The drum diameter of the sheepsfoot roller should not be less than 1,200 mm. Each roller should be equipped with cleaning fingers designed to prevent the accumulation of material between the tamping feet. The foot pressure would be calculated by taking the total mass of the roller and dividing it by the greater of: the area of the maximum number of tamping feet in one row parallel to the axis of the roller, or by 5 percent of the total foot area. The roller feet should be at least 200 mm long and should have a minimum area of at least 4,500 mm^2.

A limited range of moisture content should be permitted. The material shall not be so wet nor so dry that compaction equipment cannot compact the fill into a homogeneous mass. Material too wet shall be dried or wasted as directed by the engineer and material too dry shall be wetted as directed by the engineer. All constructed earthen lagoon components shall be graded to a tolerance of ± 50 mm.

2.5.13 Summarized Selected Design Criteria

The following selected criteria would be used for design purposes:

- A 20 year design period
- A total design population of 929 people being serviced from the piped collection system in the community of Wabowden
- A total design population of 150 people on holding tanks from the CaNickel mining camp and Ponton Motel
- A seasonal peak population of 217 people on holding tanks in the Setting Lake Wayside Park Campground
- A winter storage period of 230 days
- A total projected daily organic loading rate of 103.4 kg BOD_5/day, which includes a maximum of two holding tank pump outs per day from the campground
- A total projected hydraulic load of 82,125 m^3 during the 230 day storage period
- A height of 2.5 m from the cell floor to the top of dike in the proposed Storage Cell #2

- An operating depth of 1.44 m in the existing primary cell
- An operating depth of 1.43 m in the existing Storage Cell #1
- A discharge pipe invert of 0.3 m above the cell floor elevation in Storage Cell #2
- Utilization of the existing discharge pipe in Storage Cell #1 as an intercell pipe to the proposed Storage Cell #2
- Utilize reworked and re-compacted high plastic clay soils on site to construct the horizontal liner and vertical cut-off wall in the proposed Storage Cell #2
- The horizontal liner in Storage Cell #2 will be constructed to a minimum thickness of 1.0 m
- A 3.0 m wide vertical cut-off wall constructed with reworked clay soils will extend a minimum of 1.0 m into the horizontal clay liner and extend to the top of dike elevation in Storage Cell #2
- A 4H:1V slope will be used for the inner and outside dikes of Storage Cell #2
- The existing access road, truck turnaround and spillway for trucked effluent would continue to be utilized in the primary cell
- The existing forcemain piping will continue to be utilized into the primary cell
- A 1.5 m high barbed wire fence would be installed around the perimeter of the expanded lagoon
- Two lockable gates would be installed, one at each end of the existing lagoon access road
- Rip rap stone will be installed around the end of the intercell and discharge piping to control erosion
- A perimeter ditch will be constructed around the toe of Storage Cell #2
- Discharge from the lagoon is expected to follow existing drainage route east towards Rock Island Lake
- Site markers, warning signs, and valve markers will be installed.

2.5.14 Decommissioning

The existing lagoon cells will continue to be utilized after the upgrade is completed. Lagoon decommissioning will be considered and examined by the proponent after design year 20 has passed, or at the time a new replacement lagoon is proposed.

Decommissioning would typically require a decommissioning plan submitted to Manitoba Conservation, discussing the removal of liquid and sludge, possible removal of lagoon dikes, site grading and seeding, and future use of the lands.

2.5.15 Lagoon Maintenance and Operation

The expanded lagoon site will have two designated and trained operators from the community of Wabowden.

Maintenance of the expanded lagoon will include:

- Maintaining the fencing, gates and locks
- Ensuring the gate is locked at all times and only the local septic haulers and community Public Works department have access to the site
- Restrict truck hauling to the lagoon primary cell to that specified in Section 2.5.6.1 above
- Monitor liquid level of lagoon
- Sample lagoon effluent prior to and during discharge period, in accordance with the lagoon effluent monitoring plan
- Opening and closing the intercell and discharge piping valves
- Maintain records of discharge events and water quality testing
- Maintaining the intercell and discharge piping and valves in working condition
- Maintain rip rap stone at location of lagoon discharge to prevent erosion of soils
- Maintaining grass cover on dikes to a height of no more than 0.3 m
- Maintain a program to prevent and remove burrowing animals
- Maintain truck turnaround area
- Clearing of snow from the lagoon access road and truck turnaround.

Typical operation of the storage cell(s) in a facultative lagoon will allow for two discharges per year at the peak design loading. During operation, the intercell valve would be opened after the fall discharge of the lagoon and allowed to fill up from winter and spring loadings. Prior to June 15, the intercell valve would be closed and the storage cell effluent would be tested for the discharge criteria. If the test results are acceptable, the storage cell(s) volume from the discharge pipe invert elevation to the maximum operating level would be discharged starting on June 15. Once the storage cell(s) is fully discharged, the intercell valve could be opened and the lagoon cells would be allowed to equalize. The intercell valve would remain open and all of the lagoon cells would be allowed to fill up from the summer hydraulic loadings. The intercell valve would again be closed and the storage cell(s) effluent would be tested for the discharge criteria. If test results are acceptable, the storage cells could be discharged while the primary cell would accept hydraulic loadings to the lagoon during the discharge period. This final discharge would occur prior to the end of the discharge period, before October 31. This discharge procedure would be repeated each year. Specifically for the Wabowden lagoon, the intercell pipe between the two storage cells would typically be left open at all times.

3.0 POTENTIAL ENVIRONMENTAL IMPACTS

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

3.1 Releases to Air, Water, Land

3.1.1 Air

In general, nuisance odours occur in facultative lagoons that are improperly sized and organically overloaded. Odours are also generated under anaerobic conditions, which are common at the bottom of facultative lagoons. During the summer, the lagoon would be aerobic at the surface, facultative at the centre and anaerobic at the bottom. Minimal to no treatment would occur in the winter due to the ice cover on the surface and water temperature; the treatment process would predominantly be anaerobic during winter and would also include solids settling. Therefore, the lagoon may generate some odours for a short time each spring during the thawing or turn-over period when water temperature inversion causes turbulence in the lagoon cells and gases produced from the anaerobic treatment process are brought to the surface. Prevailing winds in the area can carry odours if the area is exposed and wind breaks are not utilized around the lagoon cells. These odours can cause a nuisance to nearby residents.

There is also a potential for greenhouse gas emissions during construction works from heavy equipment and transport vehicles. Impacts from dust generation are not expected as the construction area will meet the minimal setback distances from residences.

3.1.2 Water

Pollutants that may be released into surface water and groundwater during the operation of the lagoon would include coliforms, organic wastes, suspended solids, and other materials that are typically disposed of into the sewer system in a residential community. Pollutants in the wastewater produced by the service population are expected to be residential in nature.

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

Surface Water

Surface water may be impacted if the wastewater is not sufficiently treated and subsequently discharged from the lagoon. Effluent discharged from the lagoon would eventually reach Rock Island Lake. There is also potential to impact surface water via sedimentation from soil erosion in the discharge route during construction.

The discharge from the lagoon should not cause or contribute to flooding in or along the drainage route, therefore the lagoon would not be discharged during flooding conditions. There is no potential to impact the navigation of surface waters as a result of the lagoon expansion, as the existing drainage route is not in the immediate vicinity of a navigable body of water.

Groundwater

There is a potential for groundwater impacts if wastewater leaks/seeps through the lagoon liner or forcemain pipe and into the groundwater below. There is also a potential for groundwater impacts from equipment leaks and/or fuel spills during construction.

3.1.3 Land

The landscape would be altered by construction of the lagoon dikes and perimeter ditching. Fencing would also be installed around the perimeter of the expanded lagoon. Disturbed areas can be impacted through soil erosion if not covered of re-vegetated.

Pollutants that may be released to the land are predominantly petroleum hydrocarbons (PHCs), which could be released during construction activities. Equipment leaks, and/or re-fuelling incidences could result in impacts to the land as a result of construction activities.

3.2 Wildlife

The proposed lagoon site is located in the "Hayes River Upland" Ecoregion of Canada. Characteristic wildlife in the ecoregion include: wolf, lynx, otter, marten, beaver, moose, black bear, woodland caribou, snowshoe hare, red squirrel, short-tailed weasel, red-backed vole and chipmunk. Bird species include: spruce grouse, sharp-tailed grouse, willow ptarmigan, common nighthawk, raven, gray jay, bald eagle, hawk owl and waterfowl species.

The typical concern on any construction project is that wildlife species would being displaced through the construction works. However from observations made during the site investigation it is unlikely that the construction works will have any significant impact on wildlife in the area. In addition, the Manitoba Conservation Data Centre and Wildlife Branch was contacted regarding the proposed lagoon upgrade project and indicated that there is a nearby boreal woodland caribou population in the Wabowden area, however the lagoon expansion area does not interfere with migration corridors or important caribou habitat, therefore they do not have a concern for the development (see correspondence with Manitoba Conservation Wildlife and Ecosystem Protection Branch, June 25, 2013, and June 28, 2013 attached in Appendix B).

Impacts to wildlife and wildlife habitat are not expected to be significant, as the lagoon expansion area is surrounded by the existing lagoon cells, the lagoon access road and the community access road, indicating regular human activity in the direct vicinity.

3.3 Fisheries

The following fish species have been identified in Rock Island Lake according to correspondence with Manitoba Conservation and Water Stewardship Fisheries Branch: northern pike, perch, whitefish, white suckers and tullibee (likely). Rock Island Lake is not commercially fished. There is no specific information identifying spawning or habitat areas near the discharge location (see email correspondence with Fisheries Branch in Appendix B).

The typical concerns for impacts to fish and fish habitat are from sediments released during construction and the lagoon effluent discharges into a body of surface water utilized by fish species. These impacts could include the reduction of water quality or physical disturbances which would create an unfavorable environment for fish or fish eggs. However, impacts to fish along the discharge route are unlikely as the lagoon effluent would not be discharged directly into a body of surface water with known fish species. In addition, lagoon discharge would only occur after the spring fish spawning period has occurred and only when the treated effluent meets the water quality requirements of the Environment Act Licence for lagoon discharges.

3.4 Forestry

The area of the lagoon expansion is a forested parcel of land, which has been partially cleared. The potential impacts to forestry are low, as the area of lagoon expansion is not a commercially forested area. It is intended that the timber cleared from the site during the construction works will be utilized by the community as a source of firewood.

3.5 Vegetation

Characteristic vegetation in the Hayes River Upland Ecoregion includes: black spruce, jack pine, paper birch, willow and alder shrubs, mosses, lichens, low ericaceous shrubs and herbs. Some areas also consist of trembling aspen, white birch, white spruce and balsam fir, depending on climate and soil conditions. From site observations the tree species identified in the lagoon expansion area were black spruce, trembling aspen and balsam fir.

There is a potential concern for the removal of vegetative species through the construction works, however Manitoba Conservation Wildlife and Ecosystem Protection Branch was contacted regarding occurrences of rare or endangered vegetative species in their database at the proposed lagoon expansion site. There were no occurrences of rare species identified at the development site (see correspondence with Manitoba Conservation Wildlife and Ecosystem Branch, June 25, 2013, attached in Appendix B).

3.6 Noise Impacts

There is a potential for noise impacts in the immediate area of lagoon expansion due to the heavy equipment utilized during construction. Other than maintenance vehicles (for lagoon maintenance or mowing grass) or wastewater hauling trucks, the operation of the lagoon itself, will not have a potential for noise impacts.

3.7 Health and Safety

There is a potential for impacts to the health and safety of workers and the public during the construction works, as heavy equipment will be utilized on site.

3.8 Heritage Resources

The Community Council was not aware of any historic, traditional or heritage resources located at the proposed lagoon expansion site. The Manitoba Historic Resources Branch was contacted regarding the proposed site. The Historic Resources Branch indicated that the potential to impact significant heritage resources is low and that they have no concerns with the project (see correspondence with Manitoba Historic Resources Branch, June 25, 2013, in Appendix B).

Manitoba Aboriginal and Northern Affairs has also reviewed the site location and has no concerns for the proposed development site in regards to heritage, traditional or historic resources. While impacts to historic or heritage resources are not expected at the site, there is always potential for an unexpected discovery when excavating an area which has not recently been excavated.

3.9 Socio-Economic Implications

The lagoon expansion is not expected to have adverse socio-economic impacts. In fact, construction related economic activity is likely to have a positive economic impact on the community. In addition the community would have increased wastewater capacity upon completion of the project, which will encourage continued growth in the community. The timber resources from the expansion area will be utilized as firewood for the community and campground, which will have a positive impact.

Traffic in the community will increase from heavy construction equipment and transportation vehicles traveling to the construction site, however these impacts will only be temporary and will only take place during daylight hours, and during the construction schedule. It is possible that the community access road may be used by construction vehicles during construction which may limit the road accessibility.

3.10 Aesthetics

The lagoon expansion is not expected to have significant impacts on the general aesthetics of the area, as the lagoon construction would occur adjacent to the existing lagoon cells, on land which does not have any designated aesthetic qualities. A tree line would be maintained along the community access road to retain a natural forested look from the community access road.

4.0 MANAGEMENT PRACTICE

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

4.1 Mitigation of Impacts to Air

To reduce the potential for odour nuisance in the community, the primary cell has been sized for the projected year 20 organic loadings, from the service population. This also takes into consideration the maximum allowable organic loading rate of 56 kg BOD_5/ha/day into the lagoon primary cell, which impacts the odours generated from a wastewater treatment lagoon peak organic loading during septic truck dumping. The community will be required to limit the amount of truck hauled dumping to two holding tank loads per day from the campground, as discussed in Section 2.5.6.1 above. Therefore, nuisance odours as a result of organic over-loading are not expected.

Although the lagoon would likely generate some odours for a short time each spring, during the thawing or turn-over period, prevailing (i.e. northwesterly) winds should not cause significant impacts to the community from drifting odours, as the community is located northeast of the lagoon. Furthermore, the expanded lagoon would be located a minimum of 300 metres from the nearest resident and 460 metres from the centre of the community, as required by Manitoba Conservation.

Emissions from construction equipment and transport vehicles will be controlled through regular maintenance by the contractor, and will meet all provincial and local standards. Dust suppression methods (i.e. water spraying) will be utilized at the construction site if dry conditions create excessive dust through construction activities and transport, and becomes a nuisance to nearby residents. Due to the setback distance from residences and the surrounding forested land, it is unlikely that dust will have any impact on the community or nearby residents.

4.2 Mitigation of Impacts to Water

4.2.1 Surface Water

Impacts to surface water from discharge of lagoon effluent are not expected, as the lagoon effluent would not be discharged unless Tier I Manitoba Water Quality Standards, Objectives and Guidelines, and the Federal Wastewater Systems Regulations, as described in Section 2.5.9.1 above.

Impacts to nearby surface waters due to discharge of the lagoon are not expected, as treatment will occur in the lagoon cells and measures such as a trickle discharge would be utilized to further reduce nutrient loading to downstream surface waters.

Erosion from any excess material stockpiles would be prevented by the use of silt fencing at drainage locations and by either covering any bare soil stockpiles temporarily or seeding with grass if stockpile is to remain after construction is complete. Clean rock material from an appropriate land-based source would be utilized as rip rap to reduce occurrence of erosion at the lagoon discharge outlet. Silt fencing would be installed in the perimeter ditching during

construction and should remain in place until grass growth is established in disturbed areas. Perimeter ditch slopes would be seeded with grass to control erosion and sediment entry into the discharge route. Disturbance of the soils adjacent to the perimeter ditches and discharge route would be minimized during construction.

To minimize impacts from construction equipment on surface waters, the construction specifications should outline to the contractor the requirements for handling and storage of fuels and hazardous materials during construction, as per federal and provincial regulations. The construction specifications should state wording similar to the following:

- Diesel or gasoline should be stored in double walled tanks or have containment dikes around fuel containers for volumes greater than 68.2 L (15 gallons) or in compliance with provincial regulations
- Clean up material should be available at the site, consisting of a minimum of 25 kg of suitable commercial sorbent, 30 m^2 of 6 mil PVC, and an empty fuel barrel for spill collection and disposal
- Fuel storage and hazardous material areas established for project construction should be located a minimum of 100 m from a waterbody or drainage route
- Waste hazardous materials from construction activities and equipment must be properly collected and disposed of in compliance with provincial regulations
- In the event of spills or leaks of fuels and hazardous materials, the contractor or operator should notify the project engineer and provincial authorities.

Hazardous material handling and storage are to follow all provincial and federal regulations including WHMIS and spill containment requirements.

The specifications should state that when working near water with construction equipment:

- Construction equipment is to be properly maintained to prevent leaks and spills of fuels, lubricants, hydraulic fluids or coolants
- There can be no re-fueling or servicing of construction equipment within 100 m of a water body or drainage route.

If flooding occurs along the drainage route, the community must not discharge the lagoon. The discharge should not cause or contribute to flooding in or along the drainage route. Overland flooding around the lagoon would be unlikely as there are no significant bodies of water in the direct vicinity of the lagoon.

4.2.2 Groundwater

Seepage of effluent from the lagoon is unlikely to affect groundwater as the lagoon expansion cell would utilize a reworked clay liner, having a minimum thickness of 1.0 m and a hydraulic conductivity of 1 x 10^{-7} cm/sec or less, as required by Manitoba Conservation.

Mitigation of potential impacts to groundwater during the lagoon construction activities from fuel handling, equipment leaks or fuel spills, would follow the same procedures as described above.

4.3 Mitigation of Impacts to Land

As the lagoon would utilize a clay liner, seepage to the surrounding land is expected to be negligible. To minimize the potential for the release of Petroleum Hydrocarbon (PHC) pollutants into the soil, the mitigation measures described in Section 4.2.1 above, outlining fuel-handling procedures, should be followed.

To minimize the potential for slope erosion, the outside slopes of the newly constructed dikes would be constructed at 4H:1V. In addition, the dike tops, outside slopes and permanent soil stockpiles would be seeded with grass. The location of the discharge pipe outlet would be covered with rip rap stone to minimize potential soil erosion into the ditch during discharge events.

4.4 Mitigation of Impacts to Vegetation

The removal of vegetation will be limited to the construction area by clearly marking the site boundaries prior to construction. Vegetation outside of this construction area will not be damaged.

4.5 Mitigation of Noise Impacts

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

4.6 Mitigation of Impacts to Health and Safety

To minimize impacts to health and safety of workers and the public, the construction specifications should state that the contractor have a safety program in place, in accordance with all federal and provincial health and safety regulations. During construction, site access will be limited to the construction crew only. Personal protective equipment will be worn in accordance with the contractor's safety program. The lagoon will be surrounded with a barbed wire fence and lockable gates to prevent public access during lagoon operation.

4.7 Mitigation of Impacts to Heritage Resources

If any significant historic or heritage resources are discovered in the course of excavation or construction, the specifications should identify that works are to temporarily cease and an investigation of the site is to be conducted by the community, Manitoba Historic Resources Branch and any other provincial or federal authority as may be required.

4.8 Socio-Economic Implications

If traffic from the construction activities limits access to the community access road, the contractor will place warning signs on the road and provide flagmen to direct traffic around the areas of construction.

5.0 RESIDUAL AND CUMULATIVE EFFECTS

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

No negative residual effects are anticipated through the construction and operation of the expanded wastewater treatment lagoon, due to the mitigation measures described above. Positive residual effects are expected from the properly sized wastewater treatment system, which will allow for expansion of the service area in the future. A properly sized lagoon will also prevent the requirements for emergency discharges in the future. The timber resources removed from the expansion site will be stockpiled at the community public works yard for processing into firewood. This will require the temporary use of land at the public works yard, which needs to be considered by the community. No other construction projects in the area are expected to create cumulative effects on the service area.

