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P&R #8.238 JRCC

A-677.02

TOWN OF ALTONA

Environment Act Proposal
for the
Altona Lagoon Expansion

PROVINCE OF MANITOBA
G. R.
COUSIN
14/08/11
REGISTERED PROFESSIONAL ENGINEER

Prepared by:

David Kelly

David Kelly, P. Eng.
Municipal Engineer

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: 14/08/11

Reviewed by:

Jerry Cousin, P. Eng.
President

August 2014

JRCC
ENGINEERING CONSULTANTS

ACKNOWLEDGMENTS

To prepare this feasibility study, various sources of information were investigated and researched. JR Cousin Consultants Ltd. thanks the Town of Altona who contributed data and content for this study.

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:
Altona Lagoon Expansion

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

Legal name of the applicant:
Town of Altona

Mailing address of the applicant: Box 1630, Altona, Manitoba, R0G 0B0

Contact Person: Mr. Dan Gagne

City: Altona
Province: Manitoba
Postal Code: R0G 0B0

Phone Number: 204-324-6468
Fax: 204-324-1550
email: dan.gagne@altona.c

Location of the development: 1 km east of Altona

Contact Person: Mr. Dan Gagne

Street Address: n/a

Legal Description: NE 09-02-01 WPM

City/Town: Altona
Province: Manitoba
Postal Code: R0G 0B0

Phone Number: 204-324-6468
Fax: 204-324-1550
email: dan.gagne@altona.

Name of proponent contact person for purposes of the environmental assessment:
Jason Cousin, JR Cousin Consultants Ltd.

Phone: 204-489-0474
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Mailing address:
91 A Scurfield Blvd
Winnipeg, Manitoba
R3Y1G4

Email address: jrcousin@jrcc.ca

Webpage address: www.jrcc.ca

Date:
Aug 8/14

Signature of proponent, or corporate principal of corporate proponent:

Printed name: Jason Cousin

1.0 INTRODUCTION AND BACKGROUND

The development described herein is for the upgrade and expansion of the existing Town of Altona wastewater treatment lagoon.

1.1 Introduction

The Town of Altona currently operates an aerated lagoon on NE 09-02-01 that requires expansion to meet projected growth. The Town of Altona is proposing to construct a new Aeration Cell 4, a new Storage Cell 5 and a sewage treatment building to provide nutrient reduction and disinfection.

An Environment Act Licence is required from Manitoba Conservation for the construction and operation of the upgraded lagoon. JR Cousin Consultants Ltd. (JRCC) was retained for the related engineering services.

1.2 Contact Information

Mr. Jason Cousin, P.Eng.
JR Cousin Consultants Ltd.
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R3Y 1G4
Phone 204-489-0474, Fax 204-489-0487

Mr. Dan Gagne
Supervisor of Financial Services
Town of Altona
111 Centre Avenue
Box 1630
Altona, Manitoba
R0G 0B0

1.3 Background Information

The Town of Altona's lagoon facility is located on NE 09-02-01 WPM. The lagoon was constructed in stages, beginning with the initial lagoon construction in 1971. The most recent upgrade was completed in 2008 when three aeration cells were constructed and existing Storage Cell 3 was remediated.

Sewage enters the lagoon in the Primary Aeration Cell 1 through a 350 mm forcemain. The 350 mm forcemain was installed in 2008 and connects to the existing 150 mm and 300 mm forcemains from Lift Station #1 and Lift Station #4.

Sewage from the old Altona low pressure sewer connects directly into the Primary Aeration Cell 1 through a dedicated 200 mm forcemain.

The current facility operates five cells. The three primary aeration cells and Storage Cell 3 are PVC lined lagoons with 5:1 inside slopes. Storage Cell 4 is a clay lined storage cell with 4:1 inside slopes. The three primary aeration cells operate with a 3.9 m operating depth. The two storage cells have a 2.1 m operating depth, however the bottom 0.3 m of the storage cells are not discharged, resulting in a usable storage depth of 1.8 m. There is a sixth existing cell, Storage Cell 2, however the cell is leaking and is not currently in operation. The following table summarizes the hydraulic capacities of each cell.

Description	Hydraulic Capacity
Primary Aeration Cell 1	44,900 m^3
Primary Aeration Cell 2	29,200 m^3
Primary Aeration Cell 3	29,200 m^3
Storage Cell 3 (usable storage)	120,900 m^3
Storage Cell 4 (usable storage)	161,800 m^3
Storage Cell 2 (not in use)	83,800 m^3

The three primary cells are aerated using 192 MAT Diffuser TA22 fine bubble aeration system with floating laterals. Air is provided to the diffusers using 1 - 60 hp Kaeser Omega Blower EB420C and 2 - 75 hp Kaeser Omega Blowers EB420C 575V, 3 phase motors. The blowers are located in a 40 m^2 steel building on a thickened edge concrete foundation. The blowers are intended to operate as two prime blowers and one standby, providing 1,920 scfm of air to the lagoon. Reviewing the Nelson Environmental *Operation & Maintenance Manual, Altona WWSP Aeration*, May 2009, the aeration system was designed to treat 800 kg BOD_5/day at a flow rate of 2,000 m^3 per day.

The existing lagoon facility is equipped with a truck dump spillway and turnaround constructed in 2008.

The three existing primary cells and Storage Cell 3 were constructed with a PVC liner, complete with weeping tile underneath. The weeping tile is connected to a lift station located near the northwest corner of Primary Cell 3, which pumps water collected in the weeping tile system up to the ground surface, which then drains from the site through perimeter ditches. The weeping tile under the liner in Storage Cell 3 is connected to a manhole southeast of Storage Cell 3. The weeping tile manhole is not connected to the weeping tile lift station, so the lagoon operators pump out that manhole when it fills with water.

The lagoon facility discharges the effluent through surfaces ditches, eventually flowing into the Plum River, which flows into the Red River.

1.4 Description of Previous Studies

A report entitled *Town of Altona – Lagoon Expansion Feasibility Study* was completed by JRCC in January 2014. This report discussed increasing the organic capacity of the lagoon by constructing a new aeration cell, Aeration Cell 4, and discussed gravity upflow sand filtration with ferric chloride addition to remove phosphorus. Various options for increasing the storage capacity of the lagoon were discussed, including remediating Storage Cell 2, raising the dikes on Storage Cell 4, and constructing a new storage cell, Storage Cell 5.

The Town of Altona reviewed the report and chose to proceed with a new aeration cell and sewage treatment building, while selecting the construction of Storage Cell 5 to increase the storage capacity of the lagoon.

A pre-design report for the selected options entitled *Town of Altona – Lagoon Expansion Preliminary Design Report* was completed by JRCC in July 2014. The pre-design report is attached with this EAP document and is referenced several times throughout this document.

2.0 DESCRIPTION OF THE DEVELOPMENT

For each heading there is an information request from the Information Bulletin - Environment Act Proposal Report Guidelines. 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 proposed aerated lagoon expansion site is located immediately northeast and southwest of the existing Town of Altona lagoon within NE 09-02-01 WPM. The site is located on PT Plan 4077 WLTO.

There are four lots located on NE 09-02-01 WPM, all of which are owned by the Town of Altona. The Certificates of Title for NE 09-02-01 WPM (Title No. A 35036, A 60755, A 60756, and A 60757) are attached 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 records, the mines and minerals and sand and gravel in the NE 1/4 of NE 09-02-01 WPM are granted to individuals and the crown has no interest (see email correspondence from the Crown Lands & Property Agency, dated May 8, 2014 in Appendix B).

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 northeast and southwest of the existing Town of Altona lagoon cells. A portion of the land directly north of Secondary Cell 4 is currently being used as a compost area, while remainder of the land is currently being used for agricultural purposes. The site is bordered by an unnamed road allowance to the east and north, and agricultural land to the south and west (see Plan 1 in Appendix D).

Soil would be excavated in the area of the proposed lagoon expansion for construction of the lagoon dikes and drainage ditches. The existing compost area will be relocated to another section of land to accommodate the lagoon expansion. A sewage treatment building would be constructed on the south east corner of the proposed aerated primary cell.

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 existing lagoon site and lagoon expansion site is currently zoned AR40 (Agriculture Restricted, minimum of 40 acres), based on the zoning designations in the RM of Rhineland. A wastewater treatment lagoon is permitted under the zoning designation. See e-mail correspondence from the RM of Rhineland dated July 30, 2014 in Appendix B.

2.4.1 Land Classification

According to the Agriculture and Agri-Food Canada Manitoba Agri-Map the proposed lagoon expansion site has a "fine" surface texture, a slope of "0 – 2%", "imperfect" soil drainage, "moderate limitations" to "moderately severe limitations" of the soil capability for agriculture and "very low" risk of water erosion. According to the Canada Land Inventory Soil Capability for Agriculture map for the Winnipeg region, one portion of the proposed lagoon expansion site is designated as $(2^{8}_{W}3^{2}_{W})$ which means Class 2 and Class 3 in a 8:2 ratio. Both The soils with a Class 2 and Class 3 rating have a limitation of excess water (2W, 3W). The other portion of the proposed lagoon expansion site is designated as $(1^{7}\,2^{3}_{X})$ which means Class 1 and Class 2 in a 7:3 ratio. Class 1 soils have no significant limitations in use for crops, while the Class 2 soils have moderate limitation caused by the cumulative effect of several adverse characteristics (2X).

According to the Nutrient Management Regulation 62/2008, soils designated as Class 1, Class 2, or Class 3 are part of water quality management zone N1. Because the site is located in water quality management zone N1, there are no restrictions for construction of a wastewater treatment lagoon.

The Red River is designated as a "vulnerable water body" according to the Nutrient Management Regulation 62/2008, but the Plum River, and the Rempel Drain are not. A river designated as vulnerable requires a 30 m nutrient buffer zone. The proposed lagoon is located approximately 21.6 km from the Red River and thus is not within the nutrient buffer zone.

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 environmental licence. Lagoon construction works are proposed to begin in the spring of 2015, dependent upon approval of funding. Commissioning and operation of the lagoon is proposed to begin upon completion of construction and after approval for use is obtained from Manitoba Conservation.

2.5.2 Basis for Proposed Lagoon Expansion Site Selection

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: Lagoon Expansion Site Location in Relation to Manitoba Conservation Guidelines

Manitoba Conservation Guideline	Proposed Relation to Site
1. Lagoons must be located a minimum of 460 m from any community centre.	The proposed new lagoon is located approximately 2.0 km from the nearest community centre (Town of Altona).
2. 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), this distance is shown on Plan 1, attached in the Appendix.	The proposed new lagoon Storage Cell 5 is located 307 m from the nearest resident. The proposed new primary cell is 685 m from the nearest resident.
3. Consideration should be given to sites in which prevailing winds are in the direction of uninhabited areas.	The prevailing winds are from the north and west. The lagoon is located east of the Town of Altona.
4. Sites with an unobstructed wind sweep across the lagoon are preferred.	The site surrounding the proposed lagoon cells is the existing lagoon and agricultural field with no nearby windbreaks.
5. Areas that are habitually flooded shall be avoided.	The proposed new lagoon dikes will constructed at or above the existing lagoon top of dike elevation which have had no reports of flooding.
6. Sewage lagoons are to be designed and constructed such that the interior surface of the proposed lagoon is underlain by at least one metre of soil having a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. In areas sensitive to groundwater contamination, a flexible synthetic liner may be recommended.	Based on the geotechnical investigation, the in-situ soils will be capable of providing a consistent permeability of 1 x 10^{-7} cm/sec. A vertical cut-off wall constructed of re-compacted clay soils will be extended through the silt layer into the horizontal insitu liner.

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 cells. Plan 1 in Appendix D, shows the minimum setback distance requirements for the expanded lagoon to the local residents and town.

2.5.3 Lagoon Drainage Route

The discharge route from the lagoon will follow the existing lagoon discharge route from the storage cells into existing ditches on the north and east side of the existing lagoon, before flowing north to the Rempel Drain. The Rempel Drain then flows northeast to the Plum River. From the existing lagoon, the discharge route to the Plum River is 16.3 km. The drainage route is shown on Plan 2 attached in Appendix D.

2.5.3.1 Fish Species Information

The Manitoba Conservation and Water Stewardship Fisheries Branch were contacted regarding any potential concerns with fish species along the drainage route. The Fisheries Branch indicated that given that as long as effluent meets or exceeds the Water Quality Standard, Objectives and Guidelines, any fisheries concerns should be addressed.

The Fisheries Branch indicated that the Plum River supports a number of species. According to the Fish Inventory and Habitat Classification System (FIHCS) the following fish species have been found in the Plum River: Carp, Fathead Minnow, Sand Shiner, and White Sucker.

The Fisheries Branch indicated that the Rempel Drain supports a couple of species. According to FIHCS Black Bullhead and Fathead Minnow have been found in the Rempel Drain.

See July 27, 2014 email correspondence from Manitoba Conservation and Water Stewardship – Fisheries Branch in Appendix B.

2.5.3.2 Water Quality Information

Manitoba Conservation and Water Stewardship was contacted for water quality data in the Plum River. Results from one sample from the Plum River near PTH 75 were provided, dated April 18, 1977. The water quality from that sample is as follows:

Table B: Water Quality in the Plum River near PTH 75, April 18, 1977

Parameter	Average Concentration	Unit
Ammonia (NH_3)	0.03	mg/L
Biochemical Oxygen Demand	2.9	mg/L
Total Coliforms	240	MPN/100 mL

Parameter	Average Concentration	Unit
Fecal Coliforms	23	MPN/100 mL
Nitrogen Dissolved NO_3 & NO_2	0.05	mg/L
Nitrogen Total Kjeldahl (TKN)	0.4	mg/L
Oxygen Dissolved	10.6	mg/L
Phosphorus Total (P)	0.16	mg/L
Conductivity (at 25C)	627	uS/cm
Total Suspended Solids (TSS)	33	mg/L
Turbidity	25	NTU

Parameters below the detectable limit were assumed to be at the detectable limit for the purposes of averaging.

The effluent from the aerated lagoon is expected to meet the Provincial and Federal effluent regulations which include limits of 25mg/L BOD_5, 25mg/L TSS, 200 fecal coliform/100 ml sample, 1.0 mg/L total phosphorus and 1.25 mg/L un-ionized ammonia, expressed as (N).

Based on the concentrations shown in Table B, the Plum River has a TSS concentration above the discharge requirements of the lagoon and lower concentration of BOD_5, fecal coliforms, total phosphorus and ammonia.

2.5.4 Access Road

The existing access road will continue to be used to access the lagoon and sewage treatment building. The existing access road connects to the existing mile road at the southeast corner of the lagoon site. There is another access point along the north dike of Storage Cell 3, off of the existing mile road north of the lagoon.

2.5.5 Weeping Tile Modifications

The weeping tile collection system will be modified to allow for easier maintenance by the Town of Altona. A pipe will be installed from the weeping tile manhole near Storage Cell 3 to the weeping tile lift station near Primary Cell 3 so that weeping tile manhole no longer has to be manually pumped out. The discharge from the weeping tile manhole will be altered to discharge into Storage Cell 2, which is not being used for storage of lagoon effluent. Discharging weeping tile water into Storage Cell 2 will mitigate drainage issues caused by weeping tile water freezing in drainage ditches after being pumped to the surface during winter months, blocking perimeter ditches on the lagoon site.

3.0 LAGOON SIZING

3.1 Population Contributing Effluent

The five main contributors to the proposed lagoon are:

- The Town of Altona's residential and commercial population
- Bussed in students
- The RM of Rhineland – old Altona low pressure sewer
- The RM of Rhineland – septic tank pumpouts
- Bunge, a major local industry

For a detailed breakdown of population and number of septic tanks serviced, see of the *Town of Altona – Lagoon Expansion Preliminary Design Report* Section 3.0 attached in Appendix C.

3.2 Lagoon Loading

3.2.1 Organic Loading

The organic loading calculation is based upon the organics in typical residential wastewater and septage. A summary of the projected organic loading in design year 25 (2039) is described in Table C, below.

Table C: Summary of total 25 year (2039) design organic loading to the facility

Description	Organic Load (kg BOD_5/day)
Town of Altona, including bussed in students and old Altona LPS	499.6
RM of Rhineland – septic tank pumpouts	74.3
Bunge	470.4
Total	**1,044.3**

For a detailed breakdown of the organic loading see *Town of Altona – Lagoon Expansion Preliminary Design Report* Section 3.0 attached in Appendix C.

3.2.2 Hydraulic Loading

The hydraulic loading calculation is based upon available lift station meter readings, infiltration rates and typical wastewater production rates. A summary of the projected hydraulic loading in design year 25 (2039) is described in Table D, below.

Table D: Summary of total 25 year (2039) design hydraulic loading to the facility

Description	Average Day Flow (m^3)	Average Day Flow (m^3) During Storage Period
Town of Altona, including bussed in students and old Altona LPS	2,518	2,105
RM of Rhineland – septic tank pumpouts	54	0
Bunge	560	588
Total	**3,132**	**2,693**

The storage capacity of the lagoon based on design year 25 loadings is 484,740 m^3 with 180 days of storage.

For a detailed breakdown of the hydraulic loading see Section 3.0 of the *Town of Altona – Lagoon Expansion Preliminary Design Report* attached in Appendix C.

4.0 LAGOON STORAGE CAPACITY

4.1 Lagoon Storage Period

Typically, facultative lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from aeration of the primary cells, chemical addition and sand filtration, and UV disinfection.

JRCC is hereby requesting an allowable discharge period of April 16 to October 31 (166 days of winter storage).

The storage cells will be sized to accommodate storage from November 1 to April 30 (180 days of winter storage) to provide a small buffer for spring conditions hindering early discharge.

4.2 Storage Cells

The proposed aerated lagoon system will utilize the three existing aeration cells, the two storage cells currently in use, a new aeration cell, and a new storage cell. The following section describes the lagoon storage cells.

The two existing lagoon storage cells currently in use, Storage Cell 3 and Storage Cell 4 will continue to be used for effluent storage. A new cell, Storage Cell 5, will be constructed east of the existing Storage Cell 3, and north of Storage Cell 4 and Primary Cell 3 to provide additional storage capacity.

For a detailed breakdown of each storage cell including, elevations, dike dimensions, storage volumes, proposed cell upgrades, etc. see Section 1.2 of the *Town of Altona – Lagoon Expansion Preliminary Design Report* attached in Appendix C.

4.2.1 Storage Cell 5 Sizing

The proposed Storage Cell 5 was not sized based on the required hydraulic storage of the system, but rather the cell was sized to utilize all available land on the northeast portion of the quarter section that the existing lagoon occupies. The outside toe of the lagoon must be set a minimum of 30 m from property line. There are two existing residences adjacent to the new storage cell, located on the southwest quarter of Section 15-02-01 WPM and the NW corner of section 10-02-01 WPM. Those residences are 307 m and 318 m from the toe of the new storage cell respectively, exceeding Manitoba Conservation's requirement of a 300 m setback.

The additional cost to construct Storage Cell 5 larger than required, to utilize all available area, would be lower than construction of a smaller cell at this stage and construction of an expansion cell in the future.

4.2.2 Secondary Cell Aeration Requirements

Storage Cell 5 will be designed with a maximum operating depth of 3.0 m, while Storage Cell 3 and Storage Cell 4 currently have a maximum operating depth of 2.1 m. An operating depth of 3.0 m will have some risk of the effluent becoming anaerobic and decreasing the wastewater quality unless additional aeration is provided to the cell. An operating depth in the cells of 2.1 m would have significantly less risk of the effluent becoming anaerobic.

Storage Cell 5 will be constructed with a maximum liquid level of 3.0 m but operated in Phase I with a maximum liquid level of 2.1 m and thus a linear aeration system would not be required in Cell 5 until design year 30 (2044) based on 180 days of wastewater storage; of wastewater that has been treated by primary cell aeration, filtration and UV disinfection.

Prior to design year 30, Phase II of the lagoon expansion will be constructed which involves installing a linear tubing aeration system in Storage Cell 5 with two 25 hp blowers (1 duty, 1 standby) installed in the sewage treatment building. The storage cell aeration system will provide approximately 240 cfm of air to the cell. The sewage treatment building will be designed so the additional blowers can be easily added. Installation of the aeration system will allow the operating level in Storage Cell 5 to be increased to 3.0 m, increasing the storage capacity of the lagoon to a design year 49 (2063) level.

The aeration header for Storage Cell 5 will be installed in the intercell dike between Storage Cell 4 and Aerations Cells 1, 2, and 3 to simplify the future dike raising and aeration of Storage Cell 4 to exceed design year 49 (2063) storage capacity.

Once the aeration system in Storage Cell 5 is constructed, the aeration system will not need to operate year round as the liquid level in the cells will not exceed the 2.1 m operating depth, except in mid winter. The blowers will need to be operated from late fall, to ensure the aeration lines do not freeze, until the spring discharge is completed. The blowers can be turned off after the spring discharge until late fall.

4.2.3 Phase I – Total Storage Capacity

The proposed lagoon will have a total storage capacity from all three storage cells of 514,000 m^3 with a maximum operating level of 2.1 m. The proposed storage capacity exceeds the design year 25 projected storage requirements of 484,800 m^3 based on 180 days of storage.

For Phase I the lagoon would be suitable to design year 30 (2044) based on the projected populations and lagoon loadings with 180 day of storage.

4.2.4 Phase II – Total Storage Capacity

Once Phase II of lagoon construction is completed, the proposed lagoon will have a total storage capacity from all three storage cells of 638,700 m^3 with a maximum operating level of 2.1 m in Storage Cells 3 and 4, and 3.0 m in Storage Cell 5.

5.0 LAGOON SEWAGE TREATMENT

5.1 Lagoon Treatment Requirements

A review of the *Wastewater System Effluent Regulations* June 28, 2012 and the *Manitoba Water Quality Standards, Objectives and Guidelines* November 28, 2011 was completed. The following table summarizes the treatment requirements:

Parameter	Federal Requirement	Provincial Requirement
$CBOD_5$	25 mg/L	25 mg/L
BOD_5		25 mg/L
Suspended Solids	25 mg/L	25 mg/L
Un-ionized Ammonia expressed as nitrogen (N) at 15°C	<1.25 mg/L	
Fecal Coliforms		200 per 100 mL
Phosphorus		1.0 mg/L

Sewage samples were obtained from Aeration Cell 1, Aeration Cell 3 and Storage Cell 3 Additional historical effluent quality was obtained from Lift Station 1 in May 2007. The sewage effluent is summarized below.

Parameter	Units	2007 LS #1	Aeration Cell 1	Storage Cell 3	Aeration Cell 3	Aeration Cell 3	Aeration Cell 3
			09/30/13	05/23/13	03/26/14	04/22/14	06/02/14
pH	pH units	7.6	7.6		7.5	7.6	8.2
Total Suspended Solids	mg/L	197	40				
Ammonia, Total (as N)	mg/L	19.4	20.2		13.2	25.4	11.5
Un-ionized Ammonia as N @ 15°C	mg/L		0.24		0.113		
Un-ionized Ammonia as N	mg/L					0.099	0.569
Fats, Oil & Grease	mg/L	96	9.4				
Phosphorus (P)-Total	mg/L	3.9	8.5	8.1			
Biochemical Oxygen Demand	mg/L	303	10.1	13.5			

Lab test results are available in Appendix C of the *Town of Altona – Lagoon Expansion Preliminary Design Report* attached in Appendix C of this report.

5.2 Lagoon Treatment Equipment

The proposed lagoon will treat BOD from the wastewater utilizing three existing aerated primary cells and one new aerated primary cell, operated in series each with a combined retention time of 50 days at design year 25 flow rates. Air will be provided to the cells with the two existing 75 HP blowers, the existing 60 HP blower and a new 75 HP blower. The blowers will provide approximately 2,772 cfm through HDPE headers, floating laterals and fine bubble diffusers. The system will be designed to have three blowers operational, while the fourth is on standby. The existing blowers will be relocated from the existing building to the new sewage treatment building.

The existing aeration laterals will not need to the changed, however to improve on air efficiency, three of the existing laterals in Aeration Cell 1 will be removed. The existing header will be extended to the new sewage treatment building. A baffle curtain will be installed to divide Aeration Cell 1 in two parts to minimize short circuiting and improve effluent quality.

The peak hydraulic design flow rate of the treatment equipment (filters, UV, pumps) was calculated at 3,589 L/min based on a peak day flow of 1.65 times the average day flow, based on historical lift station pump run times and utilizing 20 hours per day for treatment.

Four 2.74 m diameter continuous gravity upflow sand filters with ferric chloride addition will be utilized to reduce phosphorus to < 1 mg/L.

UV disinfection will be completed with two Trojan UV Fit 32AL50 UV disinfection units designed with a minimum UVT of 40%. During average day flows one unit will be in operation, while the other is on standby. During peak flow, both units will operate to ensure disinfection.

A sewage treatment building will be constructed to house the treatment equipment as well as an office, washroom, etc. The building will be pre-engineered steel with a metal liner panel exterior with a footprint approximately 332 m^2.

Treated effluent from the sewage treatment plant building will be directed into the storage cells during the winter storage period and directly to the ditch south of the lagoon during the summer discharge period.

For more details on the aerated primary cells, aeration system, peak flow rate calculations, filters, UV system, building, pump systems see Section 5.0 of the *Town of Altona – Lagoon Expansion Preliminary Design Report* attached in Appendix C.

6.0 TOPOGRAPHY AND GEOTECHNICAL REVIEW

6.1 Geotechnical Investigations

A total of four geotechnical investigations have been completed at the Altona lagoon site as follows:

- July 1992 by Poetker MacLaren
- August 1992 by Poetker MacLaren
- January 2006 by Cochrane
- April 2014 by AMEC.

The investigations determined that the site generally has a topsoil layer between 0.3 and 0.6 m thick, followed by a varying layer of low to medium plastic clay to a depth of 1 m. Following the clay layer was a silt layer with some sand layers intermixed. A continuous layer of high plastic clay started between 3 and 4 m below the ground surface.

The lower clay layer had the hydraulic conductivity tested on one sample in 2006 with results of 4.4 x 10^{-8} cm/s and one sample in 1992 with results of 4.0 x 10^{-8} cm/s. The test results show the lower clay layer is suitable for use as an insitu lagoon liner as it meets Manitoba Conservation's requirements of 1.0 x 10^{-7} cm/s.

Hydraulic conductivity tests were also completed on two samples in 1992 on the upper clay layer with results of 9 x 10^{-8} cm/s and 3 x 10^{-8} cm/s. One sample from the upper clay layer in the 2014 investigation was tested for insitu hydraulic conductivity with a result of 8.6 x 10^{-7} cm/s. respectively. A sample of the upper medium plastic silty clay from Trench 2 (near TH17 of the original field investigation) was re-worked and re-compacted to 95% of Standard Proctor Density. The sample underwent hydraulic conductivity testing and achieved a hydraulic conductivity of 1.17 x 10^{-8} cm/s. The August 11, 2014 addendum to the AMEC report, pertaining to the sampling, is in Appendix C.

Based on slope stability analysis completed during the 2014 investigation, the inside slopes of the new aeration cell and new storage cell were recommended to be 5:1 slopes. The outside slopes of all the dikes were recommended to be 4:1 slopes.

The complete summaries of the past investigations can be found in Section 2.1 of the *Town of Altona – Lagoon Expansion Preliminary Design Report,* attached in Appendix C.

6.2 Topography

A topographic GPS survey of the existing ground at the lagoon and the proposed lagoon expansion site was completed in May 2014 using GPS survey equipment. The top of dike elevation of the three existing aeration cells and Storage Cell 3 is approximately 247.50 m. The top of dike elevation for Storage Cell 2, which is not in use, and Storage Cell 4 is about 246.60 m.

The area for the new lagoon storage cell gently slopes to the north, with elevation around 244.4 m along the north side of Storage Cell 4 and Aeration Cell 3, dropping to between 243.4 m and 243.8 m along the north edge of the property. The area for the new lagoon aeration cell on the southwest corner of the property is relatively flat ranging between 244.4 m and 244.8 m.

For details see Section 2.1 of the *Town of Altona – Lagoon Expansion Preliminary Design Report* attached in Appendix C.

7.0 LAGOON OPERATION, MAINTENANCE AND DECOMMISSIONING

7.1 Operation and Maintenance

Maintenance of the aerated lagoon will include:

- Lagoon Cells and Access Roads
    - Maintaining the fencing, gate and lock
    - Ensuring the gate is locked at all times and only the local septic haulers and Town of Altona Public Works department have access to the site
    - Maintaining the intercell and discharge piping and valves
    - Maintaining grass cover on dikes to a height of no more than 0.3 m in height
    - Maintain a program to prevent and remove burrowing animals
    - Maintain truck turnaround area and spillway
    - Clearing of snow from the lagoon access road, truck turnaround area and spillway
    - Complete effluent sampling prior to discharge.
- Sewage Treatment Equipment
    - Monitor and service lift station pumps
    - Record and monitor mag meters readings and lift station hour meters
    - The diffuser membranes will require minimal cleaning and maintenance. For cleaning, additional airflow can be introduced to the diffusers causing the membrane pores to flex, temporarily breaking off any formed precipitation or fouling. No chemical cleaning or water wash is required
    - Diffusers will require replacement in approximately 12 years
    - Aeration blowers will require filter changes every six months, oil changes every year and belt replacement every two years
    - Refilling phosphorus reduction chemical and adjusting dosage rates based on laboratory testing of the lagoon effluent
    - Sand filters will require an airlift replacement once per year
    - Check UV bulbs and complete manual bulb cleaning where required. The UV will be equipped with an automatic wiping system as well as a chemical cleaning system to reduce operator maintenance
    - General building cleaning and maintenance.

7.2 Sludge Management

7.2.1 Aerated Primary Cells

In a typical facultative lagoon, solids in wastewater will settle to the bottom of the cell and accumulate as sludge. Oxygen is not available at the bottom of a facultative lagoon cell and thus the anaerobic sludge will accumulate over time. Based on past experience with facultative lagoons in Manitoba, sludge will require removal approximately every 20 – 25 years.

With aerated primary cells, the diffusers are suspended near the bottom of the cells which blow fine bubbles up through the wastewater. Wastewater will rise with the bubbles and fall between the diffusers creating convection currents within the aerated primary cells. Solids in the wastewater will fall through the downward motion of the wastewater between the diffusers. When the sludge reaches the bottom of the cell, oxygen provided by the diffusers allow aerobic sludge digestion to take place at the sludge-wastewater interface. The process results in minimal organic sludge accumulation in the cells.

Backwash from the sand filters will be sent to the primary cell which contains phosphorus and suspended solids. This will accumulate in the primary cell. The sludge from the filter backwash will also undergo aerobic sludge digestion with the oxygen provided by the diffusers to reduce the quantity of sludge in the cells.

Sludge accumulation projections were provided by Nelson Environmental Inc based on typical wastewater influent characteristics. Based on the assumptions, the total surface area of Primary Cells 1, 2, 3, and 4 is 25,641 m^2, and over a 20 year time period the lagoon will generate approximately 21,133 m^3 of sludge with the average sludge depth of 0.82 m.

The actual sludge accumulation in the aerated primary cells should be evaluated and removed if the actual depth is 0.5 m or greater.

7.3 Lagoon Decommissioning

The existing lagoon cells will not be decommissioned as part of the lagoon upgrade and expansion works.

No date has been set for decommissioning of the upgraded and expanded lagoon system. Phase I of the lagoon system is designed for design year 29 storage loadings 25 year treatment loadings.

8.0 POTENTIAL ENVIRONMENTAL IMPACTS

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

8.1 Releases to Air, Water, Land

8.1.1 Air

In general, **facultative** lagoons 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. **Aerated** lagoons provide oxygen to the wastewater year round which prevents the lagoon from becoming anaerobic which greatly reduces the potential for odours.

There is 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.

Environmental management practices to mitigate the above potential impacts to the air are provided in Section 9.1 of this report.

8.1.2 Water

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

Pollutants that have a potential to be released into the surface or groundwater during the lagoon upgrade 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 flow into the Rempel Drain, followed by the Plum River and eventually reach the Red River PTH 75. There is also potential to impact surface water via sedimentation from soil erosion in the discharge stream during the construction works.

The discharge from the lagoon should not cause or contribute to flooding in or along the drainage route. The lagoon would not be discharged during flood conditions, or during freezing conditions. There is no potential to impact the navigation of surface waters as a result of the lagoon project, as the flow from discharging the lagoon is minimal compared to normal flow in the Rempel Drain.

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 or fuel spills during construction.

Environmental management practices to mitigate the above potential impacts to water are provided in Section 9.2 of this report.

8.1.3 Land

The land would be significantly altered by construction of the new cell dikes and perimeter ditching. A building would also be constructed south of the lagoon.

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

Disturbed areas can be impacted through soil erosion if not covered or re-vegetated. Environmental management practices to mitigate the above potential impacts to the land are provided in Section 9.3 of this report.

8.2 Wildlife

The proposed lagoon site is located in the "Lake Manitoba Plain" Ecoregion of Canada. Characteristic wildlife includes white-tailed deer, coyote, rabbit and ground squirrel. Bird species include waterfowl.

The Manitoba Conservation Data Centre was contacted regarding the proposed lagoon project and indicated that there were no occurrences of rare species at the proposed lagoon expansion site in their database. Refer to the Manitoba Conservation Wildlife and Ecosystem Branch, May 12, 2014 email correspondence, attached in Appendix B.