6.0 MONITORING AND FOLLOW-UP

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

Monitoring of the lagoon operation is to be conducted by a trained lagoon operator, who is to ensure the lagoon is operated under the requirements of the environmental licence. The operator is to ensure liquid levels in the lagoon cells are maintained within the required limits; conduct sampling of lagoon effluent prior to and during discharge; and is to ensure water quality guidelines as described in the Environment Act Licence are met. The operator is also to maintain records of discharge events and water quality monitoring. If there are any concerns with the operation of the lagoon, the owner is to contact the local environment officer to discuss options. The construction contractor is to ensure that grass growth occurs on slopes and disturbed areas, after the construction activities are completed.

7.0 FUNDING AND APPROVALS

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

Funding for this project is being obtained through MANA. A work permit will be required through Manitoba Conservation and Water Stewardship, Lands Branch for the construction works to commence. A timber permit will be required through Manitoba Conservation and Water Stewardship, Forestry Branch for the clearing of timber resources from the site. No additional approvals, licences or permits are required for the lagoon construction and operation. The Community Council will also be responsible for registering the lagoon with Environment Canada and providing annual monitoring reports to Environment Canada under the Federal *Wastewater Systems Effluent Regulations*.

8.0 PUBLIC CONSULTATION

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

Public consultation through a designated public forum, by the community of Wabowden Council, has not been conducted to date for the residents of Wabowden and is not being planned in the future. Any public concerns raised by residents will be addressed by the Community Council. Public comments received by Manitoba Conservation through the public registry during the Environmental Act Proposal review period will be addressed prior to lagoon construction.

9.0 CONCLUSION

Based on the design of the project and the implementation of the mitigation measures identified in Section 4.0 above, no significant negative environmental impacts are anticipated.

The proponent would like to complete the requirements of the Environment Act Proposal as soon as possible so that the lagoon design and construction can begin in accordance with the proposed project schedule as outlined in Section 2.5.1 above.

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

APPENDICES

Appendix A

Crown Lands & Property Agency – Lands Branch, June 13, 2014 Email Correspondence and Lot Plan

Appendix B

Table 1: Community of Wabowden Population, Hydraulic, and Organic Loading Projections

Manitoba Conservation and Water Stewardship – Fisheries Branch, June 21, 2013 Email Correspondence

Manitoba Conservation and Water Stewardship - Wildlife and Ecosystem Protection Branch, June 25, 2013 Email Correspondence

Manitoba Culture, Heritage, Tourism and Sport – Historic Resources Branch, June 25, 2014 Email Correspondence

Manitoba Conservation and Water Stewardship – Wildlife Branch, June 28, 2013 Email Correspondence

Appendix C

Test Hole Logs

Stantec Consulting Ltd. Soils Analysis Report, March 4, 2014

Driller's Well Logs

Appendix D

Title Page

Plan L1: Existing Lagoon and Test Hole Location Plan

Plan L2: Expanded Lagoon with Setbacks

Plan L3: Proposed Lagoon Layout Plan

Plan L4: Proposed Lagoon Drainage Route

Plan L5: Dike Details

Plan L6: Fence, Silt Fence, Valve, Sign, Valve Marker, Rip Rap and Ditch Details

Appendix A

Crown Lands & Property Agency – Lands Branch, June 13, 2014
Email Correspondence and Lot Plan

Oswald Wohlgemut

From: Little, Karen (CLPA) [Karen.Little@gov.mb.ca]
Sent: Thursday, June 13, 2013 11:25 AM
To: 'Oswald Wohlgemut'
Subject: RE: Wabowden Lagoon Expansion Project - Mineral Rights
Attachments: 5712 NLTO 1.jpg

Good morning Oswald, according to The Crown Land Registry System this date:

- Parcel "A" Plan 5712 NLTO in Section 20-68-8 WPM and Parcel "B" Plan 5712 NLTO in E ½ 20-68-8 WPM are reserved on behalf of the Community Council of Wabowden for maintaining a sewage lagoon (SLAG06808W).
- The Mines & Minerals and Sand & Gravel within these two parcels are owned by the Province of Manitoba (HMQ Manitoba).

Sincerely,

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

CLPA

An Agency of MB Infrastructure and Transportation

From: Oswald Wohlgemut [mailto:owohlgemut@jrcc.ca]
Sent: June-12-13 4:47 PM
To: Little, Karen (CLPA)
Subject: Wabowden Lagoon Expansion Project - Mineral Rights

Hello Karen,

JR Cousin Consultants Ltd. is submitting an Environmental Act Proposal for the Ministry of Aboriginal and Northern Affairs, regarding the Community of Wabowden Lagoon expansion project (located at SW 20-68-8 WPM). Based on conversations with MANA, the land currently used for the lagoon is owned by the Crown and reserved for the community under Reservation No. SLAG06808W. The existing lagoon and expansion area are identified under Plan 5712 Lot A. Could you confirm who owns the mineral rights in this parcel of land?

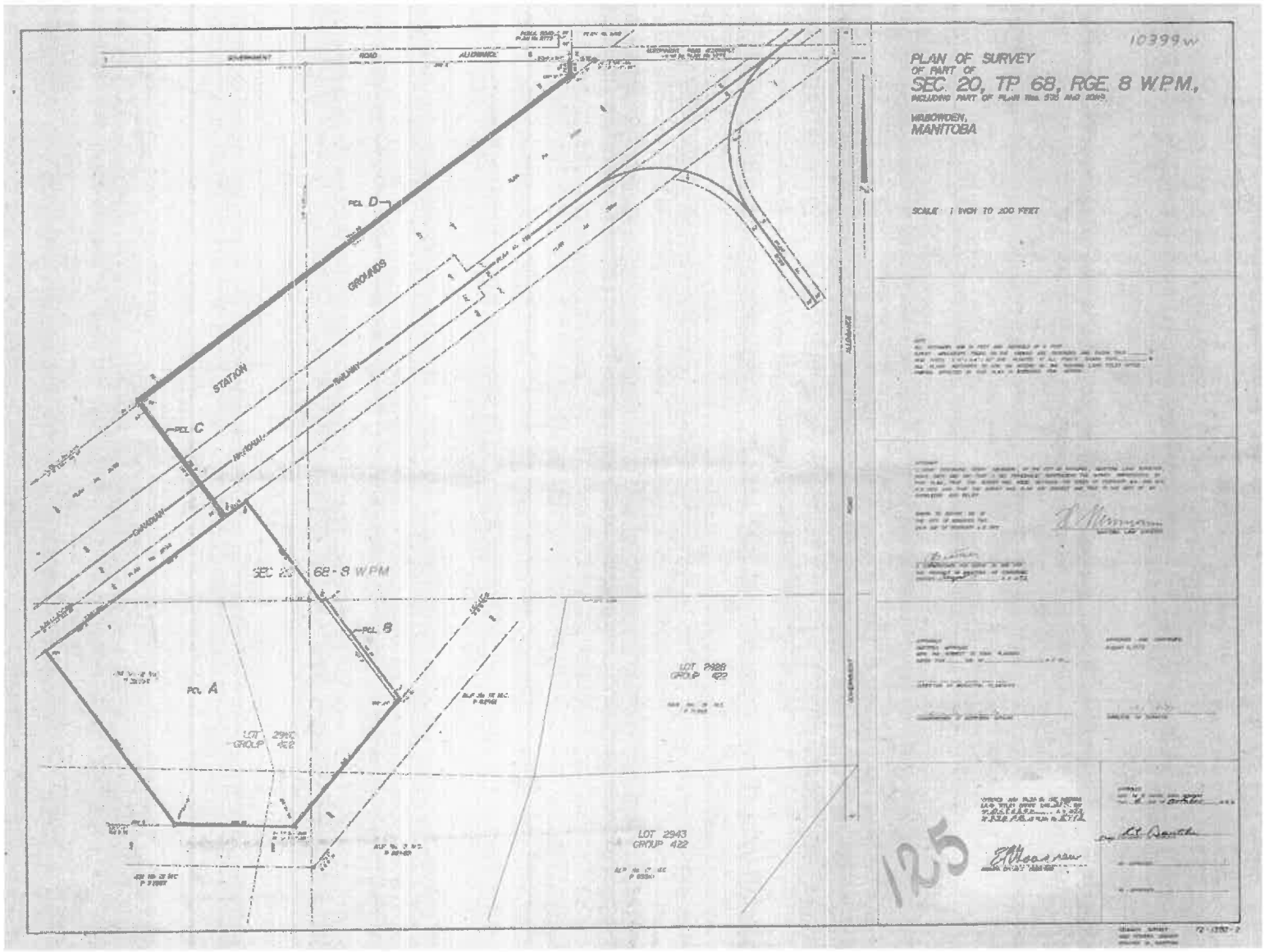
Let me know if you have any questions.

Thank you,

Oswald Wohlgemut, M.Sc.
Environmental Scientist

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

5712 nlto 1.jpg (6265x4712x24b jpeg)



Appendix B

Table 1: Community of Wabowden Population, Hydraulic, and Organic Loading Projections

Manitoba Conservation and Water Stewardship – Fisheries Branch, June 21, 2013
Email Correspondence

Manitoba Conservation Wildlife and Ecosystem Protection Branch, June 25, 2013
Email Correspondence

Manitoba Culture, Heritage, Tourism and Sport – Historic Resources Branch, June 25, 2013
Email Correspondence

Manitoba Conservation and Water Stewardship – Wildlife Branch, June 28, 2013
Email Correspondence

Table 1: Community of Wabowden Population, Hydraulic, and Organic Loading Projections

TABLE 1: COMMUNITY OF WABOWDEN - POPULATION, HYDRAULIC AND ORGANIC LOADING PROJECTIONS

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13	Col 14	Col 15	Col 16	Col 17	Col 18	Col 19
		Population				**Hydraulic Loading**								**Organic Loading**				
Calendar Year	**Design Year**	Wabowden Population Growth per year 1.8%	CaNickel Mine Population Growth per year 0.0%	Setting Lake Wayside Park Campground Seasonal Population Growth per year 0.0%	Ponton Motel Population Growth per year 0.0%	Daily per Capita Wastewater Production* Wabowden (litres)	Daily per Capita Wastewater Production CaNickel Mine (litres)	Daily per Capita Wastewater Production Settling Lake Wayside Park Campground (140 day season) (litres)	Daily per Capita Wastewater Production Ponton Motel (litres)	Daily Wastewater Production Commercial Businesses (litres)	Daily Wastewater Production WTP Backwash (litres)	Daily Wastewater Production All Sources (cu. m.)	Wastewater Volume **For 230 Days** All Sources (cu. m.)	Daily per Capita B.O.D. Community of Wabowden, CaNickel Mine, Ponton Motel (kg)	B.O.D. DAILY LOADING Holding Tank Hauling from Cermmercial Businesses (kg)	B.O.D. PEAK DAILY LOADING Septage Hauling from Campground (max 2 holding tank loads) (kg)	Daily B.O.D. Production All Sources (kg)	Primary Cell Area Req'd at 0.75 m (@56kgBOD/ha/day) (sq. m.)
2014	0	650	150	182	10	360	46	30	190	390	13500	257	59,048	0.076	0.07	20.6	82.2	14,684
2015	1	662	150	182	10	360	46	30	190	390	13500	261	60,016	0.076	0.07	20.6	83.1	14,843
2016	2	674	150	182	10	360	46	30	190	390	13500	265	61,003	0.076	0.07	20.6	84.0	15,004
2017	3	686	150	182	10	360	46	30	190	390	13500	270	62,007	0.076	0.07	20.6	84.9	15,169
2018	4	698	150	182	10	360	46	30	190	390	13500	274	63,029	0.076	0.07	20.6	85.9	15,336
2019	5	711	150	182	10	360	46	30	190	390	13500	279	64,069	0.076	0.07	20.6	86.8	15,507
2020	6	723	150	217	10	360	46	30	190	390	13500	283	65,130	0.076	0.07	20.6	87.8	15,681
2021	7	736	150	217	10	360	46	30	190	390	13500	288	66,208	0.076	0.07	20.6	88.8	15,857
2022	8	750	150	217	10	360	46	30	190	390	13500	293	67,306	0.076	0.07	20.6	89.8	16,037
2023	9	763	150	217	10	360	46	30	190	390	13500	297	68,423	0.076	0.07	20.6	90.8	16,220
2024	10	777	150	217	10	360	46	30	190	390	13500	302	69,561	0.076	0.07	20.6	91.9	16,407
2025	11	791	150	217	10	360	46	30	190	390	13500	307	70,719	0.076	0.07	20.6	92.9	16,597
2026	12	805	150	217	10	360	46	30	190	390	13500	313	71,897	0.076	0.07	20.6	94.0	16,790
2027	13	820	150	217	10	360	46	30	190	390	13500	318	73,097	0.076	0.07	20.6	95.1	16,986
2028	14	834	150	217	10	360	46	30	190	390	13500	323	74,319	0.076	0.07	20.6	96.2	17,187
2029	15	849	150	217	10	360	46	30	190	390	13500	329	75,563	0.076	0.07	20.6	97.4	17,391
2030	16	865	150	217	10	360	46	30	190	390	13500	334	76,829	0.076	0.07	20.6	98.5	17,598
2031	17	880	150	217	10	360	46	30	190	390	13500	340	78,117	0.076	0.07	20.6	99.7	17,809
2032	18	896	150	217	10	360	46	30	190	390	13500	345	79,429	0.076	0.07	20.6	100.9	18,024
2033	19	912	150	217	10	360	46	30	190	390	13500	351	80,765	0.076	0.07	20.6	102.2	18,243
2034	**20**	**929**	**150**	**217**	**10**	**360**	**46**	**30**	**190**	**390**	**13500**	**357**	**82,125**	**0.076**	**0.07**	**20.6**	**103.4**	**18,466**

* Includes infiltration

Manitoba Conservation and Water Stewardship – Fisheries Branch,
June 21, 2013 Email Correspondence

Oswald Wohlgemut

From: Janusz, Laureen R (CWS) [Laureen.Janusz@gov.mb.ca]
Sent: Friday, June 21, 2013 12:18 PM
To: 'Oswald Wohlgemut'
Cc: Macdonald, Don (CWS)
Subject: Fish Info Rock Island Lake

Hi Oswald,

I have checked our files and also spoke with the regional fisheries manager regarding information on Rock Island Lake. There is nothing in our files.

According to Don Macdonald, Regional Fisheries Manager, there is *mainly pike, with perch, whitefish and white suckers*. He would assume there are also tullibee, but does not know for sure. It is not currently commercially fished. Licences were issued in the distant past, but no production was ever recorded.

There is no specific information that identifies spawning or other important habitats near the discharge location (NW 22-68-8). On the map it looks like it is north east of where Rock Island Creek enters the lake. In an Environmental Effects Monitoring report done for CaNickel the following is noted: *Northern Pike (Esox lucius) are known to migrate upstream from Halfway Lake to spawn in Rock Island Lake and the lower third of the Bucko Lake Outlet (i.e. Bucko Creek).* I believe that Don also indicated that Lake Whitefish also migrate up to spawn in Rock Island Lake.

Given there are lake whitefish present, it would be beneficial to plan for increased lagoon capacity so effluent can be held for a longer period of time (i.e. no release between September 1 – June 30th).

Oswald it might be worth trying to locate the EIS submission for Bucko Lake Mine. We believe there is a description of Rock Island Lake in that document. We had issued a permit to Agassiz North in 2000 for them to conduct the studies supporting that EIS. Unfortunately it does not appear that a report summarizing the fish collections was ever submitted to us.

If you have any questions please feel free to contact either Don or I. Thanks.

Any questions
Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch
Conservation and Water Stewardship
Phone: 204 945-7789
Cell: 204 793-1154
Email: Laureen.Janusz@gov.mb.ca

From: Oswald Wohlgemut [mailto:owohlgemut@jrcc.ca]
Sent: June-12-13 5:02 PM
To: Janusz, Laureen R (CWS)
Subject: Fish Species - Rock Island Lake

Hello Laureen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environment Act Proposal on behalf of Manitoba Aboriginal and Northern Affairs for the Community of Wabowden Lagoon Expansion Project. The proposed expansion will be located adjacent to the existing lagoon cells and will discharge into Rock Island Lake located at NW 22-68-8 WPM.

If you have the data, please provide a list of fish species known to exist in Rock Island Lake and any fish spawning information you may have near the discharge area, as we would like to include this information in the Environment Act Proposal.

Please do not hesitate to contact us if you have any questions.

Thank you,

Oswald Wohlgemut, M.Sc.
Environmental Scientist

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

Manitoba Conservation Wildlife and Ecosystem Protection Branch,
June 25, 2013 Email Correspondence

Oswald Wohlgemut

From: Friesen, Chris (CWS) [Chris.Friesen@gov.mb.ca]
Sent: Tuesday, June 25, 2013 2:16 PM
To: 'Oswald Wohlgemut'
Cc: Trim, Vicki (CWS)
Subject: RE: Wabowden Lagoon - Species at Risk

Oswald

Thank you for you information request. I completed a search of the Manitoba Conservation Data Centre database for your area of interest. This area is within the range of a caribou herd – please contact Vicki Trim (copied) for questions about potential impacts and mitigation.

The information provided in this letter is based on existing data known to the Manitoba Conservation Data Centre of the Wildlife and Ecosystem Protection Branch at the time of the request. These data are dependent on the research and observations of our scientists and reflects our current state of knowledge. An absence of data does not confirm the absence of any rare or endangered species. Many areas of the province have never been thoroughly surveyed, therefore, the absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present. The information should not be regarded as a final statement on the occurrence of any species of concern, nor should it substitute for on-site surveys for species or environmental assessments. Also, because our Biotics database is continually updated and because information requests are evaluated by type of action, any given response is only appropriate for its respective request.

Please contact the Manitoba CDC for an update on this natural heritage information if more than six months passes before it is utilized.

Third party requests for products wholly or partially derived from our Biotics database must be approved by the Manitoba CDC before information is released. Once approved, the primary user will identify the Manitoba CDC as data contributors on any map or publication using data from our database, as the Manitoba Conservation Data Centre; Wildlife and Ecosystem Protection Branch, Manitoba Conservation.

This letter is for information purposes only - it does not constitute consent or approval of the proposed project or activity, nor does it negate the need for any permits or approvals required by the Province of Manitoba.

We would be interested in receiving a copy of the results of any field surveys that you may undertake, to update our database with the most current knowledge of the area.

If you have any questions or require further information contact me directly at (204) 945-7747.

Chris Friesen
Biodiversity Information Manager
Manitoba Conservation Data Centre
204-945-7747
chris.friesen@gov.mb.ca
http://www.gov.mb.ca/conservation/cdc/

From: Oswald Wohlgemut [mailto:owohlgemut@jrcc.ca]
Sent: June-19-13 12:02 PM
To: Friesen, Chris (CWS)
Subject: Wabowden Lagoon - Species at Risk

Hello Chris,

J.R. Cousin Consultants is conducting an Environment Act Proposal on behalf of Manitoba Aboriginal and Northern Affairs for the Community of Wabowden lagoon expansion project. The construction works will occur at SW 20-68-8 WPM. The area proposed for expansion is a naturally forested area located adjacent to the existing lagoon cells. Works will include dike construction, perimeter ditch construction and fence installation.

Please provide information on any at risk wildlife and plant species that are known to exist in the location outlined above, as well as any registered habitat areas, as we would like to include that information in the Environmental Assessment.

Please let us know if you have any questions.

Thank you,

Oswald Wohlgemut, M.Sc.
Environmental Scientist

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

Manitoba Culture, Heritage, Tourism and Sport – Historic Resources Branch, June 25, 2013 Email Correspondence

Oswald Wohlgemut

From: Sitchon, Myra (CHT) [Myra.Sitchon@gov.mb.ca]
Sent: Tuesday, June 25, 2013 3:14 PM
To: 'Oswald Wohlgemut'
Subject: Re: No concerns - Wabowden Lagoon Project

Good afternoon,
In response to your memo regarding the above-noted proposed project, I have examined Branch records for areas of potential concern. The potential to impact significant heritage resources is low, and, therefore, the Historic Resources Branch has no concerns with the project.

If at any time however, significant heritage resources are recorded in association with these lands during development, the Historic Resources Branch may require that an acceptable heritage resource management strategy be implemented by the developer to mitigate the effects of development on the heritage resources.

If you have any questions or comments, please contact me at 945-6539.

Thanks,
Myra

Myra L. Sitchon,
Impact Evaluation Archaeologist,
Archaeological Assessment Services Unit,
Historic Resources Branch
Main Floor- 213 Notre Dame Avenue, Winnipeg, MB R3B 1N3
myra.sitchon@gov.mb.ca

Phone: (204) 945-6539
Toll Free: 1-800-282-8069+extension(6539)
Fax: (204) 948-2384
Website: http://www.manitoba.ca/heritage

Manitoba
Culture, Heritage and Tourism

Manitoba Conservation and Water Stewardship – Wildlife Branch,
June 28, 2013 Email Correspondence

Oswald Wohlgemut

From: Trim, Vicki (CWS) [Vicki.Trim@gov.mb.ca]
Sent: Friday, June 28, 2013 3:21 PM
To: Oswald Wohlgemut
Subject: RE: Wabowden Lagoon - Species at Risk
Attachments: Wabowden Boreal Woodland Caribou Relocations 2009to2013.jpg; Wabowden Caribou Locations in Relation to Bucko Lake Lagoon Expansion.jpg

Good afternoon Oswald,

I have attached two maps showing locations of the Wabowden boreal woodland caribou population. Locations represent GPS relocations collected from Iridium neck collars deployed since January 2009 to the present. Approximately 50 female caribou have been collared to date in the Wabowden range.

The first map shows locations recorded within the Wabowden caribou range from all 50 (approx.) collars. The second maps shows locations in proximity to the Lagoon Expansion Area. About 10% of the collared caribou have inhabited areas in proximity to Bucko Lake during spring, summer and fall.

No caribou observations have been recorded at or immediately adjacent to the LEA. As you can see in the second map, the LEA is approximately 2 km from the closest recorded caribou location. Development of the Lagoon Expansion is not a concern w.r.t. the Wabowden boreal woodland caribou population as this area does not intersect or interfere with migration corridors or important caribou habitat such as calving, rutting or winter sites.

If you need any more information, please do not hesitate to contact me.

Sincerely,

Vicki Trim
Caribou Biologist
Wildlife Branch
Conservation and Water Stewardship
Box 28, 59 Elizabeth Drive
Thompson MB R8N 1X4
blackberry: 204-679-0659
fax: 204-677-6359
email: Vicki.Trim@gov.mb.ca

Please note that I no longer have an office landline but I can be reached on my blackberry at 204-679-0659.

From: Oswald Wohlgemut [mailto:owohlgemut@jrcc.ca]
Sent: June-26-13 1:41 PM
To: Trim, Vicki (CWS)
Subject: Wabowden Lagoon - Species at Risk

Hello Vicki,

I was forwarded your information from Chris Friesen at the Manitoba Conservation Data Centre with regards to a potential concern of caribou near a proposed lagoon expansion project in the Community of Wabowden at SW 20-68-8

WPM. The expansion is to occur in a parcel of land located to the southeast and adjacent to the existing lagoon cells adjacent and the lagoon access road (see attached plan).

From a review of species at risk in the project area Mr. Friesen informed us of a possible concern for caribou in the area. Could you provide additional information regarding potential caribou habitats, migration routes and concerns relating to the proposed project.

Let us know if you have any questions.

Thank you,

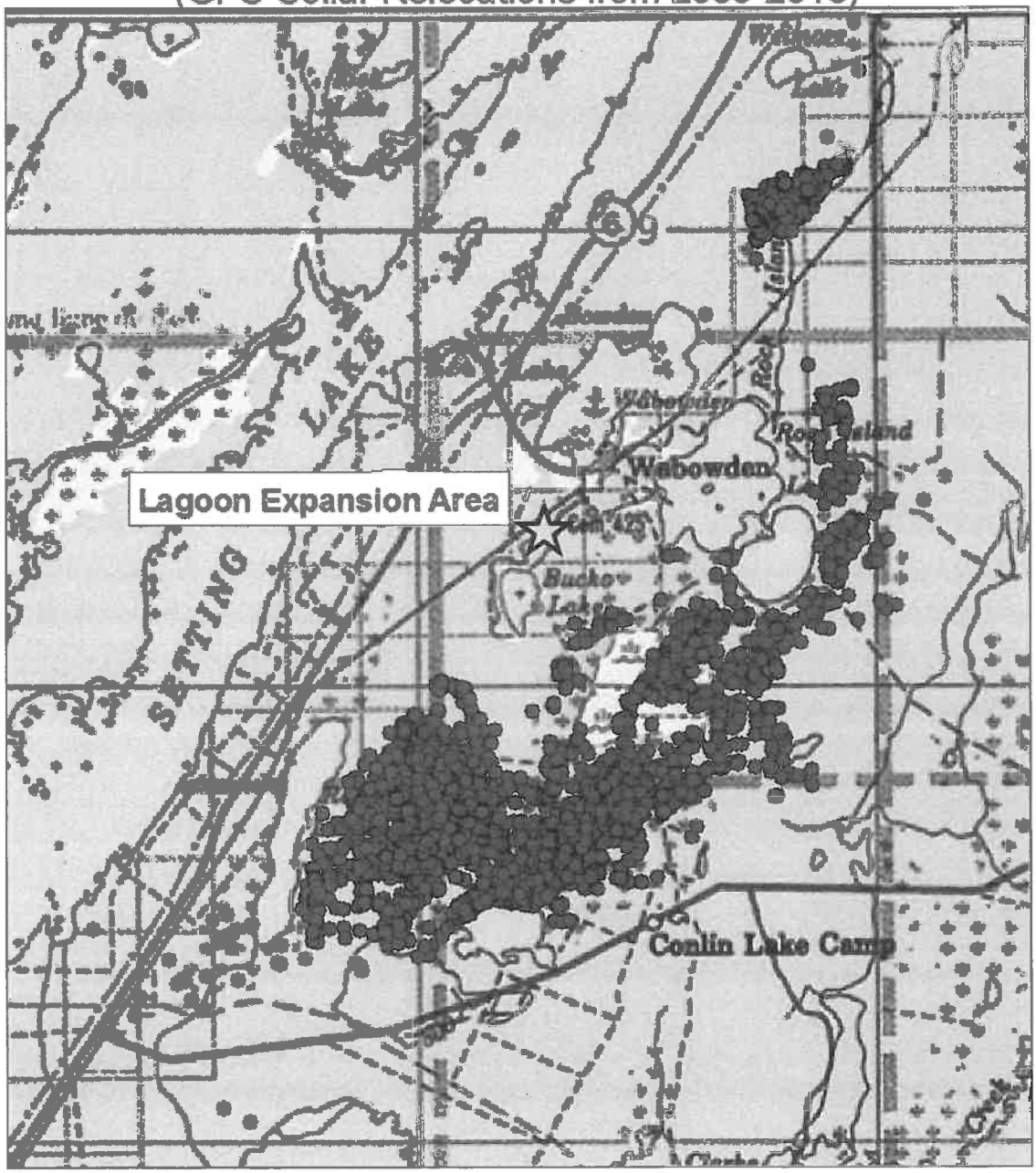
Oswald Wohlgemut, M.Sc.
Environmental Scientist

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

wabowden caribou locations in relation to bucko lake lagoon expansion.jpg (816x1056x24b jpeg)

Wabowden Boreal Woodland Caribou Locations In Relation to Bucko Lake Lagoon Expansion Area

(GPS Collar Relocations from 2009-2013)



Manitoba Conservation and Water Stewardship
Created June 28, 2013 by Vicki Trim
*For display purposes only

Appendix C

Test Hole Logs

Stantec Consulting Ltd. Soils Analysis Report, March 4, 2014

Driller's Well Logs

Test Hole Logs

J. R. Cousin Consultants Ltd.

TEST HOLE LOGS

SYMBOL INDEX


GW. : Well graded gravels and gravel sand mixtures, little or no fines


GP. : Poorly graded gravels, gravel - sand mixtures, little or no fines


GM. : Silty gravels, gravel-sand-silt mixtures


GC. : Clayey gravels, gravel-sand-clay mixtures


SW. : Well graded sands, gravelly sands, little or no fines


SP. : Poorly graded sands, or gravelly sands, little or no fines


SM. : Silty sands, sand-silt mixtures


SC. : Clayey sands, sand-clay mixtures


ML. : Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity


CL. : Inorganic clays of low plasticity, gravelly clays, sandy or silty clays, lean clays


OL. : Organic silts and organic silty clays of low plasticity


CI. : Inorganic clays of medium or intermediate plasticity


MH. : Inorganic silts, fine sandy or silty soils


CH. : Inorganic clays of high plasticity, fat clays


OH. : Organic clays of medium to high plasticity, organic silts


Pt. : Peat, humus, swamp soils with high organic contents

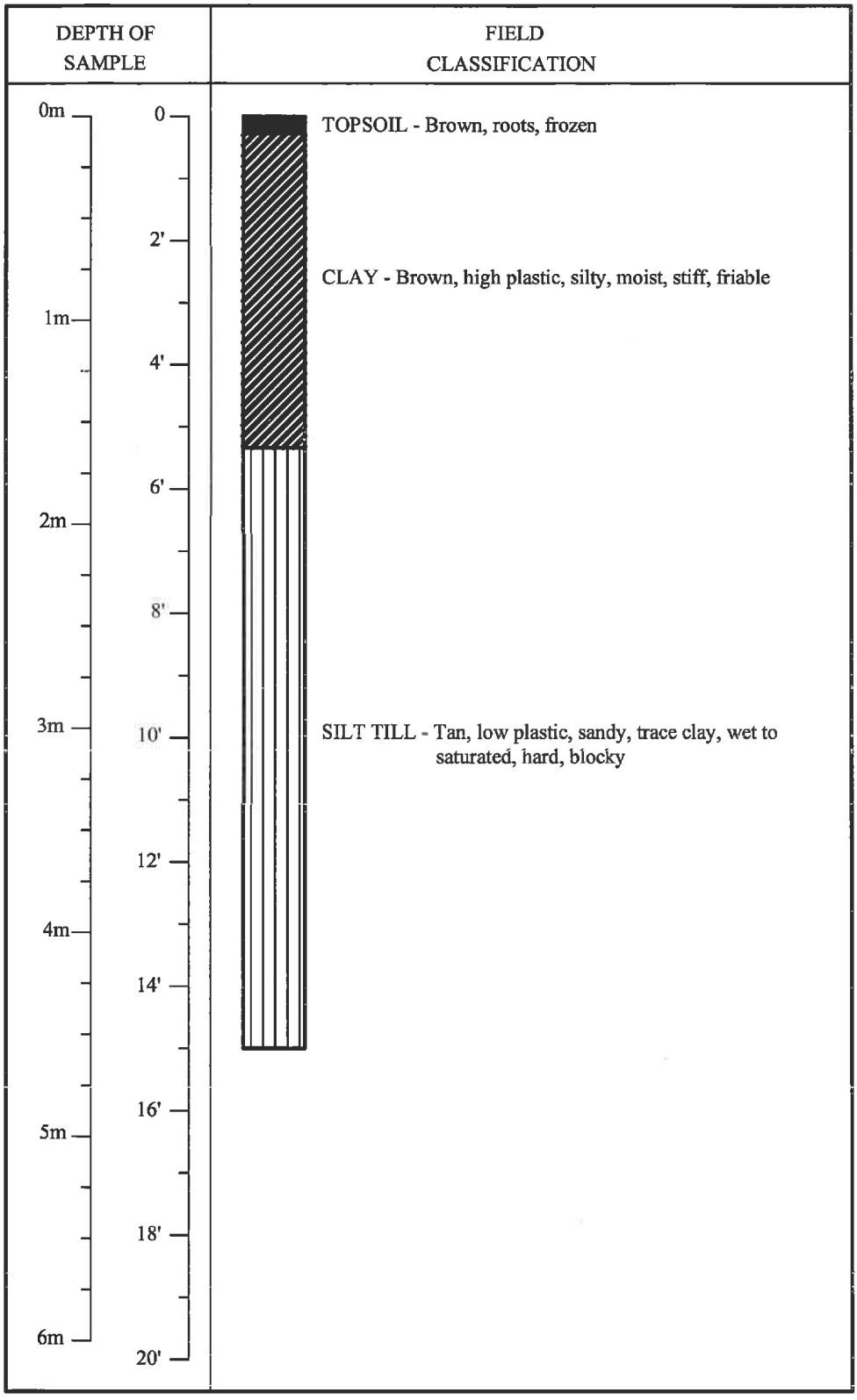

TOPSOIL

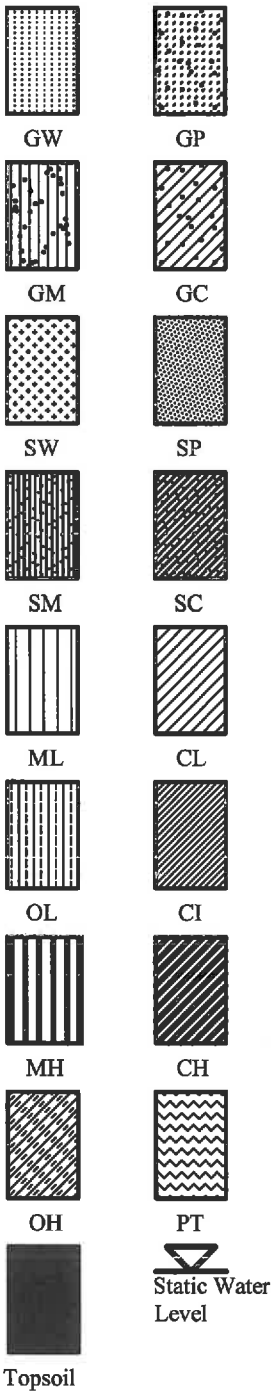
The soil logs are based upon objective data available to us at the time of forming our opinions. The soil logs indicate site specific soil characteristics and must not be generalized over larger areas due to the limited number of test holes as compared to that of an unlimited number of test holes. Every effort is made to evaluate the information by methods generally recognized. The soil logs represent our opinions. J. R. Cousin Consultants Ltd. cannot be responsible for actual site conditions proved to be materially at variance from our analysis or from the data generalization over untested areas.

J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522517E, 6083454N
ELEVATION : 227.849m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 1





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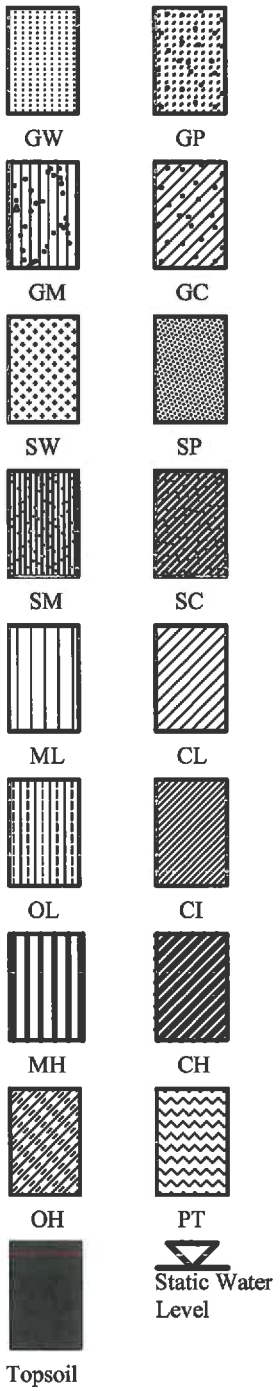
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522572E, 6083571N
ELEVATION : 227.308m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 2

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m / 0	TOPSOIL - Brown, organic, roots, frozen
2'	CLAY - Brown, high plastic, silty, moist, stiff, friable
1m / 4'	
6'	SILT TILL - Tan, low plastic, sandy, trace clay, wet to saturated, hard, blocky
2m / 8'	CLAY - Brown, high plastic, trace sand, trace silt, wet, stiff
3m / 10'	SILT TILL - Tan, low plastic, sandy, trace clay, saturated, soft
12'	- Frozen down to 2.0m
4m / 14'	
16'	
5m / 18'	
6m / 20'	



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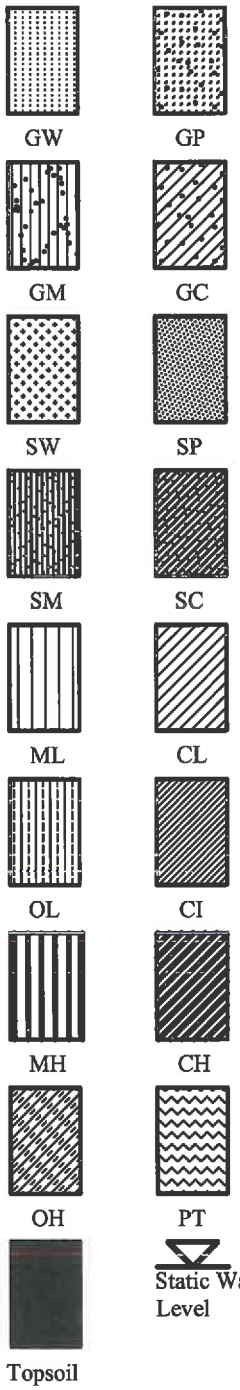
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522684E, 6083608N
ELEVATION : 225.972m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 3

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	
2'	PEAT - Brown, saturated, organic material
1m – 4'	
6'	
2m – 8'	
	CLAY - Brown, high plastic, trace silt, wet, firm
3m – 10'	
12'	
4m – 14'	SILT TILL - Tan, low plastic, sandy, trace clay, wet to saturated, hard, blocky
16'	
5m – 18'	
6m – 20'	