Impacts to wildlife and wildlife habitat are not expected, as the lagoon expansion is to be located on agricultural land which is regularly disturbed by farming activities.

8.3 Fisheries

Impacts to fish along the discharge route are unlikely as the lagoon effluent would be discharged after fish spawning has normally occurred and only when the treated effluent meets current Manitoba Conservation water quality guidelines for surface discharge.

8.4 Forestry

There are no potential impacts to forestry as the area of lagoon expansion has been previously cleared due to agriculture and no forestry areas would be impacted.

8.5 Vegetation

Characteristic vegetation in the Lake Manitoba Plain ecoregion is classified as being a transitional area between areas of boreal forest to the north and aspen parkland to the southwest. It is a mix of trembling aspen/oak groves and rough fescue grasslands.

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. Refer to Manitoba Conservation Wildlife and Ecosystem Protection Branch email correspondence dated May 12, 2014, attached in Appendix B.

No significant impacts to vegetation in the development area are anticipated, as the site is currently agricultural land which is disturbed regularly through farming activities.

8.6 Noise Impacts

There is a potential for noise impacts in the immediate area due to the heavy equipment utilized during construction. Mitigation measures described in Section 9.4 below will be in place during the construction works.

The blowers within the building will have self-contained sound attenuation enclosures which will limit the sound levels to approximately 73 dB(A). The only other potential sources for noise impacts will be the maintenance vehicles (for lagoon effluent sampling or mowing grass), septic hauling trucks, and periodic chemical delivery trucks.

8.7 Health and Safety

There is a potential for impacts to the health and safety of workers and the public during the construction works. Mitigation measures described in Section 9.5 below will be in place during the construction works.

8.8 Heritage Resources

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. Refer to the Manitoba Historic Resources Branch May 13, 2014 e-mail correspondence, attached in Appendix B.

While impacts to historic or heritage resources are not expected at the site, there is a potential for an unexpected discovery when excavating an area which has not previously been excavated. Mitigation measures described in Section 9.6 below will be in place during the construction works.

8.9 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 Town of Altona. In addition, The Town of Altona would have increased wastewater capacity upon completion of the project, which will encourage future development and growth.

8.10 Aesthetics

The lagoon expansion is not expected to have adverse impacts on the general aesthetics of the area, as the lagoon construction would occur adjacent to the existing lagoon cells.

9.0 MANAGEMENT PRACTICE

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

9.1 Mitigation of Impacts to Air

To reduce the potential for odour nuisance in the community, the primary cell aeration system will be sized for the projected year 25 organic loadings, from the contributing populations. Nuisance odours as a result of organic loading are not expected due to the aeration system maintaining aerobic conditions year round.

Furthermore, the proposed lagoon upgrade/expansion would be located a minimum of 300 metres from the nearest resident, as required by Manitoba Conservation.

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

9.2 Mitigation of Impacts to Water

9.2.1 Surface Water

Impacts to surface water from discharge of lagoon effluent are not expected, as the lagoon effluent would not be discharged unless Provincial and Federal discharge requirements are met, as follows:

1. The organic content of the effluent, as indicated by the five day biochemical oxygen demand would not be greater than 25 mg/L
2. The total suspended solids would not be greater than 25 mg/L
3. The fecal coliform content of the effluent, as indicated by the MPN index would not be greater than 200 per 100 ml of sample, or Escherichia coli content not greater than 200 per 100 ml of sample.
4. The total phosphorus content of the effluent would not exceed 1 mg/L
5. The un-ionized ammonia expressed as nitrogen (N) at 15°C content of the effluent would not exceed 1.25 mg/L.

Erosion from excess material stockpiles would be prevented by the use of silt fencing at drainage locations and by either covering the soil stockpiles or seeding with grass. Clean rock (free of fine materials) from an appropriate land-based source would be utilized to eliminate 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. 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 specification 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, and comply with provincial regulations
- 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.

There would be no impacts to navigation as a result of the lagoon project, as the flow from discharging the lagoon is about 2% of the flow estimated in the Rempel Drain during the May 2014 site survey. If flooding occurs along the drainage route, the Town must not discharge the lagoon. The discharge should not cause or contribute to flooding in or along the drainage route.

9.2.2 Groundwater

Seepage of effluent from the lagoon is unlikely to affect groundwater as the new lagoon primary cells and storage cell extensions would utilize a clay liner, having a hydraulic conductivity less than 1×10^{-7} cm/sec, as required by Manitoba Conservation guidelines.

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 in Section 9.2.1 above.

9.3 Mitigation of Impacts to Land

The lagoon will utilize the insitu high plastic clay as the horizontal liner under the existing and proposed wastewater treatment lagoon cells. A vertical cut-off wall will be extended through the silt layer into the high plastic clay layer surrounding the new and proposed lagoon cells to completely seal the lagoon.

To minimize the potential for the release of Petroleum Hydrocarbon (PHC) pollutants into the soil, the mitigation measures described in Section 9.2.1 above outlining fuel-handling procedures should be followed.

To minimize the potential for slope erosion, the outside slopes of the dikes would be constructed with a 4:1 slope and the dike tops, outside slopes and soil stockpiles would be seeded with grass. The discharge outlet location would be covered with rip-rap to eliminate soil erosion into the ditch during discharge events.

9.4 Mitigation of Noise Impacts

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

The aeration blowers would have self-contained sound attenuation enclosures which will should limit the sound levels to approximately 73 dB(A).

9.5 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.

9.6 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 RM, Manitoba Historic Resources Branch and any other authority as may be required.

10.0 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 upgraded 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 future development and expansion of the Town of Altona.

11.0 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 discharge, and is to ensure water quality guidelines as described in the environmental licence are met. The lagoon operator would also be responsible for the operation and maintenance activities described in Section 7.1.

The construction contractor is to ensure that grass growth occurs on slopes and disturbed areas, after the construction activities are completed.

12.0 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 will be through the Town and other possible derived sources i.e. MWSB. No additional approvals, licences or permits are required for the lagoon construction and operation.

13.0 PUBLIC CONSULTATION

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

Public consultation by the Town of Altona has not been conducted to date. Public comments will be received by Manitoba Conservation through the public registry during the Environmental Act Proposal review period.

14.0 CONCLUSION

Based on the design of the project and the implementation of the mitigation measures identified in Section 9.0 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 construction can begin by the time specified in Section 2.5.1 above.

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

APPENDICES

Appendix A

Certificate of Title A 35036

Certificate of Title A 60755

Certificate of Title A 60756

Certificate of Title A 60757

Appendix B

Crown Lands and Property Agency, May 8, 2014 Email Correspondence

RM of Rhineland July 30, 2014 Email Correspondence

Manitoba Conservation and Water Stewardship – Fisheries Branch, July 27, 2014 Email Correspondence

Manitoba Conservation Data Centre, May 12, 2014 Email Correspondence

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Appendix C

Town of Altona – Lagoon Expansion Preliminary Design Report

Addendum to Geotechnical Investigation, AMEC, August 2014

Appendix D

Plan 1: Lagoon Layout Plan with Setbacks to Existing Residences

Plan 2: Lagoon Drainage Route

Appendix A

Certificate of Title A 35036

Certificate of Title A 60755

Certificate of Title A 60756

Certificate of Title A 60757

NO
FURTHER DEALING
WITH ANY PART OF THIS
LAND WILL BE ACCEPTED
FOR REGISTRATION UNTIL A
PLAN IS REGISTERED
DATE

Cert. No. **A 35036**

MANITOBA

Certificate of Title

UNDER "THE REAL PROPERTY ACT."

THE TOWN OF ALTONA

is now seized of an estate in fee simple in possession subject to such encumbrances, liens and interests as are notified by memorandum underwritten (or endorsed hereon) in all that piece or parcel of land known and described as follows,

Lot 1, S.P. Plan No. 2347, M.L.T.O., in the N.E.¼ 9-2-1, W.P.M.

IN WITNESS WHEREOF I have hereunto signed my name and affixed my Seal of office this **Seventh** day of **March**
One thousand nine hundred and **Eighty-Six**
Signed in the presence of

J Compton

District Registrar
for **MORDEN**

Form No. PS-F-8

From No. **A 9154** **All** REQUEST ~~*Transfer*~~ **86-1344** *Application* **9341**

	REGISTERED		
Mortgage for $.....................................	*The* *day of* *19* *at*	 *TO* *Deputy District Registrar*	*No.*
Mortgage for $.....................................	*The* *day of* *19* *at*	 *TO* *Deputy District Registrar*	*No.*
Mortgage for $.....................................	*The* *day of* *19* *at*	 *TO* *Deputy District Registrar*	*No.*
Mortgage for $.....................................	*The* *day of* *19* *at*	 *TO* *Deputy District Registrar*	*No.*
Mortgage for $.....................................	*The* *day of* *19* *at*	 *TO* *Deputy District Registrar*	*No.*

No. 36725 AT
FILED 30 Mar. 1978 11:08 a.m.
BY Manitoba Telephone System

36737 AT
30 Mar. 1978 11:20 a.m.
Manitoba Telephone System

Address For Service

Box 1630
Altona, Manitoba
ROG OBO

MANITOBA
Certificate of Title
UNDER THE REAL PROPERTY ACT

Cert. No. A 60755

J93

LAGOON LANDS
FROM MARY PENNER

B/L No. 1380.

District Of Morden

Sworn Value: $ 49,980.00
Consideration: $ 49,980.00

From Title: A 35039 A11
Instrument No.: 92-1338

TOWN OF ALTONA

is registered owner subject to such entries recorded hereon, in the following described land:

Lot 4 SP Plan 2347 MLTO
in the NE 1/4 9-2-1 WPM

SIGNED by me this 16th day of March, 1992.

For The District Registrar

Instrument			Land Transferred To	New C.T. Number	For the District Registrar
Type	Number	Date			

MG 1398 REV.'86

Instrument			Target Registration	Particulars	For the District Registrar	Discharges		
Type	Number	Date				Regn. #	Date	For District Registrar
C	83-5545	83 08 15		By: The Manitoba Telephone System - E 40'	Compton			

AC - Assignment of Caveat / cession de notification d'opposition
Agrt - Agreement to Amend or Extend Mortgage / convention de modification d'hypothèque
BL - Builder's Lien / privilège du constructeur
C - Caveat / notification d'opposition
E - Easement / servitude
J - Judgment / jugement
L - Lien / privilège
Misc - Miscellaneous / divers
M - Mortgage / hypothèque
MM - Mortgage of Mortgage / sous-hypothèque
NEPS - Notice Exercising Power of Sale / avis de vente en exécution
PDM - Partial Discharge of Mortgage / mainlevée partielle en matière d'hypothèque
PL - Plan / plan
PostP - Postponement / subordination de charge
PPS - Personal Property Security Notice / avis en matière de sûreté sur les biens personnels
PWA - Party Wall Agreement / convention en matière de murs mitoyens
PWC - Partial Withdrawal of Caveat / retrait partiel de notification d'opposition
TM - Transfer of Mortgage / transfert d'hypothèque
TS - Tax Sale / vente pour défaut de paiement de taxe
WN - Withdrawal of Notice / retrait d'avis

Duplicate Certificate of Title Issued

Request Number	Date	Recipient
	92 03 16	Wiens & Cole

J/93

LAGOON LANDS
FROM HENRY & ANNA
HOEPPNER.
B/L No. 1380

Address For Service

Box 1630
Altona, Manitoba
ROG OBO

MANITOBA
Certificate of Title
UNDER THE REAL PROPERTY ACT

Cert. No. A 60756

District Of Morden

Sworn Value: $ N/A
Consideration: $ N/A

From Title: A 35037 All
Instrument No.: 92-1339

TOWN OF ALTONA

is registered owner subject to such entries recorded hereon, in the following described land:

Lot 2 SP Plan 2347 MLTO
in the NE 1/4 9-2-1 WPM

SIGNED by me this 16th day of March, 1992.

Crampton
For The District Registrar

Instrument			Land Transferred To	New C.T. Number	For the District Registrar
Type	Number	Date			

MG 1398 REV.'86

Instrument			Target Registration	Particulars	For the District Registrar	Discharges		
Type	Number	Date				Regn. #	Date	For District Registrar
C	31128	66 09 26		By: The Manitoba Telephone System	D Compton			
C	36725	78 03 30		By: Manitoba Telephone System - N 20' NE 1/4 exc. Wly 66 2/3 Rds.	D Compton			
C	83-5544	83 08 15		By: The Manitoba Telephone System - E 40'	D Compton			

AC - Assignment of Caveat / cession de notification d'opposition
Agrt - Agreement to Amend or Extend Mortgage / convention de modification d'hypothèque
BL - Builder's Lien / privilège du constructeur
C - Caveat / notification d'opposition
E - Easement / servitude
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Duplicate Certificate of Title Issued

Request Number	Date	Recipient
	92 03 16	Wiens & Cole

Address For Service

Box 1630
Altona, Manitoba
ROG OBO

MANITOBA
Certificate of Title
UNDER THE REAL PROPERTY ACT

Cert. No. A 60757

J/93

LAGOON LANDS
FROM HENRY & ANNA
HOEPPNER.
B/L No. 1380

District Of Morden

Sworn Value: $ N/A
Consideration: $ N/A

From Title: A 35038 A11
Instrument No.: 92-1339

TOWN OF ALTONA

is registered owner subject to such entries recorded hereon, in the following described land:

Lot 3 SP Plan 2347 MLTO
in the NE 1/4 9-2-1 WPM

SIGNED by me this 16th day of March, 1992.

For The District Registrar

Instrument			Land Transferred To	New C.T. Number	For the District Registrar
Type	Number	Date			

MG 1398 REV. '86

Instrument			Target Registration	Particulars	For the District Registrar	Discharges		
Type	Number	Date				Regn. #	Date	For District Registrar
C	31128	66 09 26		By: The Manitoba Telephone System	DLCompton			
C	83-5544	93 08 15		By: The Manitoba Telephone System - E 40'	DLCompton			

AC - Assignment of Caveat / cession de notification d'opposition
Agrt - Agreement to Amend or Extend Mortgage / convention de modification d'hypothèque
BL - Builder's Lien / privilège du constructeur
C - Caveat / notification d'opposition
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Misc - Miscellaneous / divers
M - Mortgage / hypothèque
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PWC - Partial Withdrawal of Caveat / retrait partiel de notification d'opposition
TM - Transfer of Mortgage / transfert d'hypothèque
TS - Tax Sale / vente pour défaut de paiement de taxe
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Duplicate Certificate of Title Issued

Request Number	Date	Recipient
	92 03 16	Wiens & Cole

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Manitoba Conservation Data Centre, May 12, 2014 Email Correspondence

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

Crown Lands and Property Agency, May 8, 2014 Email Correspondence

From: Little, Karen (CLPA) [Karen.Little@gov.mb.ca]
Sent: May-08-14 9:15 AM
To: 'David Kelly'
Subject: RE: Town of Altona Lagoon Expansion - Mines and Minerals

Good morning David, according to our records this date, the mines & minerals and sand & gravel in NE 9-2-1 WPM were originally granted in 1894 to Peter Ewert. The Crown has no interests.

To determine the current ownership of these under-rights you will need to do titles searches at The Morden Land Titles Office. (Note: under-rights may have reverted back to the Crown by way of tax sale, which we are not aware of).

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 the Manitoba Government

From: David Kelly [mailto:dkelly@jrcc.ca]
Sent: May-07-14 3:44 PM
To: Little, Karen (CLPA)
Subject: Town of Altona Lagoon Expansion - Mines and Minerals

Hi,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the expansion of the existing Town of Altona lagoon. The lagoon expansion is to occur immediately northeast and southwest of the existing lagoon.

The existing lagoon and lagoon expansion will be located on the NE 09-02-01-W.

Could you please confirm the owner of the mineral rights for this property.

Thank you,

David Kelly, P.Eng.

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

***

RM of Rhineland July 30, 2014 Email Correspondence

David Kelly

From:	rhinelnd@mymts.net
Sent:	July-30-14 3:02 PM
To:	'David Kelly'
Subject:	RE: Town of Altona lagoon property zoning

Hi David,

You've got it.

If you need anything else, please let me know.

Lorraine

From: David Kelly [mailto:dkelly@jrcc.ca]
Sent: Wednesday, July 30, 2014 2:37 PM
To: Rhineland@mts.net
Cc: 'Jason Cousin'
Subject: Town of Altona lagoon property zoning

Hello,

Just to confirm our conversation on the phone,

The existing Town of Altona lagoon and expansion area, both located on Section NE 09-02-01 WPM, is zoned by the RM of Rhineland as "AR40" or Agricultural Restricted, minimum of 40 acres. A wastewater treatment lagoon is permitted in land zoned as AR40 under conditional use, which has previously been applied for and granted by the RM.

Thanks

David Kelly, P.Eng.

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

Manitoba Conservation and Water Stewardship – Fisheries Branch, July 27, 2014 Email Correspondence

David Kelly

From: Janusz, Laureen R (CWS) [Laureen.Janusz@gov.mb.ca]
Sent: July-27-14 10:44 AM
To: David Kelly
Cc: Klein, Geoff (CWS)
Subject: RE: Town of Altona Lagoon Expansion - Fisheries Info
Attachments: BERENS_PLUM_REMPEL_FIHCS_20140725.pdf

Hi David,

My apologies for the delay in responding. Attached is the information we have on Rempel Drain and the Plum River from our FIHCS. Berens River was included by mistake. Please note that information from FHICS comes from a number of sources and as such we cannot guarantee the species listed are 100% accurate. Also the species when entered are not linked to a location so the list includes everything reported to be found in the waterbody.

From what you have described below it would seem that as long as the effluent meets or exceeds the Water Quality Standard, Objectives and Guidelines any fisheries concerns should be addressed.

Laureen Janusz
Fisheries Science and Fish Culture Section
Fisheries Branch,
Manitoba Conservation and Water Stewardship
Box 20, 200 Saulteaux Crescent
Winnipeg, MB R3J 3W3

Phone: 204.945.7789
Cell: 204.793.1154
Fax: 204.948-2308
Email: Laureen.Janusz@gov.mb.ca

From: David Kelly [mailto:dkelly@jrcc.ca]
Sent: July-11-14 3:29 PM
To: Janusz, Laureen R (CWS)
Subject: RE: Town of Altona Lagoon Expansion - Fisheries Info

Hi Laureen,

I was going through my files and I did not see a response to my request below regarding the Altona Lagoon. Can you please take a look and get back to me?

Thanks

David Kelly, P.Eng.

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

From: David Kelly [mailto:dkelly@jrcc.ca]
Sent: May-07-14 3:36 PM
To: 'Laureen.Janusz@gov.mb.ca'
Subject: Town of Altona Lagoon Expansion - Fisheries Info

Hi Laureen,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the expansion of the existing Town of Altona lagoon. The lagoon expansion is to occur immediately northeast and southwest of the existing lagoon. The existing lagoon and lagoon expansion will be located on the NE 09-02-01-W.

The aerated lagoon will have highly treated effluent with phosphorus reduction and UV disinfection.

The lagoon expansion will utilize the existing lagoon discharge route. Effluent flows north and east in the existing ditches and the Rempel Drain for approximately 16.3 km before flowing into Plum River within Section NW 04-03-01-E. A plan of the discharge route is attached.

Could you please respond with any comments or concerns you have with the proposed project. Also, could you please provide a list of the fish species that are found in the Plum River.

David Kelly, P.Eng.

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

Manitoba Conservation Data Centre, May 12, 2014 Email Correspondence

David Kelly

From: Friesen, Chris (CWS) [Chris.Friesen@gov.mb.ca]
Sent: May-12-14 10:39 AM
To: 'David Kelly'
Subject: RE: Town of Altona Lagoon Expansion - Species at Risk

David

Thank you for your information request. I completed a search of the Manitoba Conservation Data Centre's rare species database and found no occurrences at this time for your area of interest.

The information provided in this letter is based on existing data known to the Manitoba Conservation Data Centre at the time of the request. These data are dependent on the research and observations of CDC staff and others who have shared their data, and reflect our current state of knowledge. **An absence of data in any particular geographic area does not necessarily mean that species or ecological communities of concern are not present**; in many areas, comprehensive surveys have never been completed. Therefore, this information should be regarded neither as a final statement on the occurrence of any species of concern, nor as a substitute for on-site surveys for species as part of environmental assessments.

Because the Manitoba CDC's 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 pass before it is utilized.

Third party requests for products wholly or partially derived from Biotics 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 Biotics data, as follows as: Data developed by the Manitoba Conservation Data Centre; Wildlife Branch, Manitoba Conservation and Water Stewardship.

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 please 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: David Kelly [mailto:dkelly@jrcc.ca]
Sent: May-07-14 3:43 PM
To: Firlotte, Nicole (CWS)
Cc: Friesen, Chris (CWS)
Subject: Town of Altona Lagoon Expansion - Species at Risk

Hi,

J.R. Cousin Consultants Ltd. (JRCC) is preparing an Environmental Act Proposal for the expansion of the existing Town of Altona lagoon. The lagoon expansion is to occur immediately northeast and southwest of the existing lagoon.

The existing lagoon and lagoon expansion will be located on the NE 09-02-01-W.

Could you please confirm there are no 'species at risk' known to exist on the property.

Thank you,

David Kelly, P.Eng.

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

***

Manitoba Historic Resources Branch, May 13, 2014 Email Correspondence

David Kelly

From: Sitchon, Myra (TCHSCP) [Myra.Sitchon@gov.mb.ca]
Sent: May-13-14 11:39 AM
To: 'dkelly@jrcc.ca'
Subject: No concerns - Town of Altona Lagoon Expansion, Heritage Resources

Good morning,
In response to your memo regarding the above-noted 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 proposed 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, *Ph.D.*
Impact Assessment 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
Tourism, Culture, Heritage, Sport and Consumer Protection

Appendix C

Town of Altona – Lagoon Expansion Preliminary Design Report

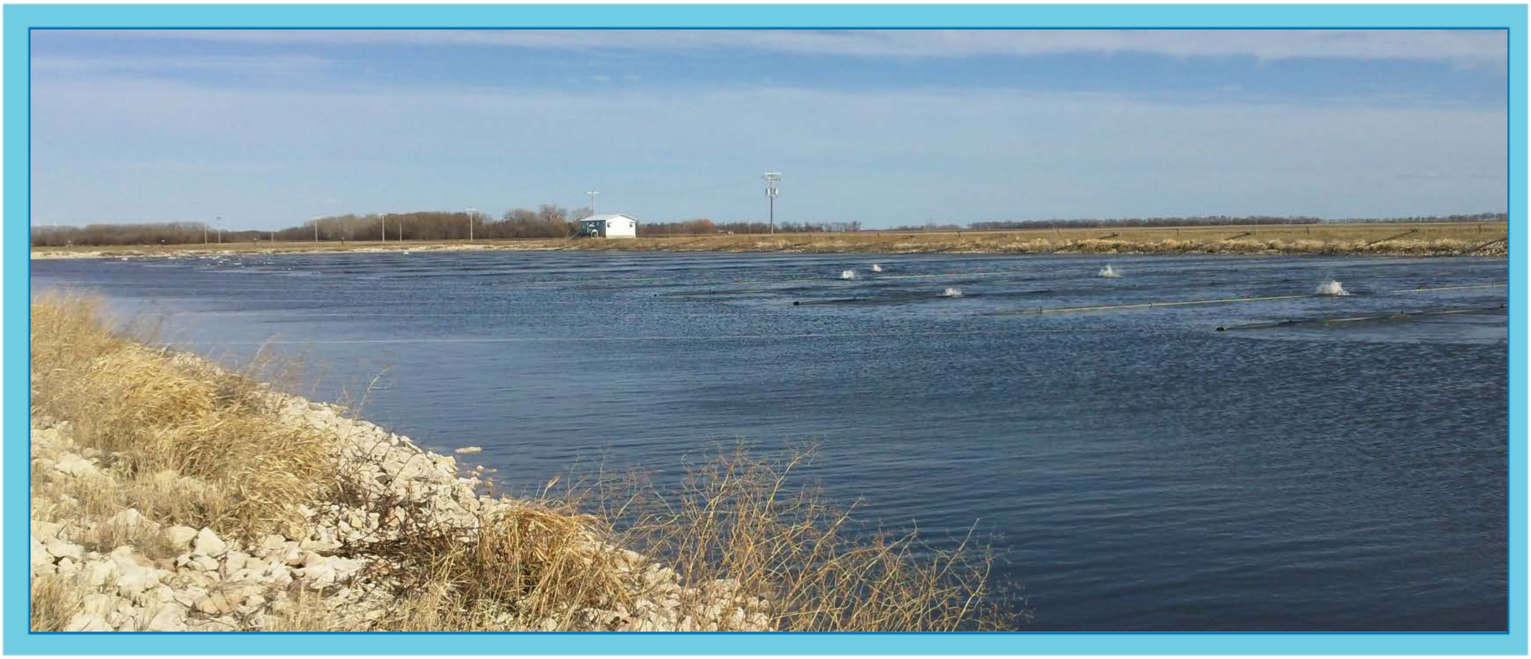
Addendum to Geotechnical Investigation, AMEC, August 2014

Town of Altona – Lagoon Expansion Preliminary Design Report

Town of Altona

Lagoon Expansion
Preliminary Design Report

July 2014



JRCC ENGINEERING CONSULTANTS

[illegible]

P&R #8.232 JRCC

A-677.02

TOWN OF ALTONA

Lagoon Expansion

Preliminary Design Report

J.R.L. COUSIN
Member
22391
14/07/02

APEGM
Certificate of Authorization
J. R. Cousin Consultants Ltd.
No. 234 Date: 14/07/02

Prepared by:

Jason Cousin, P.Eng.
Senior Municipal Engineer

Reviewed by:

Jerry Cousin, P. Eng.
President

Issued: July 2014

ACKNOWLEDGMENTS

To prepare this feasibility study, various sources of information were investigated and researched. JR Cousin Consultants Ltd. thanks the Town of Altona who contributed data and content for this study.

REMARKS

The findings and recommendations in this report were prepared in accordance with generally accepted professional engineering principles and practices. The findings and recommendations were based upon objective data available to us at the time of forming our opinions and the accuracy of the report depends upon the accuracy of this data.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Existing Facilities

The current sewage treatment facility is located on the on NE 09-02-01 and operates five cells. There are three primary aeration cells and two active storage cells. An additional storage cell exists, however has been taken out of service as it is prone to leakage and requires a liner upgrade. The existing storage cells have a hydraulic storage capacity of 282,700 m^3. The existing aeration system was designed to accommodate an organic load of 800 kg BOD_5/day. The existing facility has no nutrient reduction systems.

Geotechnical Investigation

Historical geotechnical investigations completed in 1992 and 2006 were reviewed and a geotechnical investigation was completed by AMEC Environment and Infrastructure (AMEC) in 2014 specifically for this project. AMEC indicated that there is an upper medium plastic clay followed by a silt layer, underlain by a high plastic clay. Hydraulic conductivity testing was completed on various soils and identified that the upper and lower high plastic clays generally meet Manitoba Conservation's permeability requirements for a soil liner. The silt layer was tested and does not meet Manitoba Conservation's permeability requirements for a soil liner.

Topographical Survey

A topographical survey was completed in May 2014 of the lagoon site and the proposed expansion area. The top of dike of the three existing aeration cells and Storage Cell 3 is approximately 247.50 m. The top of dike of Storage Cell 4 and Storage Cell 2 is approximately 246.60 m. The land around the lagoon where construction can occur varies between 243.4 m and 244.8 m

Population and Wastewater Production

The sewage treatment facility services the Town of Altona, the RM of Rhineland and a local industry, Bunge. The year 2039 design population for the facility is 10,962 in addition to the Bunge Industrial loading. The population consists of 6,574 people connected to the piped system and 4,388 people completing septic tank cleanouts.

The design organic loading to the sewage treatment facility is 1,044.3 kg BOD_5/day. The design average day sewage flow to the sewage treatment facility is 3,132 m^3 per day.

Lagoon Storage Capacity

Typically lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from the filters and UV unit in the sewage treatment building. The storage cells will be sized to accommodate storage from November 1 to May 1 (180 day storage) to provide a small buffer for spring conditions hindering early discharge. The storage period will use 180 days as opposed to 230 days.

The existing storage cells would have a combined storage capacity of 282,700 m^3. The design year 25 (2039), 180 day storage requirement is 484,776 m^3. Additional storage capacity is required to meet the 180 day design storage requirements.

To accommodate the design storage requirements, Storage Cell 5 will be constructed. The Storage Cell will be constructed to accommodate an operating depth of 3.0 m with aeration, however the full operating depth will not be initially required. The storage cell will be limited to an operating depth of 2.1 m until the aeration is installed. The operation depth of 2.1 m will provide sufficient capacity until year 2043, at such time where aeration can be added to Storage Cell 5. The storage capacity of the lagoon will be 514,000 m^3 with the 2.1 m operating depth of Storage Cell 5 and 638,700 m^3 with the 3.0 m operating depth of Storage Cell 5.

To allow the construction of Storage Cell 5, the existing compost site will need to be relocated off of the lagoon land. Modifications will also be required to the existing Storage Cell 3 and Aeration Cells weeping tile system to accommodate the construction of Storage Cell 5.

Storage Cell 5 will be constructed with a clay liner, using the high plastic clay layer below the floor as the horizontal liner and using a high plastic clay keyway and high plastic clay interior slope on portions of the lagoon to provide the vertical liner.

Lagoon Sewage Treatment

To increase the organic capacity of the lagoon, an additional aeration cell will be provided to increase the hydraulic retention time in the aeration cells. With the addition of a fourth aeration cell, the aeration system would have a 50 day hydraulic retention. The existing Aeration Cell 1 will be divided into two cells with a baffle curtain. Replacement of the existing diffusers will be completed in addition to placement of new diffusers in the new aeration cell. An additional blower is also required to produce the additional air for the aeration system. The aeration system will be upgraded to accommodate the year 2039 design organic load of 1,044.3 kg BOD_5/day.

The sewage treatment facility will be designed to accommodate an average day flow rate of 2,610 L/min and a peak flow rate of 4,502 L/min. At the design flow rates, the system will accommodate the daily flow in a 20 hour operating day.

Phosphorous and TSS reduction will be completed using four 2.74 m diameter gravity upflow sand filters. Ferric chloride coagulant will be injected in the piping upstream of the sand filters. A continuous reject stream will be returned to Aeration Cell 4, where the removed phosphorous will settle to the bottom of the cell.

To disinfect the effluent, two pressure flow ultraviolet (UV) disinfection systems will be provided. The UV systems will be equipped with an automatic wiping system as well as a chemical cleaning system to reduce operator maintenance. All of the effluent will pass through the UV to be disinfected prior to being discharged into the storage cells or to the municipal ditch during continuous discharge operation.

Testing was completed on the un-ionized ammonia and the results identified the un-ionized ammonia was below the discharge requirements. No formal ammonia reduction process has been included in the sewage treatment system.

Elevated levels of FOG are entering the lagoon from Bunge. The FOG naturally breaks down; however it can be problematic for the sand filters. The existing lift station currently has an aeration system to help with operation difficulties caused by elevated FOG. At the present time, no targeted FOG treatment will be added to the treatment process, however, should FOG become an increased operational issue, Bunge pre-treatment or enzyme pre-treatment may be required.

A new sewage treatment building will be constructed to house all of the process and testing equipment for the wastewater treatment system as the existing building is too small. The building will be a pre-engineered steel building with a 332 m^2 footprint. Due to the filter height requirements, the building will have a split level roof to accommodate the equipment.

A water service connection to the Altona Rural Pipeline will be installed to provide water at the sewage treatment building.

Two main pumping systems are required in the sewage treatment system: the filter feed pumps and the treated effluent discharge pumps. Both systems will be designed with a submersible duplex pumping system.

Cost Estimate

The following is a summarization of the capital costs for a 2014/2015 construction season. The costs for each year after this projection period should be inflated per prevailing inflation and market conditions.

Class C Cost Estimate

Description	Total
Construction Cost	$7,494,340
GST 5%	$374,700
Contingency 15%	$1,124,200
Engineering 15%	$1,124,200
Total Project Cost	**$10,117,440**

1.0 INTRODUCTION

The Town of Altona retained JR Cousin Consultants Ltd. (JRCC) to provide engineering services for a preliminary design and Environmental Act Proposal for the Town of Altona lagoon upgrade.

The need to upgrade and expand the Altona lagoon was identified in the *RPGA Planning District Wastewater Management Plan*. The lagoon facility is reported to be very near or at, both the organic capacity and the hydraulic capacity. With the growing population of the area and the demand of local industry, an upgrade to the Altona lagoon is required. JRCC previously completed a feasibility study in January 2014 to determine upgrades to accommodate a 25 year growth.

1.1 Scope of Services

The scope of services is to prepare a preliminary design and Environmental Act Proposal for the first phase of the Altona lagoon upgrade, based on recommendations from the feasibility study and feedback from council.

The preliminary design report will address the following items:

- Preliminary design of Storage Cell 5 with a 3 m operating level, to be located on the northeast corner of the lagoon site
- Preliminary design of Aeration Cell 4, to be located on the southwest corner of the lagoon site
- Preliminary design of a new sewage treatment building, to be located adjacent to Aeration Cell 4
- Pre-treatment options for wastewater from Bunge's facility will be reviewed
- Recommendations for the removal of the composting site to allow for the construction of Storage Cell 5.