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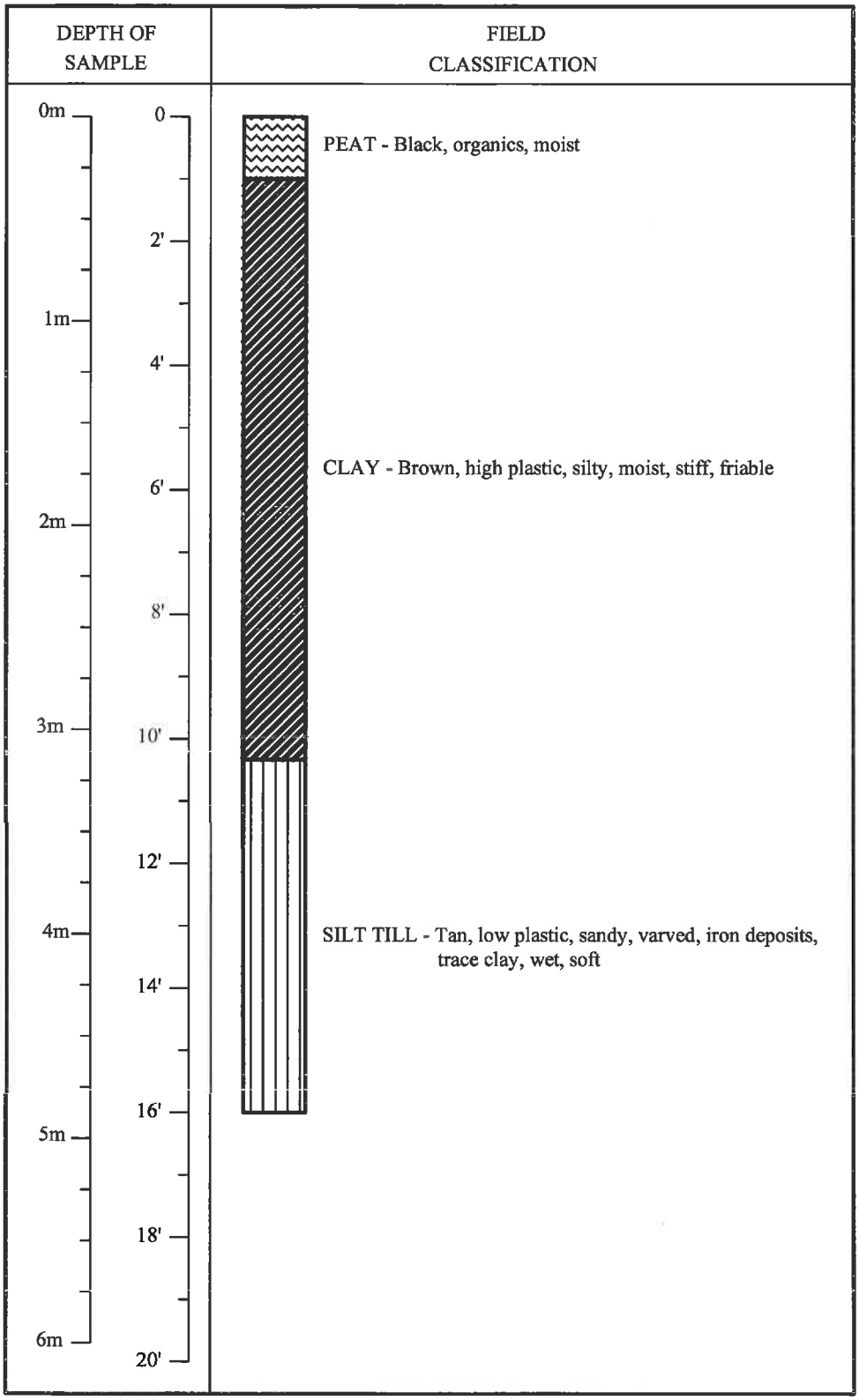
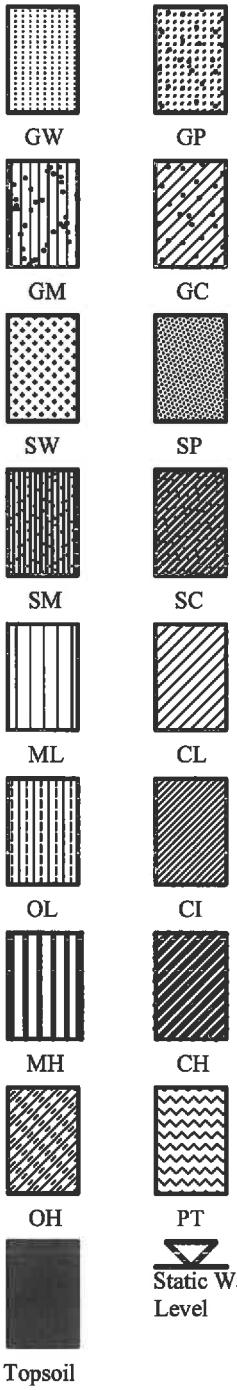
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522709E, 6083685N
ELEVATION : 225.074m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 4





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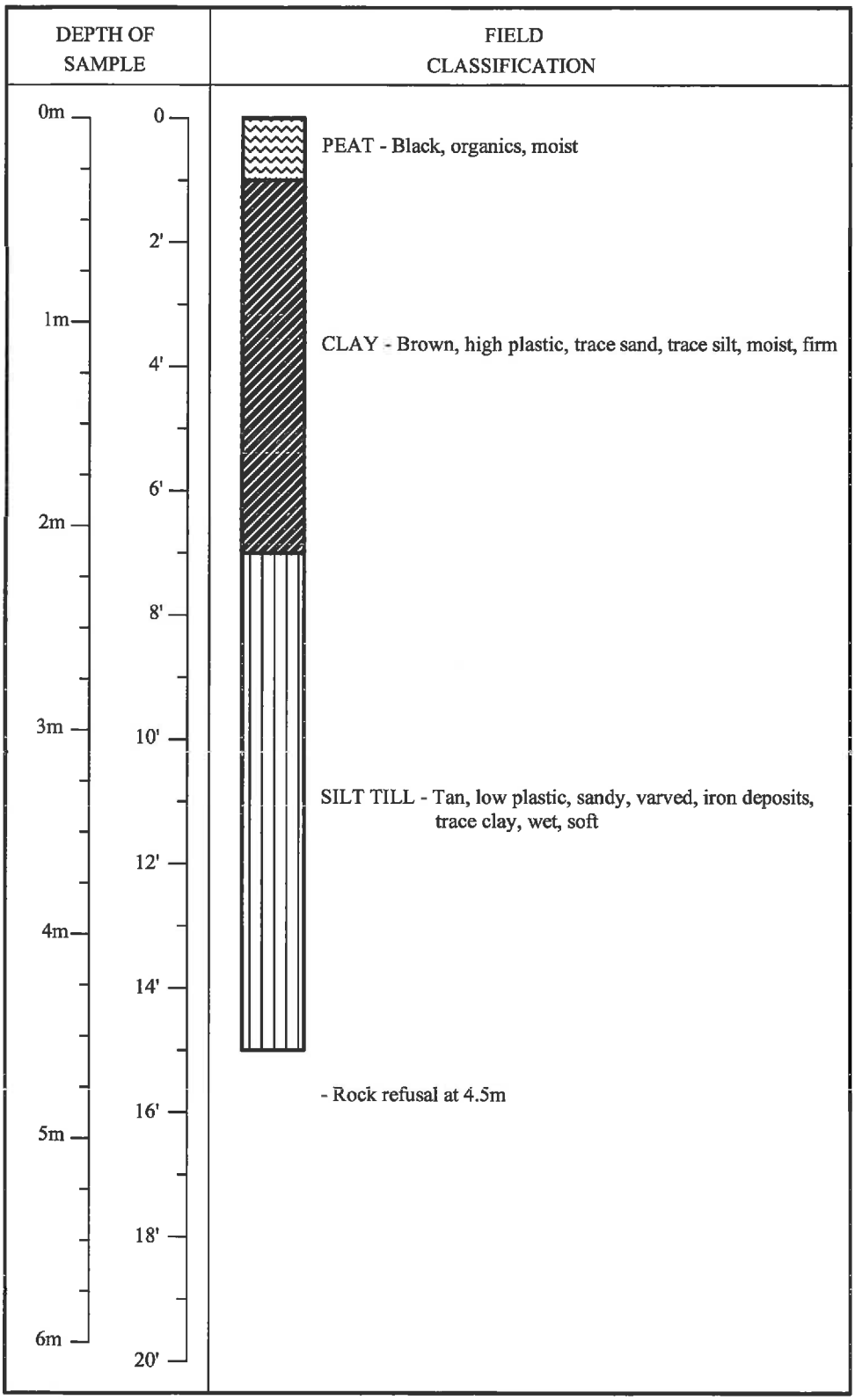
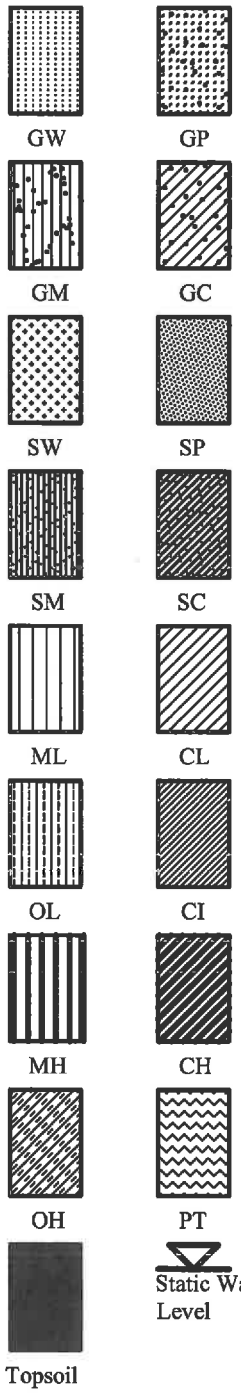
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522738E, 6083622N
ELEVATION : 225.244m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 5





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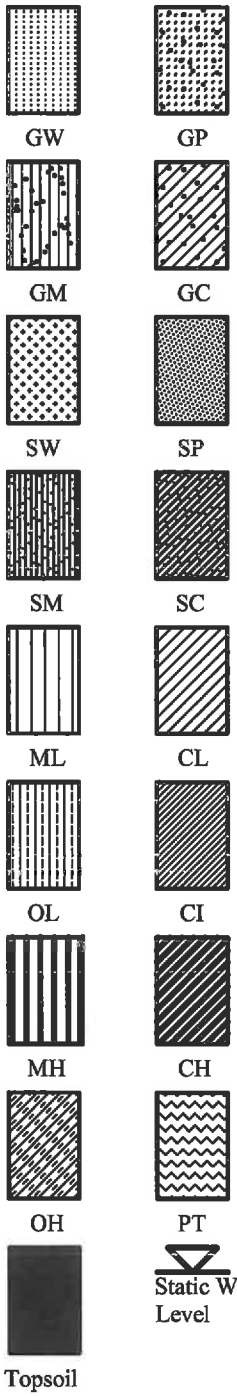
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522872E, 6083716N
ELEVATION : 223.556m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 6

DEPTH OF SAMPLE		FIELD CLASSIFICATION
0m	0	TOPSOIL - Black, organics, moist
	2'	
1m		
	4'	CLAY - Brown, high plastic, silty, moist, stiff, friable
	6'	
2m		
	8'	
3m	10'	SILT TILL - Tan, low plastic, sandy, varved, iron deposits, trace clay, wet to saturated, soft
	12'	
4m		
	14'	
	16'	
5m		
	18'	
6m	20'	



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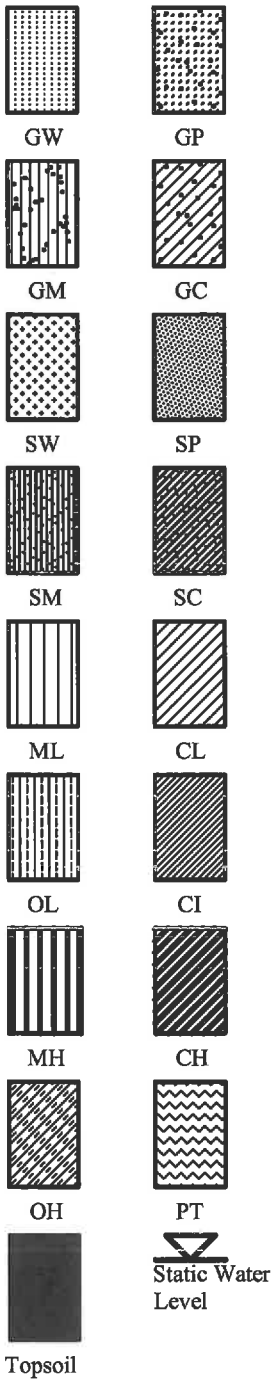
J. R. Cousin Consultants Ltd.

TEST HOLE LOG SHEET

LOCATION : SW 20-68-8 WPM
CODE : W-449.01
DATE : February 19, 2014
COORDINATES : 522808E, 6083465N
ELEVATION : 224.787m
PROJECT : Wabowden Lagoon Expansion
METHOD OF SAMPLING : Backhoe
TEST HOLE # 7

DEPTH OF SAMPLE	FIELD CLASSIFICATION
0m – 0	TOPSOIL - Brown, organic, roots, moist
2'	CLAY - Brown, high plastic, silty, moist, stiff, friable
1m – 4'	SILT TILL - Tan, low plastic, sandy, varved, iron deposits, trace clay, wet, soft
6'	
2m	- Bedrock refusal at 1.8m
8'	
3m – 10'	
12'	
4m – 14'	
16'	
5m	
18'	
6m – 20'	



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Stantec Consulting Ltd. Soils Analysis Report, March 4, 2014

Stantec Consulting Ltd.
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999
Fax: (204) 488-6947

March 4, 2014
File: 123301406

Attention: Oswald Wohlgemut
J.R. Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, MB
R3Y 1G4

Dear Oswald,

Reference: Wabowden Lagoon Expansion

Soil samples were submitted to our laboratory on February 27, 2014. The following tests were conducted on selected soil samples:

- water content (ASTM D2216)
- particle size analysis (ASTM D422)
- liquid limit, plastic limit, and plasticity index (ASTM D4318)
- soil classification (ASTM D2487)
- visual classification

The test results for the soil samples are summarized in the attached Table 1 and in the attached particle size analysis and Atterberg limit reports.

An assessment of the bagged soil samples were conducted to determine whether the soil represented by the bagged samples could be used in-situ as a lagoon liner and would obtain a hydraulic conductivity of less than 1.0 x 10-7 cm/sec without being reworked, and when re-moulded and re-compacted.

Based upon previous testing conducted in our laboratory, homogeneous soil samples with a plasticity index greater than 25 and a clay content greater than 50% will typically have a hydraulic conductivity of 1.0 x 10-7 cm/sec or less. Sample TH5 at 2.2 – 4.5 m is considered nonplastic with a clay content of 15.2%, which does not fall within this range and considered not suitable to used as a lagoon liner. The remaining bagged samples were considered suitable for use as a lagoon liner. Our comments regarding the potential use of the material as a liner are based upon the soil being homogeneous with no preferential flow paths. It should be noted that estimating the hydraulic conductivity of a soil based upon classification test results (plasticity index and particle size analysis) alone might be misleading if the soil contains layers of sand, silt, or organic material.

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

Reference: Wabowden Lagoon Expansion

Regards,

STANTEC CONSULTING LTD.

Jason Thompson, CET
Manager, Materials Testing
Services Phone: (204) 928-4004
Fax: (204) 488-6947
jason.thompson@stantec.com

Attachment: Table 1 – Summary of Soil Test Data
3 x Particle Size Analysis Test Reports
1 x Atterberg Limits Test Report

Stantec Consulting Ltd.
199 Henlow Bay
Winnipeg MB R3Y 1G4
Tel: (204) 488-6999
Fax: (204) 488-6947

Table 1
Summary of Soil Test Data
Wabowden Lagoon Expansion

Testhole	Depth (m)	Visual Classification	Water Content (%)	Gravel (%) 75 to 4.75 mm	Sand (%)			Silt (%) <0.075 to 0.005 mm	Clay (%) <0.005 mm	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification ASTM D2487	Potential use as a lagoon liner when re-moulded and re-compacted	Potential use as a lagoon liner without being reworked
					Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm								
TH2	2.0-3.2	brown, firm, moist, high plasticity, trace silt, trace sand	35.5	0.0	0.0	0.2	0.4	9.8	89.6	58	21	37	CH (Fat Clay)	Yes	Yes
TH5	0.3-2.2	brown, firm, moist, high plasticity, trace silt, trace sand	28.2	0.0	0.0	0.1	0.4	10.4	89.1	52	20	32	CH (Fat Clay)	Yes	Yes
TH5	2.2-4.5	tan, soft, moist, nonplastic, some clay	28.4	0.0	0.0	0.0	0.5	84.3	15.2	non-plastic			ML (Silt)	No	No

Notes:
1. A high speed stirring device was used for 1 minute to disperse the test samples for particle size analysis.
2. Atterberg limits conducted in accordance with ASTM D4318 Method B (one-point liquid limit).
3. The soil samples were air-dried during sample preparation for Atterberg limits and particle size analysis.

PARTICLE SIZE ANALYSIS
ASTM D422

JR Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

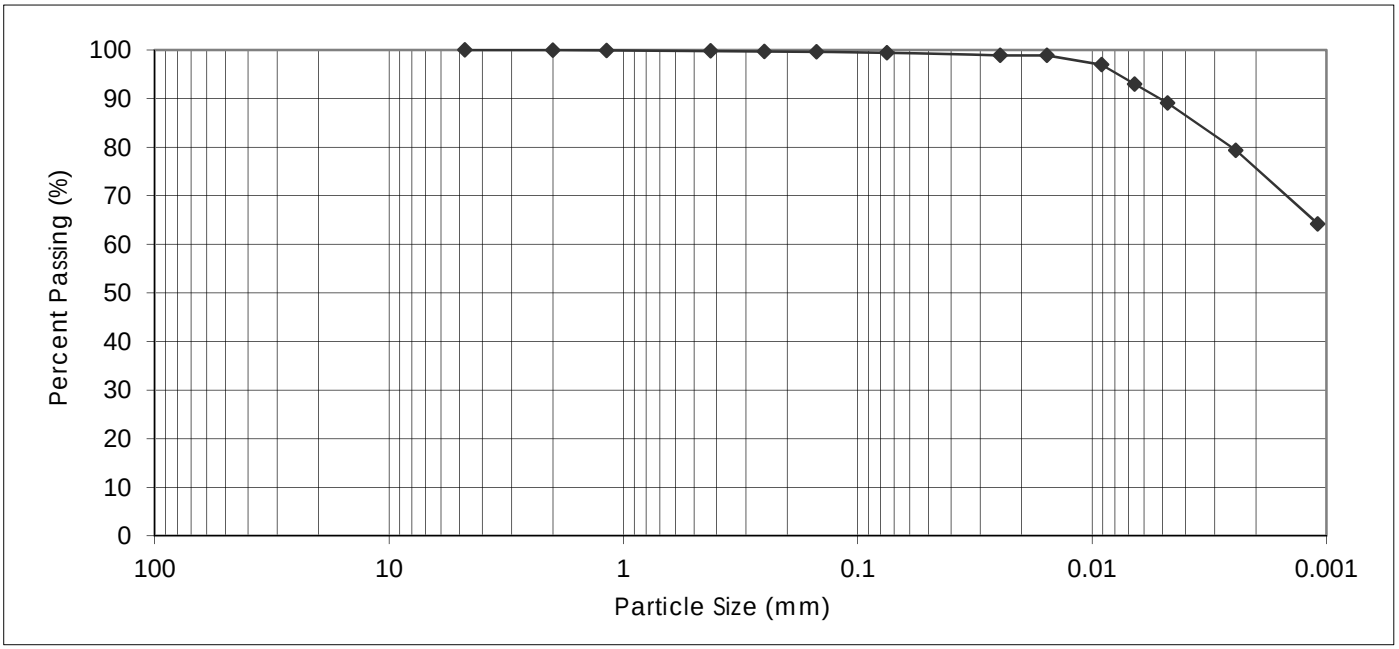
PROJECT: Wabowden Lagoon Expansion

Attention: Oswald Wohlgemut

PROJECT NO.: 123301406

SAMPLED BY: Client
SAMPLE ID: TH2 at 2.0 - 3.2 m

DATE RECEIVED: February 27, 2014
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	99.9
0.425 mm	99.8
0.250 mm	99.7
0.150 mm	99.6
0.075 mm	99.4
0.005 mm	89.6
0.002 mm	74.5
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.2	0.4	9.8	89.6	NT*

NT* Sample not tested for colloids

March 4, 2014

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

PARTICLE SIZE ANALYSIS
ASTM D422

JR Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

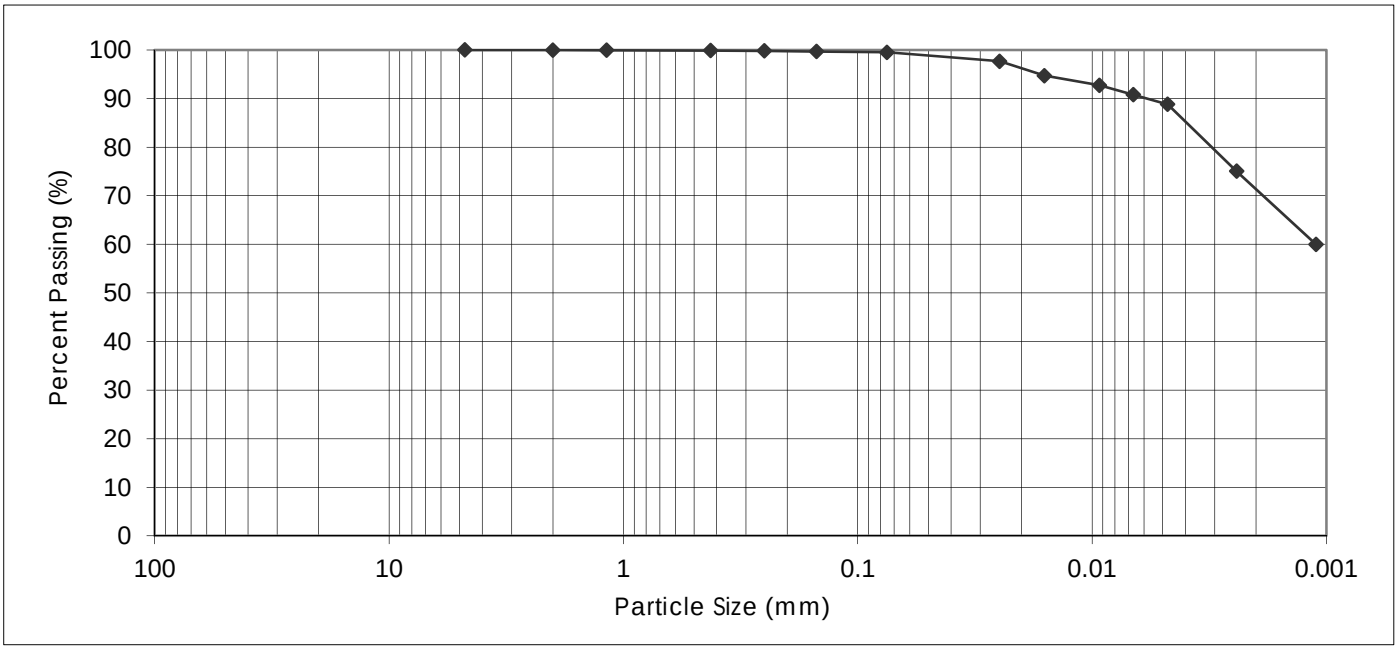
PROJECT: Wabowden Lagoon Expansion

Attention: Oswald Wohlgemut

PROJECT NO.: 123301406

SAMPLED BY: Client
SAMPLE ID: TH5 at 0.3 - 2.2 m

DATE RECEIVED: February 27, 2014
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	99.7
0.075 mm	99.5
0.005 mm	89.1
0.002 mm	70.2
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.1	0.4	10.4	89.1	NT*

NT* Sample not tested for colloids

March 4, 2014

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

PARTICLE SIZE ANALYSIS
ASTM D422

JR Cousin Consultants Ltd.
91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

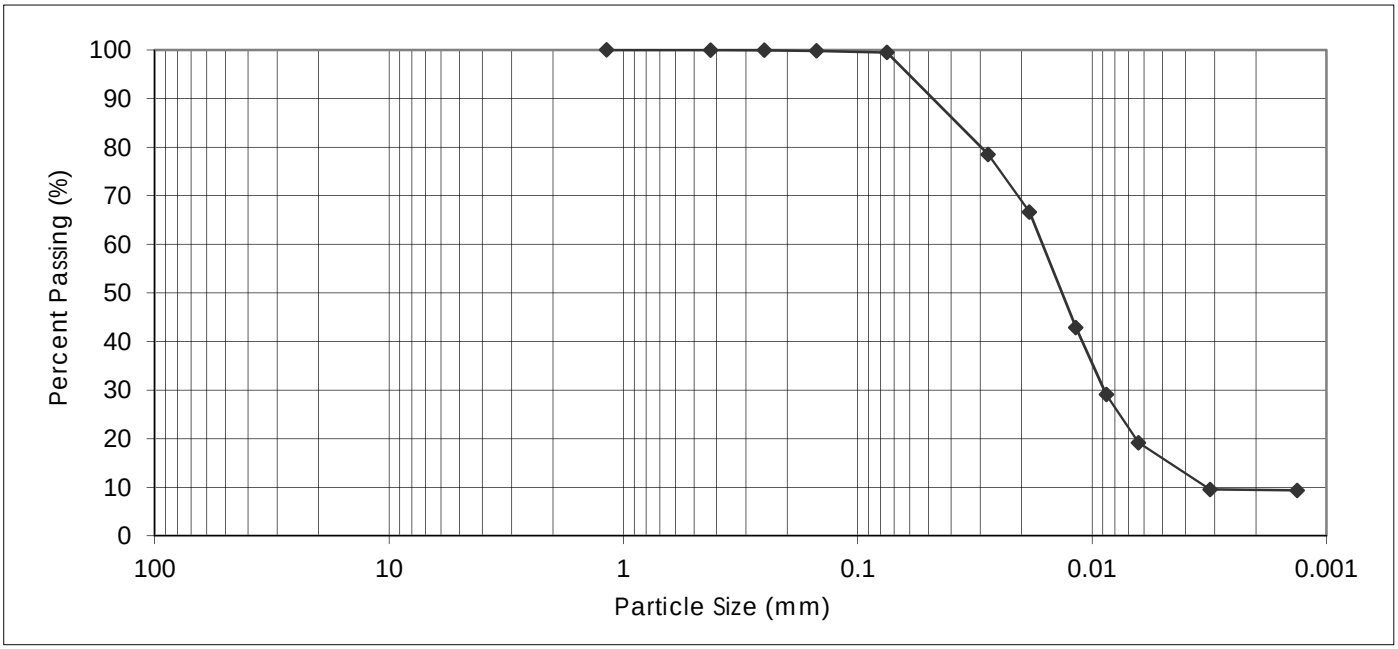
PROJECT: Wabowden Lagoon Expansion

Attention: Oswald Wohlgemut

PROJECT NO.: 123301406

SAMPLED BY: Client
SAMPLE ID: TH5 at 2.2 - 4.5 m

DATE RECEIVED: February 27, 2014
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	100.0
0.250 mm	99.9
0.150 mm	99.8
0.075 mm	99.5
0.005 mm	15.2
0.002 mm	9.4
0.001 mm	NT*

Gravel, % 75 to 4.75 mm	Sand, %			Silt, % <0.075 to 0.005 mm	Clay, % <0.005 mm	Colloids, % < 0.001 mm
	Coarse <4.75 to 2.0 mm	Medium <2.0 to 0.425 mm	Fine <0.425 to 0.075 mm			
0.0	0.0	0.0	0.5	84.3	15.2	NT*

NT* Sample not tested for colloids

March 4, 2014

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

Stantec

Atterberg Limits

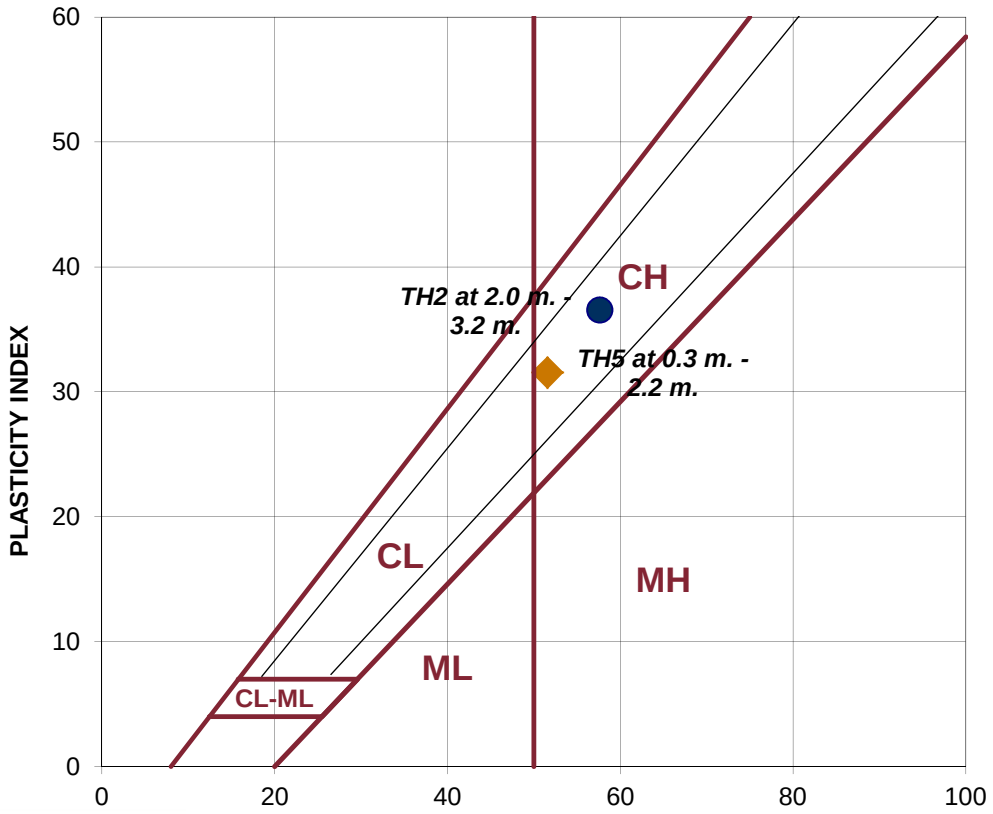
ASTM D4318
Method B- One Point

Client: JR Cousin Consultants Ltd.
Project Name: Wabowden Lagoon Expansion
Project No: 123301406
Tested By: Nestor Abarca

LABORATORY
199 Henlow Bay
Winnipeg, Manitoba
Canada R3Y 1G4

Tel: (204) 488-6999

Sample: TH2 at 2.0 m. - 3.2 m.			Sample: TH5 at 0.3 m. - 2.2 m.	
LIQUID			LIQUID	
1	2	Trial No.	1	2
27	27	Number of Blows	24	24
488	503	Container Number	527	411
39.81	43.45	Wt. Sample (wet+tare)(g)	35.76	35.56
34.79	38.30	Wt. Sample (dry+tare)(g)	31.57	30.55
26.14	29.31	Wt. Tare (g)	23.46	20.81
8.7	9.0	Wt. Dry Soil (g)	8.1	9.7
5.0	5.2	Wt. Water (g)	4.2	5.0
58.0%	57.3%	Water Content (%)	51.7%	51.4%
58.6%	57.8%	Corrected Water Content (%)	51.4%	51.2%
PLASTIC			PLASTIC	
1	2	Trial No.	1	2
457	538	Container Number	492	463
37.38	36.08	Wt. Sample (wet+tare)(g)	39.85	37.45
35.36	33.97	Wt. Sample (dry+tare)(g)	37.72	35.29
25.67	24.11	Wt. Tare (g)	27.16	24.39
9.7	9.9	Wt. Dry Soil (g)	10.6	10.9
2.0	2.1	Wt. Water (g)	2.1	2.2
20.8%	21.4%	Water Content (%)	20.2%	19.8%
AVERAGE VALUES			AVERAGE VALUES	
1	2		1	2
LL	58		LL	52
PL	21		PL	20
PI	37		PI	32
CLASSIFICATION			CLASSIFICATION	
CH			CH	



CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

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

Driller's Well Logs

LOCATION: NW28-68-8W

Well_PID: 9431
Owner: NORTHERN AFFAIRS
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #16
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085837
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 19

WELL LOG

From (ft.)	To (ft.)	Log
0	14.0	LIGHT BROWN CLAY
14.0	19.0	LIGHT GREY CLAY
19.0	27.0	HARD, LIGHT GREY CLAY
27.0	31.5	GREY TILL, VERY GRITTY, BOULDERS, GRANITIC ROCK PARTICLES SOME CLAYEY GRAVEL LAYERS, GRANITE BEDROCK AT 31.5 FEET

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date: 1967 Oct 19
Pumping Rate: 0.3 Imp. gallons/minute
Water level before pumping: 6.0 ft. below ground
Pumping level at end of test: 22.0 ft. below ground
Test duration: 4 hours, minutes
Water temperature: ?? degrees F

REMARKS

N OF FIRE TOWER, 50 FT S OF CULVERT, GROUND LEVEL ELEV EST 755 FT

LOCATION: NW28-68-8W

Well_PID: 9424
Owner: NORTHER AFFAIRS
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #17
Well Use: TEST WELL
Water Use:

UTMX: 524017
UTMY: 6085837
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 19

WELL LOG

From (ft.)	To (ft.)	Log
0	23.5	LIGHT BROWN TO LIGHT GREY CLAY
23.5	27.0	SANDY, GRITTY TILL OR CLAYEY SAND AND GRAVEL
27.0	30.0	VERY GRITTY TILL OR CLAYEY GRAVEL, GRANITE BEDROCK AT 30 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

N OF FIRE TOWER, 250 FT S OF TH #16, GROUND LEVEL ELEV EST 755 FT
CHEMICAL ANALYSIS ALSO SAMPLE FROM BOWDEN LAKE TAKEN TO COMPARE
SURFACE WATER WITH GROUNDWATER IN WABOWDEN

LOCATION: SW28-68-8W

Well_PID: 9433
Owner: FRONTIER SCHOOL DIV
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #1
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 16

WELL LOG

From (ft.)	To (ft.)	Log
0	16.0	LIGHT BROWN SILTY CLAY
16.0	20.0	GRAVEL, GRANITE PARTICLES
20.0	21.5	GRANITE

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date:	1967 Oct 19
Pumping Rate:	0.3 Imp. gallons/minute
Water level before pumping:	7.0 ft. below ground
Pumping level at end of test:	21.0 ft. below ground
Test duration:	3 hours, minutes
Water temperature:	?? degrees F

REMARKS

NEAR SCHOOL, 16 FT FROM HOUSE GROUND LEVEL ELEV EST 765 FT

LOCATION: SW28-68-8W

Well_PID:	9434
Owner:	FRONTIER SCHOOL DIV
Driller:	GLOBE DRILLING CO.
Well Name:	WABOWDEN TH #10
Well Use:	TEST WELL
Water Use:	
UTMX:	524017
UTMY:	6085033
Accuracy XY:	UNKNOWN
UTMZ:	
Accuracy Z:	
Date Completed:	1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	8.0	LIGHT BROWN CLAY, GRANITE BEDROCK AT 8 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

67 FT W + 97 FT N OF SCHOOL

LOCATION: SW28-68-8W

Well_PID: 9437
Owner: FRONTIER SCHOOL DIV
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #11
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	5.0	LIGHT BROWN CLAY, GRANITE BEDROCK AT 5 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

200 FT E OF RD TO SCHOOL

LOCATION: SW28-68-8W

Well_PID: 9436
Owner: FRONTIER SCHOOL DIV
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #12
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	8.0	LIGHT BROWN CLAY

8.0	9.5	GRAVELLY TILL OR CLAYEY GRAVEL
9.5	10.0	GRANITE BEDROCK

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

200 FT E OF RD TO SCHOOL

LOCATION: SW28-68-8W

Well_PID: 9435
Owner: FRONTIER SCHOOL DIV
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #13
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	18.0	GREYISH BROWN CLAY
18.0	33.0	BLUISH GREY, GREASY CLAY, SOFT
33.0	34.5	FINE TO COARSE SAND
34.5	37.0	HARD, LIGHT GREY, SILTY CLAY
37.0	37.5	BOULDER
37.5	42.0	VERY HARD GREY TILL, GRANITE BEDROCK AT 42 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

SE CORNER OF SCHOOL YARD

LOCATION: SW28-68-8W

Well_PID: 9429
Owner: DEPT OF HEALTH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #14
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	10.0	LIGHT BROWN CLAY, GRANITE BEDROCK AT 10 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

NEAR NURSING STATION, 80 FT N OF NURSING STATION, 28 FT E OF FORESTRY OFFICE, GROUND LEVEL ELEV EST 747 FT

LOCATION: SW28-68-8W

Well_PID: 9430
Owner: NORTHERN AFFAIRS
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #15
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 19

WELL LOG

From	To	Log

From (ft.)	To (ft.)	Log
0	16.5	LIGHT BROWN CLAY, GRANITE BEDROCK AT 16.5 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

.25 MI N OF FIRE TOWER, GROUND LEVEL ELEV EST 760 FT

LOCATION: SW28-68-8W

Well_PID: 9422
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #2
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 16

WELL LOG

From (ft.)	To (ft.)	Log
0	15.0	BROWN CLAY, GREASY
15.0	16.5	GRANITE, TWO THIN LAYERS
16.5	17.0	GRANITE BEDROCK

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

87 FT W OF FIRE TOWER, 350 FT N OF TRACKS

LOCATION: SW28-68-8W

Well_PID: 9423
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #3
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 16

WELL LOG

From (ft.)	To (ft.)	Log
0	12.5	BROWN CLAY, GREASY
12.5	15.3	FINE GRAVEL AND SAND
15.3	16.3	GRANITE

No construction data for this well.

Top of Casing: ft. below ground

PUMPING TEST

Date: 1967 Oct 16
Pumping Rate: ?? Imp. gallons/minute
Water level before pumping: 6.0 ft. below ground
Pumping level at end of test: ?? ft. below ground
Test duration: ??? hours, ?? minutes
Water temperature: ?? degrees F

REMARKS

220 FT W OF FIRE TOWER, 315 FT N OF TRACKS

LOCATION: SW28-68-8W

Well_PID: 9425
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #4
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:

Date Completed: 1967 Oct 17

WELL LOG

From (ft.)	To (ft.)	Log
0	15.0	BROWN CLAY, GREASY
15.0	19.0	GREY CLAY
19.0	20.0	SAND, GRANITE BEDROCK AT 20 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

350 FT W OF FIRE TOWER, 285 FT N OF TRACKS

LOCATION: SW28-68-8W

Well_PID: 9428
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #5
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 17

WELL LOG

From (ft.)	To (ft.)	Log
0	18.0	BROWN CLAY
18.0	24.0	GREY CLAY
24.0	25.0	GRANITE, VERY THIN LAYER OF FINE SAND AND CLAY, GRANITE CONTACT

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

374 FT W OF FIRE TOWER, 220 FT N OF TRACKS

LOCATION: SW28-68-8W

Well_PID: 9427
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #6
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 17

WELL LOG

From (ft.)	To (ft.)	Log
0	11.0	BROWN CLAY, GRANITE BEDROCK AT 11 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

475 FT W OF FIRE TOWER, 210 FT N OF TRACKS

LOCATION: SW28-68-8W

Well_PID: 9426
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #7
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 17

WELL LOG

From (ft.)	To (ft.)	Log
0	14.0	BROWN CLAY
14.0	15.0	CLAYEY GRAVEL OR TILL, GRANITE BEDROCK AT 15 FEET

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

255 FT W OF FIRE TOWER, 305 FT N OF CNR TRACKS GROUND LEVEL ELEV EST 752 FT

LOCATION: SW28-68-8W

Well_PID: 9421
Owner: FORESTRY BRANCH
Driller: GLOBE DRILLING CO.
Well Name: WABOWDEN TH #8
Well Use: TEST WELL
Water Use:
UTMX: 524017
UTMY: 6085033
Accuracy XY: UNKNOWN
UTMZ:
Accuracy Z:
Date Completed: 1967 Oct 17

WELL LOG

From (ft.)	To (ft.)	Log
0	9.0	LIGHT BROWN CLAY
9.0	13.0	GRAVEL AND SAND, CLAYEY
13.0	14.0	GRAVEL AND BOULDERS, GRANITE BEDROCK AT 15 FEET

WELL CONSTRUCTION

From (ft.)	To (ft.)	Casing Type	Inside Dia.(in)	Outside Dia.(in)	Slot Size(in)	Type	Material
0	8.7	casing	4.00				
8.7	14.0	perforations	4.00		0.025	WIRE WOUND S. S.	