Council has approved the plan to construct Storage Cell 5 as the first phase and thus upgrading Storage Cell 2 is not in the scope of work for this preliminary design. The preliminary design of Aeration Cell 4 and the sewage treatment building are to achieve treatment for year 2039 (year 25).

1.2 Existing Facilities

The Town of Altona's lagoon facility is located on NE 09-02-01. The lagoon was constructed in stages, beginning with the initial lagoon construction in 1971. The most recent upgrade was completed in 2008 when three aeration cells were constructed and existing Storage Cells were remediated.

Sewage enters the lagoon in the Primary Aeration Cell 1 through a 350 mm forcemain. The 350 mm forcemain was installed in 2008 and connects to the existing 150 mm and 300 mm forcemains from Lift Station #1 and Lift Station #4.

Sewage from the old Altona low pressure sewer connects directly into the Primary Aeration Cell 1 through a dedicated 200 mm forcemain.

The current facility operates five cells. The three primary aeration cells and Storage Cell 3 are PVC lined lagoons with 5:1 inside slopes. Storage Cell 4 is a clay lined storage cell with 4:1 inside slopes. The three primary aeration cells operate with a 3.9 m operating depth. The two storage cells have a 2.1 m operating depth, however the bottom 0.3 m of the storage cells are not discharged, resulting in a usable storage depth of 1.8 m. There is a sixth existing cell, Storage Cell 2, however the cell is leaking and is not currently in operation. The following table summarizes the hydraulic capacities of each cell.

Description	Hydraulic Capacity
Primary Aeration Cell 1	44,900 m^3
Primary Aeration Cell 2	29,200 m^3
Primary Aeration Cell 3	29,200 m^3
Storage Cell 3 (usable storage)	120,900 m^3
Storage Cell 4 (usable storage)	161,800 m^3
Storage Cell 2 (not in use)	83,800 m^3

The three primary cells are aerated using 192 MAT Diffuser TA22 fine bubble aeration system with floating laterals. Air is provided to the diffusers using 1 - 60 hp Kaeser Omega Blower EB420C and 2 - 75 hp Kaeser Omega Blowers EB420C 575V, 3 phase motors. The blowers are located in a 40 m^2 steel building on a thickened edge concrete foundation. The blowers are intended to operate as two prime blowers and one standby, providing 1,920 scfm of air to the lagoon. Reviewing the Nelson Environmental *Operation & Maintenance Manual, Altona WWSP Aeration*, May 2009, the aeration system was designed to treat 800 kg BOD_5/day at a flow rate of 2000 m^3 per day.

The existing lagoon facility is equipped with a truck dump spillway and turnaround constructed in 2008.

The lagoon facility discharges the effluent through surfaces ditches, eventually flowing into the Plum River, which flows into the Red River.

2.0 SITE INVESTIGATIONS

2.1 Geotechnical Investigations

Four geotechnical investigations have been completed at the Altona lagoon sites as follows:

- Investigation by Poetker MacLaren in July 1992
- Investigation by Poetker MacLaren in August 1992
- Investigation by Cochrane in January 2006
- Investigation by AMEC Environment and Infrastructure (AMEC) in April 2014.

The following sections provide a brief summary of the past investigations.

2.1.1 Investigation by Poetker MacLaren and Cochrane

Historical geotechnical information was reviewed from investigations completed in July 1992, and August 1992 by Poetker MacLaren and January 2006 by Cochrane on the lagoon facility site. A total of 35 historical test hole logs were reviewed. A copy of the test hole logs are included in Appendix B. The location of the test holes are identified on Plan EX1 in Appendix E.

The test hole logs showed a layer of topsoil from 0.3 to 0.6 m thick, underlain by a varying layer of low to medium plastic clay to the 1 m depth. Following the clay layer was a silt layer with some sand layers intermixed. A continuous layer of high plastic clay started between 3 and 4 m below the ground surface. The clay at his depth had the hydraulic conductivity tested on one sample in 2006 with results of 4.4 x 10^{-8} cm/s and one sample in 1992 with results of 4 x 10^{-8} cm/s. The test results show the lower clay layer is suitable for use as an insitu lagoon liner as it meets Manitoba Conservation's requirements of 1.0 x 10^{-7} cm/s.

Hydraulic conductivity tests were also completed on two samples in 1992 on the upper clay layer with results of 9 x 10^{-8} cm/s and 3 x 10^{-8} cm/s. The clay in the upper clay layer would be suitable for use in a lagoon liner construction. Since the upper clay layer thickness and elevation are variable, it could not be used for an insitu lagoon liner.

2.1.2 Investigation by AMEC

A geotechnical investigation was completed by AMEC in April 2014 to determine building foundation requirements, dike slope stability requirements and to provide additional site test holes in the lagoon expansion area. A total of 20 test holes were drilled and 1 test pit was excavated on the lagoon property.

Based on the slope stability analysis of the dikes, the inside slopes of the aeration cell were recommended to be 5:1 slopes and the inside slopes of the storage cells were recommended to be 5:1. The outside slopes of all the dikes are recommended to the 4:1 slopes.

The soil profile found similar site conditions to the previous investigations completed in 1992 and 2006 with a clay layer, generally underlain by a silt layer, followed by a high plastic clay layer.

Hydraulic conductivity tests were also completed on three samples. The soil in the upper clay in TH17 had an in situ hydraulic conductivity of 8.6 x 10^{-7} cm/s. Soil samples from the test hole were subsequently remolded and retested and obtained a hydraulic conductivity of 4.64 x 10^{-9} cm/s. The upper clay layer would be reworked and used for liner construction. The lower clay layer would be suitable for use insitu in a lagoon liner construction.

Test holes locations are shown on Plan EX1, attached in Appendix E. A copy of AMEC's geotechnical report and test hole logs are included in Appendix B.

2.1.3 Lagoon Liner Soil Summary

Between the four geotechnical investigation at the site, seven hydraulic conductivity tests were completed, six of them on insitu soils and one sample on a remolded soil. The following table summarizes the Test Results:

TH Location	Depth (m)	Hydraulic Conductivity
1992-TH3	0.6-1.2	3 x 10^{-8} cm/s
1992-TH3	Below 2.1	4 x 10^{-8} cm/s
1992-TH7	0.8-1.8	9 x 10^{-8} cm/s
2006-TH2	3-4	4.4 x 10^{-8} cm/s
AMEC-TH05	3.7-4.3	7.3 x 10^{-8} cm/s
AMEC-TH17	1.5-2.1	8.6 x 10^{-7} cm/s
AMEC-TH17	2-9 Remolded	4.64 x 10^{-9} cm/s

All of the insitu clay soils are suitable for a insitu clay liner meeting Manitoba Conservation 1.0 x 10^{-7} cm/s except AMEC-TH17. After the sample was remolded, it also met the hydraulic conductivity requirements. Additional soils testing is being completed on TH17 upper soils by AMEC as the remolded sample was tested with lower clay soils than the specific area that failed. At the time of this report, the test results are not currently available and will be submitted as an addendum to the geotechnical report by AMEC.

Through careful use of soils onsite, there are sufficient clay soils to construct a soil liner.

2.2 Topographical Survey

A topographical survey of the existing lagoon and proposed lagoon expansion site was completed in May 2014 using GPS survey equipment. The perimeter site ditches and cross sections of the discharge ditch were also completed.

2.2.1 Existing Cells

The existing cells were surveyed as part of the topographic survey. The top of dike of the three existing aeration cells and Storage Cell 3 is approximately 247.50 m. The top of dike of Storage Cell 4 and Storage Cell 2 is approximately 246.60 m. The bottom of the existing cells were not surveyed as they had liquid at the time of the our survey, however based on the Genivar Inc. "As Constructed" plans dated 2012 of the 2008 lagoon expansion Storage Cell 2 has a floor elevation of 244.42 m, Storage Cell 3 has a floor elevation of 244.41 m, Storage Cell 4 has a floor elevation of 243.45 m, Aeration Cells 1 and 2 have a floor elevation of 242.3 m and Aeration Cell 3 has a floor elevation of 242.2 m.

2.2.2 Lagoon Expansion Areas

The area for lagoon storage cell expansion on the north east corner of the lagoon property is gently sloping to the north, with elevations around 244.4 m along the existing Storage Cell 4 and Aeration Cell 3, dropping to between 243.4 m and 243.8 m along the north edge of the property.

The area for lagoon aeration cell expansion on the south west corner of the property is relatively flat ranging between 244.4 m and 244.8 m.

3.0 POPULATION AND WASTEWATER PRODUCTION

To properly assess the future loading demands placed on the Town of Altona's Lagoon, an understanding of existing sewage streams, future sewage streams and future growth must be understood. At the present time there are three main contributors to the lagoon: The Town of Altona's residential and commercial population, a sewage servicing agreement between the Town of Altona and the RM of Rhineland, and a major local industry called Bunge. The following sections will review the current loadings and anticipated future loadings from each sewage segment.

Typically lagoons are required to maintain 230 days of storage (November 1 to June 15). Discussions have been completed with Manitoba Conservation to allow for discharge earlier in the spring (April 16) due to enhanced treatment from the filters and UV unit in the sewage treatment building. The early discharge will depend on the ability of the receiving stream to accept the discharge without causing flooding or icing. The storage cells will be sized to accommodate storage from November 1 to May 1 (180 day storage) to provide a small buffer for spring conditions hindering early discharge. The storage period will use 180 days as opposed to 230 days. As a result, the storage volume produced over the winter has been reduced.

3.1 Town of Altona Residential and Commercial Population

3.1.1 Population Growth

The historical population data was obtained from Census Canada. An assessment of the population trend was made to determine future potential growth. The following table summarizes past population and 5 year average growth rates.

Year	Population	% Growth/Year
1996	3,318	0.69%
2001	3,434	1.55%
2006	3,709	1.96%
2011	4,088	

Based on the above table, the population growth rate has been growing at an increasing growth over the last 15 years, with an average growth rate of 1.4%.

The *RPGA Planning District Wastewater Management Plan*, prepared by Dillon, July 2013 identifies a growth rate of 4.2% for Altona to the year 2037.

During a meeting on September 30, 2013 with the Town of Altona, a decision to use 1.4% growth rate was made. The Town of Altona felt that the 4.2% growth rate in the RPGA report would not be achieved as it seemed unrealistic for the Town to triple in size over the next 25 years. To accommodate the 4.2% growth rate too much additional infrastructure and would be required to support the growth that the Town felt they would not be able to accommodate. Using the historical 1.4% growth rate seemed much more practical for planning purposes.

Using the projected growth rate of 1.4%, the 25 year design population (year 2039) is 6,039.

3.1.2 Bussed Students

The Town of Altona has four schools (Elmwood Elementary, West Park School, Parkside Junior High and W.C. Miller Collegiate), which service both the Town of Altona and the surrounding Municipality of Rhineland. Based on discussions with the Transportation Coordinator for the Borderland School Division on September 6, 2013, 566 students are bussed into the Town of Altona Schools. The population of bussed in students would have an assumed occupancy of 1/3 the population, based on the amount of time spent at school, and would therefore represent a current equivalent population of 189 people (566/3). The population of the bussed in students to the school is estimated to have a growth rate matching the RM of Rhineland.

Year	Population	% Growth/Year
1996	4,172	0.05%
2001	4,183	-0.28%
2006	4,125	1.17%
2011	4,373	

Based on the above table, the population growth rate has had variable growth over the last 15 years, with an average growth rate of 1.17% in the last 5 years.

The *RPGA Planning District Wastewater Management Plan*, July 2013 identifies a growth rate of 2% for the RM of Rhineland to the year 2037.

During a meeting on September 30, 2013 with the Town of Altona, a decision to use 2% growth rate was made for the RM of Rhineland to represent the school growth.

Using the projected growth rate of 2%, the 25 year design population (year 2039) of students is 950, resulting in an equivalent load of 317 people.

3.1.3 Commercial Population

During the September 30, 2013 meeting with the Town of Altona, a discussion occurred about the requirement to add additional loading for commercial industries in town that attracted people to the Town for work who did not live in Altona. The Town of Altona decided that based on their knowledge of the Town of Altona workforce, an equivalent number of people come to Altona for work as leave Altona each day, resulting in no additional load.

3.1.4 Organic Load

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. Based on the combined residential population and the bussed in students, a year 2039 design population is 6,356, generating 483.1 kg BOD_5/day [(6,039+3,170 x 0.076].

3.1.5 Hydraulic Load

The hydraulic load from the sewage collection system is based on the water consumption and the infiltration.

The historical water usage records for the Town of Altona were reviewed between 2008 and 2013. The Annual Altona Water usage was determined by subtracting the RM Village Meter Pit, Bunge and Bulk Water from the Total Water Sales.

	2008	2009	2010	2011	2012	2013
Annual Altona Water Usage (m^3)	361,002	334,653	332,519	353,300	359,045	334,617
Town Population	3,860	3,936	4,012	4,088	4,145	4,203
Students (equivalent)	174	177	180	183	186	189
Total Population	4,034	4,113	4,192	4,271	4,331	4,392
Annual Water Usage (L/person/day)	245	223	217	227	227	209

The average annual per capita water usage between 2008 and 2013 is 225 litres/person/day.

To determine the infiltration rate, the lift station hour meter readings were reviewed between 2008 and 2013. A lift station drawdown test was completed by Genivar on March 20, 2013. In their report, Town of Altona - Sewer Infrastructure Analysis, October 2013, they reported Lift Station #1 pumps have the following flow rates.

Pump	Flow Rate
Pump 1	51.5 L/s
Pump 2	51.5 L/s
Pump 3	45.4 L/s

The average infiltration rate of the full year is required for sizing the aerations cells and equipment inside the sewage treatment plant, however, for lagoon storage sizing only the infiltration during the storage period of November 1 to April 30 is important. Therefore both rates must be calculated.

The Town of Altona provided lift station runtime hours. They identified that the three pumps generally have even runtimes. Given the even runtimes, the flow rates from the three pumps were averaged, resulting in a flow rate of 49.5 L/s. Using the lift station runtime hours in the 180 day storage period, total daily sewage flows were calculated. The lift station hours and calculated sewage flows are summarized below:

	2008	2009	2010	2011	2012	2013
Annual Run Time (hr)	2,576	3,175	3,604	2,952	2,010	1,445
Annual Average Flow (m^3/day)	1,257	1,549	1,758	1,440	981	1,139
Storage Period Run Time (hr)	1,379	1,223	1,552	1,260	997	1,445
Storage Period Flow (m^3/day)	1,364	1,219	1,535	1,246	987	1,139

To determine the infiltration rate, the Altona water usage and Bunge sewage flows need to be deducted from the total storage period flows. Bunge sewage flows are not measured, however, an October 2013 letter from Bunge to the Town of Altona suggests that the sewage generation is approximately 53% of the water usage. The table below identifies the Daily Infiltration during the storage period between 2008 and 2013.

	2008	2009	2010	2011	2012	2013
Storage Period Flow (m^3/day)	1,364	1,219	1,535	1,246	987	1,139
Bunge Storage Period Daily Water Usage (m^3/day)	481	432	419	429	417	462
Bunge Storage Period Daily Calculated Sewage Flows (m^3/day)	255	229	222	227	221	246
Altona Storage Period Daily Water Usage (m^3/day)	990	908	900	941	958	874
System Storage Period Daily Infiltration (m^3/day)	120	83	413	79	-192	19

To calculate the per capita infiltration rate during the storage period, the daily infiltration rate is divided by the total population.

	2008	2009	2010	2011	2012	2013
System Storage Period Daily Infiltration (m^3/day)	120	83	413	79	-192	19
Town Population	3,860	3,936	4,012	4,088	4,145	4203
Students (equivalent)	174	177	180	183	186	189
Total Population	4,034	4,113	4,192	4,271	4,331	4,392
Storage Period Infiltration (litres/person/day)	30	20	99	18	-44	4

The maximum infiltration rate between 2008 and 2013 was 99 litres/person/day. In 2012, the infiltration is shown as a negative number. There would not be a case where the infiltration is negative. What is likely occurring is that not all the water used enters the sewage system, thereby suggesting a negative infiltration rate when the water usage is deducted from the sewage flows. 2012 was a very dry year, with likely very minimal infiltration.

Since the infiltration affects the storage requirement sizing of the lagoon and an under estimation results in inadequate storage, the maximum infiltration rate of 99 litres/person/day observed in 2010 is recommended for use. Discussion with the Town of Altona on October 21, 2013 during the feasibility study preparation, concurred with the use of the 2010 infiltration rate.

Based on the combined residential population and the bussed in students water usage of 225 litres/person/day and the infiltration rate of 99 litres/person/day, a total hydraulic load of 324 litres/person/day is generated. Using the year 2039 design population of daily hydraulic load of 6,356, generates a daily hydraulic load of 2,059 m^3 per day (324 x 6,356).

3.2 RM of Rhineland Servicing Agreement

3.2.1 Population

In 2011 the RM of Rhineland and the Town of Altona entered into a sewer servicing agreement. In the agreement, the Town of Altona agreed to accept septage from 1,100 rural homes and businesses, as well as the effluent from the Old Altona LPS sewage collection system, consisting of up to 50 connections. The agreement also has provisions for the allowance of 6 pre-existing connections to the low pressure sewer that are not included in the 50 connections, resulting in a total of 56 connections.

Based on the 2011 Canada Census, the RM of Rhineland had a population of 4,373 and 1,120 occupied private dwellings, resulting in a population density of 3.90 people/home.

Using the private dwelling density of 3.90 people/home, the 56 low pressure sewer connections on the Old Altona sewage collection system represent a population of 218 people.

In the *RPGA Planning District Wastewater Management Plan*, July 2013, it is estimated that only 487 properties in the RM of Rhineland are currently having their septage hauled to the Altona Lagoon. The report also states that only 30 sewage connections have been made to date to the old Altona low pressure sewage collection system.

In determining the RM of Rhineland's population and loading, no growth has been added to the number of connections and tank cleanouts identified in the 2011 RM and Town servicing agreement.

3.2.2 Organic Load

3.2.2.1 Low Pressure Sewer

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 of 218 people on the Old Altona low pressure sewer collection system. The old Altona low pressure sewer generates an organic loading of load of 16.6 kg BOD^5/day (218 x 0.076).

3.2.2.2 Septic Tank Cleanout

Truck hauled septage from surrounding rural septic tanks also needs to be considered in organic loading to the lagoon. Using the rural housing population of 3.9 people/household and assuming each septic tank is 4,500 L and is pumped out annually, each septic tank pump out generates 6.19 kg BOD_5. The tank loading is based on 200 L/person/year of septage at 0.007 kg BOD_5/L and 0.000196 kg BOD_5/L of non septage sewer ((200 x 3.9 x 0.007) + (4,500-200 x 3.9) x 0.000196 = 6.19 kg BOD_5).

Septage is permitted to be hauled to the lagoon over the time period of 135 days, as specified by Manitoba Conservation in the Environmental Licence. Within the 135 day hauling period, it is likely the majority of the hauling will occur during the normal Monday to Friday work week resulting in only 96 days effluent is hauled to the lagoon. Based on the agreement to accept sewage from 1,100 rural homes and 96 hauling days, an average of 11.5 tanks need to be pumped out daily. Since only full tanks will be pumped out, the organic load will be based on twelve tank pump outs daily, resulting in a septic tank cleanout organic load of 74.3 kg BOD_5/day (6.19 x 12).

3.2.3 Hydraulic Load

3.2.3.1 Low Pressure Sewer

The hydraulic load generated by the low pressure sewer system is based on the water consumption and the infiltration in the low pressure sewer system.

The existing old Altona low pressure sewer system has a direct connection to the existing lagoon and there are no meters recording the flow on the low pressure sewer pipeline. The Town of Altona has a water meter chamber going to some homes on the water pipeline, however since not all the homes are connected and the number of homes on the pipeline is not available, the water meter readings could not be used.

The *RPGA Planning District Wastewater Management Plan*, July 2013 identified a sewage generation rate of 157 litres/person/day, assuming only 75% of the water consumed entered the LPS. The Plan did not include any allowance for infiltration.

The water usage identified in the RPGA report is lower than typical water usages and a minimum water usage of 200 litres/person/day is recommended for planning purposes. Low pressure sewer collection systems typically have a 20% infiltration rate, resulting in an additional load of 40 litres/person/day.

During a meeting on September 30, 2013 with the Town of Altona, a decision was made to use a hydraulic loading of 200 litres/person/day plus an additional 40 litres/person/day of infiltration allowance. The use of the higher number was chosen as all agreed the RPGA value was low. Water usage of 200 litres/person/day is just slightly lower than the calculated usage for the Town of Altona. Infiltration on a low pressure sewer system is typically much lower than a gravity sewage collection system.

Based on the water usage of 200 litres/person/day and the infiltration rate of 40 litres/person/day, a total hydraulic load of 240 litres/person/day is generated. Using the year 2039 design population of daily hydraulic load of 218, generates a daily hydraulic load of 52 m^3 per day (240 x 218).

3.2.3.2 Septic Tank Cleanout

The daily hydraulic loading from the septic tank cleanout is anticipated to be 54,000 L/day (12 x 4,500).

During the typical storage period of a lagoon, the septic tank clean out would not contribute to the overall storage requirement as the septic tank cleanouts do not occur during the storage period.

3.3 Bunge Industry

Bunge is a major wet industry in the Town of Altona. They are a canola processing facility connected to the Town of Altona water and sewer systems. Bunge has advised the Town of Altona that they intended on doubling their production capacity. Construction on the plant upgrade is currently underway with full production planned for 2015.

3.3.1 Organic Loading

In their October 8, 2013 letter to the Town of Altona, Bunge identifies an average BOD_5 loading of 800 mg/L, with a maximum BOD_5 loading of 1500 mg/L. In an October 11, 2013 email, Bunge identifies that the maximum BOD_5 loading should only occur for one - 12 hour period every month. Based on the minimal occurrence of the peak loading and the hydraulic retention in the aerated lagoon to dissipate peaks, the 800 mg/L BOD loading will be used for treatment requirement sizing, resulting in a design organic load of 448 kg BOD_5/day (560 x 0.800).

Bunge also identified an average suspended solids loadings of 350 mg/L with peaks up to 500 mg/L. They also stated the oil and grease levels are expected to average at 150 mg/L with maximums around 300 mg/L.

Sampling was completed on the existing Bunge effluent at the manhole leaving their property. The test results are summarized in the following table. For the lab test results, refer to Appendix C.

Parameter	Units	2007 Bunge MH	2013 Bunge MH	2013 Bunge MH	2014 Bunge MH	2014 Bunge MH
			09/30/13	12/16/13	03/06/14	03/26/14
pH	pH units	8.7	9.95	6.54	10.52	
Total Suspended Solids	mg/L	137	47	340	330	28
Ammonia, Total (as N)	mg/L	4.6	3.4	9.4	3.8	
Un-ionized Ammonia as N @ 15°C	mg/L		2.4	0.006	3.2	
Fats, Oil & Grease	mg/L	197	36.9	2020	557	94.5
Phosphorus (P)-Total	mg/L	1.8	1.2	1.1	1.35	3.2
Biochemical Oxygen Demand	mg/L	497	210	534	240	301

3.3.2 Hydraulic Loading

The historical water usage of Bunge was reviewed for 2011, 2012 and 2013. During that period, Bunge used an average of 406 m^3 of water per day. An October 8 letter from Bunge to the Town of Altona identifies that only 53% of the water usage from Bunge enters the sewer collection system, resulting in a sewage loading of 215 m^3 per day.

Bunge has provided the Town of Altona preliminary water usage and sewage generation flows based on their plant expansion currently under construction in a letter dated October 8, 2013. Bunge has identified an annual water usage of 385,900 m^3 with an annual sewage effluent discharge of 204,300 m^3 after year 2016. The average daily sewage effluent discharge is estimated at 560 m^3 per day.

Reviewing Bunge's historical water usage, they have historically had higher water consumption during the winter months. They consumed an average of 5.9% more water during the winter months (November 1 to April 30) than the summer months in 2011, 2012 and 2013. Between In an email on April 14, 2014, Bunge confirmed that they will likely continue to have a higher water usage in the winter months. Bunge attributes the increased water usage to the inferior supply water quality form the distribution system in the winter months.

To account for the increased flow during the storage period, the estimated sewage effluent discharge has been increased by 5% to 588 m^3 per day (1.05 x 560).

3.4 Lagoon Loading Summary

3.4.1 Organic Load Summary

The total year 2039 design organic load to the facility is summarized in the following table:

Description	Organic Load kg BOD_5/day
Town of Altona and Old Altona LPS	499.6
RM of Rhineland Septic Tanks	74.3
Bunge	470.4
Total	1,044.3

The existing aerated lagoon cells have an organic treatment capacity of 800 kg BOD_5 per day. To accommodate the year 2039 design organic load, an additional 244 kg BOD_5 per day of treatment is required.

3.4.2 Hydraulic Load Summary

The total hydraulic load to the facility is summarized in the following table:

Description	Average Day Flow (m^3)	Average Day Flow (m^3) During Storage Period
Town of Altona and Old Altona LPS	2,518	2,105
RM of Rhineland Septic Tanks	54	0
Bunge	560	588
Total	3,132	2,693

The year 2039 design hydraulic load for the lagoon during the 180 day storage period is 2,693 m^3 per day, resulting in a hydraulic storage requirement of 484,776 m^3. The existing Storage Cell 3 has a storage capacity of 120,885 m^3 and Storage Cell 4 has a capacity of 161,800 m^3, resulting in an existing storage capacity of 282,685 m^3. To accommodate the year 2039 design requirement of 484,776 m^3, an additional storage capacity of 202,091 m^3 is required.

Refer to Table 1 in Appendix A for a summary of all sewage load projections.

4.0 LAGOON STORAGE CAPACITY

To increase the hydraulic storage capacity of the existing lagoon to year 2039 requirements, a new storage cell, Storage Cell 5, will be constructed on the north east corner of the lagoon property.

4.1 Storage Cell 5 New Storage Cell

Storage Cell 5 will be constructed in the north east corner of the property. The outside toe of the lagoon must be set a minimum of 30 m from the property line. There are two existing residences adjacent to the north east corner, located on the SW quarter of 15-02-01 and the NW quarter 10-02-01. Manitoba Conservation has a recommended set back guideline for a lagoon of 300 m from the nearest residence. Storage Cell 5 would exceed the minimum setback requirement from both residences if the storage cell is placed 30 m inside the property line.

4.1.1 Storage Cell 5 Construction

Storage Cell 5 will be constructed on the northeast corner of the property. The north and east dikes will be constructed using the land available, maintaining the 30 m setback to the property lines on the north and east side, while sharing a common dike with Aeration Cell 3 and Storage Cell 4 to the south, and Storage Cell 3 to the west.

Storage Cell 5 will be 4 m deep, providing 1 m free board and 3 m liquid depth. The total storage provided from Storage Cell 5 is 356,000 m^3. As per the recommendation from AMEC's geotechnical report, the interior slopes will be built at a 5:1 slope and the exterior slope will be built at a 4:1 slope. Rip Rap will be installed on the inside slopes to prevent erosion when the cell is full. With a storage cell operating at 3.0 m depth, an aeration system will be required to keep the cell from turning anaerobic. With the additional storage depth, disinfection of the effluent prior to storage will also be required to ensure that coliform limits are met for discharge.

Storage Cell 5 liner will in constructed on the inside slope of the portion of the dikes adjacent to the Aeration Cell 3, Storage Cell 4, Storage Cell 3 and Storage Cell 2. The liner will be constructed a minimum of 2 m thick. From the existing ground level, a keyway 2 m wide will be constructed through the existing silt layers and key 1 m deep into the lower high plastic clay. The new dikes on the north and east side of the lagoon will be constructed with a keyway 2 m wide from the existing ground surface, through the existing silt layers and key 1 m deep into the lower high plastic clay similar to the south and west dikes. Above the existing ground, the keyway will continue in the middle of the dike. The keyway above grade will be constructed 3 m wide to simplify construction. The keyway below existing ground will be constructed with 1:1 side slopes, as per AMEC's recommendations, to allow the excavation to remain open during construction.

Storage Cell 5 bottom liner will be the insitu high plastic clay soil several metres below the floor.

4.1.2 Storage Cell 5 Site Considerations

4.1.2.1 Existing Compost Site

There is an existing compost site on the northeast corner of the property, over the southeast corner of Storage Cell 5. As part of the Storage Cell 5 construction, the existing compost area will need to be decommissioned and relocated to a new property as there will not be any usable land remaining on the lagoon site. The existing composting site is approximately 100 m by 100 m (1 hectare). Although the relocation of the compost site is not part of JRCC's pre-design scope, Altona has advised they may relocate compost site to the existing landfill.

4.1.2.2 Storage Cell 3 Weeping Tile Manhole

The Weeping Tile manhole at the south east corner of Storage Cell 3 will be in the expanded dike between Storage Cell 3 and Storage Cell 5. The manhole acts as a collection point for the weeping tile water below Storage Cell 3. There is no discharge system in the manhole except for the Town of Altona to manually pump it out as water accumulates. The manhole rim will have to be raised to accommodate the new dike for Storage Cell 5. To eliminate the manual pumping of the manhole, piping will be extended 130 m south into the existing weeping tile lift station. Based on Genivar the record drawings, the weeping tile manhole has a stub with a flange for connection at an invert of 242.03 m on the south side. The weeping tile lift station has a capped stub at 241.43 m on the north side. Based on the available grade and the stubbed out ends, a connection between the weeping tile manhole and weeping tile lift station can be completed.

4.1.2.3 Weeping Tile Lift Station

As part of the Storage Cell 5 construction, the existing drainage ditch from the weeping tile lift station at the northwest corner of Aeration Cell 3 will be altered. The existing drainage from the lift station flows eastward to the Municipal ditch on the east side of the property. In discussions with Altona, the existing surface discharge has been problematic in winter since installation. The ground water pumped out of the lift station flows directly on the ground surface resulting in ice accumulation in the drainage ditch. The ice accumulation has resulted in maintenance issues for Altona. To alleviate the icing concerns the weeping tile water will be directed to the existing Storage Cell 2. Storage Cell 2 is currently not being used, therefore by pumping the water to the existing cell, no reduction in the lagoon operating capacity will occur.

On March 6, 2014, an hour meter was installed on the weeping tile lift station to help determine the amount of weeping tile water leaving the lift station. Between March 6 and March 17, the lift station operated 1 hour and 9 minutes. Between March 24 and May 5, the Lift station operated 4 hours 55 minutes. During the week of March 17 to

March 24, the lift station discharge piping was broken and no hours were recorded. The average day pump time between March 24 and May 5 was 7.02 min/day.

The lift station is equipped with a Flygt CP 3057.181 HT submersible pump with a 112 mm impeller and a 2.8 kW motor. Based on a review of the 2012 Cochrane Engineering Record Drawings, the lift station operates with a 6.9 m static head. Reviewing the pump curve and a 6.9 m static head, the lift station operates with a flow rate of approximately 762 L/min. The daily weeping tile water being pumped was calculated to be 5,350 L/day (762 x 7.02).

At the present time, only the aeration cell weeping tile is connected to the weeping tile lift station. Once Storage Cell 3 weeping tile is connected to the lift station, the flow will increase. A ratio of surface area between the existing aeration cells and Storage Cell 3 was used to estimate the future flow rate. The area of the aeration cells is 54,000 m^2 and the area of Storage Cell 3 is 80,500 m^2. The estimated total flow based on the proportional surface area increase is 13,325 L/day.

During a winter storage period of 180 days, the weeping tile lift station will generate 2,394 m^3 of water. (180 x 13,325) Storage Cell 2 will be able to accommodate the required storage volume of the diverted weeping tile lift station water.

4.2 Storage Cell 5 Aeration

To allow Storage Cell 5 to be operated at a depth of 3.0 m, aeration is required to ensure the effluent does not go anaerobic. Storage Cell 5 would have a linear tubing aeration system placed on the cell floor. To simplify future aeration of Storage Cell 4, the aeration header should be installed in the intercell dike between Storage Cell 4 and Aeration Cell 1, 2, 3. Two 25 hp blowers will be provided to act as a duty standby configuration.

The aeration system does not need to operate year round as the liquid level in the cells will not exceed the 2.1 m operating depth, except in mid winter. The blowers will need to be operated in late fall to ensure the aeration lines do not freeze and can be turned off after the spring discharge is completed.

4.3 Maximum Storage Cell Capacity

The total storage capacity of the facility with the three storage cells is summarized as follows:

Description	Storage Volume
Storage Cell 3 -2.1 m	120,900 m^3
Storage Cell 4 -2.1 m	161,800 m^3
Storage Cell 5 -3.0 m	356,000 m^3
Total	638,700 m^3

The available storage in Storage Cells 3 to 5 far exceeds the year 25 (2039), 180 day storage requirement of 484,776 m^3.

4.4 Storage Cell 5 Aeration Staging

Given the excess storage capacity well beyond the 25 year anticipated requirement a discussion occurred with Altona Council on May 26, 2014 to limit the operation of Storage Cell 5 to 2.1 m on an interim basis. The total storage capacity of the facility with the Storage Cell 5 limited to a 2.1 m operating level is summarized as follows:

Description	Storage Volume
Storage Cell 3 -2.1 m	120,900 m^3
Storage Cell 4 -2.1 m	161,800 m^3
Storage Cell 5 -2.1 m	231,300 m^3
Total	514,000 m^3

By limiting the current operating depth, the aeration system installation in Storage Cell 5 can be postponed until year 2043, based on current growth projections and a 180 storage period.