Top of Casing: ft. below ground

PUMPING TEST

Date:	1967 Oct 17
Pumping Rate:	0.7 Imp. gallons/minute
Water level before pumping:	3.0 ft. below ground
Pumping level at end of test:	10.0 ft. below ground
Test duration:	8 hours, minutes
Water temperature:	?? degrees F

REMARKS

255 FT W OF FIRE TOWER, 417 FT N OF CNR TRACKS, CASING AND SCREEN REMOVED AFTER TESTING, GROUND LEVEL ELEV EST 747 FT

LOCATION: SW28-68-8W

Well_PID:	9432
Owner:	FRONTIER SCHOOL DIV
Driller:	GLOBE DRILLING CO.
Well Name:	WABOWDEN TH #9
Well Use:	TEST WELL
Water Use:	
UTMX:	524017
UTMY:	6085033
Accuracy XY:	UNKNOWN
UTMZ:	
Accuracy Z:	
Date Completed:	1967 Oct 18

WELL LOG

From (ft.)	To (ft.)	Log
0	16.0	LIGHT BROWN CLAY
16.0	18.0	GRAVEL AND SAND
18.0	18.5	GRANITE

No construction data for this well.

Top of Casing: ft. below ground

No pump test data for this well.

REMARKS

67 FT W + 80 FT S OF SCHOOL

Appendix D

Title Page

Plan L1: Existing Lagoon and Test Hole Location Plan

Plan L2: Expanded Lagoon with Setbacks

Plan L3: Proposed Lagoon Layout Plan

Plan L4: Proposed Lagoon Drainage Route

Plan L5: Dike Details

Plan L6: Fence, Silt Fence, Valve, Sign, Valve Marker, Rip Rap and Ditch Details

WABOWDEN COMMUNITY

LAGOON EXPANSION

ENVIRONMENT ACT PROPOSAL

PRELIMINARY
NOT FOR CONSTRUCTION

REDUCED DRAWING SET
DO NOT SCALE

PLAN INDEX

LAGOON

JR Cousin Consultants Ltd.
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p. (204) 489-0474
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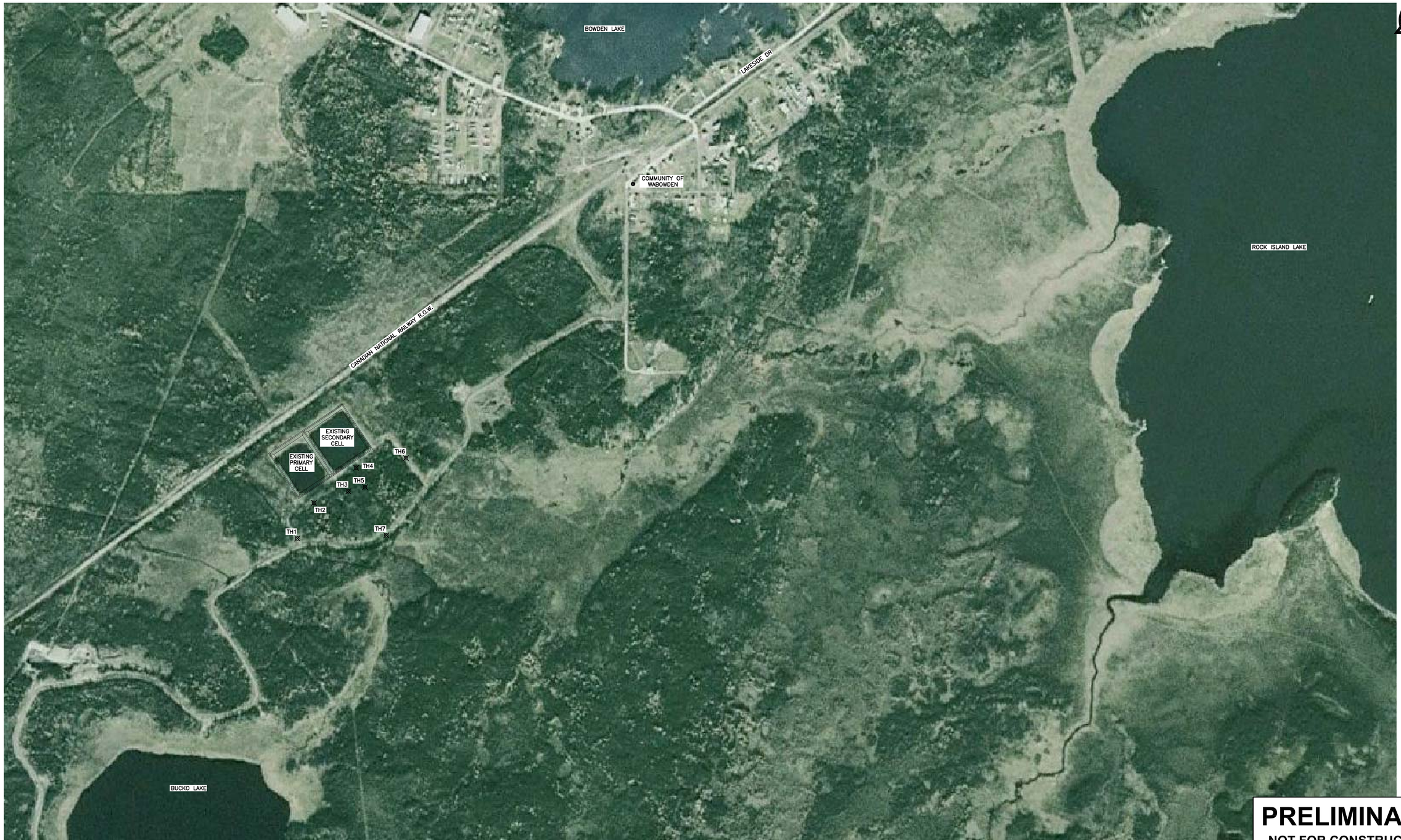
www.jrcc.ca

ENGINEERING CONSULTANTS

ENGINEERING EXCELLENCE SINCE 1981



PRELIMINARY
NOT FOR CONSTRUCTION

SCALE BAR
(IN METRES)
120 0 60 120 240 360 480 600
1:6000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/04/30

ENGINEER'S SEAL
PROVINCE OF MANITOBA
APR 30 2014
J. G. DYCK
Member
21976
REGISTERED PROFESSIONAL ENGINEER

JR Cousin Consultants Ltd.
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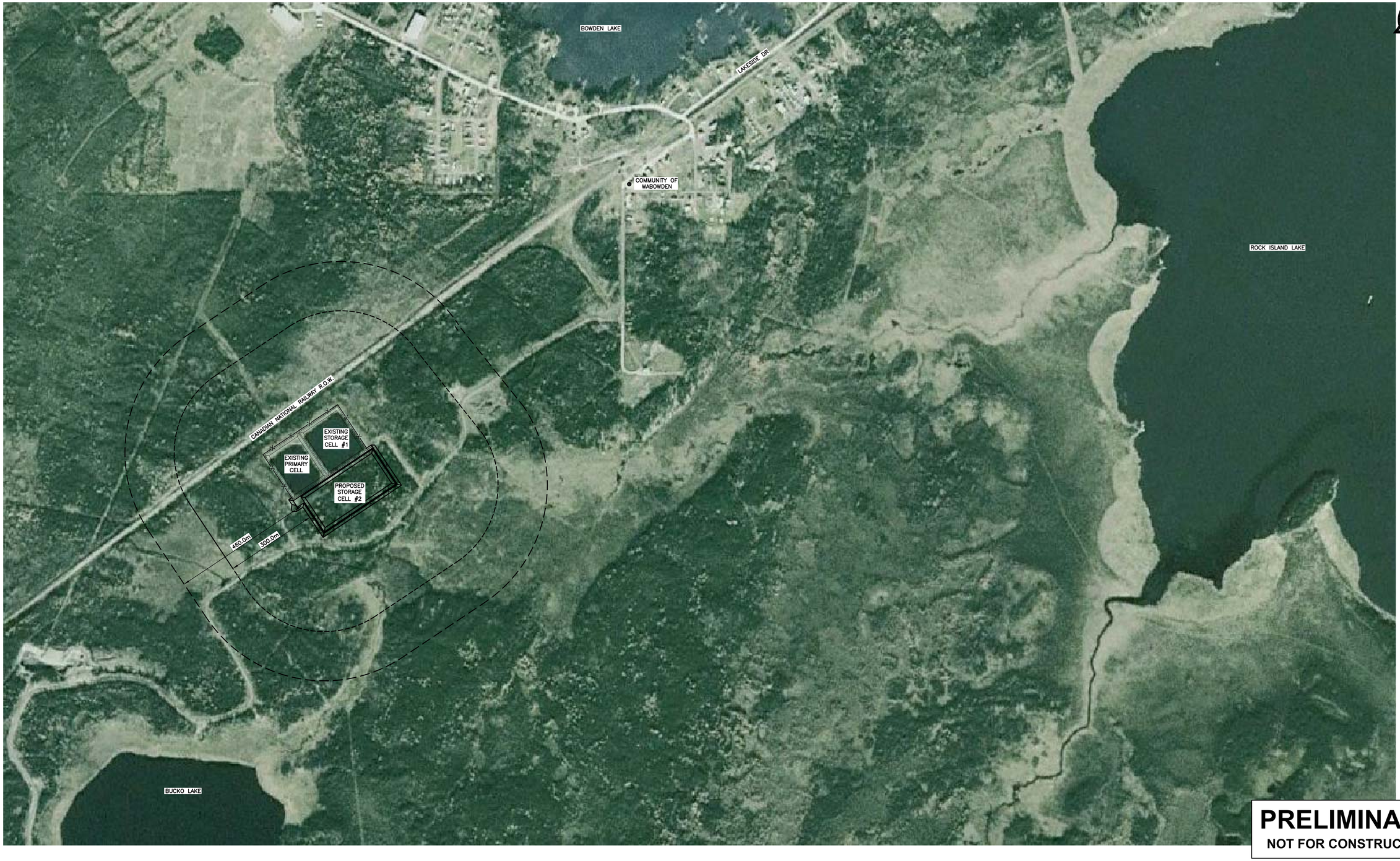
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	W-449.01
DESIGNED BY:	OW
DRAWN BY:	OT
REVIEWED BY:	JD
PROJECT:	WABOWDEN COMMUNITY LAGOON EXPANSION EAP
TITLE:	EXISTING LAGOON AND TEST HOLE PLAN
SCALE:	1:6000
DATE:	14/03/25
PLAN:	L1
SHEET:	1 of 6

May 01, 2014 - 2:57pm P:\WDG\449 Wabowden Community\449.01 Lagoon Expansion\04 Drawings\dwg\Drafts\Rev L1 - Existing Lagoon and Test Hole Location Plan.dwg



PRELIMINARY
NOT FOR CONSTRUCTION

SCALE BAR
(IN METRES)
120 0 60 120 240 360 480 600
1:6000

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		
	LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.		

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/04/30

ENGINEER'S SEAL
PROVINCE OF MANITOBA
APR 30 2014
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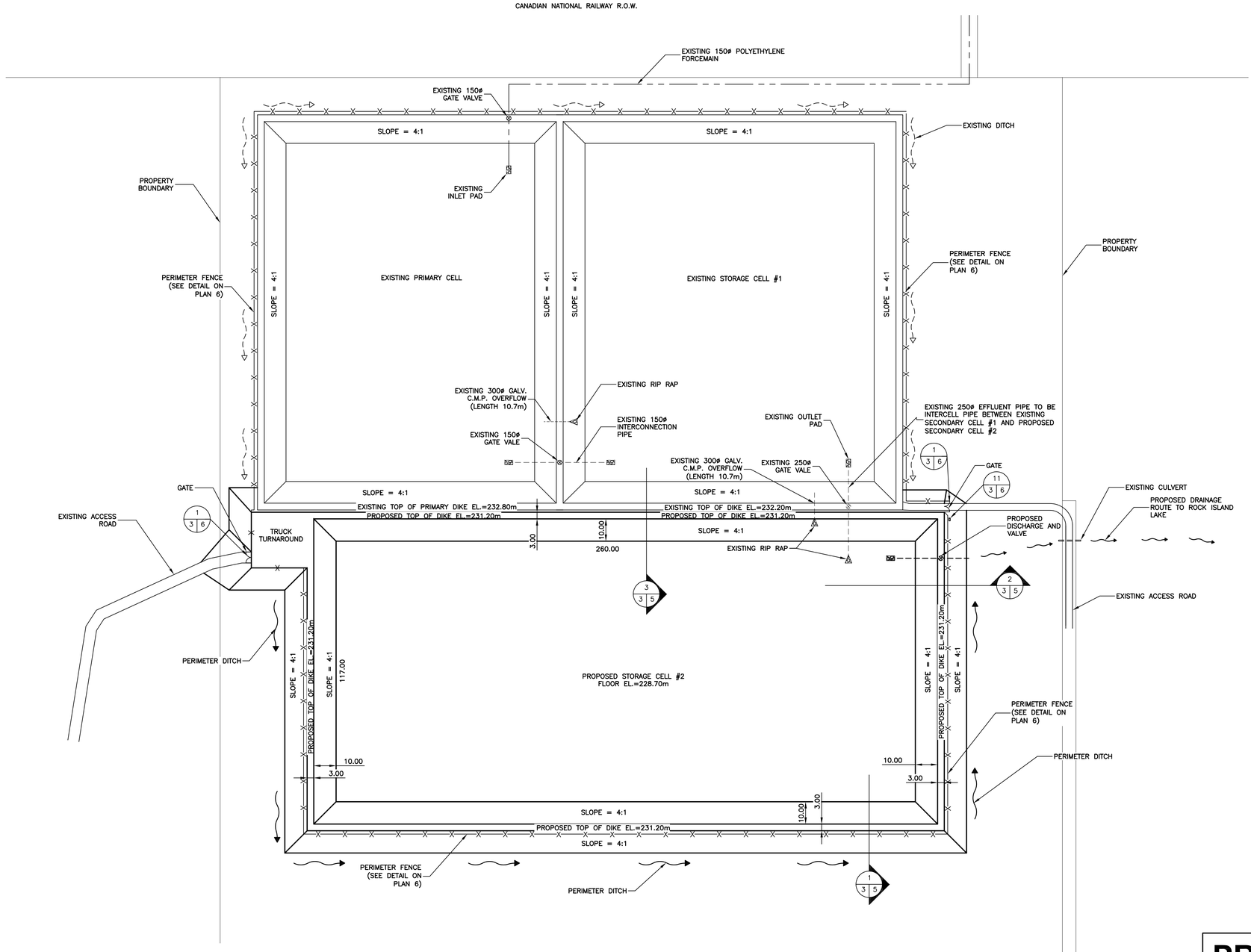
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

CODE:	W-449.01
DESIGNED BY:	OW
DRAWN BY:	OT
REVIEWED BY:	JD

PROJECT: WABOWDEN COMMUNITY LAGOON EXPANSION EAP
TITLE: EXPANDED LAGOON WITH SETBACKS

SCALE:	DATE:	PLAN:	SHEET:
1:6000	14/03/25	L2	2 of 6



SCALE BAR
(IN METRES)
20 0 10 20 40 60 80 100
1:1000

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		
	LOCATIONS OF UNDERGROUND STRUCTURES/UTILITIES AS SHOWN ARE BASED ON AVAILABLE INFORMATION BUT NO GUARANTEE IS GIVEN OR IMPLIED THAT ALL EXISTING UNDERGROUND STRUCTURES/UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND STRUCTURES/UTILITIES MUST BE OBTAINED FROM THE APPROPRIATE AUTHORITY/OWNER, BY THE CONTRACTOR, BEFORE PROCEEDING WITH CONSTRUCTION.		

APEGM
Certificate of Authorization
J.R. Cousin Consultants Ltd.
No. 234 Date: 14/04/30

ENGINEER'S SEAL
PROVINCE OF MANITOBA
APR 30 2014
J. G. DYCK
Member
21976
REGISTERED PROFESSIONAL ENGINEER

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ENGINEERING EXCELLENCE SINCE 1981

CODE:	W-449.01
DESIGNED BY:	OW
DRAWN BY:	OT
REVIEWED BY:	JD
PROJECT:	WABOWDEN COMMUNITY LAGOON EXPANSION EAP
TITLE:	PROPOSED LAGOON LAYOUT PLAN
SCALE:	1:1000
DATE:	14/03/25
PLAN:	L3
SHEET:	3 of 6

PRELIMINARY
NOT FOR CONSTRUCTION

May 02, 2014 - 4:19pm K:\449\449 Wabowden Community\449.01 Lagoon Expansion\04 Drawings\dwg\Drafts\Rev L3 - Proposed Lagoon Layout Rev4.dwg

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE BAR
(IN METRES)
300 0 150 300 600 900 1200 1500
1:15,000

No.	REVISIONS	DATE	INITIALS
	B.M. EL.		