Direction was provided by Altona Council for the dikes around Storage Cell 5 to be constructed to allow a future 3.0 m operating depth and to provide space in the sewage treatment building to accommodate the additional future blowers.

5.0 Lagoon Sewage Treatment

5.1 Lagoon Treatment Requirements

A review of the *Wastewater System Effluent Regulations*, June 28, 2012 and the *Manitoba Water Quality Standards, Objectives and Guidelines*, November 28, 2011 was completed. The following table summarizes the treatment requirements:

Parameter	Federal Requirement	Provincial Requirement
$CBOD_5$	25 mg/L	25 mg/L
BOD_5		25 mg/L
Suspended Solids	25 mg/L	25 mg/L
Un-ionized Ammonia expressed as nitrogen (N) at 15°C	<1.25 mg/L	
Fecal Coliforms		200 per 100 mL
pH		
Phosphorus		1.0 mg/L

Sewage samples were obtained from Aeration Cell #1, Aeration Cell 3 and Storage Cell 3 Additional historical effluent quality was obtained from Lift Station #1 in May 2007. The sewage effluent is summarized below.

Parameter	Units	2007 LS #1	Aeration Cell 1	Storage Cell 3	Aeration Cell 3	Aeration Cell 3	Aeration Cell 3
			09/30/13	05/23/13	03/26/14	04/22/14	06/02/14
pH	pH units	7.6	7.6		7.5	7.6	8.2
Total Suspended Solids	mg/L	197	40				
Ammonia, Total (as N)	mg/L	19.4	20.2		13.2	25.4	11.5
Un-ionized Ammonia as N @ 15°C	mg/L		0.24		0.113		
Un-ionized Ammonia as N	mg/L					0.099	0.569
Fats, Oil & Grease	mg/L	96	9.4				
Phosphorus (P)-Total	mg/L	3.9	8.5	8.1			
Biochemical Oxygen Demand	mg/L	303	10.1	13.5			

Based on the review of the sewage samples, in additional to the BOD treatment, phosphorous reduction will also be required. The un-ionized ammonia test results indicate no additional ammonia treatment is required. The lab test results, including additional testing parameters, are included in Appendix C.

5.2 BOD Treatment

5.2.1 Aeration Cells

The existing lagoon treats the BOD using three partial mix aeration cells in series with a combined organic capacity of 800 kg BOD_5/day at a flow rate of 2000 m^3 per day. The 2008 lagoon upgrade was designed with a hydraulic retention of 47 days. Based on the projected growth, the organic treatment capacity of the lagoon will be exceeded in the year 2015.

To increase the organic capacity of the lagoon, additional aeration diffusers and additional blower capacity would be required. To allow the partial mix cells to operate properly, a hydraulic retention time of around 50 days is recommend in the summer. With the increase in the design flows, an additional aeration cell would be required to maintain the hydraulic retention. Based on the average day flow of 3,132 m^3/day, a usable hydraulic capacity of 156,600 m^3 is recommended. When sizing the aeration cells, an allowance for sludge accumulation is recommended. In the new aeration cell and the existing Aeration Cell 1, a sludge allowance of 0.45 m has been included. In Aeration Cell 2 and Aeration Cell 3 a sludge allowance of 0.3 m has been included as less sludge should be settling in the final aeration cells. The existing Aeration Cell 1 has a usable summer capacity of 41,560 m^3, existing Aeration Cell 2 has a usable summer capacity of 27,730 m^3, and existing Aeration Cell 3 has a usable summer capacity of 27,730 m^3 for a total usable summer capacity of 97,020 m^3. To provide the recommended 50 day summer hydraulic retention of 156,600 m^3, a new aeration cell with a usable capacity of 59,580 m^3 will be constructed.

5.2.2 Aeration Cell Construction

A new aeration cell is recommended to be constructed to the west of Aeration Cell 1. AMEC completed a geotechnical investigation for the proposed aeration cell. Existing test hole logs west of the existing primary cell were also reviewed to determine the lagoon liner. AMEC advanced 6 test holes, TH14-TH19 and three test holes were drilled in 1992, TP231-1992, TP232-1992 and TH11-1992 at the Aeration Cell 4 site. The test holes showed an upper clay layer, followed by a silt layer on half the test holes, underlain by a high plastic clay layer starting between 2.8 m and 3.3 m below the surface. The upper clay layer would be excavated during construction and the silt layer would not provide a suitable liner meeting Manitoba Conservation's hydraulic conductivity requirements of 1.0 x 10^{-7} cm/s. Some of the test holes identified silt inclusions with the high plastic clay. AMEC conducted a hydraulic conductivity test on the upper clay soils. The insitu sample did not meet Manitoba Conservation's requirement, however once remolded, the clay was suitable for liner construction. Refer to Appendix B for test hole information.

Based on the varying soil types, the silt inclusions in the high plastic clay and the relatively small aeration cell floor area, a 1 m remolded clay liner on the floor will be constructed. To simply construction of the slopes, a 2 m thick clay liner will be installed on the inside slopes of the cell. As the operation level in the cell will remain relatively constant, rip rap will be installed, 0.5 m above and 0.5 m below the normal lagoon operating level.

AMEC completed slope stability analysis on the lagoon slopes. In accordance with the geotechnical report, 5:1 slopes will be used on the interior lagoon slopes and 4:1 slopes will be used on the exterior lagoon slopes. The top 0.15 m of soil will be stripped below the lagoon dikes to ensure all vegetation is removed from below the slopes. The top 0.15 m of soil will be mixed with other excavated soil on site to constructed the outside lagoon slope. All silt excavated from the lagoon will be incorporated into the dikes, outside of the liner area.

On the east side of Aeration Cell 4 is the existing Aeration Cell 1. Aeration Cell 1 has a PVC liner. To ensure the liner is not damaged during construction the existing dike will be widened 3 m and a 2 m thick clay liner will be placed on the interior slope of Aeration Cell 4. The clay liner will be above the existing Aeration Cell 1 weeping tile piping.

Refer to Aeration Cell 4 dike details on Plan L5 in Appendix E.

The flat bottom dimensions of Aeration Cell will be 165 m x 70 m.

5.2.3 Aeration Cells Diffusers and Blowers

Nelson Environmental was contacted regarding the lagoon aeration system expansion. They recommended that the existing diffusers be upgraded from the HA16 diffuser to a HT 25-8 diffuser. The diffusers will remain fine bubble diffusers. The existing laterals will not need to be changed, however to improve on air use efficiency, three of the existing laterals in Aeration Cell 1. The existing aeration header will be extended to the new sewage treatment building. A Baffle curtain will be installed to divide Aeration Cell 1 in two parts in minimize short circuiting and improve the effluent quality.

Aeration Cell 4 will have the same type of aeration system installed as the existing aeration cells, using floating laterals connected to the shallow buried header. The laterals will be secured against wind action with a stainless steel cable system. The cables will be fastened to anchors in the lagoon berm using a self-adjusting lateral tensioning assembly. All header and lateral piping, joints, and fittings will be thermally fused HDPE. With floating laterals the cells do not have to be dewatered or taken out of service for aeration system installation or maintenance. All maintenance can be performed from a boat with a two person crew. All header, lateral, and feeder piping will be designed to accommodate increased airflow for high pressure and volume cleaning without increasing header friction losses by more than 1 psi. This allows for management of additional organic load, improved diffuser maintenance and additional odour control.

To accommodate the additional oxygen requirements, an additional 75 HP blower will be required to supplement the existing two 75 HP blowers and the existing 60 HP blower. The system will be designed to have three of the blowers operational, with the fourth blower as a backup. The three existing blowers will be relocated from the existing building and installed in the new building.

The blowers will be controlled with variable frequency drives to provide an efficient operation of the equipment. During the initial years of operation when the system demand is below the Year 25 design oxygen transfer requirements, the operator will be able to reduce the blower operating speed, minimizing the power consumption.

5.3 Average Day and Peak Flow Requirements

The system will be designed to treat an average day hydraulic load of 3,132 m^3 per day (2,175 L/min). All treatment systems with mechanical equipment need down time each day for maintenance. It is reasonable to allow 4 hours a day for maintenance, leaving only 20 hours/day for treatment. Factoring in the daily downtime for equipment maintenance, the average day hydraulic design flow rate becomes 2,610 L/min. The system will be designed to accommodate peak loads by temporarily increasing the treatment rate of the system.

Peak hydraulic loading to the treatment facility is caused by rainfall directly into the cell and sewage flows greater than average day flows. To ensure the cells do not overtop during the peak hydraulic loading conditions, the system must have provisions to accommodate the peak hydraulic loads. Environment Canada's Website was reviewed to determine normal precipitation in Altona area. The Canadian Climate Normals from 1971-2000 at this reporting station identify the largest month's average monthly rainfall to be 86.8 mm. To account for some higher than average monthly rainfall, a 100 mm monthly rainfall will be included in the sizing of the treatment systems downstream of the aeration cells (i.e. pumps, filters). Ministry of Ontario Environment's (MOE) publication *Design Guidelines for Sewage Works 2008* recommends sewage treatment plants be designed to accommodate peak flows between two to three times average day flows. Aerated lagoons do not need to accommodate as high of peak hydraulic flows suggested for the sewage treatment plants because of the ability to pond peak flows in the freeboard zone of the lagoon cells.

Monthly rainfall of 100 mm over the four aeration cells water surface and interior dike area of approximately 70,560 m^2 generates 7,056 m^3 of precipitation. Ignoring any evaporation effects during the peak rainfall month results in a hydraulic loading rate of 163 L/min.

The historical monthly lift station #1 hour meter readings between 2008 and 2013 were reviewed. The average day runtime during the peak month was compared to the annual daily average runtime in each year to determine a peak month runtime factor. The peak month runtime factor ranged between 1.2 (2012) and 1.8 (2011). The annual average runtime hours per day, the maximum month average runtime hours per day and the peaking factor between the maximum month average are summarized in the table below.

	2008	2009	2010	2011	2012	2013
Annual Average Hours per Day	7.1	8.7	9.9	8.1	5.5	6.5
Max Month Average Hours per Day	9.6	12.8	16.1	14.6	6.6	9.2
Max Month Peak Factor	1.37	1.47	1.63	1.80	1.20	1.42
Max 2 Month Average Hours per Day	8.6	12.7	15.4	14.3	6.4	9.2
Max 2 Month Peak Factor	1.22	1.46	1.56	1.77	1.16	1.42
Max 3 Month Average Hours per Day	8.2	12.3	14.1	13.0	6.1	8.6
Max 3 Month Peak Factor	1.16	1.41	1.42	1.60	1.11	1.32

Increasing the sewage treatment facility's hydraulic capacity to 1.65 times the average day flow provides sufficient treatment capacity to accommodate most of the monthly peaks. The peak flows greater than 1.65 times the average day would be left to be stored in the aerations cells, temporarily raising the water levels. Based on the Max 2 Month Peak Factor of 1.77 times the average day, (the highest recorded peak flow) the aeration cells could accommodate 87 consecutive peak days at 1.77 times the average day with a rise of 0.5 m to the lagoon level. The lagoon level would rise based on the difference in flow rate between the hydraulic capacity of 1.65 times the average day and the peak flow of 1.77 times the average day resulting in a ponding flow rate of 261 L/min ((1.77-1.65) x 2,175). Using the 1.65 times peaking factor, the peak flow treatment capacity is 3,589 L/min (1.65 x 2,175).

Combining both the rainfall peak of 163 L/min and the sewage peak flow of 3,589 L/min results in a total system design peak flow of 3,752 L/min. As previously mentioned, all treatment systems with mechanical equipment need down time each day for maintenance. It is reasonable to allow four hours a day for maintenance, leaving only 20 hours/day for treatment. Factoring in the daily downtime for equipment maintenance, the intermittent peak hydraulic design flow rate becomes 4,502 L/min.

The aerated lagoon system will initiate the peak flow rate based on lagoon water level set points in the pumping control systems.

5.4 Phosphorous Reduction - Continuous Backwash Gravity Sand Filter System

To achieve the desired phosphorus reduction levels of <1 mg/L, filtering the effluent is required. Continuous gravity upflow sand filters will be used to remove the phosphorus. Ferric Chloride will be added to the effluent in the piping upstream of the filters to coagulate the phosphorous for removal by the filtration process. The effluent will be pumped from the inlet chamber and divided evenly between the filters. A typical filter loading rate is 120 to 200 L/min/m^2 for phosphorus with gravity upflow filters. Using four 2.74 m diameter filters and the 25 year average day design flow of 2,610 L/min, the filter loading rate will be 110.7 L/min/m^2 which is reasonable. The flow rate assumes the flow will occur 20 hours per day, allowing four hours per day for maintenance. During intermittent peak flow events, of 4,502 L/min, the filter loading rate will be 190.9 L/min/m^2. This is a reasonable loading rate for intermittent peak flow events. By using four filters rather than one large filter, the system gains redundancy in the event of problems with any single filter, as some treatment could still occur while one filter is out of service for repairs and maintenance.

The filters operate continuously by maintaining a reject stream, thereby not needing a backwash operation. The reject rate for a 2.74 m diameter sand filter is 49 to 57 L/min. The reject stream is directed back to the first aeration cell. The filtered effluent stream will be directed to treated effluent pumping chamber for UV disinfection and discharge.

In addition to phosphorous reduction, the filters also reduce the total suspended solids in the waste stream to maintain the design effluent quality 10 mg/L.

5.5 UV Disinfection

Disinfection of the effluent will be completed by a pressure flow ultraviolet (UV) disinfection systems, rated to disinfect the average day flow of 2,610 L/min. The Trojan UV Fit 32AL50 UV disinfection system is designed to accommodate a flow of 3,636 L/min with a UVT of 40%, based on a 30 day geometric mean.

During an intermittent peak flow event, the flow would be increased to 4,502 L/min, which would exceed the UV system rating of a single unit. To ensure the disinfection occurs during peak flow, a second UV unit will be provided. During non peak flow, the second UV unit will provide redundancy to the system. To reduce manual operational maintenance, the UV disinfection system will be equipped with an automatic bulb wiping system. A chemical cleaning system will also be added to improve the automatic cleaning system. The UV unit will be designed to reduce the fecal coliforms to 200 per 100 ml, provided that a UV transmittance of 40% is continuously maintained.

5.6 Un-ionized Ammonia Reduction

Based on the low un-ionized ammonia test results, no formal ammonia reduction process has been included in the sewage treatment system.

5.7 Fats, Oils and Grease

The Bunge sewage effluent has elevated FOG levels. The FOG will breakdown naturally in the aeration cells, however high levels of FOG can be a problem on the aeration diffusers, the forcemain piping to the lagoon and in the lift station. If high levels of FOG pass through the aerations cells (FOG greater than 1 mg/L), the sand filters may encounter operational difficulties.

Discussions have occurred on requiring Bunge to complete pre-treatment of their effluent, however there has been no willingness by Bunge to perform FOG pre-treatment. The Town of Altona currently uses a small aerator in the main lift station to help breakdown the FOG, however the existing aeration cells still get significant grease balls on the surface at different times of year.

As part of the current lagoon upgrade, no targeted FOG removal system has been incorporated into the lagoon upgrade, however should FOG become an increasing operational issue, pre-treatment in addition to the aeration in the lift station may be required. Pre-treatment would ideally be added at Bunge, however, alternate options could include enzyme addition at the lift station to assist in the breakdown of FOG.

5.8 Existing Site Building

The existing three blowers are located in a small building with a footprint of 40 m^2. The building is located on the south east corner of Aeration Cell 1. The building was constructed with sufficient space to add a future blower, however it could not accommodate the phosphorous or disinfection equipment, nor could it accommodate the storage cell blowers. The aeration equipment will be removed from the building and the building will be repurposed as a storage facility.

5.9 Sewage Treatment Building

The sewage treatment building will house all of the process and testing equipment for the wastewater treatment system. The sewage treatment building will be divided into rooms, including an office, washroom, blower/electrical room and a mechanical room. The mechanical room will house the filter, UV unit, ferric chloride chemical storage, effluent pumps, lab equipment and work bench.

Due to the noise generated by the blowers and air compressor, the interior walls of the building between the blower/electrical room and the rest of the building will be fully insulated for maximum noise absorption. As additional sound attenuation, each blower will be installed in a self-contained sound attenuation enclosure.

A PLC control system including full SCADA capabilities with trending and historical data will be included in the system design.

The building requires a 332 m^2 footprint to accommodate the design spatial demand of the equipment. It will be constructed using a pre-engineered steel building with a metal liner panel exterior. Due to the filter height requirements, the building will have a split level roof to accommodate the equipment. Refer to the Sewage Treatment Building Overall Layout plan for building layout details in Appendix E.

The sewage treatment building will be connected to the community's piped water system. The building sewage discharge will flow into the Aeration Cell 4.

5.10 Site Modifications in the Aeration Cell Area

5.10.1 Lagoon Forcemains

The existing 350 mm and 200 mm forcemains entering Aeration Cell 1 will to be relocated to enter Aeration Cell 4. The pipes are currently located directly west of the cell and would be exposed during the cell excavation. Temporary piping will be required during construction and a new inlet into Aeration Cell 4 will also be required.

A meter chamber will be installed for each of the forcemains to allow the flow entering into the sewage treatment facility to be measured.

A stub will be installed into the lagoon to allow for a future 300 mm forcemain connection to the lagoon.

5.10.2 Septage Receiving Station and Existing Truck Dump Spillway

To track the sewage being hauled to the lagoon, a motorized gate will be installed at the entrance to the site, replacing the existing gate. The gate will be equipped with a card reader and the PLC will keep track of the number of loads hauled by each septic tank hauler. Once the loads are recorded in the PLC, summaries would be available to track and bill each septic tank hauler.

Typically truck dump spillways are located in the first aeration cell, however based on the truck dump loading compared to the overall organic loading in the system, the existing truck dump will be left operating in the existing Aeration Cell 1.

5.11 Discharge from the Sewage Treatment Building

There are two options for discharging the treated effluent from the sewage treatment building. The first option is to pump the treated effluent to Storage Cell 3, Storage Cell 4 or Storage Cell 5. The second option is to continuously discharge the treated effluent to the municipal ditch. The continuous discharge option would be limited to the period of April 15 to November 1. In addition to the discharge period dates, the discharge ditch must be free of icing to permit continuous discharge to occur.

5.11.1 Storage Cell Discharge

A 586 m treated effluent discharge pipe will be installed between the sewage treatment building Storage Cell 3, Storage Cell 4 and Storage Cell 5. The pipe alignment going to the storage cells will pass between Aeration cell 4 and Aeration Cell 1 and head north on the west side of Aeration Cell 2 and 3. For Storage Cell 3, the discharge piping will tee off and connect to the existing 450 mm DR35 PVC piping between Storage Cell 3 and Aeration Cell 3. To connect to Storage Cell 5 and Storage Cell 4, the pipe will continue in the intercell dike between Storage Cell 5 and Aeration Cell 3. Refer to Plan L2 in Appendix E for pipe alignment.

Under average design flow operation, a 300 mm diameter pipe will be flowing at 2,610 L/min, resulting in a pipe velocity of 0.69 m/s. Under peak flow conditions of 4,502 L/min, the pipe will be operating at a velocity of 1.19 m/s. A minimum pipe velocity of 0.6 m/s is recommended to provide a cleaning velocity in the pipe. Under maximum flow conditions, the cleaning velocity will be obtained. The discharge pipe will be constructed using 300 mm diameter HDPE DR 17 piping.

5.11.2 Continuous Discharge

The existing 350 mm and 200 mm forcemains entering Aeration Cell 1 will to be relocated to enter Aeration Cell 4. The pipes are currently located directly west of the cell and would be exposed during the cell excavation. Temporary piping will be required during construction and a new inlet into Aeration Cell 4 will also be required.

A 300 mm, 60 m treated effluent pipe will also be installed heading east from the sewage treatment building to the existing ditch along the south side of the lagoon. The treated effluent would flow west to the approximately 225 m and turn north along the existing ditch on the west side of the lagoon property. The treated effluent will continue to flow north to the municipal road and turn east along the north property line of the lagoon in the municipal ditch. Once in the municipal ditch, the treated effluent will follow the existing discharge route of Storage Cell 3.

Four cross sections of the existing Municipal ditch for the first mile north of lagoon property along the discharge route were taken. Over the length of the mile, the average ditch slope was 0.05%. The existing ditch has a built up dike along the west side, against the farmer’s field. At the existing ground level, flap gate culverts were installed to allow the fields to drain in periods of low ditch flow.

The average ditch capacity along the mile was 758 L/s up to the flap gate culverts and 10,375 L/s to the top of ditch. At the narrowest cross section taken in the ditch, the ditch capacities were reduced to 667 L/s up to the flap gate culverts and 8,952 L/s to the top of ditch.

A discussion occurred with the Town of Altona Public Works on May 21 about existing lagoon discharge practices. The existing Storage Cell 3 and Storage Cell 4 are typically discharged at the same time each spring over a three week period. The combined storage capacity of the two cells is 282,700 m^3. With the cells being discharged over the three weeks (21 days), the discharge occurs at an average flow rate of 155.8 L/s.

During periods of continuous discharge from the sewage treatment building, the design flow to the discharge ditch is 43.5 L/s (2,610 L/min). The flow can be increased to 75.0 L/s (4,502 L/min) during peak flow operation.

The continuous discharge design flow is only 6.5% of the narrowest ditch capacity up to the flap culverts. The peak flow is only 11.2% of the ditch capacity. Based on the small percentage of flow being added to the ditch.

5.12 Aeration Cell Intercell Piping

The existing aeration cells are interconnected with 400 mm diameter piping. A hydraulic analysis of the existing piping was completed on both the design flow rate of 2,610 L/min and the peak flow rate of 4,502 L/min. At the design flow rate of 2,610 L/min, the internal pipe losses between Aeration Cell 1 and Aeration Cell 2 are 0.056 m. Under the peak flow rate of 4,502 L/min, the internal pipe losses increase to 0.160 m. The internal pipe losses are similar between Aeration Cell 2 and Aeration Cell 3.

To connect the Aeration Cell 4 to Aeration Cell 1, the existing forcemain piping can be repurposed as intercell piping. The two forcemains, 350 mm Altona forcemain and the 200 mm old Altona forcemain could be used in series. At the design flow rate of 2,610 L/min, the internal pipe losses between Aeration Cell 4 and Aeration Cell 1 are 0.079 m. Under the peak flow rate of 4,502 L/min, the internal pipe losses increase to 0.217 m.

The total pipe losses for the design flow of 2,610 L/min between Aeration Cell 4 and Aeration Cell 3 using the existing piping is 0.190 m. The total pipe losses for the peak flow of 4,502 L/min between Aeration Cell 4 and Aeration Cell 3 using the existing piping is 0.536 m.

The internal pipe losses will result in gradually lower lagoon operating levels between Aeration Cell 4 and Aeration Cell 3. The 0.190 m elevation difference under design flow is reasonable. The 0.536 m elevation difference under peak flow is beginning to become significant.

To alleviate the 0.536 m elevation difference under peak flow, all the existing intercell piping could be replaced at a considerable expense due to the existing PVC liner that would require repair. If the intercell pipes were replaced with 500 mm piping, at the design flow rate of 2,610 L/min, the internal pipe losses between Aeration Cell 4 and Aeration Cell 1 would be 0.064 m. Under the peak flow rate of 4,502 L/min, the internal pipe losses increase to 0.181 m.

Due to the complications of replacing the existing intercell piping, additional freeboard can be provided in Aeration Cell 1 to allow the water level to pond up under peak flow conditions, allowing the Aeration Cell 3 to remain closer to the normal operating level.

5.13 Pumping Systems

Two main pumping systems are required in the sewage treatment system: the filter feed pumps and the treated effluent discharge pumps. Both systems will be designed with a submersible duplex pumping system.

5.13.1 Filter Feed Pump

The filter feed pump will normally operate at the average day flow of 2,610 L/min, however will be sized to accommodate the peak intermittent flow rate of 4,502 L/min. The pump will be controlled based on the start and stop set point levels of the lagoon. In addition to the average day flow and peak flow, the pump must accommodate a reject rate of 57 L/min per filter, resulting in a pump capacity requirement of 2,838 L/min for the average day flow and 4,730 L/min. The pump will lift the effluent from the bottom of the liquid control manhole and discharge the effluent at the top of the filter. The normal static head on the pump is 8.4 m. Using a combination of 150 mm, 200 mm and 250 mm internal building piping, the system operating head will be 12.1 m under peak flow conditions. The pumps will be VFD driven to optimize the pump performance and to maintain constant flow.

5.13.2 Treated Effluent Discharge Pump

The discharge pump will normally operate at the average day flow of 2,610 L/min, however must be sized to accommodate the peak intermittent flow rates of 4,502 L/min. The pump will lift the effluent from the bottom of the treated discharge chamber and pump the effluent through the UV disinfection system and to the storage cells or the discharge ditch.

Depending upon the lagoon water level, there is a negative static head on the pump. The normal static head on the pump varies between a vacuum of 0.2 m and a vacuum of 3.1 m. To empty the discharge chamber the pump must be capable of a static head of 6.4 m. Using a 200 mm internal piping and 300 mm piping to the storage cells, the system operating head will be 8.1 m under peak flow conditions. The pump will be VFD driven to optimize the pump performance. A 200 mm modulated plug valve will be installed on the discharge line to ensure the system does not siphon and to provide a minimum 2.1 m back pressure on the pump during low storage cell levels.

6.0 COST ESTIMATE

6.1 General

The cost estimate is based on report information. This cost estimate is an opinion of probable costs. This opinion is based on assumptions as to the actual conditions that will be encountered onsite; the specific decision and design of other design professionals engaged i.e. geotechnical soils analysis; the means and methods of construction the Contractor will utilize; the costs and extent of labour, equipment and materials the Contractor will employ; Contractor's techniques in determining prices and market conditions at the time; and other factors over which JR Cousin Consultants Ltd. has no control. Given the assumptions that must be made, JR Cousin Consultants Ltd. cannot guarantee the accuracy of our opinions of cost.

6.2 Summarized Capital Costs

An itemized budget class "C" cost estimate of construction and non-construction costs is presented in Appendix D. The following is a summarization of the capital costs for each area of required works for a 2014/2015 construction season. The costs for each year after this projection period should be inflated per prevailing inflation and market conditions.

Class C Cost Estimate

Description	Total
Construction Cost	$7,494,340
GST 5%	$374,700
Contingency 15%	$1,124,200
Engineering 15%	$1,124,200
Total Project Cost	**$10,117,440**

6.3 Operating and Maintenance Costs

Operating and maintenance costs have been estimated based on preliminary equipment motor sizes and preliminary chemical consumptions. The majority of the operating costs are related to system energy consumption and chemical addition.

Long term equipment replacement costs of the building and equipment have not been included in the summary, only maintenance costs associated with the treatment equipment have been included. Operator time and lab testing costs has also been excluded from the operating and maintenance costs. The estimated operating cost of the sewage treatment facility is $268,320, based on present day costs and the year 25 design loadings. Until the year 25 design loadings are met, operating costs will be lower as energy consumption and chemical usage can be reduced. Energy consumption is based on the Town of Altona Existing Lagoon April 2014 average billing kWh cost. Refer to Appendix D for the detailed Operation and Maintenance Costs.

7.0 NEXT STEPS

With the completion of the Pre-Design Report, the next step in the lagoon upgrade project is for the Town of Altona to prepare the industrial services agreement with Bunge. The industrial services agreement is required as part of the licensing process for the lagoon upgrade for Manitoba Conservation.

Discussions are required between the Town of Altona and the RM of Rhineland to obtain their approval on the intermittent continuous discharge of the lagoon in the municipal ditches.

Based on the discussions during our May 26, 2014 meeting with Council, JRCC will proceed directly into the preparation of the Environmental Act Proposal for the lagoon operating license. Prior to the proposal being submitted to Manitoba Conservation, the Town of Altona should have the industrial services agreement and discussions with the RM of Rhineland initiated.

Once the Environmental Act Proposal is submitted, the detailed design of the lagoon upgrade can be initiated. The lagoon upgrade design can be initiated immediately, however it cannot be completed until after the Environmental Act Proposal has been accepted and a license provided by Manitoba Conservation. JRCC would be pleased to provide a proposal to the Town of Altona for the detailed design of the lagoon upgrade.