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CODE:	W-449.01
DESIGNED BY:	OW
DRAWN BY:	OT
REVIEWED BY:	JD

PROJECT: WABOWDEN COMMUNITY LAGOON EXPANSION EAP
TITLE: PROPOSED LAGOON DRAINAGE ROUTE

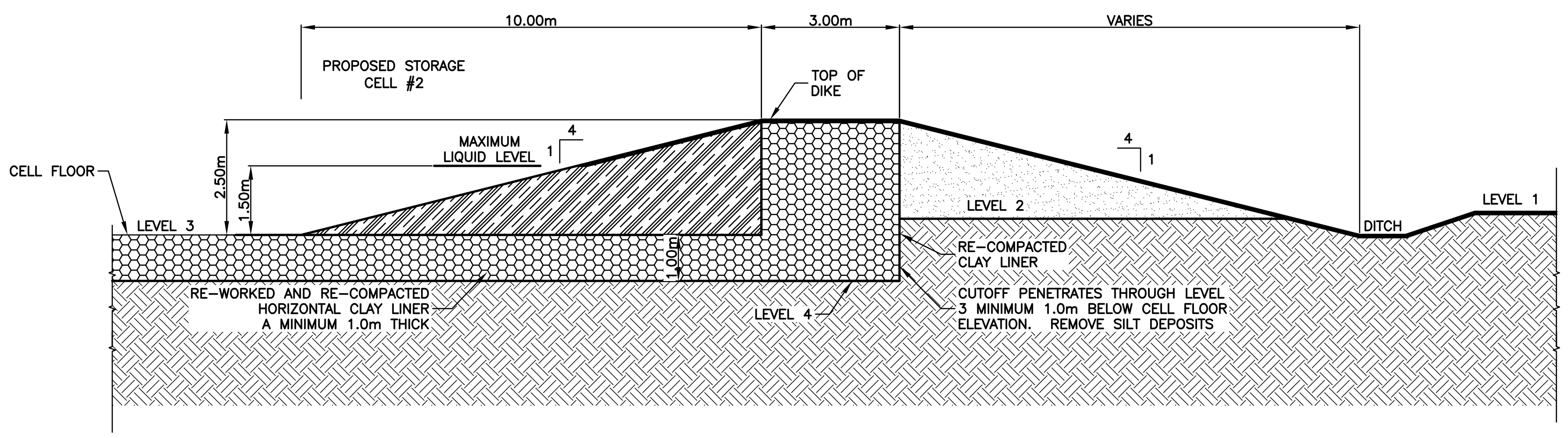
SCALE:	DATE:	PLAN:	SHEET:
1:15,000	14/03/25	L4	4 of 6

May 02, 2014 - 4:02pm K:\JOBS\449 Wabowden Community\449.01 Lagoon Expansion\04 Drawing\Layout\[Drafts]Rev 14 - Proposed Lagoon Drainage Route.dwg

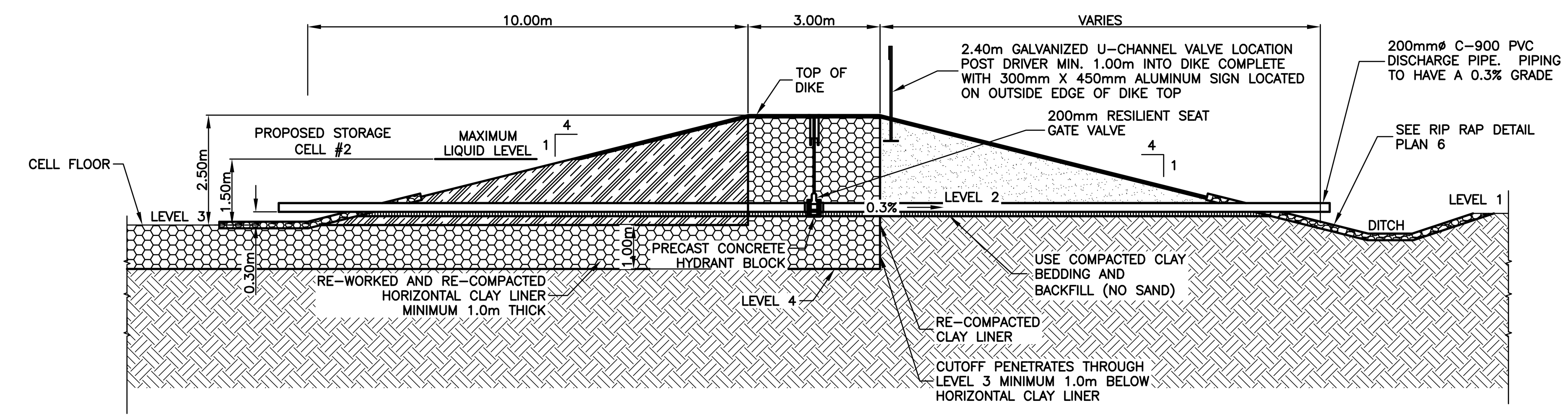
LEGEND:

- EXCAVATED AND COMPACTED MEDIUM PLASTIC CLAY TYPE SOIL
- EXCAVATED AND COMPACTED MIXTURE OF SOILS
- INSITU MEDIUM PLASTIC CLAY TYPE SOIL
- EXISTING DIKE
- RIP RAP
- TOPSOIL
- EXCAVATED AND COMPACTED MEDIUM PLASTIC CLAY TYPE SOIL
- EXISTING LINER

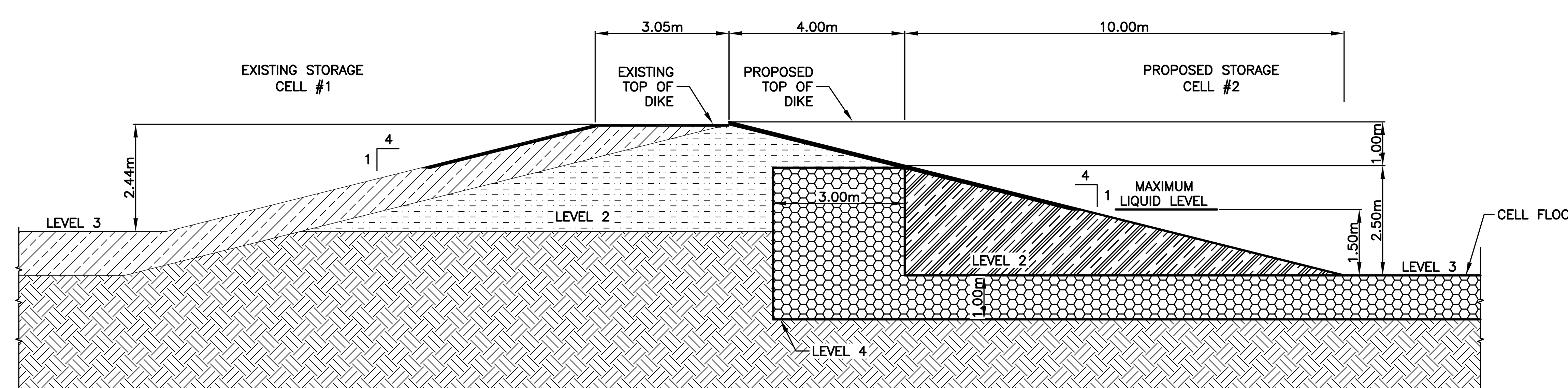
LEVEL 1 – PRE-CONSTRUCTION EXISTING GROUND ELEVATION
LEVEL 2 – ELEVATION FOLLOWING TOPSOIL REMOVAL
LEVEL 3 – FINISHED CELL BOTTOM ELEVATION
LEVEL 4 – BOTTOM OF HORIZONTAL LINER AND CUTOFF WALL



1/3|5 TYPICAL STORAGE CELL PERIMETER DIKE
SCALE = 1:100



2/3|4 PERIMETER DIKE AT DISCHARGE PIPE
SCALE = 1:100



3/3|5 INTERCELL DIKE
SCALE = 1:100

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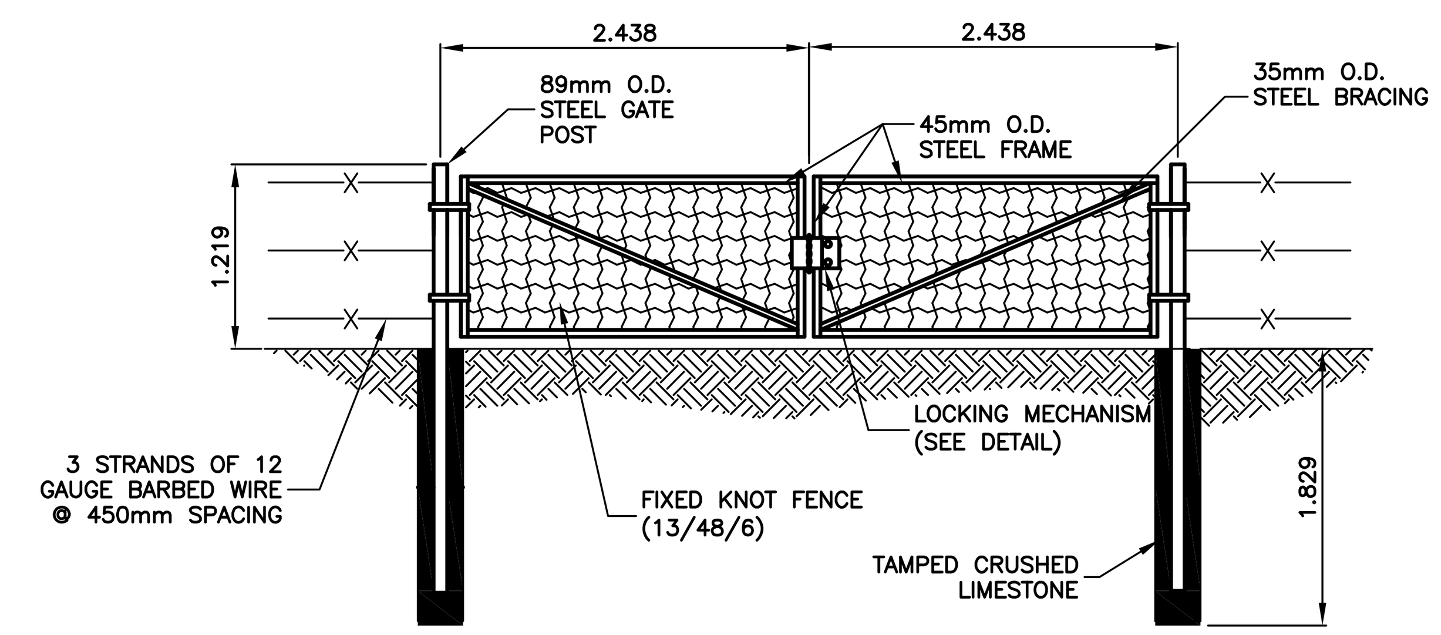
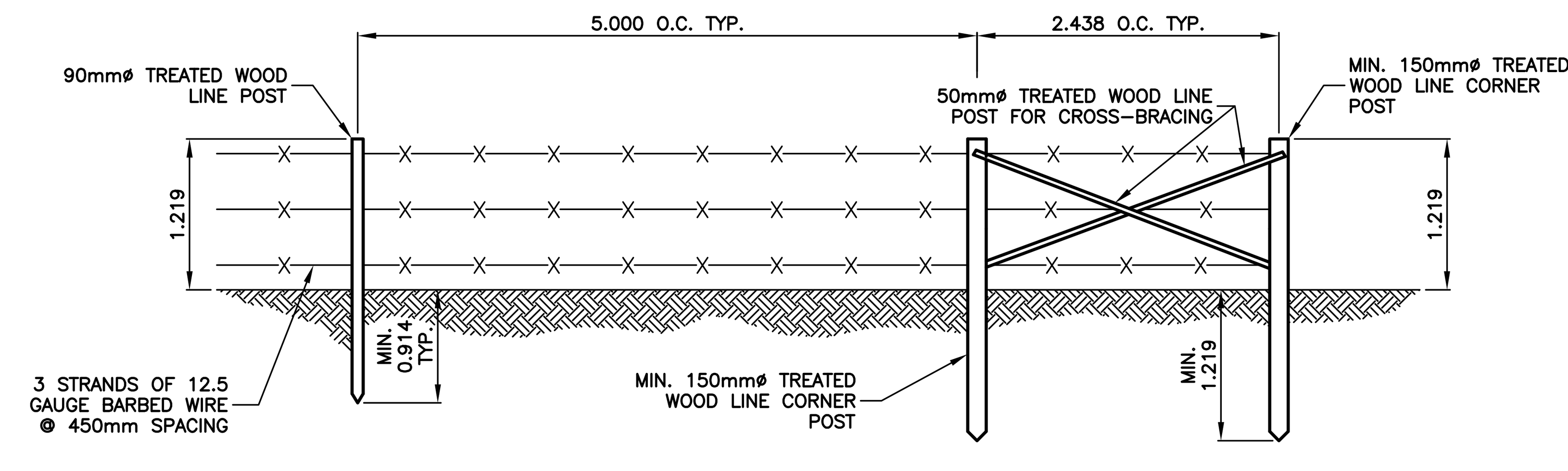
CODE: W-449.01
DESIGNED BY: OW
DRAWN BY: OT
REVIEWED BY: JD

PROJECT: WABOWDEN COMMUNITY LAGOON EXPANSION EAP
TITLE: DIKE DETAILS
SCALE: 1:100
DATE: 14/03/27
PLAN: L5
SHEET: 5 of 6



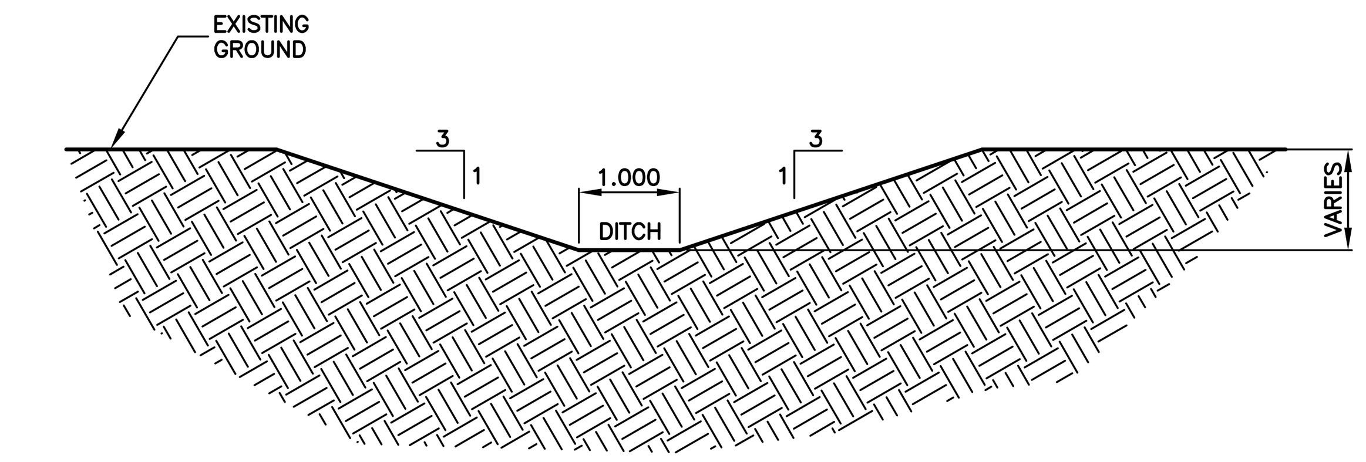
1 / 3 6 GATE DETAIL
SCALE = 1:50



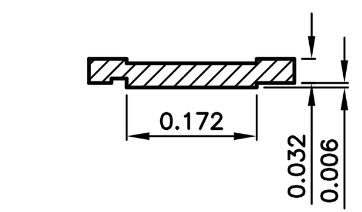
NOTE:

- PROVIDE CROSS BRACING AT CORNERS POSTS IN BOTH DIRECTIONS.
- SHOWN DIAMETER REFERS TO SMALLEST END OF POST.

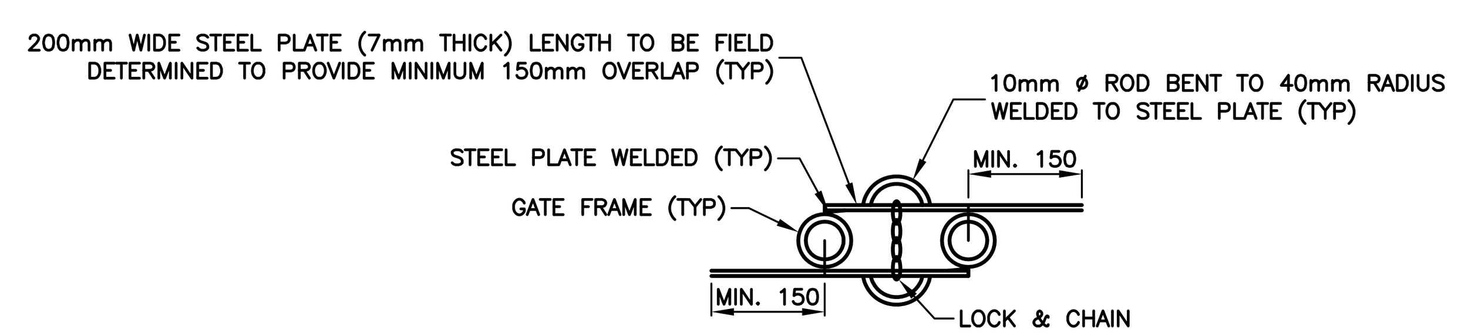
2 / 6 FENCE DETAIL
SCALE = 1:50



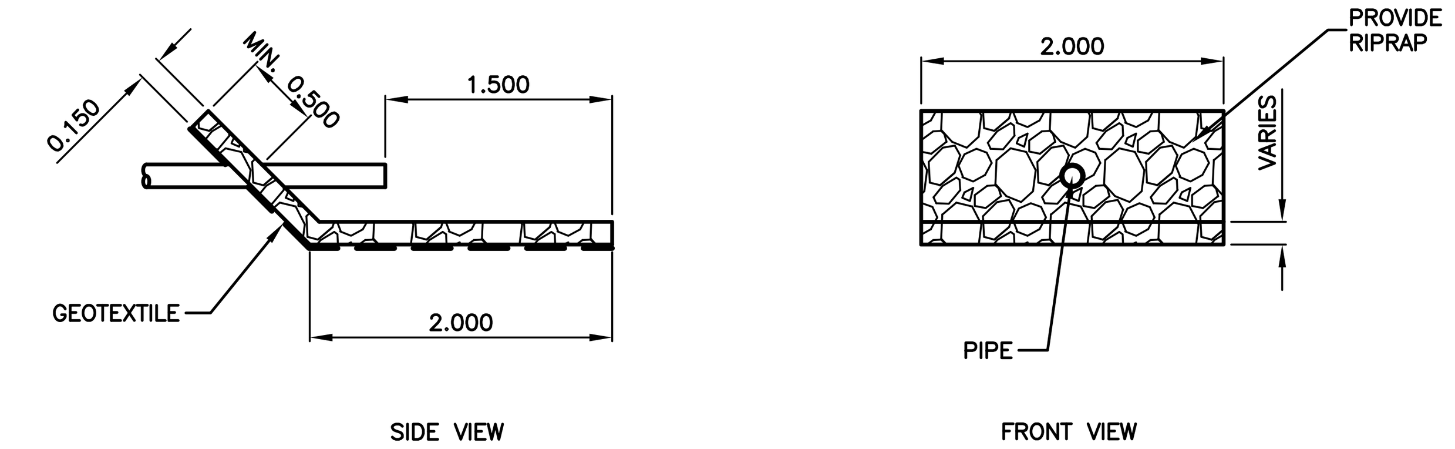
3 / 6 TYPICAL DISCHARGE DITCH DETAIL
SCALE = 1:75



COVER DETAIL
SCALE = 1:10



4 / 6 LOCK DETAIL
SCALE = 1:10



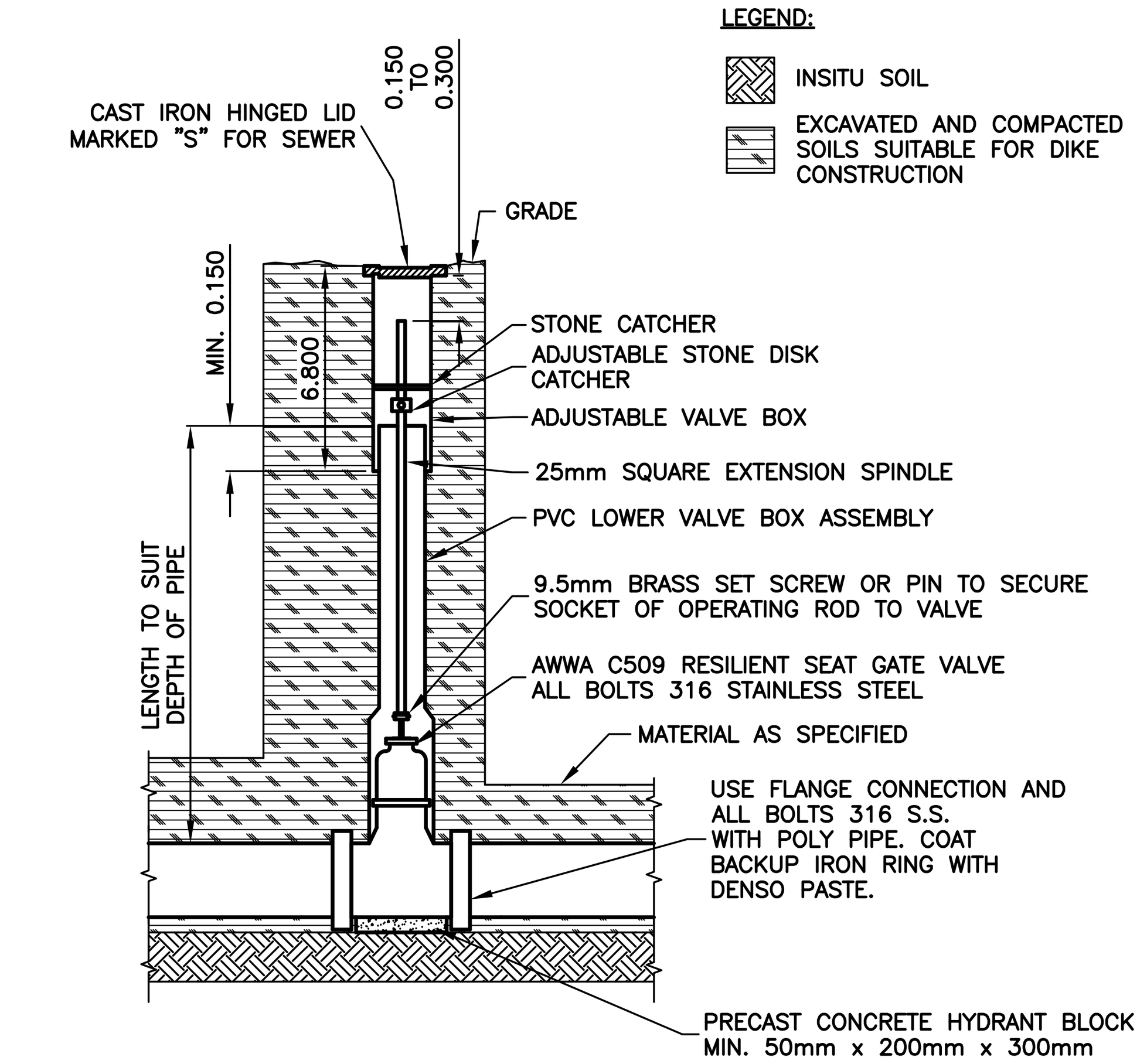
NOTE:

–RIPRAP MATERIAL SHALL BE WELL GRADED 125mm TO 150mm HARD, DENSE, ROUNDED & DURABLE FIELD STONE.