APPENDIX

Appendix A

Table 1: Population, Hydraulic, and Organic Loading Projections for the Town of Altona

Appendix B

Poetker MacLaren Limited, July 1992, Test Holes

Poetker MacLaren Limited, August 1992, Test Holes

Cochrane Engineering, January 2006, Test Holes

AMEC, June 2014, Geotechnical Investigation

Appendix C

Sewage Sample Data

Appendix D

Cost Estimates

Operation and Maintenance Costs

Appendix E

Plan 1:	Lagoon Test Holes and Existing Ground Contours
Plan 2:	Proposed Lagoon Cells
Plan 3:	Pipe Layout Plan
Plan 4:	Lagoon Sections - Storage Cell 5 Dikes at Existing Cells
Plan 5:	Lagoon Sections - Storage Cell 5 Dike
Plan 6:	Lagoon Sections - Aeration Cell 4 Dike
Plan 7:	Sewage Treatment - Process Diagram
Plan 8:	Sewage Treatment Building - South and West Elevation
Plan 9:	Sewage Treatment Building - North and East Elevation
Plan 10:	Sewage Treatment Building - Overall Layout

Appendix A

Table 1: Population, Hydraulic, and Organic Loading Projections for the Town of Altona

Table 1

POPULATION, HYDRAULIC, AND ORGANIC LOADING PROJECTIONS FOR THE TOWN OF ALTONA

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	Col 20	Col 21	Col 22	Col 23	Col 24	Col 25	Col 26	Col 27	Col 28	Col 29
PROJECT YEAR	YEAR	POPULATION									ORGANIC LOADING					HYDRAULIC LOADING												
		TOWN OF ALTONA	BUSSED-IN STUDENTS		OLD ALTONA LOW PRESSURE SEWER		TOTAL PIPED POPULATION	R.M. of Rhineland			DAILY PER CAPITA BOD	DAILY BOD PRODUCTION	DAILY BOD PRODUCTION	BUNGE PRODUCTION	DAILY BOD PRODUCTION	ALTONA PIPED SEWAGE COLLECTION					OLD ALTONA PIPED SEWAGE COLLECTION			SEPTIC TANK DAILY PUMP OUTS	BUNGE DAILY WATEWATER PRODUCTION	TOTAL DAILY WASTEWATER PRODUCTION	TOTAL DAILY WASTEWATER PRODUCTION DURING THE STORAGE PERIOD	180 Day WASTEWATER PRODUCTION
		1.4% Growth/year	2.00% Growth/year		3.9 Residents per Connection			SEPTIC TANKS	POPULATION 3.9 Residents per Connection	SEPTIC TANK PUMP OUTS / DAY	Piped	Piped	Septic Tanks	800 mg/L BOD	Total	DAILY/CAPITA SEWAGE GENERATION	INFILTRATION	INFILTRATION DURING STORAGE PERIOD	TOTAL	TOTAL DURING STORAGE PERIOD	DAILY/CAPITA SEWAGE GENERATION	INFILTRATION	TOTAL					
			Actual	Equivalent (1/3)	Connections	Population					(kg)	(kg)	6.19 kg/day	(kg)	(kg)	(L/person/day)	(L/person/day)	(L/person/day)	(m^3)	(m^3)	(L/person/day)	(L/person/day)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
0	2011	4,088																										
0	2012	4,145																										
0	2013	4,203	566	189	30	117	4,509	487	1,899	6	0.076	342.7	37.1	172.0	**551.8**	225	161	99	1695	1423	200	40	28	27	215	**1,965**	1,666	**299,876**
0	2014	4,262	577	192	31	121	4,575	512	1,997	6	0.076	347.7	37.1	338.4	**723.3**	225	161	99	1719	1443	200	40	29	27	423	**2,198**	1,895	**341,144**
1	2015	4,322	589	196	32	125	4,643	537	2,094	6	0.076	352.9	37.1	368.0	**758.0**	225	161	99	1744	1464	200	40	30	27	460	**2,261**	1,954	**351,709**
2	2016	4,383	601	200	33	129	4,712	562	2,192	6	0.076	358.1	37.1	448.0	**843.3**	225	161	99	1769	1485	200	40	31	27	560	**2,387**	2,076	**373,673**
3	2017	4,444	613	204	34	133	4,781	587	2,289	7	0.076	363.4	43.3	448.0	**854.7**	225	161	99	1794	1506	200	40	32	32	560	**2,418**	2,098	**377,636**
4	2018	4,506	625	208	35	137	4,851	612	2,387	7	0.076	368.7	43.3	448.0	**860.0**	225	161	99	1820	1527	200	40	33	32	560	**2,444**	2,120	**381,658**
5	2019	4,569	638	213	36	140	4,922	637	2,484	7	0.076	374.0	43.3	448.0	**865.4**	225	161	99	1846	1549	200	40	34	32	560	**2,471**	2,143	**385,715**
6	2020	4,633	651	217	37	144	4,994	662	2,582	7	0.076	379.5	43.3	448.0	**870.9**	225	161	99	1872	1571	200	40	35	32	560	**2,498**	2,166	**389,873**
7	2021	4,698	664	221	38	148	5,067	687	2,679	8	0.076	385.1	49.5	448.0	**882.6**	225	161	99	1899	1594	200	40	36	36	560	**2,530**	2,189	**394,089**
8	2022	4,764	677	226	39	152	5,142	712	2,777	8	0.076	390.8	49.5	448.0	**888.3**	225	161	99	1926	1617	200	40	36	36	560	**2,558**	2,213	**398,364**
9	2023	4,831	691	230	40	156	5,217	737	2,874	8	0.076	396.5	49.5	448.0	**894.0**	225	161	99	1954	1640	200	40	37	36	560	**2,587**	2,237	**402,716**
10	2024	4,899	705	235	41	160	5,294	762	2,972	8	0.076	402.3	49.5	448.0	**899.9**	225	161	99	1982	1663	200	40	38	36	560	**2,616**	2,262	**407,127**
11	2025	4,968	719	240	42	164	5,372	787	3,069	9	0.076	408.2	55.7	448.0	**912.0**	225	161	99	2010	1687	200	40	39	41	560	**2,650**	2,287	**411,596**
12	2026	5,038	733	244	43	168	5,450	812	3,167	9	0.076	414.2	55.7	448.0	**917.9**	225	161	99	2039	1711	200	40	40	41	560	**2,680**	2,312	**416,123**
13	2027	5,109	748	249	44	172	5,530	837	3,264	9	0.076	420.3	55.7	448.0	**924.0**	225	161	99	2068	1736	200	40	41	41	560	**2,710**	2,337	**420,728**
14	2028	5,181	763	254	45	176	5,611	862	3,362	9	0.076	426.5	55.7	448.0	**930.2**	225	161	99	2098	1761	200	40	42	41	560	**2,741**	2,363	**425,392**
15	2029	5,254	778	259	46	179	5,692	887	3,459	10	0.076	432.6	61.9	448.0	**942.5**	225	161	99	2128	1786	200	40	43	45	560	**2,776**	2,389	**430,070**
16	2030	5,328	794	265	47	183	5,776	912	3,557	10	0.076	439.0	61.9	448.0	**948.9**	225	161	99	2159	1812	200	40	44	45	560	**2,808**	2,416	**434,870**
17	2031	5,403	810	270	48	187	5,860	937	3,654	10	0.076	445.4	61.9	448.0	**955.3**	225	161	99	2190	1838	200	40	45	45	560	**2,840**	2,443	**439,728**
18	2032	5,479	826	275	49	191	5,945	962	3,752	11	0.076	451.8	68.1	448.0	**967.9**	225	161	99	2221	1864	200	40	46	50	560	**2,877**	2,470	**444,644**
19	2033	5,556	843	281	50	195	6,032	987	3,849	11	0.076	458.4	68.1	448.0	**974.5**	225	161	99	2253	1891	200	40	47	50	560	**2,909**	2,498	**449,638**
20	2034	5,634	860	287	51	199	6,120	1,012	3,947	11	0.076	465.1	68.1	448.0	**981.2**	225	161	99	2285	1918	200	40	48	50	560	**2,943**	2,526	**454,690**
21	2035	5,713	877	292	52	203	6,208	1,037	4,044	11	0.076	471.8	68.1	448.0	**987.9**	225	161	99	2318	1946	200	40	49	50	560	**2,976**	2,554	**459,801**
22	2036	5,793	895	298	53	207	6,298	1,062	4,142	12	0.076	478.7	74.3	448.0	**1,001.0**	225	162	99	2357	1974	201	40	50	54	560	**3,021**	2,584	**465,034**
23	2037	5,874	913	304	54	211	6,389	1,087	4,239	12	0.076	485.6	74.3	448.0	**1,007.9**	225	163	99	2397	2002	202	40	51	54	560	**3,062**	2,613	**470,327**
24	2038	5,956	931	310	55	215	6,481	1,112	4,337	12	0.076	492.6	74.3	448.0	**1,014.9**	225	164	99	2438	2030	203	41	52	54	560	**3,104**	2,643	**475,680**
25	2039	6,039	950	317	56	218	6,574	1,125	4,388	12	0.076	499.6	74.3	448.0	**1,021.9**	225	161	99	2453	2059	200	40	52	54	560	**3,120**	2,672	**480,880**

Table 2 - 180 Day Storage

POPULATION, HYDRAULIC, AND ORGANIC LOADING PROJECTIONS FOR THE TOWN OF ALTONA

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	Col 20	Col 21	Col 22	Col 23	Col 24	Col 25	Col 26	Col 27	Col 28	Col 29	Col 30
PROJECT YEAR	YEAR	POPULATION									ORGANIC LOADING					HYDRAULIC LOADING													
		TOWN OF ALTONA	BUSSED-IN STUDENTS		OLD ALTONA LOW PRESSURE SEWER		TOTAL PIPED POPULATION	R.M. of Rhineland			DAILY PER CAPITA BOD	DAILY BOD PRODUCTION	DAILY BOD PRODUCTION	BUNGE PRODUCTION	DAILY BOD PRODUCTION	ALTONA PIPED SEWAGE COLLECTION					OLD ALTONA PIPED SEWAGE COLLECTION			SEPTIC TANK DAILY PUMP OUTS	BUNGE DAILY WATEWATER PRODUCTION	BUNGE DAILY WATEWATER PRODUCTION DURING THE STORAGE PERIOD	TOTAL DAILY WASTEWATER PRODUCTION	TOTAL DAILY WASTEWATER PRODUCTION DURING THE STORAGE PERIOD	180 Day WASTEWATER PRODUCTION
		1.4% Growth/year	2.00% Growth/year		3.9 Residents per Connection			SEPTIC TANKS	POPULATION 3.9 Residents per Connection	SEPTIC TANK PUMP OUTS / DAY	Piped	Piped	Septic Tanks	800 mg/L BOD	Total	DAILY/CAPITA SEWAGE GENERATION	INFILTRATION	INFILTRATION DURING STORAGE PERIOD	TOTAL	TOTAL DURING STORAGE PERIOD	DAILY/CAPITA SEWAGE GENERATION	INFILTRATION	TOTAL						
			Actual	Equivalent (1/3)	Connections	Population					(kg)	(kg)	6.19 kg/day	(kg)	(kg)	(L/person/day)	(L/person/day)	(L/person/day)	(m^3)	(m^3)	(L/person/day)	(L/person/day)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)	(m^3)
0	2011	4,088																											
0	2012	4,145																											
0	2013	4,203	566	189	30	117	4,509	487	1,899	6	0.076	342.7	37.1	157.6	**537.4**	227	161	96	1704	1419	200	40	28	27	197	197	**1,956**	1,644	**295,846**
0	2014	4,262	577	192	31	121	4,575	512	1,997	6	0.076	347.7	37.1	338.4	**723.3**	227	161	96	1728	1439	200	40	29	27	423	423	**2,207**	1,891	**340,342**
1	2015	4,322	589	196	32	125	4,643	537	2,094	6	0.076	352.9	37.1	368.0	**758.0**	227	161	96	1753	1459	200	40	30	27	460	460	**2,270**	1,949	**350,896**
2	2016	4,383	601	200	33	129	4,712	562	2,192	6	0.076	358.1	37.1	470.4	**865.7**	227	161	96	1778	1480	200	40	31	27	560	588	**2,396**	2,099	**377,888**
3	2017	4,444	613	204	34	133	4,781	587	2,289	7	0.076	363.4	43.3	470.4	**877.1**	227	161	96	1804	1501	200	40	32	32	560	588	**2,427**	2,121	**381,840**
4	2018	4,506	625	208	35	137	4,851	612	2,387	7	0.076	368.7	43.3	470.4	**882.4**	227	161	96	1829	1523	200	40	33	32	560	588	**2,454**	2,144	**385,850**
5	2019	4,569	638	213	36	140	4,922	637	2,484	7	0.076	374.0	43.3	470.4	**887.8**	227	161	96	1855	1544	200	40	34	32	560	588	**2,480**	2,166	**389,894**
6	2020	4,633	651	217	37	144	4,994	662	2,582	7	0.076	379.5	43.3	470.4	**893.3**	227	161	96	1882	1567	200	40	35	32	560	588	**2,508**	2,189	**394,040**
7	2021	4,698	664	221	38	148	5,067	687	2,679	8	0.076	385.1	49.5	470.4	**905.0**	227	161	96	1909	1589	200	40	36	36	560	588	**2,540**	2,212	**398,244**
8	2022	4,764	677	226	39	152	5,142	712	2,777	8	0.076	390.8	49.5	470.4	**910.7**	227	161	96	1936	1612	200	40	36	36	560	588	**2,568**	2,236	**402,506**
9	2023	4,831	691	230	40	156	5,217	737	2,874	8	0.076	396.5	49.5	470.4	**916.4**	227	161	96	1964	1635	200	40	37	36	560	588	**2,597**	2,260	**406,845**
10	2024	4,899	705	235	41	160	5,294	762	2,972	8	0.076	402.3	49.5	470.4	**922.3**	227	161	96	1992	1658	200	40	38	36	560	588	**2,626**	2,285	**411,243**
11	2025	4,968	719	240	42	164	5,372	787	3,069	9	0.076	408.2	55.7	470.4	**934.4**	227	161	96	2021	1682	200	40	39	41	560	588	**2,660**	2,309	**415,699**
12	2026	5,038	733	244	43	168	5,450	812	3,167	9	0.076	414.2	55.7	470.4	**940.3**	227	161	96	2050	1706	200	40	40	41	560	588	**2,690**	2,335	**420,212**
13	2027	5,109	748	249	44	172	5,530	837	3,264	9	0.076	420.3	55.7	470.4	**946.4**	227	161	96	2079	1731	200	40	41	41	560	588	**2,721**	2,360	**424,804**
14	2028	5,181	763	254	45	176	5,611	862	3,362	9	0.076	426.5	55.7	470.4	**952.6**	227	161	96	2109	1756	200	40	42	41	560	588	**2,752**	2,386	**429,453**
15	2029	5,254	778	259	46	179	5,692	887	3,459	10	0.076	432.6	61.9	470.4	**964.9**	227	161	96	2139	1781	200	40	43	45	560	588	**2,787**	2,412	**434,118**
16	2030	5,328	794	265	47	183	5,776	912	3,557	10	0.076	439.0	61.9	470.4	**971.3**	227	161	96	2170	1806	200	40	44	45	560	588	**2,819**	2,438	**438,903**
17	2031	5,403	810	270	48	187	5,860	937	3,654	10	0.076	445.4	61.9	470.4	**977.7**	227	161	96	2201	1832	200	40	45	45	560	588	**2,851**	2,465	**443,747**
18	2032	5,479	826	275	49	191	5,945	962	3,752	11	0.076	451.8	68.1	470.4	**990.3**	227	161	96	2233	1859	200	40	46	50	560	588	**2,888**	2,492	**448,648**
19	2033	5,556	843	281	50	195	6,032	987	3,849	11	0.076	458.4	68.1	470.4	**996.9**	227	161	96	2265	1885	200	40	47	50	560	588	**2,921**	2,520	**453,627**
20	2034	5,634	860	287	51	199	6,120	1,012	3,947	11	0.076	465.1	68.1	470.4	**1,003.6**	227	161	96	2297	1912	200	40	48	50	560	588	**2,954**	2,548	**458,664**
21	2035	5,713	877	292	52	203	6,208	1,037	4,044	11	0.076	471.8	68.1	470.4	**1,010.3**	227	161	96	2330	1940	200	40	49	50	560	588	**2,988**	2,576	**463,760**
22	2036	5,793	895	298	53	207	6,298	1,062	4,142	12	0.076	478.7	74.3	470.4	**1,023.4**	227	161	96	2363	1968	200	40	50	54	560	588	**3,027**	2,605	**468,933**
23	2037	5,874	913	304	54	211	6,389	1,087	4,239	12	0.076	485.6	74.3	470.4	**1,030.3**	227	161	96	2397	1996	200	40	51	54	560	588	**3,062**	2,634	**474,164**
24	2038	5,956	931	310	56	218	6,484	1,100	4,290	12	0.076	492.8	74.3	470.4	**1,037.5**	227	161	96	2431	2024	200	40	52	54	560	588	**3,098**	2,664	**479,582**
25	2039	6,039	950	317	56	218	6,574	1,100	4,290	12	0.076	499.6	74.3	470.4	**1,044.3**	227	161	96	2466	2053	200	40	52	54	560	588	**3,132**	2,693	**484,776**

Appendix B

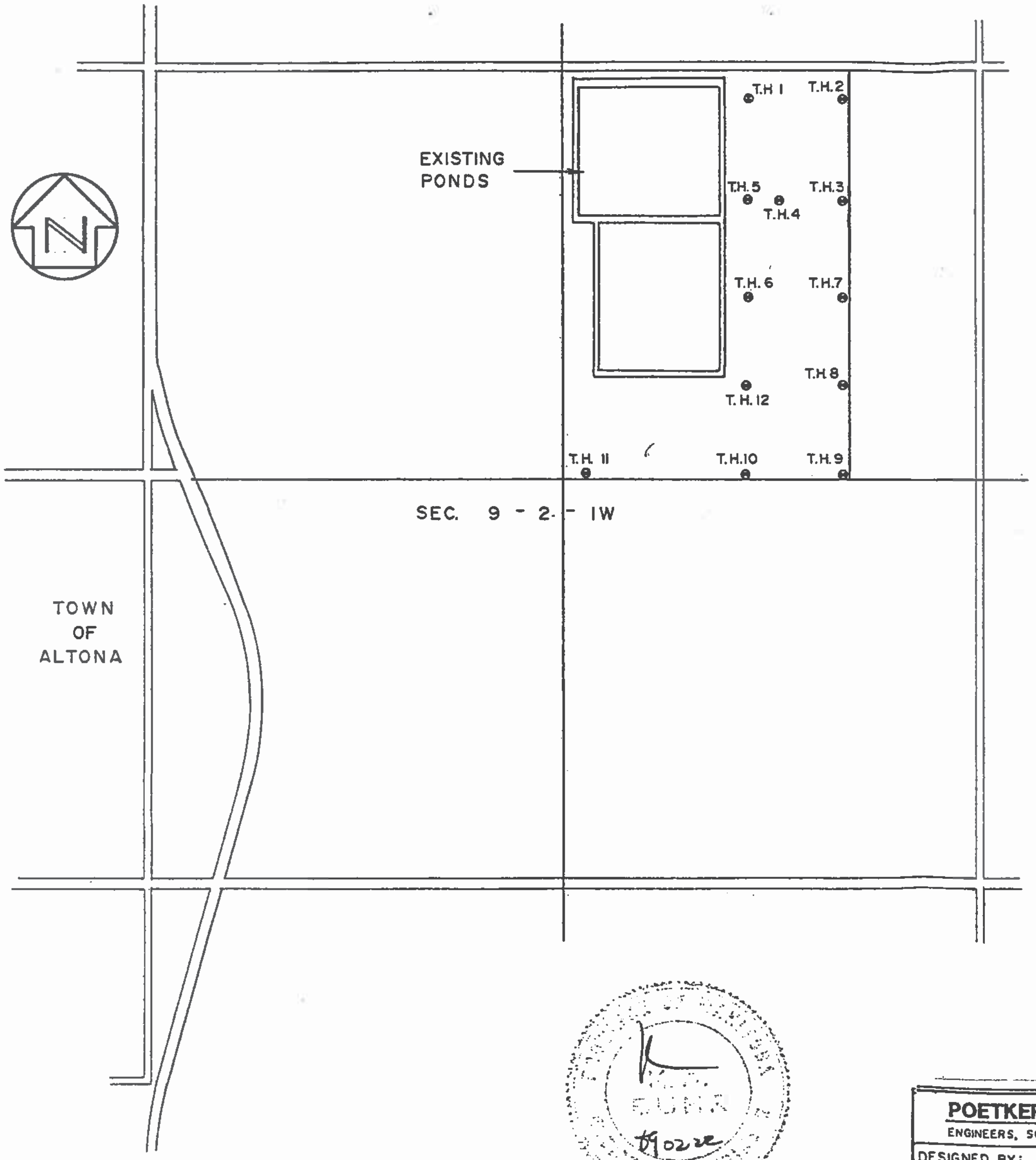
Poetker MacLaren Limited, July 1992, Test Holes

Poetker MacLaren Limited, August 1992, Test Holes

Cochrane Engineering, January 2006, Test Holes

AMEC, June 2014, Geotechnical Investigation

Poetker MacLaren Limited, July 1992, Test Holes



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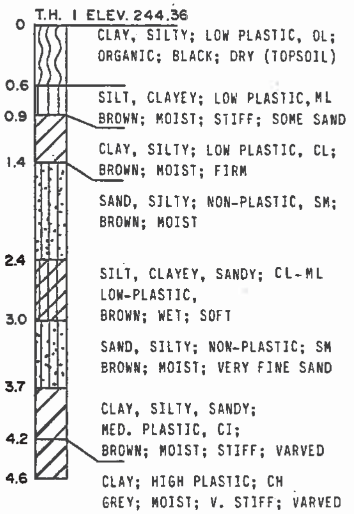
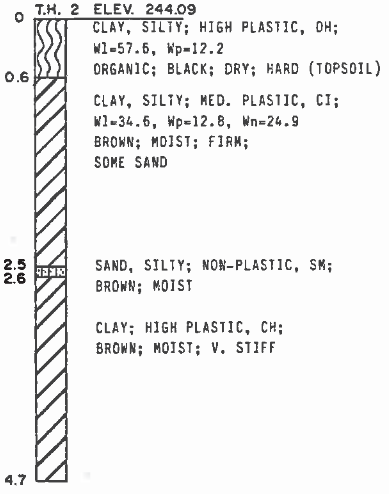
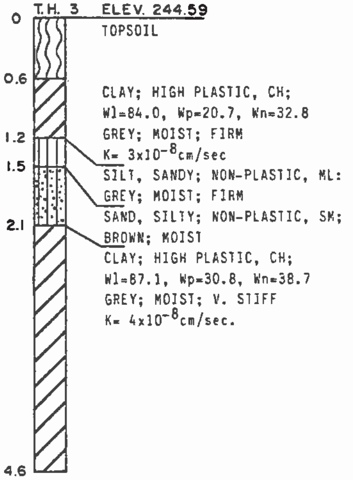
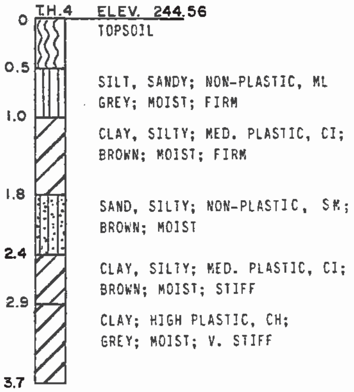
89022

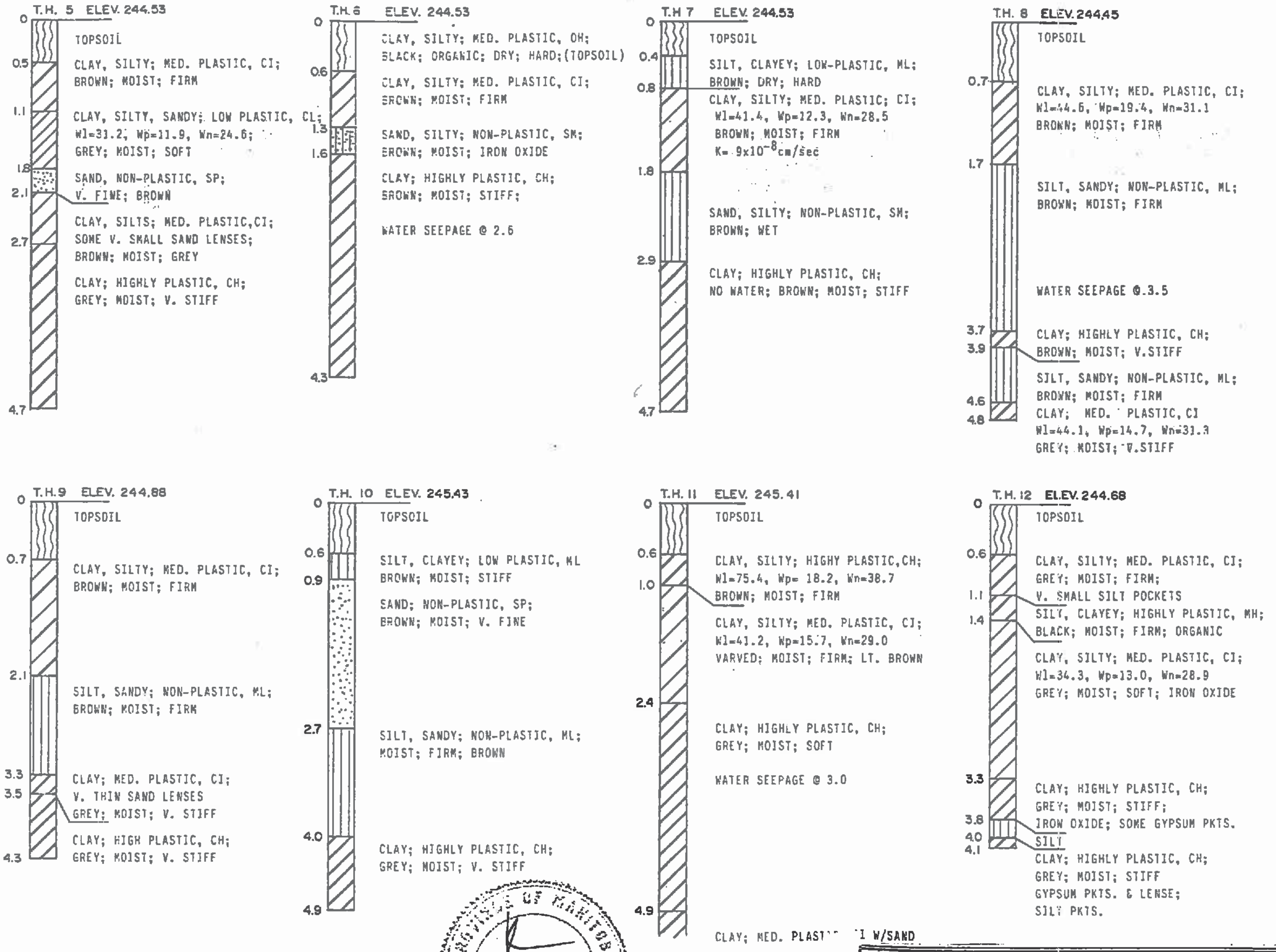








POETKER MacLAREN LIMITED ENGINEERS, SCIENTISTS & PROJECT MANAGERS		CLIENT:	Canada TOWN OF ALTONA Manitoba	
DESIGNED BY:	K.A.B.	PROJECT:	WASTEWATER STABILIZATION POND	
DRAWN BY:	L.H.	DESCRIPTION:	LOCATION PLAN & SOIL LOGS	
CHECKED BY:	W.H.B.	DATE: JULY, 1992	SHEET OF	DWG. NO. 110-06-02-D2
APPROVED BY:	W.H.B.			



T.H. 5 ELEV. 244.53

0 TOPSOIL

0.5 CLAY, SILTY; MED. PLASTIC, CI; BROWN; MOIST; FIRM

1.1 CLAY, SILTY, SANDY; LOW PLASTIC, CL; Wl=31.2, Wp=11.9, Wn=24.6; GREY; MOIST; SOFT

1.8 SAND, NON-PLASTIC, SP; V. FINE; BROWN

2.1 CLAY, SILTS; MED. PLASTIC,CI; SOME V. SMALL SAND LENSES; BROWN; MOIST; GREY

2.7 CLAY; HIGHLY PLASTIC, CH; GREY; MOIST; V. STIFF

4.7

T.H. 6 ELEV. 244.53

0 CLAY, SILTY; MED. PLASTIC, OH; BLACK; ORGANIC; DRY; HARD;(TOPSOIL)

0.6 CLAY, SILTY; MED. PLASTIC, CI; BROWN; MOIST; FIRM

1.3 SAND, SILTY; NON-PLASTIC, SM; BROWN; MOIST; IRON OXIDE

1.6 CLAY; HIGHLY PLASTIC, CH; BROWN; MOIST; STIFF;

WATER SEEPAGE @ 2.6

4.3

T.H 7 ELEV. 244.53

0 TOPSOIL

0.4 SILT, CLAYEY; LOW-PLASTIC, ML; BROWN; DRY; HARD

0.8 CLAY, SILTY; MED. PLASTIC; CI; Wl=41.4, Wp=12.3, Wn=28.5 BROWN; MOIST; FIRM K= 9x10^{-8}cm/sec

1.8 SAND, SILTY; NON-PLASTIC, SM; BROWN; WET

2.9 CLAY; HIGHLY PLASTIC, CH; NO WATER; BROWN; MOIST; STIFF

4.7

T.H. 8 ELEV. 244.45

0 TOPSOIL

0.7 CLAY, SILTY; MED. PLASTIC, CI; Wl=44.6, Wp=19.4, Wn=31.1 BROWN; MOIST; FIRM

1.7 SILT, SANDY; NON-PLASTIC, ML; BROWN; MOIST; FIRM

WATER SEEPAGE @.3.5

3.7 CLAY; HIGHLY PLASTIC, CH; BROWN; MOIST; V.STIFF

3.9 SILT, SANDY; NON-PLASTIC, ML; BROWN; MOIST; FIRM

4.6 CLAY; MED. PLASTIC, CI Wl=44.1, Wp=14.7, Wn=31.3 GREY; MOIST; V.STIFF

4.8

T.H.9 ELEV. 244.88

0 TOPSOIL

0.7 CLAY, SILTY; MED. PLASTIC, CI; BROWN; MOIST; FIRM

2.1 SILT, SANDY; NON-PLASTIC, ML; BROWN; MOIST; FIRM

3.3 CLAY; MED. PLASTIC, CI; V. THIN SAND LENSES GREY; MOIST; V. STIFF

3.5 CLAY; HIGH PLASTIC, CH; GREY; MOIST; V. STIFF

4.3

T.H. 10 ELEV. 245.43

0 TOPSOIL

0.6 SILT, CLAYEY; LOW PLASTIC, ML BROWN; MOIST; STIFF

0.9 SAND; NON-PLASTIC, SP; BROWN; MOIST; V. FINE

2.7 SILT, SANDY; NON-PLASTIC, ML; MOIST; FIRM; BROWN

4.0 CLAY; HIGHLY PLASTIC, CH; GREY; MOIST; V. STIFF

4.9

T.H. 11 ELEV. 245.41

0 TOPSOIL

0.6 CLAY, SILTY; HIGHY PLASTIC,CH; Wl=75.4, Wp= 18.2, Wn=38.7 BROWN; MOIST; FIRM

1.0 CLAY, SILTY; MED. PLASTIC, CI; Wl=41.2, Wp=15.7, Wn=29.0 VARVED; MOIST; FIRM; LT. BROWN

2.4 CLAY; HIGHLY PLASTIC, CH; GREY; MOIST; SOFT

WATER SEEPAGE @ 3.0

4.9 CLAY; MED. PLAST[illegible]I W/SAND

T.H. 12 ELEV. 244.68

0 TOPSOIL

0.6 CLAY, SILTY; MED. PLASTIC, CI; GREY; MOIST; FIRM; V. SMALL SILT POCKETS

1.1 SILT, CLAYEY; HIGHLY PLASTIC, MH; BLACK; MOIST; FIRM; ORGANIC

1.4 CLAY, SILTY; MED. PLASTIC, CI; Wl=34.3, Wp=13.0, Wn=28.9 GREY; MOIST; SOFT; IRON OXIDE

3.3 CLAY; HIGHLY PLASTIC, CH; GREY; MOIST; STIFF; IRON OXIDE; SOME GYPSUM PKTS.

3.8 SILT

4.0 CLAY; HIGHLY PLASTIC, CH; GREY; MOIST; STIFF GYPSUM PKTS. & LENSE; SILT PKTS.

4.1

K.A. BUHR

POETKER MacLAREN LIMITED
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY:	K.A.B.
DRAWN BY:	L.H.
CHECKED BY:	W.H.B.
APPROVED BY:	W.H.B.

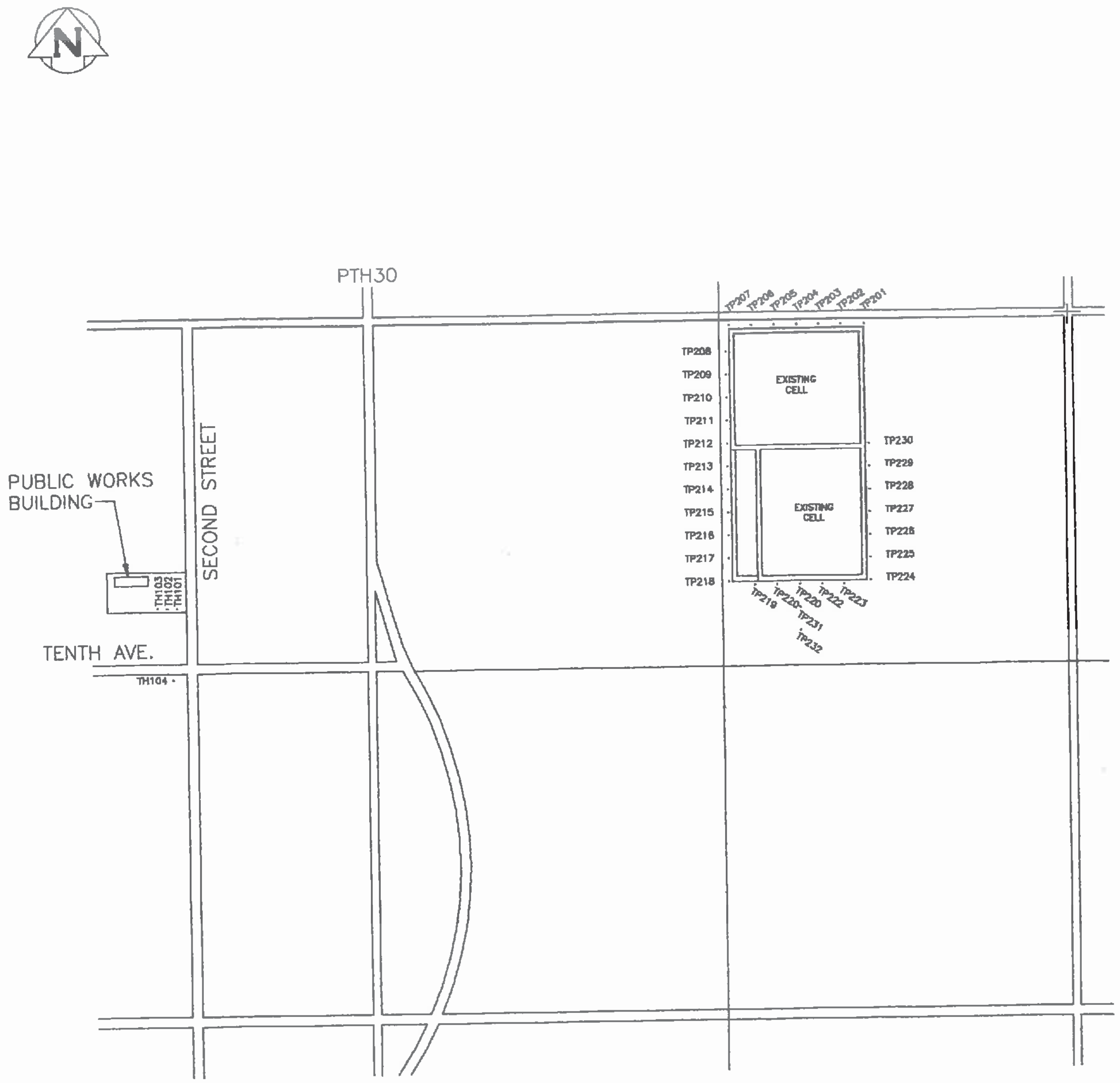
CLIENT: Canada TOWN OF ALTONA Manitoba

PROJECT: WASTEWATER STABILIZATION POND

DESCRIPTION: SOIL LOGS

DATE: JULY, 1992 SHEET OF DWG. NO. 110-06-02-D3

Poetker MacLaren Limited, August 1992, Test Holes



POETKER MacLAREN LIMITED

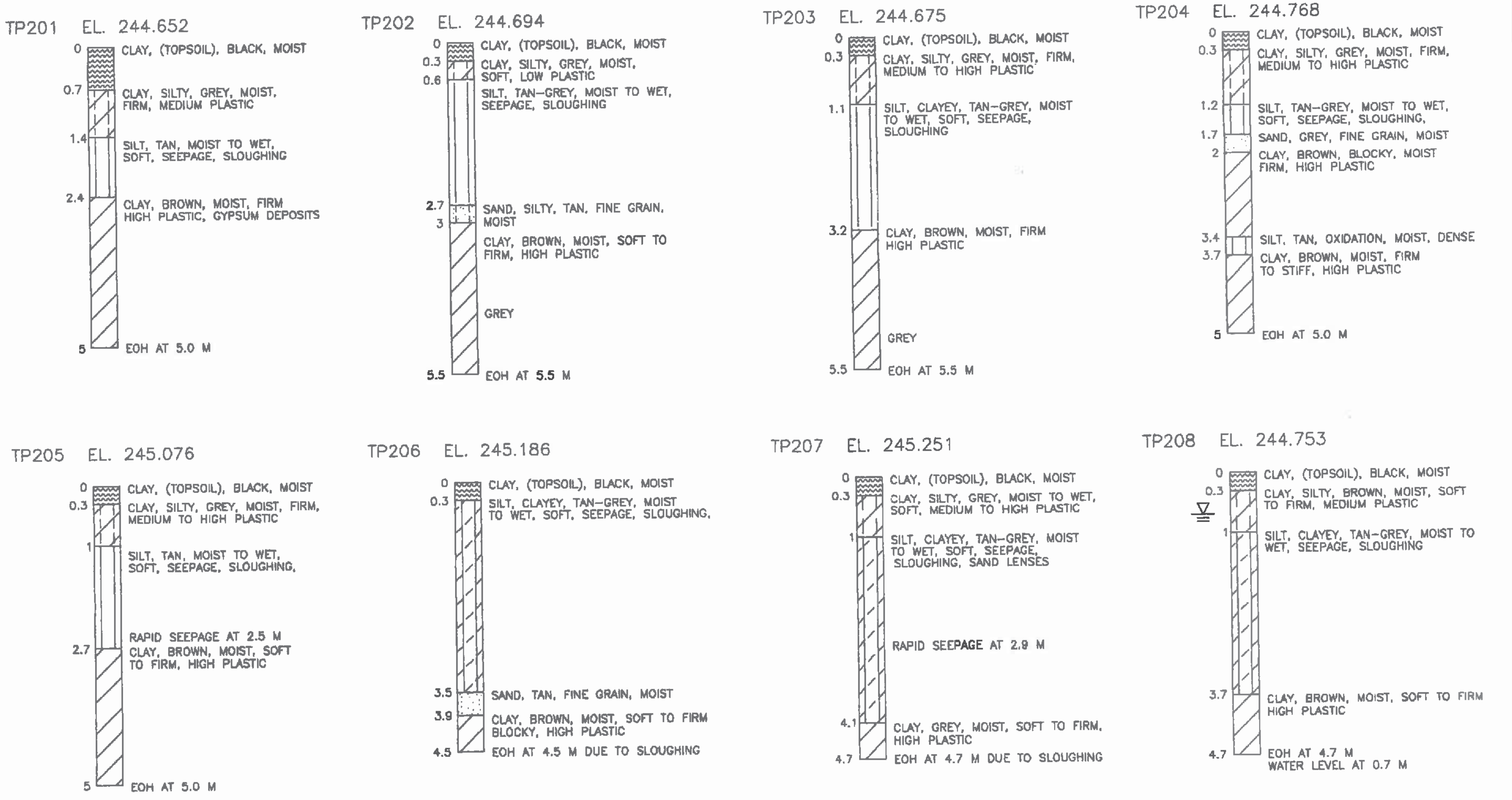
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY :	A.E.	DRAWN BY :	E.G./H.P.C.C.
CHECKED BY :	A.E.	APPROVED BY :	A.E.
DATE :	AUGUST 1992	DWG. NO. :	FIGURE 1

CLIENT : TOWN OF ALTONA
MANITOBA CANADA

PROJECT : SUBSURFACE INVESTIGATION
ALTONA MANITOBA

DESCRIPTION : SITE PLAN AND
TEST HOLE LOCATIONS



NOTE: TEST PIT DEPTHS ARE IN METRES.