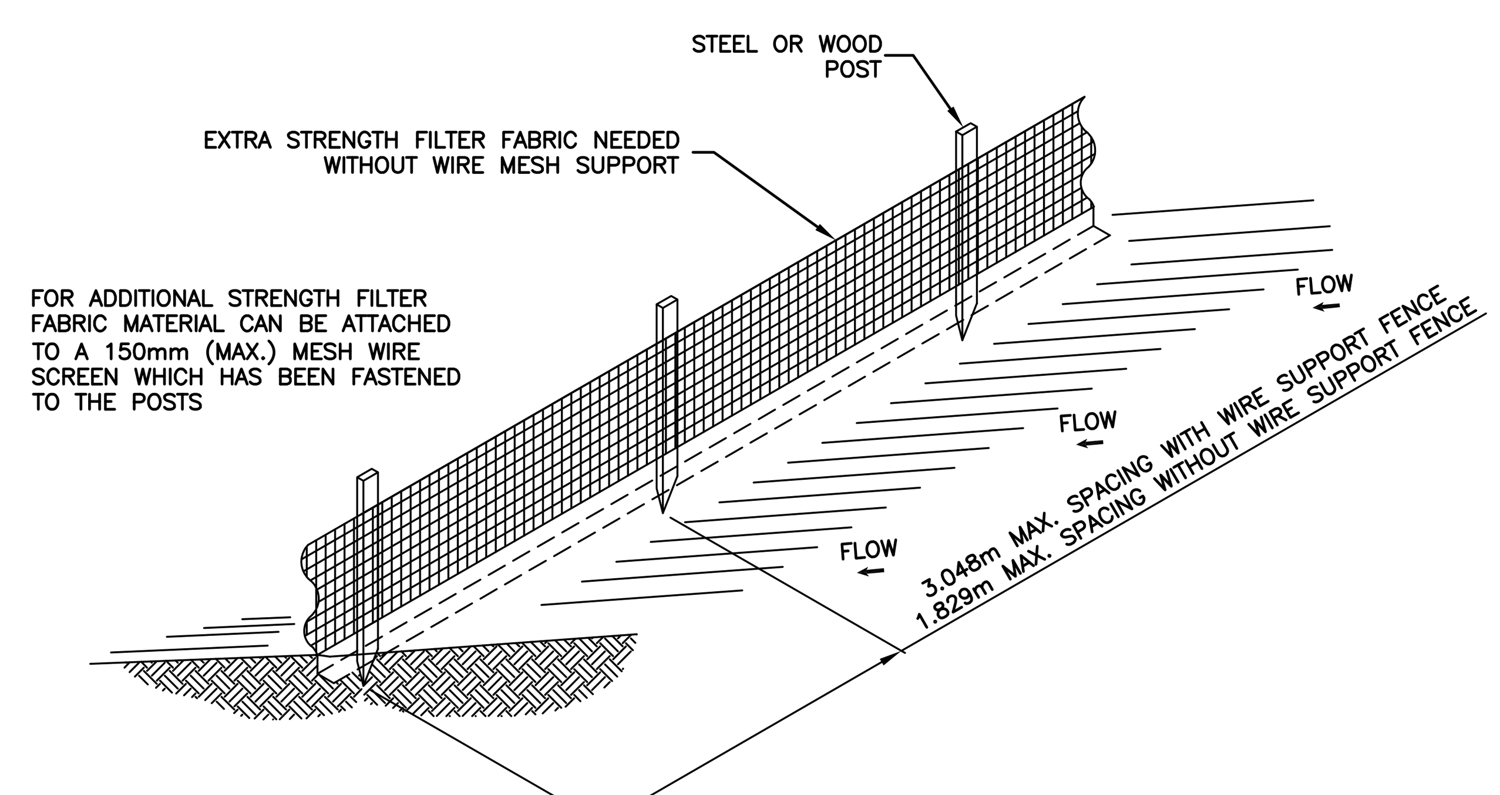
5 / 6 RIPRAP DETAIL
SCALE = 1:50

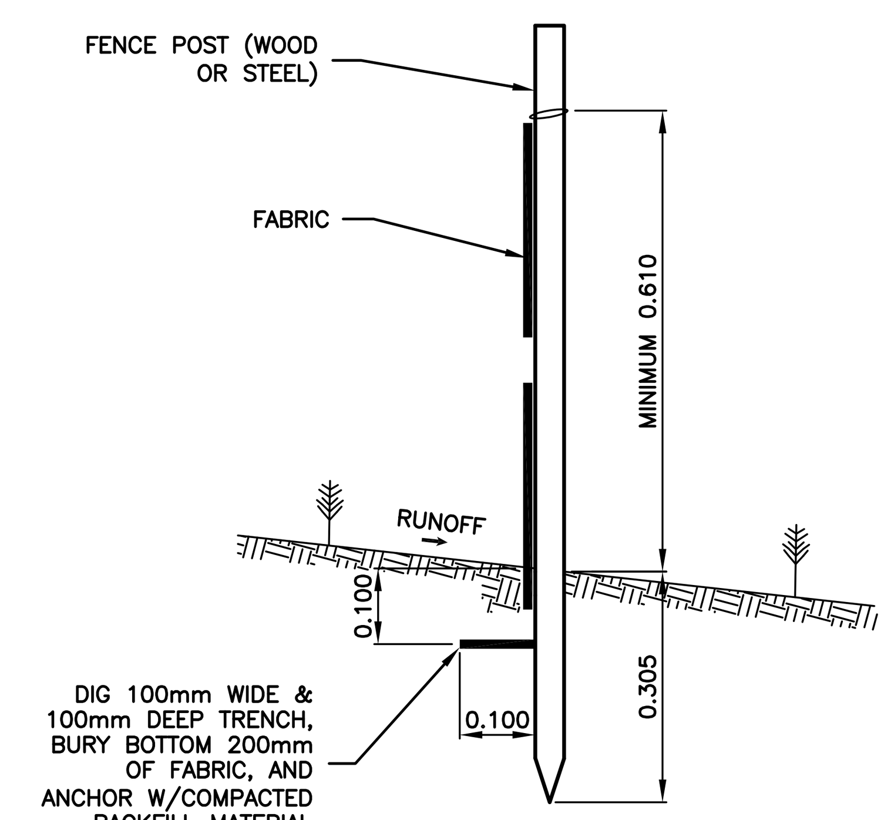
LEGEND:

- INSITU SOIL
- EXCAVATED AND COMPACTED SOILS SUITABLE FOR DIKE CONSTRUCTION

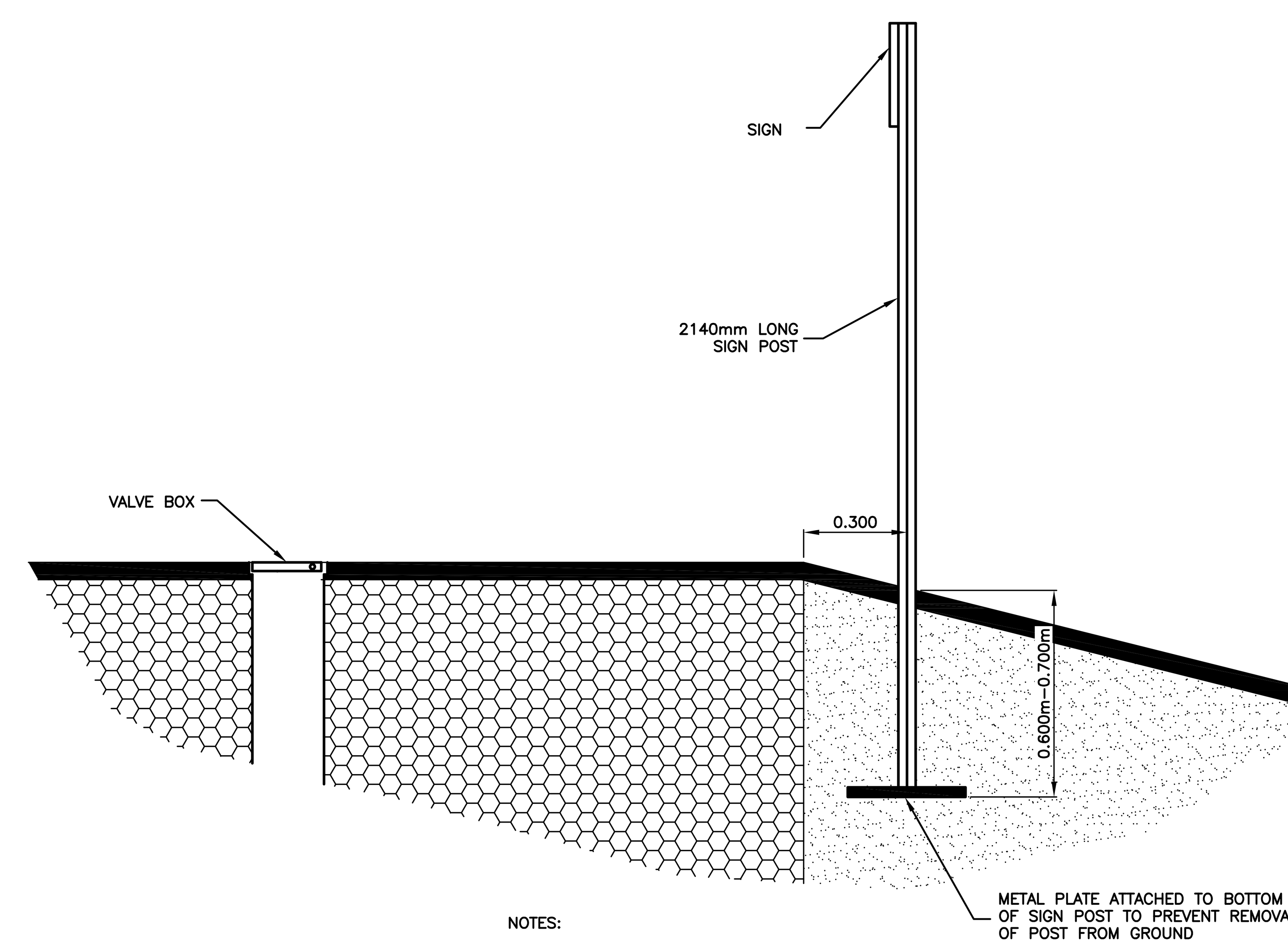


10 / 6 TYPICAL VALVE DETAIL
SCALE = 1:25





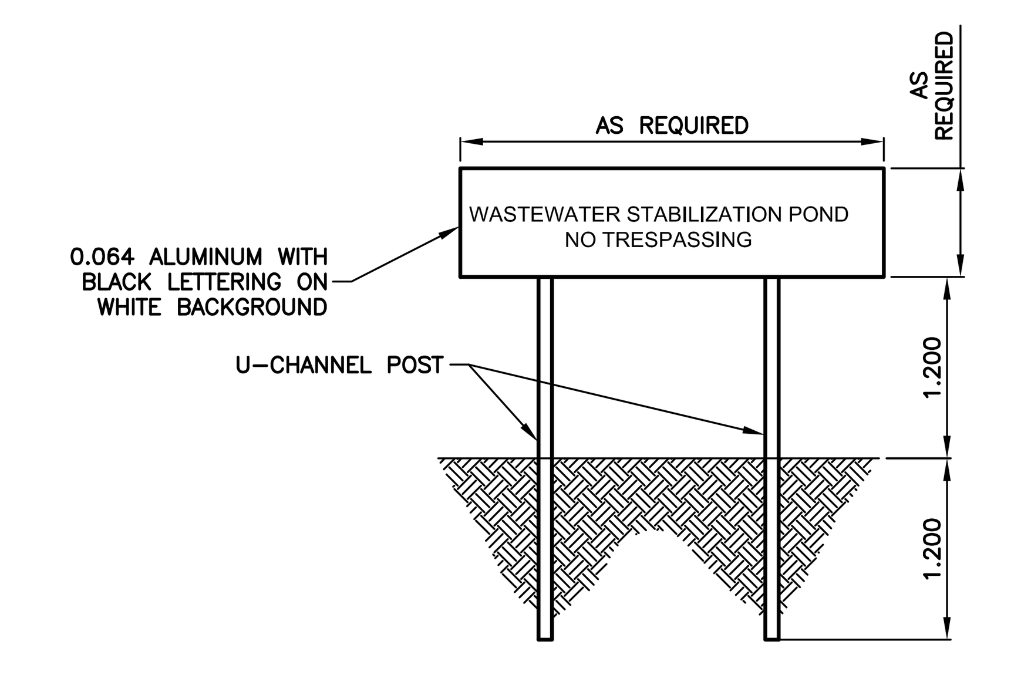
7 / 6 SILT FENCE SECTION
SCALE = 1:10



NOTES:

- MINIMUM SIGN SIZE: 300mm X 450mm
- MINIMUM POST LENGTH: 2140mm
- CROSSING MARKERS TO BE SET IN 200mmø X 1.0m CONCRETE AS PER SPECIFICATIONS

9 / 6 VALVE MARKER DETAIL
SCALE = 1:15

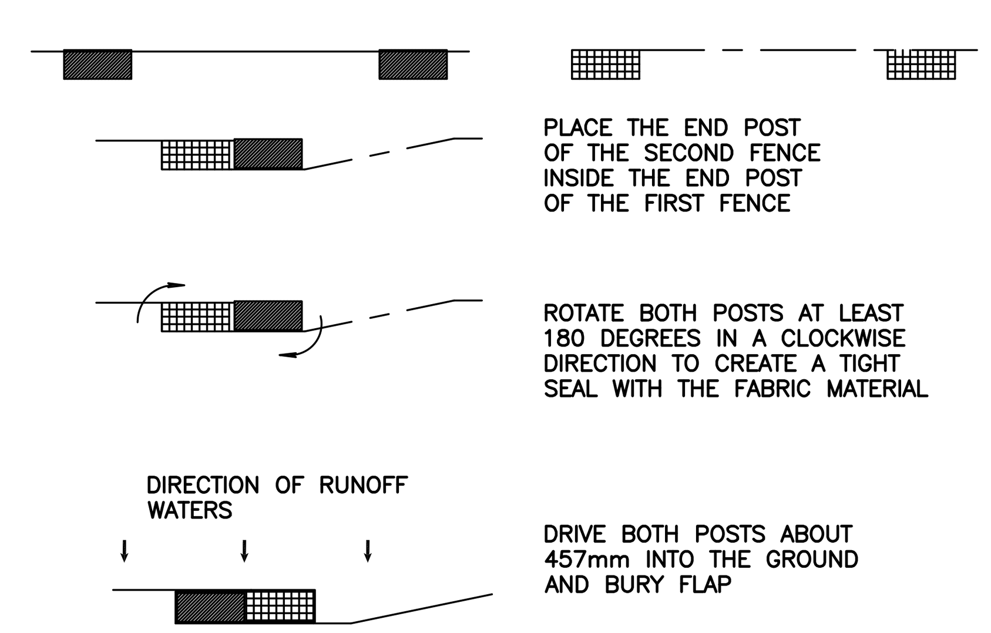


11 / 3 6 LAGOON SITE MARKER DETAIL
SCALE = 1:50

NOTES:

1. THE HEIGHT OF A SILT FENCE SHALL NOT EXCEED 914mm.
2. HE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS.
3. POSTS SHALL BE SPACED A MAXIMUM OF 3.048m APART AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 300mm. WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 1.829m.
4. A TRENCH SHALL BE EXCAVATED APPROXIMATELY 100mm WIDE AND 100mm DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.
5. WHEN STANDARD STRENGTH FILTER FABRIC IS USED, A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST 25mm LONG, TIE WIRES, OR HOG RINGS. THE WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 50mm AND SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
6. THE STANDARD STRENGTH FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 200mm OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 914mm ABOVE THE ORIGINAL GROUND SURFACE.
7. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.
8. SILT FENCING TO BE POLYPROPYLENE SYNTHETIC FIBRE WITH ULTRAVIOLET STABILIZERS. AMOCO 1198 OR APPROVED EQUAL.
9. WOOD POSTS TO BE 38mm X 89mm (2" X 4"), POINTED AT ONE END AND FABRICATED.
10. INSTALL ALL SUPPORTING POSTS ON THE DOWN SLOPE SIDE OF THE FENCING
11. MAINTAIN SILT FENCE THROUGHOUT CONSTRUCTION AND UNTIL REVEGETATION OCCURS.

6 / 6 SILT FENCE DETAIL
SCALE = 1:40



8 / 6 ATTACHING TWO SILT FENCES
SCALE = 1:10

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CODE: W-449.01
DESIGNED BY: OW
DRAWN BY: OT
REVIEWED BY: JD

PROJECT: WABOWDEN COMMUNITY LAGOON EXPANSION EAP

TITLE: FENCE, SILT FENCE, VALVE, SIGN, VALVE MARKER, RIP RAP AND DITCH DETAILS

SCALE: AS NOTED
DATE: 14/03/27
PLAN: L6
SHEET: 6 of 6