POETKER MacLAREN LIMITED

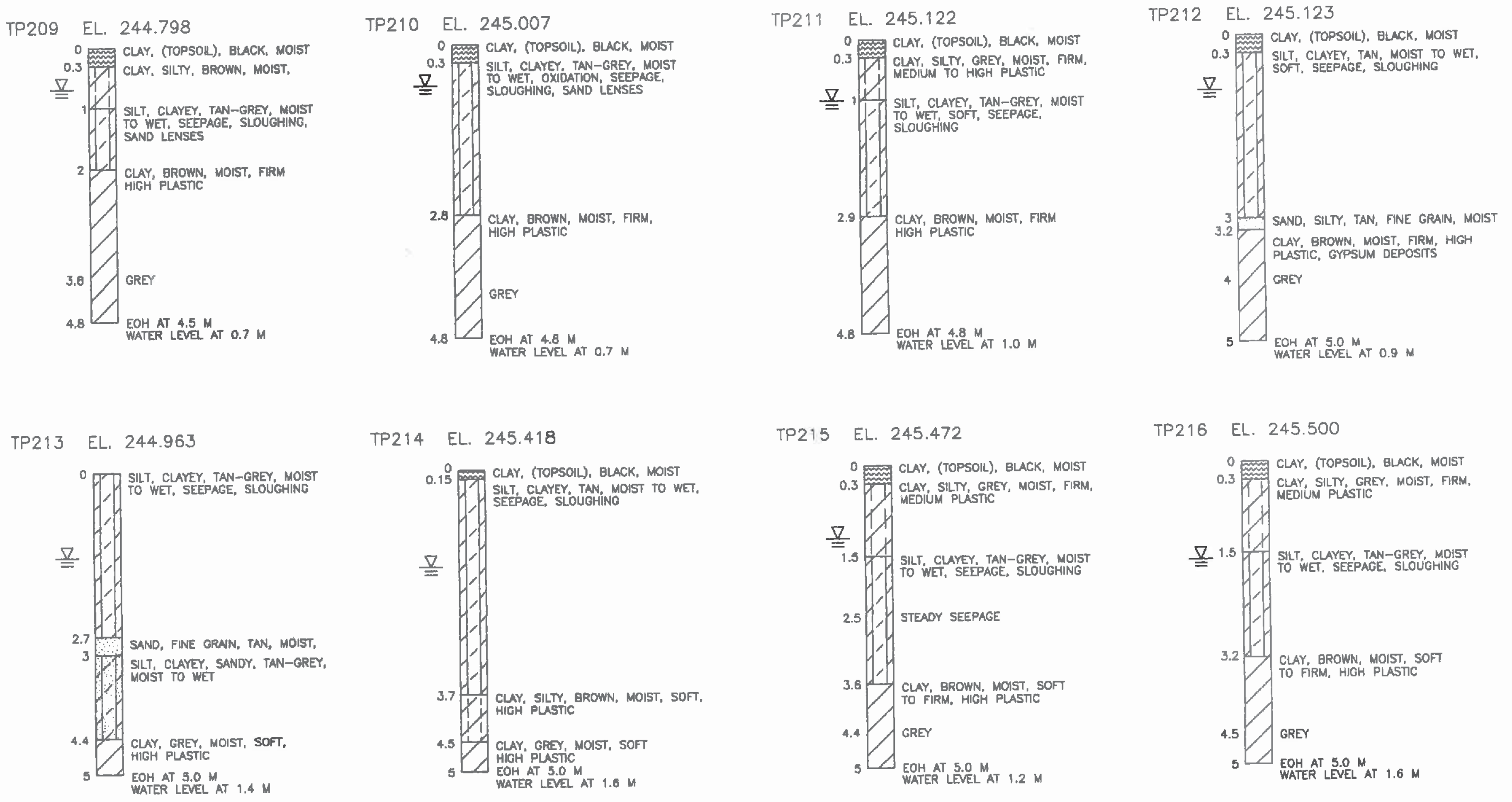
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY:	A.E.	DRAWN BY:	E.G.
CHECKED BY:	A.E.	APPROVED BY:	A.E.
DATE:	AUGUST 1892	DWG. NO.:	FIGURE 2

CLIENT: TOWN OF ALTONA
MANITOBA CANADA

PROJECT: WASTE WATER STABILIZATION POND
ALTONA MANITOBA

DESCRIPTION: SOIL LOGS



NOTE: TEST PIT DEPTHS ARE IN METRES.

POETKER MacLAREN LIMITED

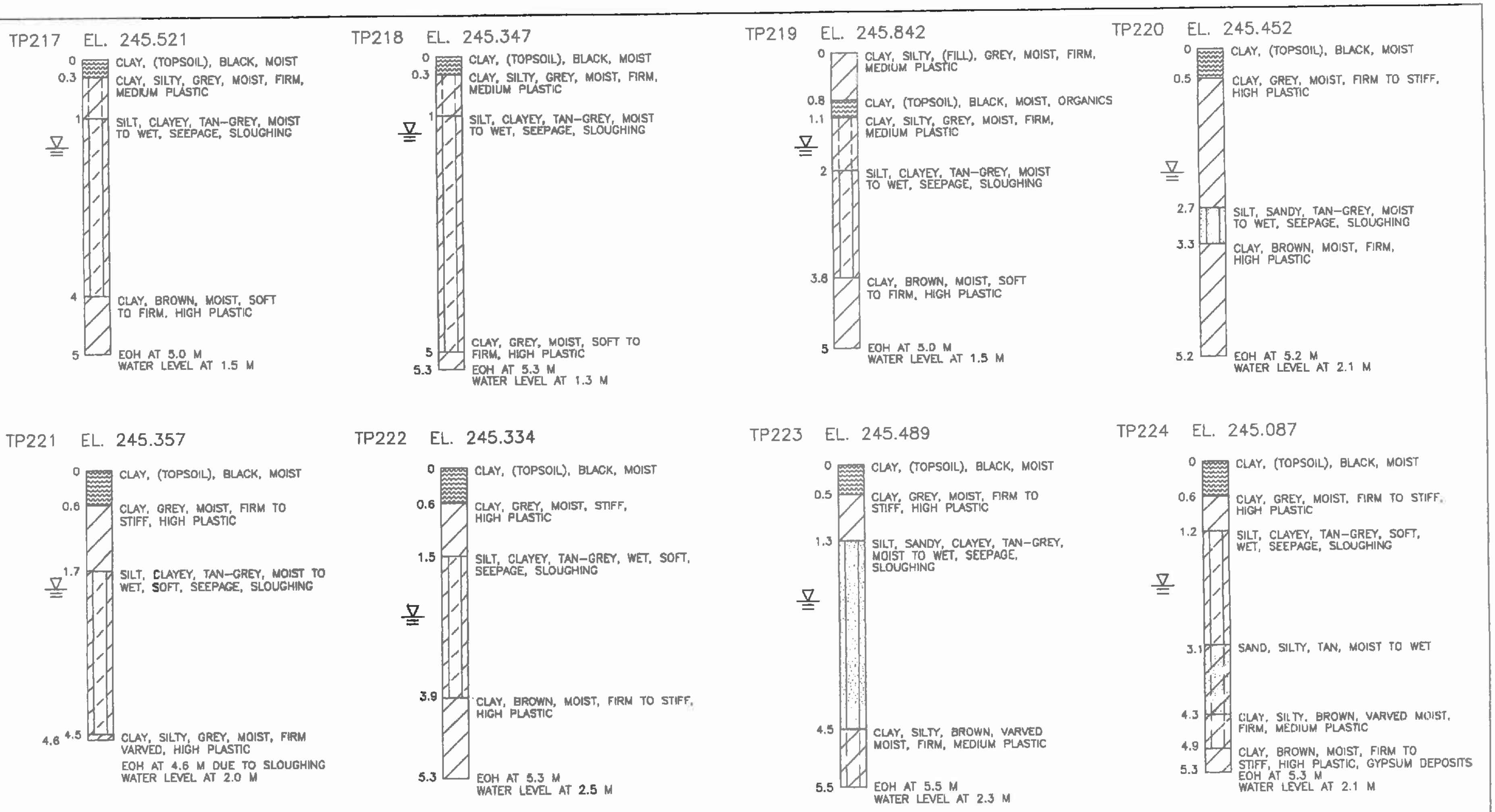
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY :	A.E.	DRAWN BY :	E.G.
CHECKED BY :	A.E.	APPROVED BY :	A.E.
DATE :	AUGUST 1992	DWG. NO. :	FIGURE 3

CLIENT :
TOWN OF ALTONA
MANITOBA CANADA

PROJECT :
WASTE WATER STABILIZATION POND
ALTONA MANITOBA

DESCRIPTION
SOIL LOGS



NOTE: TEST PIT DEPTHS ARE IN METRES.

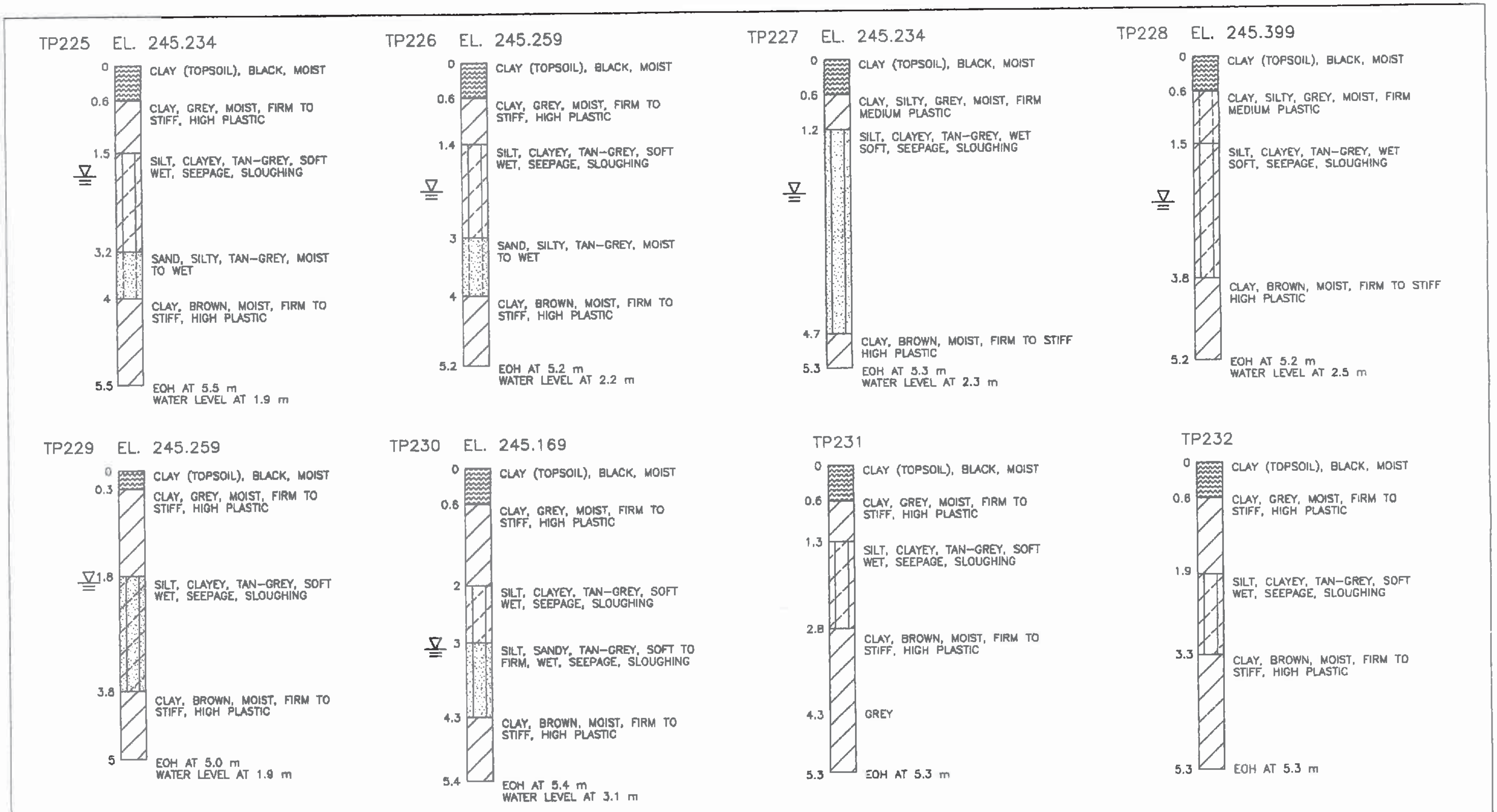
POETKER MacLAREN LIMITED
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY :	A.E.	DRAWN BY :	E.G.
CHECKED BY :	A.E.	APPROVED BY :	A.E.
DATE :	AUGUST 1992	DWG. NO. :	FIGURE 4

CLIENT : TOWN OF ALTONA
MANITOBA CANADA

PROJECT : WASTE WATER STABILIZATION POND
ALTONA MANITOBA

DESCRIPTION : SOIL LOGS



NOTE: TEST PIT DEPTHS ARE IN METRES.

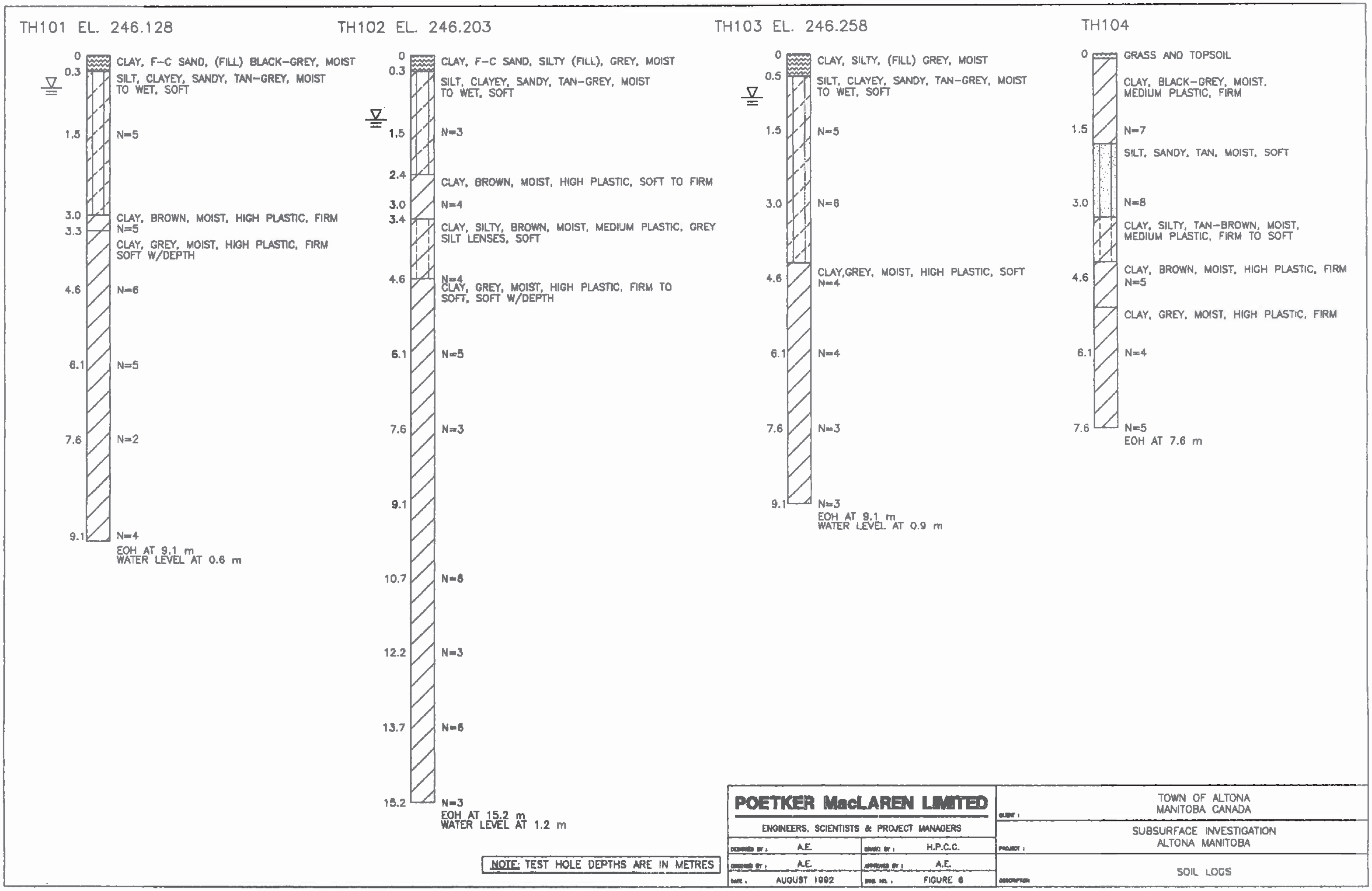
POETKER MacLAREN LIMITED
ENGINEERS, SCIENTISTS & PROJECT MANAGERS

DESIGNED BY:	A.E.	CHECKED BY:	H.P.C.C.
DRAWN BY:	A.E.	APPROVED BY:	A.E.
DATE:	AUGUST 1992	DWG. NO.:	FIGURE 5

CLIENT: TOWN OF ALTONA
MANITOBA CANADA

PROJECT: WASTE WATER STABILIZATION POND
ALTONA MANITOBA

DESCRIPTION: SOIL LOGS



NOTE: TEST HOLE DEPTHS ARE IN METRES

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DESIGNED BY:	A.E.	DRAWN BY:	H.P.C.C.
CHECKED BY:	A.E.	APPROVED BY:	A.E.
DATE:	AUGUST 1992	DWG. NO.:	FIGURE 6

CLIENT: TOWN OF ALTONA
MANITOBA CANADA

PROJECT: SUBSURFACE INVESTIGATION
ALTONA MANITOBA

DESCRIPTION: SOIL LOGS

Cochrane Engineering, January 2006, Test Holes

COCHRANE ENGINEERING

Project No: WE-04-124-00-WE

TH1

Project: Altona WWSP

Client: Town of Altona

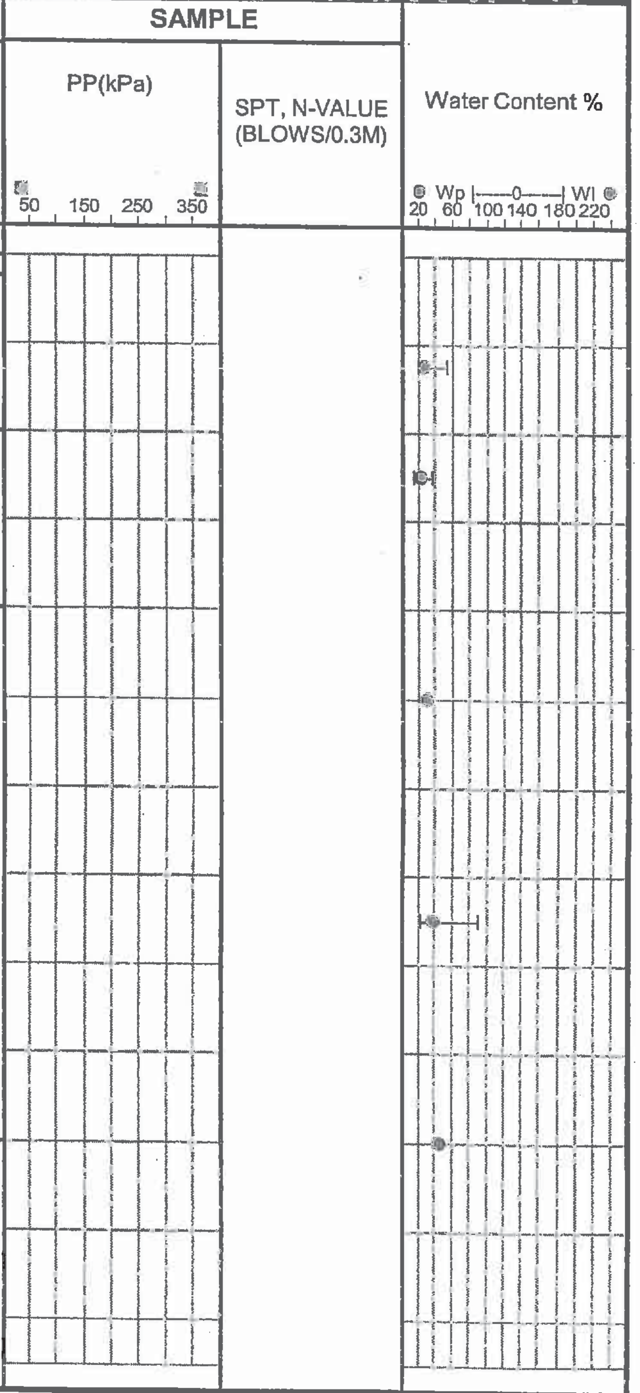
Location: NE 1/4 9-2-1 WPM

Enclosure:

Engineer: SSU

SUBSURFACE PROFILE

Depth (ft / m)	Description	Depth/Elev.,m
0 / 0	Ground Surface	100
0–1.5 ft	***TOPSOIL*** sandy, black, trace of rootlets, black	
1.5–4 ft	***CLAY*** grey-black, fissured; brown below 0.6m, stiff	98.9
4–8 ft	***CLAYEY SILT*** soft, tan-brown, moist to wet	97.7
8–20 ft	***CLAY*** stiff to firm, brown, fissured; firm below 2.7m; grey at 3.9m. TESTHOLE CAVED IN AT 2.1M AFTER DRILLING.	94
	End of Testhole	



Drill Method: S/S Auger

Drill Date: 01/17/06

Hole Size: 125mm

Cochrane Eng. Ltd.
#600-5 Donald Street
Winnipeg, MB.
R3L 2T4

Elevation:

Checked by: SSU

Sheet: 1 of 1

COCHRANE ENGINEERING

Project No: WE-04-124-00-WE

TH2

Project: Altona WWSP

Client: Town of Altona

Location: NE 1/4 9-2-1 WPM

Enclosure:

Engineer: SSU

SUBSURFACE PROFILE				SAMPLE		
Depth ft m	Symbol	Description	Depth/Elev.,m	PP(kPa) 50 150 250 350	SPT, N-VALUE (BLOWS/0.3M)	Water Content % Wp ⊢—0—⊣ Wl 20 60 100 140 180 220
0		Ground Surface	100			
		TOPSOIL sandy, black, trace of rootlets, black				
		CLAY grey-biack, fissured	99.3			
		CLAYEY SILT soft, tan-brown, moist to wet	97.1			
		CLAY stiff to firm, brown, fissured; grey at 5.5m. TESTHOLE CAVED IN AT 1.8M AFTER DRILLING.	94			
		End of Testhole				

Drill Method: S/S Auger

Drill Date: 01/17/06

Hole Size: 125mm

Cochrane Eng. Ltd.
#600-5 Donald Street
Winnipeg, MB.
R3L 2T4

Elevation:

Checked by: SSU

Sheet: 1 of 1

AMEC, June 2014, Geotechnical Investigation

GEOTECHNICAL INVESTIGATION ALTONA WASTEWATER TREATMENT FACILITY (AWTF) UPGRADES ALTONA, MANITOBA

Submitted to:

J.R. Cousin Consultant Ltd.

91A Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1N4

Submitted by:

AMEC Environment & Infrastructure
A Division of AMEC Americas Limited

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R3Y 1N4
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24 June 2014

WX17367

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1.0 INTRODUCTION

At the request of Mr. Jason Cousin, P. Eng. of J.R. Cousin Consultants Ltd. (JRCC), AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), completed a geotechnical investigation for the proposed upgrades to the existing Altona Wastewater Treatment Facility (AWTF) located in Altona, Manitoba. The purpose of the geotechnical investigation was to verify the subsurface soil and groundwater conditions at the site in order to provide geotechnical recommendations for foundation design and construction for the aeration building, and to provide evaluation of the suitability of existing soils for use as clay liner material. Additionally, slope stability assessments of new dikes and future dike raises, including assessments of excavation slopes during construction of new cells and/or cut-off trenches were required. The scope of work for the project was outlined in AMEC's proposal number WPG2014.019, dated 24 January 2014. Authorization to proceed was received from Mr. Cousin on 14 February 2014.

This report summarizes the field and laboratory testing programs, describes the subsurface conditions encountered at the test hole locations, provides comment on the suitability of common fill for cell/dike construction, and presents the results of stability analyses for new cell and dike construction and future dike raises, and presents foundation recommendations for the proposed aeration building.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

The AWTF is located northeast of the Town of Altona, roughly 800 meters east of the intersection of PR201 and 14th Avenue. The site is bounded by 14th Avenue to the north, an un-named Mile Road to the east, and by farmland to the south and west. At the time of the geotechnical investigation, the site was occupied by the existing cells as illustrated in Figure 1.

Based on review of the test hole elevations collected by AMEC, prairie level within the footprint of the proposed works undulated between approximate elevations 243.7 m and 245.8 m. Currently the existing dykes have crests between elevations 246.5 m and 247.5 m, and side slopes of about 4H:1V.

2.2 Proposed Development

Based on information provided by JRCC AMEC understands the proposed AWTF upgrade would include the following new construction and modifications, as illustrated in Figure 1:

- Construction of a new secondary cell (Secondary Cell No. 5) at the northeast corner of the overall AWTF facility, with a cell floor elevation of 243.5m to 243.65 m; a top of dike elevation of 247.5 m; and a normal operating liquid level of 245.75 to 246.5 m.

- Construction of a new primary cell (Primary Cell No. 4) at the southwest corner of the overall AWTF facility, with a cell floor elevation of 242.3 m and a top of dike elevation of 247.3 to 247.5 m.
- Construction of a cut-off wall through the east dike of existing secondary cell No. 3.
- Construction of a cut-off wall around the perimeter of existing secondary cell No. 2.
- Raising of the south, east and west dykes of the existing secondary cell No. 2 from elevation 246.5 m to elevation 247.5 m.
- Lowering of the cell floor elevation of the existing secondary cell No. 2 from elevation 244.42 m to elevation 244.1 m.
- Construction of a new aeration building.

With respect to construction of the new cells, AMEC understands that cell construction was being directed at excavating to the proposed cell floor elevations, and re-using the excavated material for construction of the dikes, as appropriate based on soil conditions. Given anticipation of silt below the proposed cell floor elevations, to as deep as elevation 239 m (i.e. about 5 m below cell floor elevations); AMEC understands that the clay component (i.e. core and/or cut-off walls) of the dikes would be keyed into the highly plastic clay underlying the silt to provide containment meeting Manitoba Environment Regulations. In this regard, AMEC understood that the liner would comprise an in-situ liner composed of the highly plastic clay underlying the silt, and that containment through the silt would be provided by a clay keyway and/or cut-off wall.

Details of the proposed aeration building were not provided; however, consistent with similar cell upgrades, AMEC assumed that the aeration building will consist of a pre-engineered steel building constructed with a structural slab foundation. Details on building size and foundation loads were not provided.

3.0 GEOTECHNICAL INVESTIGATION PROGRAM

Prior to initiating drilling, AMEC notified public utility providers (i.e. Manitoba Hydro, MTS, Town of Altona, etc.) of the intent to drill in order to clear public utilities, and where required, met with said representatives on-site.

On 17 and 18 March 2014, AMEC supervised the drilling of a total of twenty test holes, and the excavation of a single test trench, at the approximate locations illustrated in Figure 1. UTM coordinates and grade elevations at each of the test holes were obtained by AMEC using a Trimble RTK GPS Unit. The holes were drilled using a track mounted Acker drill rig equipped with 125 mm diameter solid stem augers; operated by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba. The number and depth of the test holes and test trench was in keeping with the scope of work outlined in AMEC Proposal 2014.019.

During drilling and excavating, AMEC field personnel visually classified the soil stratigraphy within the boreholes in accordance with the Modified Unified Soil Classification System (MUSCS); as well as noted any observed seepage and/or sloughing conditions. Disturbed grab samples were collected at selected depths from the auger cuttings, while relatively undisturbed

Shelby tube samples were also collected at selected test holes and selected depths. The in-situ relative consistency of cohesive overburden was evaluated within the test holes using pocket penetrometer readings. The recorded pocket penetrometer readings are shown on the logs.

Upon completion of drilling, the depth to slough and groundwater level within each test hole was obtained after an elapsed time of about 10 minutes. Subsequently, the test holes were backfilled with bentonite to a minimum of 4 m below grade, with the remainder of the test hole backfill with auger cuttings to grade. Depths in which silt layers were found were fully backfilled with bentonite irrespective of their location within the soil stratigraphy.

All samples collected were sealed in the field and shipped to AMEC's Winnipeg laboratory for review by the project engineer and testing. A laboratory testing program was conducted on selected soil samples obtained from the test holes. The laboratory testing program consisted of moisture content determinations, four Atterberg Limits, four Particle Size Analyses by Hydrometer method, two unconfined compressive strength tests, two hydraulic conductivity tests completed on in-situ Shelby tube samples, and one proctor and hydraulic conductivity test completed on a remolded clay sample. The cell pressure, backpressure, and hydraulic gradients used in the hydraulic conductivity tests are summarized on the hydraulic conductivity test reports, and were selected in accordance with typical test procedures for Winnipeg clays and liner applications.

Detailed test hole logs summarizing the sampling, field testing, laboratory test results, and subsurface conditions encountered at the test hole locations are presented in Appendix A. Actual depths noted on the test hole logs may vary by ± 0.3 m from those recorded due to the method by which the soil cuttings are returned to the surface. Summaries of the terms and symbols used on the test hole log and of the Modified Unified Soil Classification System are also presented in Appendix A. Hydraulic conductivity test reports are presented in Appendix B. Particle Size Distribution curves and a copy of the moisture density relationship (Standard Proctor) are also provided in Appendix B.

4.0 SUBSURFACE CONDITIONS

4.1 Stratigraphy

Consistent with the regional geology and anticipated conditions, the stratigraphy at the test hole locations consisted of the following, in descending order from grade level:

- Clay Fill or Organic Clay
- Upper Weathered Clay with silt lenses/layers
- Silt / Clay and Silt
- Lower High Plastic Clay

Stick logs illustrating the stratigraphy encountered within the footprint of the Secondary Cell No. 5 as a function of elevation are illustrated in Figure 2. Stick logs illustrating the stratigraphy encountered within the footprint of the Primary Cell No. 4 as a function of elevation are illustrated in Figure 3. For detailed descriptions, the test hole logs in Appendix A should be consulted.

4.2 Groundwater and Sloughing Conditions

Seepage and sloughing conditions were noted during drilling and excavating, and the depth to the accumulated water level within the test hole was measured about ten minutes after drilling at each test hole location. Installation of wells for long term monitoring of groundwater levels was not within the AMEC's scope of work.

Slight sloughing and seepage of the wet silt layer during drilling was observed at four test hole locations (TH02, TH08, TH15 and TH16). The depths to slough and groundwater noted upon auger drilling completion are summarized in Table 1.

Table 1: Slough and Groundwater Levels Upon Drilling Completion

Test hole	Test hole Elev. (m)	Termination Depth (m)	Depth to Slough (m)	Depth to Groundwater (m)
TH01	243.97	4.6	none observed	none observed
TH02	243.89	4.6	2.1	2.1
TH03	243.70	4.6	none observed	none observed
TH04	246.71	7.6	none observed	none observed
TH05	244.04	4.6	none observed	none observed
TH06	244.90	9.1	none observed	none observed
TH07	247.30	7.6	none observed	none observed
TH08	244.45	9.1	8.7	8.5
TH09	244.29	4.6	none observed	none observed
TH10	244.44	9.1	none observed	none observed
TH11	244.16	4.6	none observed	none observed
TH12	244.31	4.6	none observed	none observed
TH13	244.47	4.6	none observed	none observed
TH14	245.77	10.7	none observed	none observed
TH15	245.73	10.1	10	none observed
TH16	244.72	6.1	1.5	none observed
TH17	244.68	9.1	none observed	none observed
TH18	244.79	6.1	none observed	none observed
TH19	244.80	6.1	none observed	none observed
TH20	243.79	9.1	none observed	none observed
Trench1	244.33	4.3	none observed	none observed

It should be noted that only short-term seepage and sloughing conditions were observed and that groundwater levels should be expected to fluctuate annually, seasonally, or as a result of construction activity.

Overall, groundwater levels within the open boreholes at the site are expected to be governed by perched groundwater within the silt layer. AMEC recommends that the groundwater table be assumed at the top of the silt layer for design and construction considerations.

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 General Evaluation

The stratigraphy and soil conditions encountered within the test holes advanced at the site are considered typical of conditions within the Altona region. From a foundations perspective for the aeration building, soil conditions are considered suitable for the use of a variety of pile foundation alternatives including bored cast-in-place (CIP) concrete friction piles, driven steel piles, or driven pre-cast pre-stressed concrete piles (PPCPs). Selection of which pile foundation alternative to employ will depend on foundation loads, allocation of construction and performance risks, and cost estimates. Based on till not having been encountered within the depth of any of the test holes (i.e. above elevation 235 m), AMEC anticipated that CIP concrete friction piles would comprise the preferred foundation alternative. In this regard, foundation recommendations presented in this report have been limited to bored CIP concrete friction piles. Recommendations for alternate pile types can be provided upon request.

With respect to common fill and re-use of common fill as dike and liner material, the upper weathered clay is considered suitable for re-use; however, re-working of the material is recommended to remove the silt lenses frequently observed. The shallow low plastic silt is considered unsuitable for use as low permeable liner material, or as a construction material in general. Comparison of existing grades to the proposed cell floor elevations indicated very minimal excavation below existing grade is required to achieve the cell floor elevation of 244.1 m within the footprint of Secondary Cell No. 5, and excavation depths of 2.4 m to 3.5 m are required to achieve the cell floor elevation of 242.3 m within the footprint of new Primary Cell No. 4. An excavation depth of 0.32 m is required to lower of the cell floor elevation of the existing secondary cell No. 2 from elevation 244.42 m to elevation 244.1 m. Soil conditions within the existing cell are not known at this time.

The following sections provide discussion and recommendations as they pertain to: borrow material for cell/dike construction; dike stability; cut-off trench construction, bored concrete friction piles; downdrag and dragload on foundation extending through fill; frost design considerations; and foundation concrete.

5.2 Temporary Excavations

AMEC anticipates that temporary excavations will be required for construction of clay cut-off and/or keying of new dikes through the shallow silt and into the underlying high plastic clay. Furthermore, temporary excavations will be required for the installation of any pipelines into and out of the cells. Based on a cell floor elevation of 243.5 m to 243.65 m and a bottom of silt layer extending as deep as elevation 239.79 m within the boreholes advanced within the footprint Secondary Cell No. 5 (See Figure 2), excavation up to about 6 m below cell floor elevation around the perimeter of Secondary Cell No. 5 may be required for construction of the cut-off walls a minimum of 1 m into the underlying highly plastic clay. Based on a cell floor elevation of 242.3 m and a bottom of silt layer extending as deep as elevation 242.3 m within the footprint of new Primary Cell No. 4 (See Figure 3), excavation up to 1 m to 2 m below cell floor elevation around the perimeter of Primary Cell No. 4 may be required for construction of the cut-off walls a minimum of 1 m into the underlying highly plastic clay.

Soils conditions over the depth of the excavation will depend on the starting elevation for the excavation. Assuming initial grading to 0.3 m above the cell floor design elevation prior to excavating the trench for the cut-off walls, AMEC anticipated soil conditions over the depth of the excavation for the cut-off walls would consist of 0.3 m to 2.0 m of medium to high plastic clay underlain by low to medium plastic clay and silt, followed by highly plastic clay anticipated between elevations 240 m and 243 m. Generally, favourable base conditions are expected for excavations extending in the underlying highly plastic clay soils; however, sloughing and some influx of groundwater could be encountered and should be anticipated from the wet silt layers. Where encountered, it is anticipated that groundwater seepage could be handled by grading the base of the excavation to temporary sumps from which collected groundwater could be removed by pumping.

As a minimum, all excavations should comply with the requirements of Manitoba Workplace Safety and Health. Excavation works should be undertaken by an experienced contractor and should also be monitored by knowledgeable safety and geotechnical personnel. Workers should not be allowed into open excavations without proper protection and appropriate confined space training.

In accordance with Manitoba Workplace Safety and Health, vertical trench excavations within which workers are required to enter are permitted up to a maximum of 1.2 m below grade prior to requiring the use of shoring or other suitable support structure. Where excavations are required to extend to depths greater than 1.2 m below grade, or where instability within the upper 1.2 m of a vertical trench excavation is observed, either a sloped excavation or trench box supported excavation should be adopted. Given the susceptibility of the wet silt to sloughing, AMEC recommends that the sideslopes of short term excavations extending through silty clay and silt layers be cut back to inclinations no steeper than 1H:1V (Horizontal:Vertical), although flatter inclinations are likely to be required particularly where wet silt and/or active groundwater seepage is encountered, where considerable sloughing from the silt is observed, or where excavations remain open for a longer time period.

Construction planning should be directed at minimizing the length of time an excavation is left open and accordingly, work should be completed in small sections and backfilled as soon as practical. The stability of all excavations should be monitored on an ongoing basis and inspected regularly for signs of instability. If sloughing of the sidewalls is observed, the cut slope angle should be flattened until a stable angle of repose for the soil has been attained. Alternatively, if sloughing of the upper soils somewhere within the excavation depth is an issue, a benched excavation could be maintained at the interface of the unstable and stable soils to allow a collection area for sloughing of the upper soils. Where signs of instability (i.e. tension cracks, sloughing soils, toe bulging, etc) are detected, these conditions should be brought to the immediate attention of AMEC so that appropriate solutions to the problem areas can be determined.

Stockpiles of materials and excavated soil should be placed away from the excavation crest by a minimum distance equal to the depth of excavation. Similarly, wheel loads should be kept back at least 1 m from the crest of the excavation.

Backfill quality requirements and recommendation for placement and compaction for the clay cut-off walls and for construction of the clay keys beneath new dikes are presented in Section 5.3.

Backfill quality requirements for utility trenches should be assessed during design from a standpoint of pipe support, referring to the manufacturer’s recommendations for bedding and compaction below, adjacent and immediately above the pipes. Any requirements for imported trench backfill material should also be established. All trench backfill should be free of excessive organic content and of any deleterious material such as tree roots, litter, silt, etc.

Trench backfill overlying any underground utility installations should be compacted to a minimum 92 percent of SPMDD within landscaped areas and to a minimum of 95 percent of SPMMD within areas providing bearing support (such as for overlying dike fill) at soil moisture contents near or slightly above (i.e. 0 to +3 percent) the OMC to minimize potential for fill settlement. More stringent backfill criteria may be required for pipe support, and the pipe manufacturers specifications should be referenced in this regard.

5.3 Cell Construction Recommendations

5.3.1 Borrow Material

AMEC envisaged and understood that common fill resulting from excavation of the new cells, excavation of cut-off trenches and deepening of existing cells, would be used to construct the cut-off wall through existing dikes and the clay core of new dikes. Based on soil conditions observed at the borehole locations, common fill from the cell excavations will consist of silty clay with frequent silt and sand lenses, underlain by shallow wet silt.

For evaluation purposes, ‘suitable’ borrow for liner construction is defined as material that is both ‘satisfactory’ from a design performance requirement, and of ‘favourable’ constructability (i.e. material handling, placement, and workability).

In accordance with regulations for lagoon design and operation set forth by Manitoba Environment, ‘satisfactory’ core and liner materials for wastewater facilities shall be capable of meeting or exceeding a hydraulic conductivity criterion of $1x10^{-7}$ cm/s. The ability of materials encountered at the site to meet this performance requirement was assessed based on material index properties (i.e. Atterberg Limit and Particle Size Analysis), two hydraulic conductivity tests completed on in-situ Shelby Tube samples, and one hydraulic conductivity test completed on a remolded sample.

Recognizing that borrow materials can be wetted and/or dried to achieve the desired moisture content for placement and compaction, borrow material is sometimes not evaluated as unsuitable solely on the basis of excessive moisture content. Notwithstanding however, at some point above or below optimum moisture content, the effort it requires to moisture condition excessively dry or wet soils becomes impractical and uneconomical. In this regard, the favourability of borrow material was evaluated on the basis of constructability indicated by the liquidity index (LI) of the test samples given by the following expression:

$$LI = \frac{w - PL}{LL - PL}$$

Where: w = in-situ gravimetric moisture content (%)
PL = Plastic Limit (%)
LL = Liquid Limit (%)

The constructability of the material was characterized using the criteria in Table 2.

Table 2: Constructability Evaluation Criteria

Liquidity Index	Constructability Qualification
LI < 0.0	Marginal, Dry
0.0 <= LI <= 0.1	Suitable, Dry of OMC
0.1 <= LI < 0.2	Preferred, Near OMC
0.2 to 0.4	Suitable, Slightly Wet of OMC
0.4 <= LI < 0.6	Marginal, Very Moist
0.6 <= LI	Unsuitable, Wet

In-situ moisture content results, Atterberg Limit results, and the resulting characterization of constructability based on the liquidly index for each of the test samples are summarized in **Error! Reference source not found.**. Hydraulic conductivity test results are also summarized in **Error! Reference source not found.**.

Table 3: Atterberg Limit Results and Estimated Optimum Moisture Contents

Sample ID and Depth	In-situ Moisture Content (%)	Liquid Limit	Plastic Limit	Particle Size Analysis				Liquidity Index	Constructability of in-situ Moisture Condition	Hydraulic Conductivity (cm/s)
				Gravel (%)	Sand (%)	Silt (%)	Clay (%)			
TH02, 3.0 m	34.1	33	20	0.0	1.6	76.9	21.4	1.08	Unsuitable, Wet	n/a
TH03, 0.6 m	35.3	60	22	0.0	0.3	46.0	53.7	0.35	Suitable, Slightly Wet of OMC	n/a
TH05, 3.6 m	36.6	42	20	0.0	0.5	61.8	37.7	0.75	Unsuitable, Wet	7.33 x 10^{-8} (Shelby Tube)
TH08, 4.6 m	50.2	96	28	0.0	3.8	16.5	79.7	0.33	Suitable, Slightly Wet of OMC	n/a
TH15, 2.1 m	32.1	44	19	0.0	39.8	26.7	33.4	0.52	Marginal, Very Moist	n/a
TH17, 2.1 m	23.4	30	17	0.0	1.1	72.6	26.3	0.49	Marginal, Very Moist	8.61 x 10^{-7*} (Shelby Tube)
TH17, Samples 5 to 13	n/a	66	18	0.0	2.6	35.6	61.8	0.53	Marginal, Very Moist	4.64 x 10^{-9} (Remolded to 100% SPMDD**)

* In-situ test sample does not meet hydraulic conductivity performance criteria of 1.0 x 10-7 cm/s.
** SPMDD = Standard Proctor Maximum Dry Density

Based on evaluation of the results, ‘suitable’ clay borrow meeting the performance criterion of $1.0x10^{-7}$ cm/s shall have a liquid limit of 30 percent or higher, and a clay fraction of 30 percent or greater. In this regard, ‘silt’ and ‘clay and silt’ layers noted on the test hole logs are not recommended as material capable of meeting the performance criterion for construction of the clay cut-off walls; however, depending on moisture condition and drying requirements, may be suitable for re-use as berm material. Where silt varves are noted within the clay, such as was the observed condition for the hydraulic conductivity test completed on TH17 at 2.1 m below grade, the clay is considered capable of meeting the performance criterion when remolded to remove the varves. Although the remold test samples was remolded to 100% of SPMDD, AMEC anticipates the sample will meet the performance criterion at a minimum compaction specification of 95% of SPMDD.

It is anticipated that with the exception of drying of near surface borrow (i.e. within the upper 0.5 to 1.0 m), nearly all excavated material (common fill) will be above optimum moisture content and may require drying prior to placement and compaction. Regarding drying, moisture contents can be reduced by as much as 3 to 5 percent in a day during optimum drying conditions, generally by excavating, spreading and disking. An alternative measure may be to blend clay with higher than optimum moisture contents with drier material; however, significant volumes of material dry of optimum was not encountered at the test hole locations.

5.3.2 General Subgrade Preparation and Dike Construction

The following is a list of general geotechnical recommendations for cell construction and construction of new dikes:

1. All topsoil/organic clay should be stripped from within the proposed cell footprint, including the new dike alignments. Organics can be stockpiled and used for as dressing and for vegetation along the surface of dike slopes.
2. The cell base should be further excavated to the design subgrade elevation, maintaining the existing sidelopes of adjacent existing dikes (i.e. at slopes of 4H:1V). Suitable excavated materials, consisting of medium to high plastic clay, should be separated into separate stockpiles and used for the liner and dike construction. Geotechnical personnel should be present at all times during borrow and placement to monitor the selection of suitable soils. Any poor quality materials such as wet silt, cobbles, boulders or tree roots; should be wasted.
3. Although AMEC understood that the silt layer would be left in place within the area of the cell floor, AMEC cautions that silt remaining at the surface upon excavation to rough grade elevation is likely to present challenges to constructability. Generally, wet silt such as that encountered at the site provides for unfavourable subgrade conditions for placement and compaction of overlying dike fill. If silt at the subgrade level precludes placement and compaction of the overlying fill, the silt should be subexcavated until a stable bearing condition is achieved for placement and compaction of the overlying fill.
4. The subgrade beneath the footprint of the dikes should be scarified and compacted to a minimum of 95 percent of the standard Proctor maximum dry density (SPMDD -

ASTM Method D-698). Excluding the material for the cut-off wall, the overlying dike fill should consist of ‘suitable’ medium to high plastic clay and silt placed in lifts that are compatible with the compaction equipment used, but typically using uniform compacted lifts 200 mm in thickness, and uniformly compacted to a minimum 95 percent of SPMDD. The ability of compaction equipment to uniformly compact lifts over 200 mm thick should be confirmed with a test strip program. All material must be placed at moisture contents ranging from zero percent to 3 percent wet of optimum moisture content.

5. Clay to construct the key and/or cut-off wall should consist of medium to high plastic clay meeting the hydraulic conductivity performance criteria of 1.0×10^{-7} cm/s when placed in accordance with the recommendations set forth in step 4. Recommendations for temporary excavation of the key/cut-off wall are provided in Section 0. Given the difficulty in placing clay fill within the trench excavation, it is imperative that moisture contents be close to optimum prior to placement, such that the target compaction criteria can be realistically met.
6. From a geotechnical perspective, the location of the clay cut-off wall has little impact on the long term performance and stability of the dikes given the fairly similar nature and strength characteristic of the clay cut-off material and the dike material. In this regard, the configuration of the clay cut-off wall may range from a cut-off wall as provided in the conceptual drawings provided by JRCC, to a surface blanket of adequate thickness with adequate erosion production to maintain minimum liner requirements. In this regard, the configuration and location of the cut-off shall be determined by JRCC with emphasis placed on constructability and mitigating impacts to existing berm stability.
7. In order to mitigate the risk of destabilization of the existing dike slopes, excavation and construction of the clay key/cut-off below cell floor elevation along the toe of the existing dikes should be staged in lengths not greater than 20 m and backfill should proceed immediately upon completion of excavation.
8. Clay subgrade and clay fill should be protected from frost and drying effects during construction and at all times prior to commissioning.
9. The dike crest should be wide enough to permit service vehicles to access the cell (3.0 to 4.0 m wide, minimum).
10. Perimeter dikes should be finished by using topsoil and seeding to mitigate erosion.

5.4 Dike Stability

5.4.1 Methodology

AMEC completed a series of slope stability analyses to assess dike slope requirements. The analyses were conducted using SLOPE/W, a limit equilibrium software package developed by Geo-Slope International.

Six cross-sections (Cross-Sections 1A, 1B, and 2 through 5) illustrating the generalized soil stratigraphy and proposed slope configurations are illustrated in Figure 4 through Figure 9. The top of dyke elevation, cell floor elevation, sideslope configuration, and normal liquid level for each of the cross-sections are summarized in Table 6. The cross-sections were developed from preliminary design sections of the proposed AWTF upgrades by JRCC, which presented AMEC with key information on existing and new cell floor elevations, dike crest elevations, maximum liquid levels, and preliminary slope configurations.

The generalized soil stratigraphy for the models was developed through interpolation of soil conditions and average elevations of each soil layer within AMEC’s test holes. AMEC further assumed that all fill used to construct the new dikes would consist of medium to high plastic clay. Drained and undrained soil properties for the slope stability analyses were selected based on AMEC’s previous experience with the soils in the vicinity of the site, and are summarized in Table 4. The selected values are considered to be representative of the soil types expected.

Table 4: Material Properties for Slope Stability Analyses

Material	Unit Weight (kN/m^3)	Drained Condition		Undrained Condition	
		Cohesion (kPa)	Internal friction angle (degrees)	Cohesion (kPa)	Internal friction angle (degrees)
Proposed Berm Fill	19.5	1	20	1	20
Existing Berm Fill	19.5	1	20	1	20
Cut-off Wall Clay Fill	19.5	1	20	$0.22\ \sigma'_v \geq 10$	0
Sand	18	0	30	0	30
Silt	18	0	20	0	20
Medium to High Plastic above Elev. 240.0 m	16.7	3	16	10	0
High Plastic below Elev. 240.0 m	17.3	3	12	$0.22\ \sigma'_v \geq 10$	0

With respect to factors of safety, a target factor of safety of 1.4 to 1.5 is considered appropriate for long term slope stability for both interior and exterior pond/dike slopes under the normal operating condition. A target factor of safety of 1.2 to 1.3 is considered appropriate for short term slope stability for both interior and exterior pond/dike slopes under both construction and extreme operating conditions. Two pond level and groundwater conditions were considered for the purpose of evaluating the stability of the internal face of the dike slopes under normal and extreme operating conditions:

1. Normal Operating Condition – Interior Cell Slopes – The normal operating condition for interior cell slopes for each of the proposed dikes was developed to represent final construction and operation of the adjacent ponds at maximum liquid levels given by 1 m below crest elevation. Steady state seepage analyses were completed to determine normal groundwater conditions through the dike.

2. Rapid Drawdown Condition – Interior Cell Slopes – The extreme operating condition for interior dikes was developed to represent dewatering of one of the cells. Given assumption of rapid drawdown and clay slopes, undrained conditions are expected to develop over the short term (i.e. where the dewatering rate is faster than the permeability of the dike material), and in this regard, undrained shear strength parameters were used to evaluate temporary stability. Transient seepage analyses were also completed to estimate groundwater drawdown through the dikes with time, and long term stability analysis for the drawdown condition were also completed using drained soil strength parameters and equilibrated steady state porewater pressures. In summary, stability analyses for rapid drawdown were completed for two soil stress and porewater cases as follows:

Case 1. Undrained Stability analysis completed using undrained soil strength parameters and a dewatered pond while maintaining porewater pressures and effective soil stresses consistent with long term operation of both ponds prior to dewatering (i.e. instantaneous dewatering); and

Case 2. Drained Stability analysis completed using drained soil strength parameters and equilibrated steady state porewater pressures and soil stresses.

With respect to construction stability, the configurations shown on the conceptual drawings provided by JRCC and duplicated in AMEC's slope stability cross-sections indicate vertical cut faces through existing dykes of between 2 m and 8 m in height. Such excavation configurations are routinely used in construction; however will not meet a minimum slope stability target of 1.2 to 1.3 commonly assumed for temporary construction conditions. The stability of vertical and steeply sloped excavations observed in construction in cohesive clay soil is temporary and is at maximum value immediately upon excavation at which time effective soil stress does not change and negative porepressure conditions develop in response to removal of soil. However, over the duration of the excavation, effective soils stress and the stability of the excavation decreases as porepressure conditions attempt to return to the pre-excavation condition. The time at which the excavation becomes unstable cannot accurately be predicted, and environmental effects have great impact on the duration of excavation stability. In this regard design and construction planning should be directed at limiting the extent and the duration of temporary excavations to as short as practical. Furthermore, these excavation configurations would only be a consideration where workers are not required to enter the excavation.

From a geotechnical perspective, the location of the clay cut-off wall has little impact on the long term performance and stability of the dikes given the fairly similar nature and strength characteristic of the clay cut-off material and the dike material. In this regard, the configuration of the clay cut-off wall may range from a cut-off wall as provided in the conceptual drawings provided by JRCC, to a surface blanket of adequate thickness with adequate erosion production to maintain minimum liner requirements. In this regard, the configuration and location of the cut-off shall be determined by JRCC with emphasis placed on constructability and mitigating impacts to existing berm stability. As a recommended minimum, excavation slopes shall not exceed an angle of repose of 1H:1V (Horizontal:Vertical), and the duration of an excavation shall not exceed one month.

5.4.2 Slope Stability Results

Slope Stability results for normal and rapid drawdown conditions for each of the six cross-sections are summarized in Table 5.

Table 5: Cross-Section Summary and Slope Stability Analysis Results

Model Description	Crest Elev.	Pond Floor Elev.	Proposed Sideslope Configuration	Normal Liquid Level	Factor of Safety	
					Normal Operation	Rapid Drawdown
Cross-Section1A Secondary Cell No. 5 – 3 m liquid depth	247.5	243.5	5H:1V	246.5	2.10	1.33
Cross-Section 1B Secondary Cell No. 5 – 2.1 m liquid depth	247.5	243.65	4H:1V	245.75	1.78	1.22
Cross-Section 2 Secondary Cell No. 2 – North Dike	247.5	244.1	4H:1V	246.5	2.06	1.34
Cross-Section 3 Secondary Cell No. 2 – West & South Dike	247.5	244.1	4H:1V	246.5	1.93	1.37
Cross-Section 4 Secondary Cell No. 2 – East Dike	247.5	244.1	4H:1V	246.5	1.93	1.50
Cross-Section 5 Primary Cell No. 4	247.5	242.3	5H:1V	246.5	1.75	1.43

5.4.3 Final Recommended Sideslope Configurations

Based on the slope stability results presented in Section 5.4.2, the following final slope configuration are considered acceptable as meeting recommended factor of safety targets for normal operating and rapid drawdown conditions:

- Interior slopes for the new secondary cell 5 should be no steeper than 4H:1V for a normal liquid operating elevation of 245.75 m, and 5H:1V for a normal liquid operating elevation of 246.50 m. This recommendation is applicable to dike raises and new dike construction, and is provided on the basis of the top of dike and cell floor elevations presented in Table 5.

- Interior slopes for the raising of existing secondary cell no. 2 should be no steeper than 4H:1V. This recommendation is provided on the basis of the top of dike, cell floor, and normal liquid operating elevations presented in Table 5.

- Interior slopes for the new primary cell 4 should be no steeper than 5H:1V. This recommendation is applicable to dike raises and new dike construction, and is provided on the basis of the top of dike, cell floor, and normal liquid operating elevations presented in Table 5.

- Exterior slopes for new perimeter dike construction for the new secondary cell 5 and the new primary cell 4 should be no steeper than 4H:1V.

5.5 Bored Concrete Piles

5.5.1 Axial Compressive Resistance – Bored Concrete Piles

Bored concrete piles may be designed as friction piles. The unfactored (ultimate) axial compressive resistance of a single, bored concrete pile may be determined using the unfactored unit shaft friction values outlined in Table 6.

Table 6: Unit Shaft Friction for Bored Concrete Friction Piles - ULS

Elevation[1] (m)	Assumed Soil Type2	Unfactored Unit Shaft Friction (kPa)
245.7 to X[3]	All	0
X to 240	Silt / Firm to Stiff Clay	45
240 to 235	Firm Clay	30

[1] Existing grade is approximately 245.7 m.
2 Based on evaluation of test holes TH14 and Th15 only, advanced at the footprint of the proposed aeration building.
[3] X = 1.5 m below slab/crawlspace grade in heated areas, or the depth of frost penetration in unheated areas, as recommended to account for possible movement of the soil away from the perimeter of the pile.

Based on the *2010 National Building Code of Canada* (NBCC 2010), a geotechnical resistance factor, Φ = 0.4 should be applied to the unfactored geotechnical compressive resistance of the pile to obtain the factored geotechnical resistance at the Ultimate Limit State (ULS) for compressive loading conditions. The following recommendations also apply to the design of bored cast-in-place concrete piles.

- The weight of the embedded portion of the pile may be neglected in the design.

- The pile embedment depth, pile diameter, steel reinforcement and concrete compressive strength should be determined by the structural engineer, as required, to provide sufficient resistance to the applied loads.
- For conventionally bored straight shaft piles, the minimum pile spacing should be at least three pile diameters in order to act as single piles.
- Frost design considerations are outlined in Section 5.7.
- Recommendations for uplift resistance calculations are provided in Section 5.5.2.
- A void space (minimum of 150 mm thick) should be constructed, using a compressible and biodegradable material, below all piles caps and to accommodate movements of the underlying soil.

Recommended procedures for the installation of conventionally bored, cast in-place concrete piles are:

- Wet soil conditions and slight sloughing of the shallow silt and silty clay layers were noted during drilling, in particular at test hole locations TH15 and TH16. Steel casing should be installed in the augured excavations to control caving and groundwater seepage so that piles are cast in clean, dry holes. The level of fresh concrete in the casing must be maintained above the caving or seepage zone as the casing is withdrawn, and should be sufficiently high to equilibrate pressures inside and exterior of the casing to prevent collapse or squeezing of the sidewall into the pile bore.
- All piles should be poured immediately after completion of drilling to reduce the potential for seepage and swelling or squeezing of the pile bore, as well as to mitigate stress relief which could negative impact pile settlement performance. Concrete should be poured in accordance with the latest edition of Canadian Standards Association A23.1 (Concrete Materials and Methods of Concrete Construction). Where required, dewatering of pile test holes should be managed using a bailing bucket or a submersible pump subject to actual field conditions.
- A qualified and experienced inspector should be on site during the entire period of pile installation. The inspector should keep complete and accurate records of the pile installations.

5.5.2 Tensile (Uplift) Resistance – Bored Concrete Piles

In the case of straight shaft friction piles, the uplift resistance of a single pile will be provided by the sustained downward load on the pile (if applicable) and shaft friction along the length of pile embedded below the depth of frost penetration. The unfactored (ultimate) uplift resistance of a friction pile can be determined using the unfactored unit shaft friction values outlined in Table 6.

Based on the *2010 National Building Code of Canada* (NBCC 2010), a geotechnical resistance factor, $\Phi = 0.3$ should be applied to the unfactored geotechnical tensile resistance of the pile to obtain the factored geotechnical resistance at the Ultimate Limit State (ULS) for tensile loading conditions.

5.5.3 Serviceability and Pile Settlement – Bored Concrete Piles

The settlement of a single pile depends on the applied load, strength-deformation properties of the foundation soils, load transfer mechanism, load distribution over the pile embedment depth, and the relative proportions of the load carried by shaft friction and end-bearing. A pile settlement limit value was not specified by the structural agent for use in developing geotechnical resistance limits for the serviceability limit state design criterion. Notwithstanding, assuming good workmanship, inclusive of good excavation, the predicted settlement of a bored friction pile at working loads equal to a maximum given by the factored shaft frictional resistance of the pile is 0.5 to 1.5 % of the shaft diameter plus the elastic shortening of the pile due to the compressive load acting on the pile.

5.5.4 Lateral Resistance (Single Pile)

Significant horizontal (or lateral) loading conditions requiring evaluation of lateral load resistance of piles is not anticipated. Consequently, recommendations pertaining to the lateral load resistance of piles are not provided here-in.

5.5.5 Pile Group Effects

Generally, piles will behave individually in compression (i.e. Group efficiency $\eta = 1.0$) when a minimum centre-to-centre spacing of 5 pile diameters is provided between adjacent piles. However, for circumstances in which piles are closely spaced and/or the piles are connected by a rigid pile cap forcing equal settlement behaviour at the pile heads, interaction between the piles will occur and should be considered in design.

The nominal (ultimate) bearing resistance of a pile group shall be taken as the lesser of: 1) the sum of the individual nominal resistances of each pile in the group; or 2) the nominal resistance of an equivalent pier consisting of the piles and the block of soil within the area bounded by the piles.

5.6 Downdrag, “Drag Load”, and Negative Shaft Friction

Construction of the dikes for the new primary aeration cells will result in fill thicknesses of about 2.5 m within and immediately adjacent to the foundation footprint of the proposed aeration building. Given the nature of the soils at the Site, the additional surcharge load imposed by the fill is expected to result in consolidation of the existing highly plastic clays underlying the proposed dikes. In this regard, the foundation (piles) will be subject to downdrag and/or ‘drag load’ conditions.

For clarity, the term downdrag refers to the downward settlement of a deep foundation unit due to settlement at the neutral plane of the pile, where the neutral plane may be defined as the point of zero relative movement between the soil and pile at the soil/pile interface. Contrarily, the term ‘drag load’ refers to the load (or the integration of negative shaft friction above the neutral plane) transferred to a deep foundation unit resulting from the downward movement of soil relative to the pile at the soil/pile interface. The terms are inversely related; that is the ‘drag load’ is at its maximum when the downdrag is at its minimum, and vice-versa. From a geotechnical perspective, downdrag is a settlement issue, and needs to be considered in evaluating the settlement performance of piles. Contrarily, the ‘drag load’ is a structural design issue, and needs be considered in evaluating the structural strength of piles.

With respect to ‘drag load’, the ‘drag-load’ induced on a pile is given by negative shaft friction integrated over the length of pile above the neutral plane. For cast-in-place concrete friction piles, the neutral plane may be taken as lying at a depth approximately equal to the lower third point of the pile embedment length. The negative shaft friction shall be taken as the unit shaft friction values outlined in Table 6, and a load factor of 1.25 should be applied to obtain the factored ‘drag’ load. As per the Canadian Foundation Engineering Manual (CFEM 2006), the resulting ‘drag load’ is additive to sustained (or permanent) loads only, and need not be included with live loads. In other words, ‘drag load’ and live load do not act simultaneously. In evaluating the structural strength of the piles, two loading conditions must be considered: a single load scenario consisting of the sum of ‘drag load’ and sustained loads (i.e. excludes transient live loads); and the load combination scenario of sustained load (excluding ‘drag load’) and transient live loads.

With respect to downdrag, the downdrag of a pile foundation is given by settlement at the neutral plane. Between the pile head and the neutral plane, settlement of the piled foundation at the pile head is due to axial shortening of the pile. Given AMEC understanding that the piles will extend through 2.5 m of new fill placed at the site, primary consolidation of highly plastic clay below the neutral plane could result in additional pile settlement of 40 mm to 90 mm above typical friction pile foundation settlement up to about 1.5 % of the pile diameter. This evaluation has been presented on the assumption of minimum 8 m long piles, and assumed soil consolidation parameters and changes in effective stress. Changes in effective stress below the neutral plane will depend on final fill configuration, and the location of the neutral plane will depend on foundation configuration and foundation loads. AMEC can review the final foundation configuration for potential downdrag upon request once a foundation configuration has been completed.

5.7 Frost Design Considerations

5.7.1 Frost Penetration Depth

The upper stratigraphy at the test hole locations, and across the site, is considered moderately to highly frost susceptible in the presence of water, and as such, frost effects should be considered for foundations or surface structures sensitive to movement. Based on historical temperature data for the Altona area, a design frost penetration, assuming cohesive soils from ground surface, may be taken as 2.4 m below final grade in unheated areas that will not have regular snow or vegetative ground cover. Where the structure is of sufficient size and where there is beneficial heat loss into the soil from the superstructure and/or foundations, the depth of frost penetration may be reduced along the perimeter of the structure. Alternatively, the depth of frost penetration (and thus frost effects) may potentially be reduced by installing insulation. AMEC can provide recommended insulation details for specific development conditions upon request.

5.7.2 Pile Foundations

Frost forces applied to pile foundations include adfreeze pressures acting along the pile shafts within the depth of frost penetration. If pile caps are used and extend beyond the perimeter of the underlying pile, then frost heave forces acting on the undersides of the pile caps, as well as any connecting supports (i.e. lateral tie between the piles) will also need to be considered.

5.7.2.1. Frost Heave

To reduce the potential of frost heave pressures, a void-forming product should be installed beneath the underside of the pile caps and any other structural element located within the depth of frost penetration. The recommended minimum thickness of the void should be 150 mm. Alternatively, a compressible material may be used in lieu of a void forming material, and the uplift pressures may be taken as the crushing strength of the compressible medium. It is recommended that a frost heave of 150 mm be assumed in determining the required thickness for the void-filler and the associated uplift pressures associated with the thickness used.

The finished grade adjacent to each pile cap or grade beam should be capped with well compacted clay and sloped away so that the surface runoff is not allowed to infiltrate and collect in the void space or in the compressible medium.

5.7.2.2. Adfreeze Stresses

Resistance to adfreeze and frost heave forces will be provided by the sustained vertical loads on the foundation, the buoyant weight of the foundation and dead weight of the structure, and the soil uplift resistance component provided by the length of the pile extending below the depth of frost penetration. In the case of straight shaft piles supporting lightly–loaded unheated facilities, the piles should be embedded a minimum of 8 m below final grade in order to provide sufficient frictional resistance against potential adfreeze stresses. For heated structures which allow beneficial heat loss into the soil, minimum pile lengths of 6 m are recommended. Where piles for heated structures are exposed to unheated conditions during construction, they should be designed for the unheated condition.

Adfreeze stresses along the sides of pile caps and buried substructures can be reduced by the installation of a ‘bond-break’ or ‘friction reducer’ within the zone of frost penetration. Friction reducers could consist of a system of poly wrapped sono-tubes. A smooth geosynthetic liner material, fixed to the shaft of the pile or to the sides of the pile cap would also be a suitable bond-break.

5.8 Foundation Concrete

Where concrete elements outlined in this report and all other concrete in contact with the local soil will be subjected in service to weathering, sulphate attack, a corrosive environment, or saturated conditions, the concrete should be designed, specified, and constructed in accordance with concrete exposure classifications outlined in the latest edition of CSA standard A23.1, Concrete Materials and Methods of Concrete Construction. In addition, all concrete must be supplied in accordance with current Manitoba and National Building Code requirements.

Based on significant data gathered through previous work in the Altona area, water soluble sulphate concentrations in the soil are typically in the range of 0.2% to 2.0%. As such, the degree of sulphate exposure at the site may be considered as 'severe' in accordance with current CSA standards, and the use of sulphate resistance cement (Type HS or HSb) is recommended for concrete in contact with the local soil. Furthermore, air entrainment should be incorporated into any concrete elements that are exposed to freeze-thaw to enhance its durability.

It should be recognized that there may be structural and other considerations, which may necessitate additional requirements for subsurface concrete mix design.

5.9 Construction Monitoring and Testing

All engineering design recommendations presented in this report are based on the assumption that an adequate level of testing and monitoring will be provided during construction and that all construction will be carried out by a suitably qualified contractor experienced in foundation and earthworks construction. An adequate level of testing and monitoring is considered to be:

- for earthworks: full-time monitoring and compaction testing.
- for deep foundations: design review and full time monitoring during construction.
- for concrete construction: testing of plastic and hardened concrete in accordance with the latest editions of CSA A23.1 and A23.2; and review of concrete supplier's mix designs for conformance with prescribed and/or performance concrete specifications.

AMEC requests the opportunity to review the design drawings, and the installation of the foundations, to confirm that the geotechnical recommendations have been correctly interpreted. AMEC would be pleased to provide any further information that may be needed during design and to advise on the geotechnical aspects of specifications for inclusion in contract documents.

6.0 CLOSURE

The findings and recommendations presented in this report were based on geotechnical evaluation of the subsurface conditions observed during the site investigation described in this report. If conditions other than those reported in this report are noted during subsequent phases of the project, or if the assumptions stated herein are not in keeping with the design, this office should be notified immediately in order that the recommendations can be verified and revised as required. Recommendations presented herein may not be valid if an adequate level of inspection is not provided during construction, or if relevant building code requirements are not met.

The site investigation conducted and described in this report was for the sole purpose of identifying geotechnical conditions at the project Site. Although no environmental issues were identified during the fieldwork, this does not indicate that no such issues exist. If the owner or other parties have any concern regarding the presence of environmental issues, then an appropriate level environmental assessment should be conducted.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially in near surface soil conditions. A contingency should always be included in any construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

This report has been prepared for the exclusive use of J.R. Cousin Consultants Ltd., and their agents, for specific application to the project described in this report. The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and written advice from AMEC. Any use that a third party makes of this report, or any reliance or decisions made based on this report, are the responsibility of those parties. AMEC accepts no responsibility for damages suffered by a third party as a result of decisions made or actions based on this report.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, either expressed or implied, is made.

Respectfully submitted,
AMEC Environment & Infrastructure,
A Division of AMEC Americas Limited

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No. 555 Date: 24 June 2014

Reviewed by:

Harley Pankratz, P.Eng.
Vice President, Eastern Prairies/Northern Alberta

FIGURES

P: \JOBS\17300'S\17360'S\17367 ALTONA WTF UPGRADES\DRAWINGS\WX17367_MASTER.DWG

NOTE:

- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENTAL & INFRASTRUCTURE REPORT No. ___ DATED ___.

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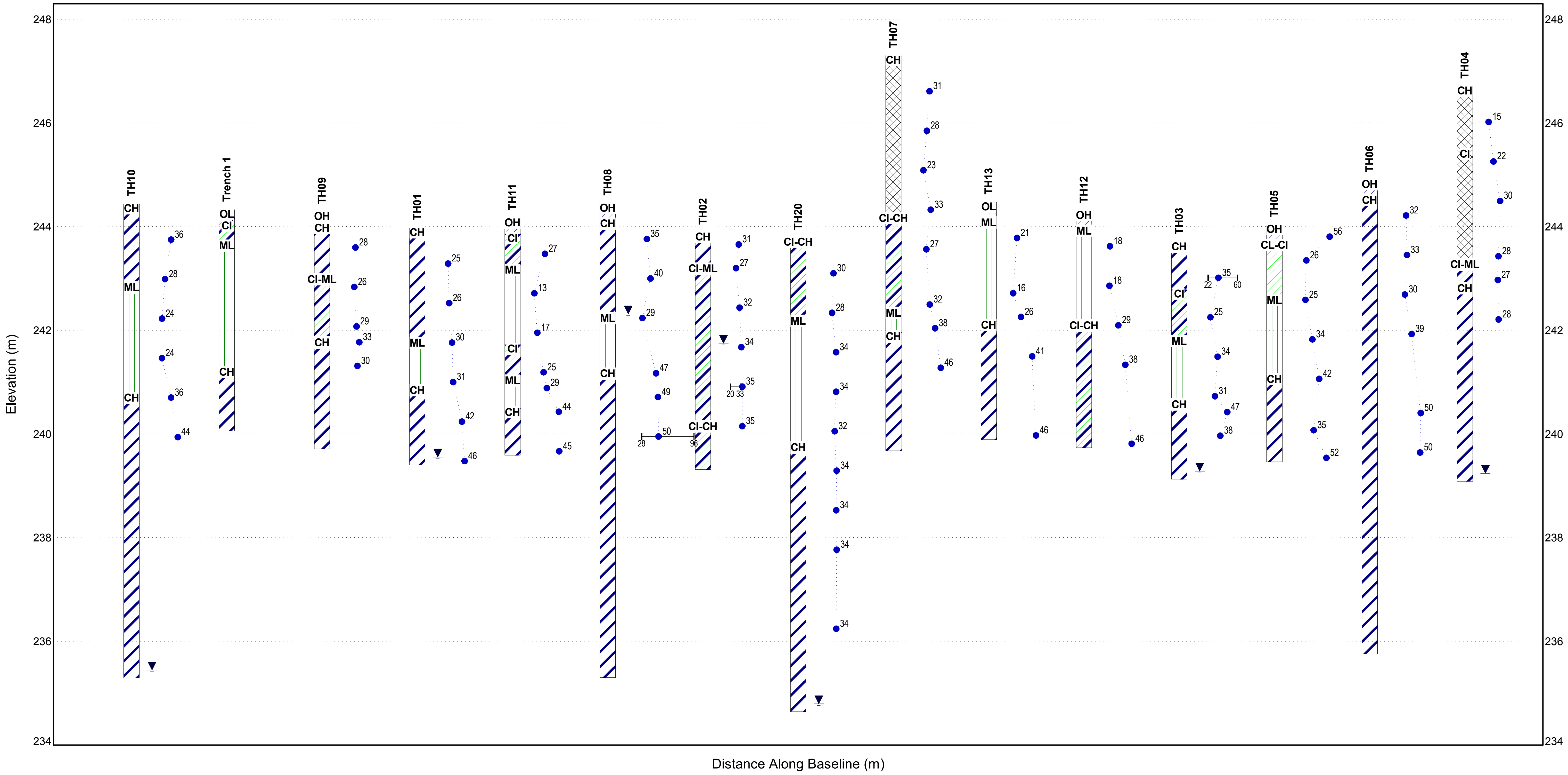
DWN BY:	MD
CHK'D BY:	KJ
DATUM:	NAD83
PROJECTION:	UTM Zone 14 U
SCALE:	AS SHOWN

GEOTECHNICAL INVESTIGATION
PROPOSED UPGRADES TO ALTONA
WASTEWATER TREATMENT FACILITY
ALTONA, MANITOBA

TEST HOLE LOCATION PLAN

DATE:	MAY 2014
PROJECT NO:	WX17367
REV. NO.:	A
FIGURE NO:	FIGURE 1



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CHK'D BY:	KWJ
DATUM:	N/A
PROJECTION:	N/A
SCALE:	NTS

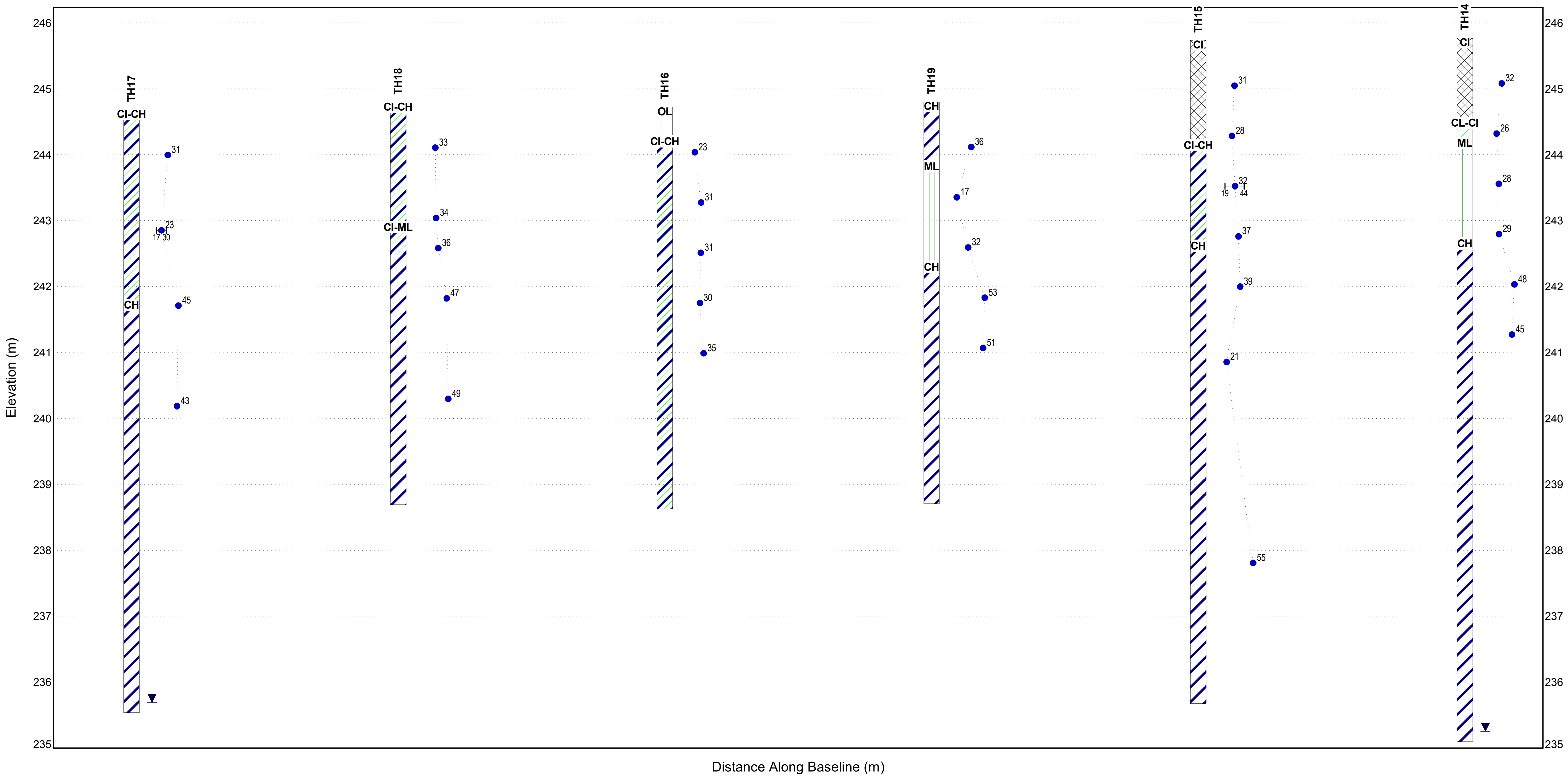
PROJECT:

Altona Wastewater Treatment Facility Upgrades

TITLE:

Stratigraphy Within the Footprint of Secondary Cell No. 5

DATE:	14/05/2014
PROJECT No.:	WX17367.1000
REVISION No.:	0
FIGURE No.:	2



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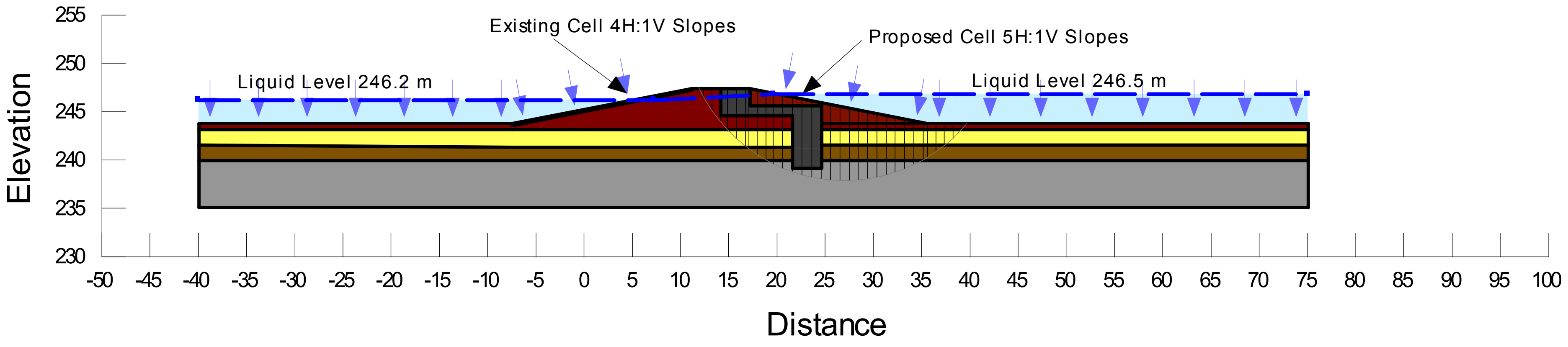
CHK'D BY: KWJ
DATUM: N/A
PROJECTION: N/A
SCALE: NTS

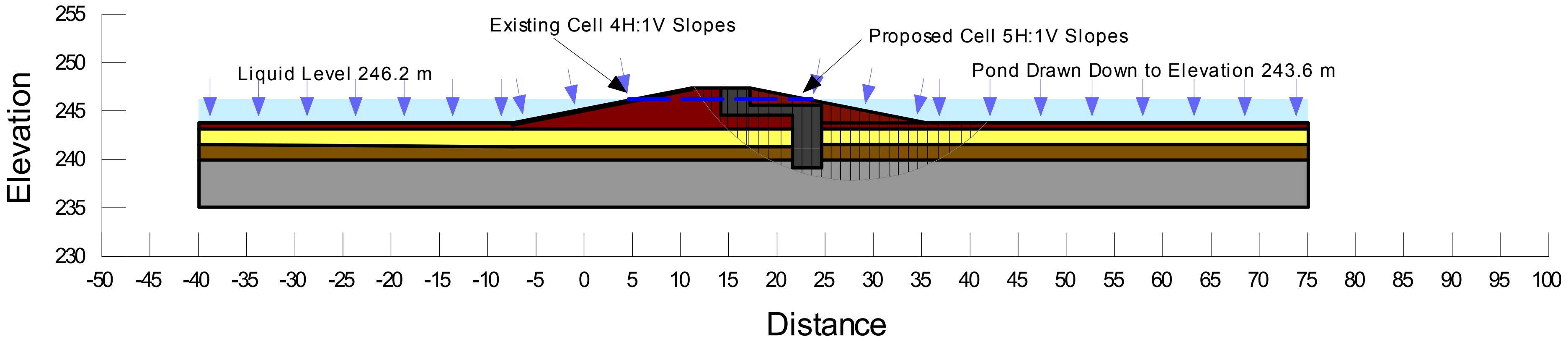
PROJECT: Altona Wastewater Treatment Facility Upgrades

TITLE: Stratigraphy Within Footprint of Primary Cell No. 4

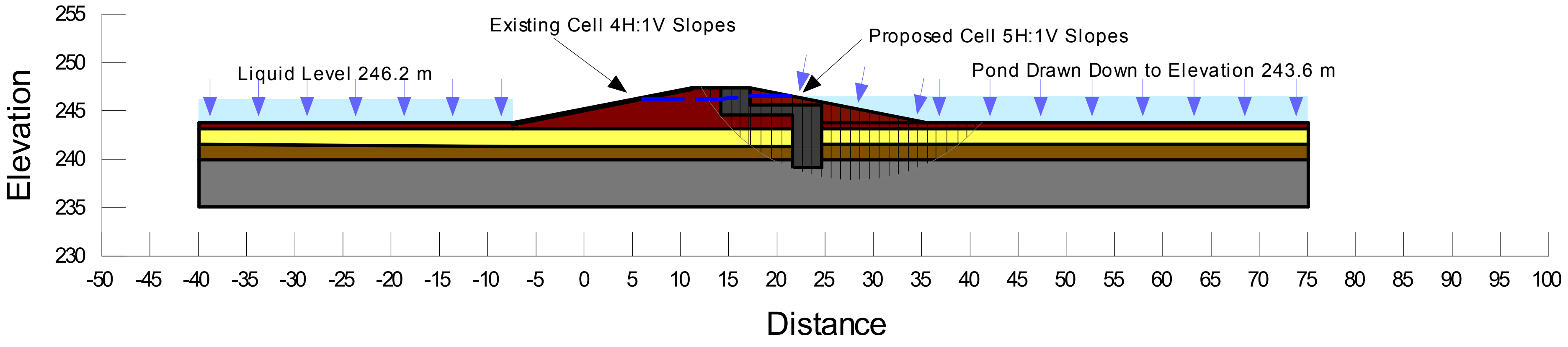
DATE: 14/05/2014
PROJECT No.: WX17367.1000
REVISION No.: 0
FIGURE No.: 3



A) Normal Operating Condition (Both Ponds Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 2.10



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.33



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.88

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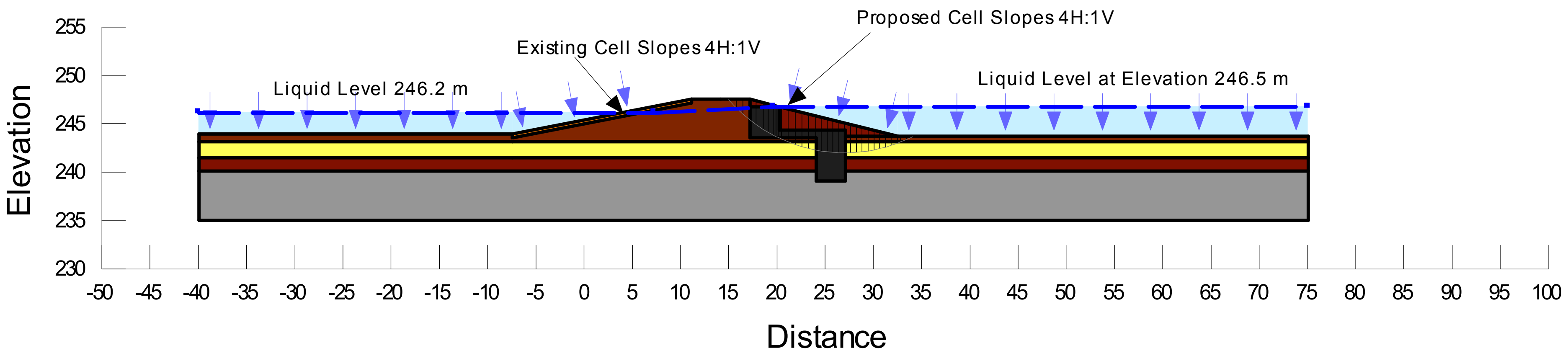
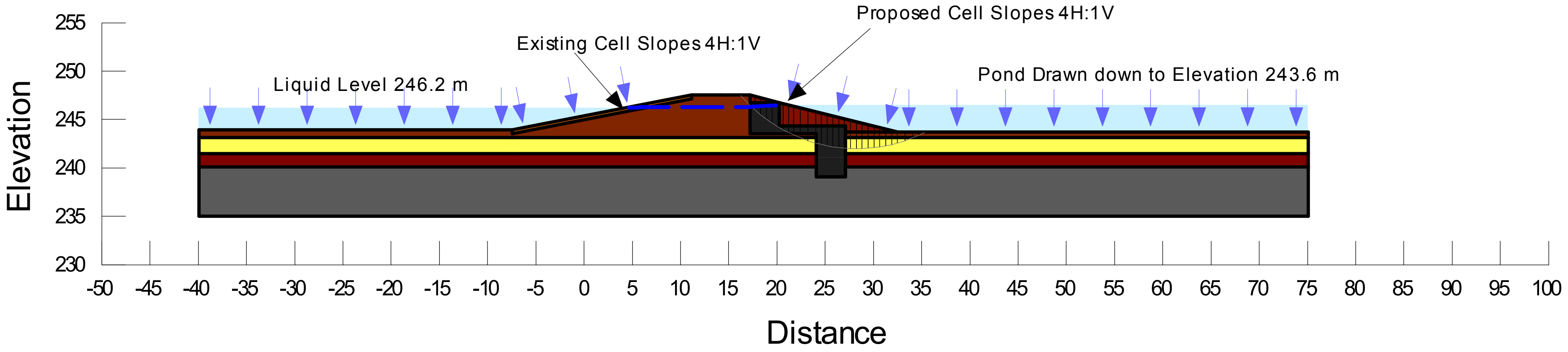
POND SLOPE STABILITY
CROSS SECTION #1A
(PROPOSED SECONDARY CELL NO. 5,
3.0M LIQUID DEPTH)

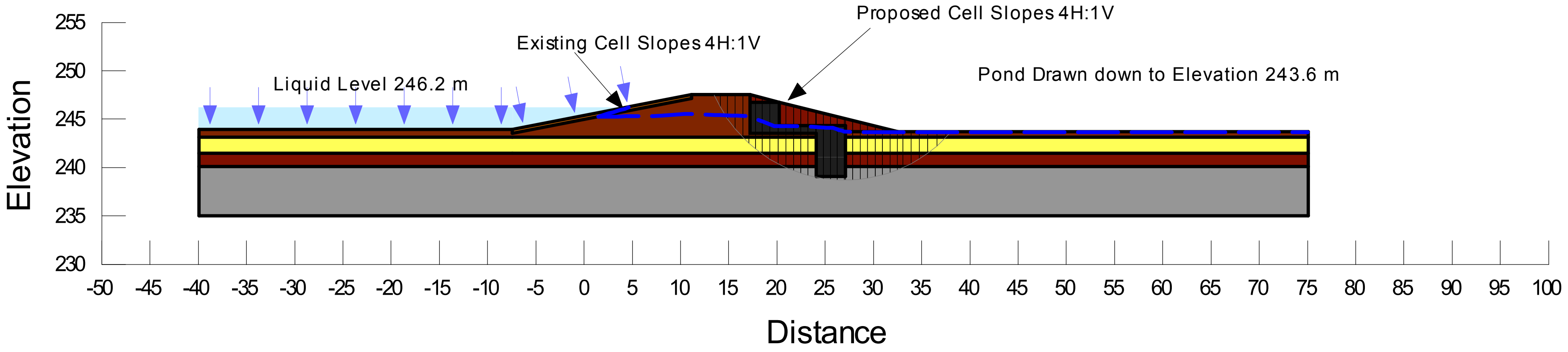
Drawn by: KWJ	Scale: As Shown	Date:14 May 2014	Proj. No.: WX17367	Figure: 4	**ALTONA WTF LAGOON UPDRAGES** **ALTONA, MANITOBA**



A) Normal Operating Condition (Both Ponds Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 1.78



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.42



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.22

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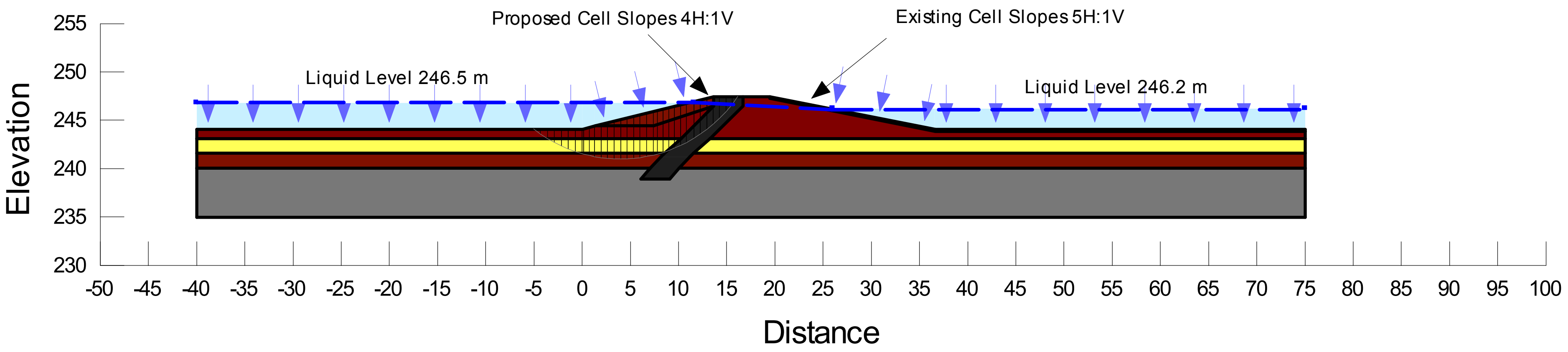
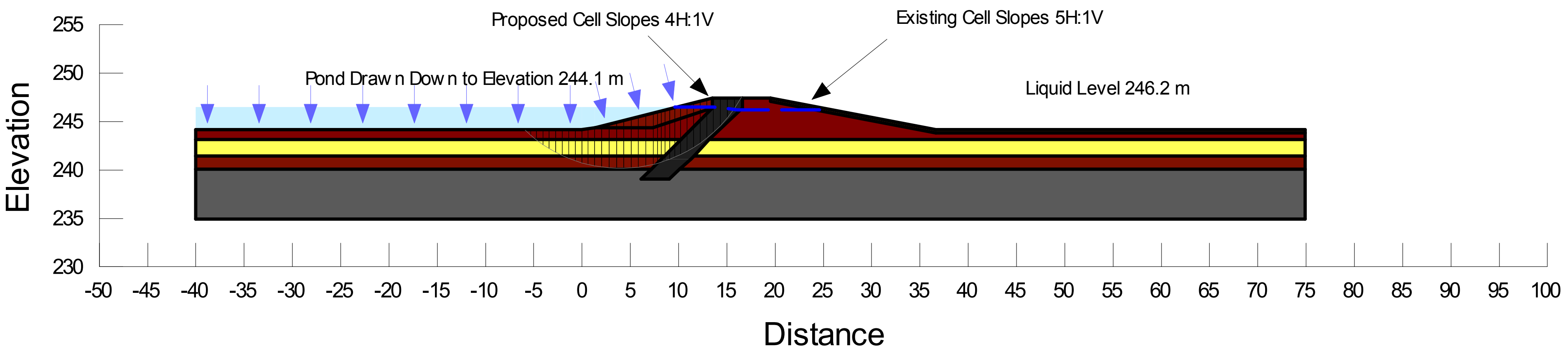
POND SLOPE STABILITY
CROSS SECTION #1B
(PROPOSED SECONDARY CELL
NO.1B, LIQUID LEVEL 2.1M)

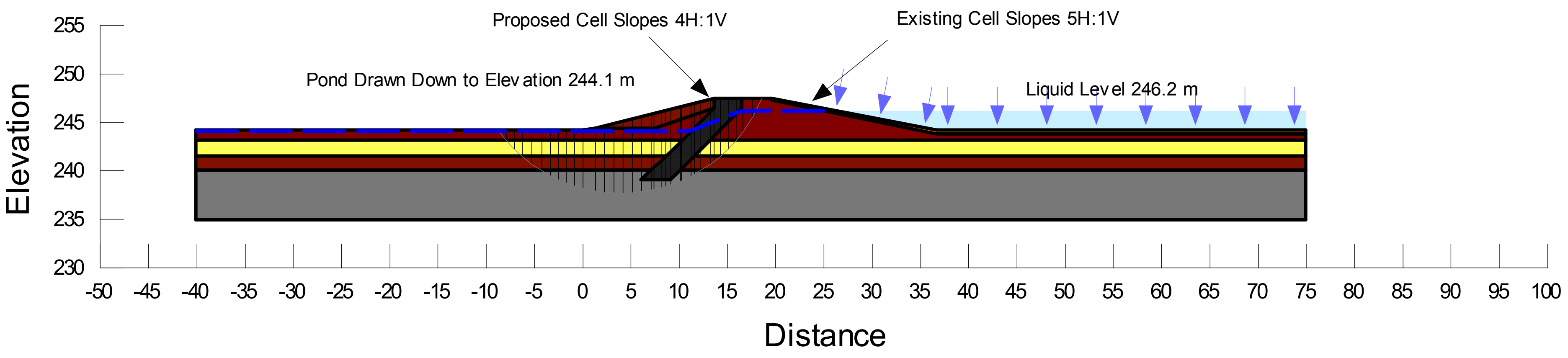
Drawn by: KWJ	Scale: As Shown	Date:14 May 2014	Proj. No.: WX17367	Figure: 5	**ALTONA WTF LAGOON UPDRAGES** **ALTONA, MANITOBA**



A) Normal Operating Condition (Both Ponds Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 2.06



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.58



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.34

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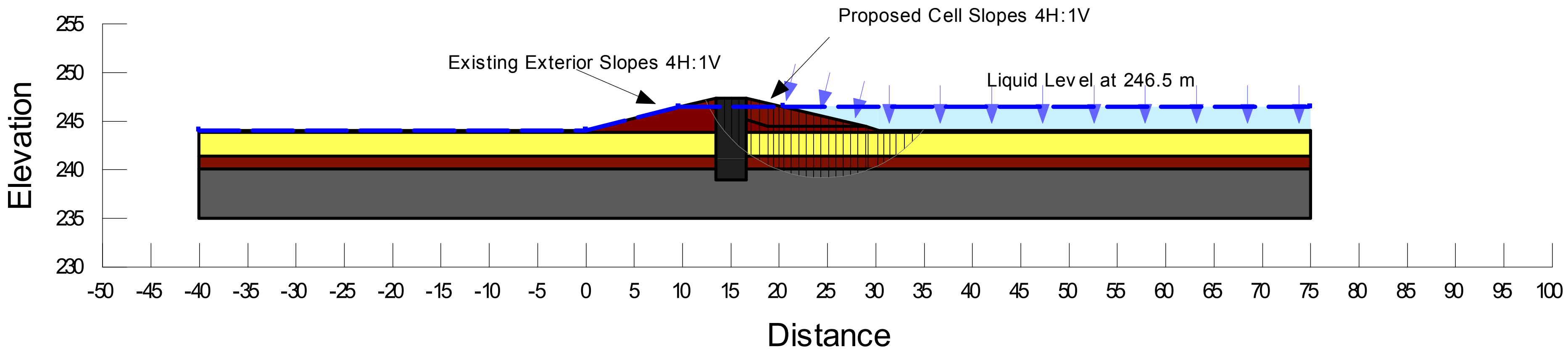
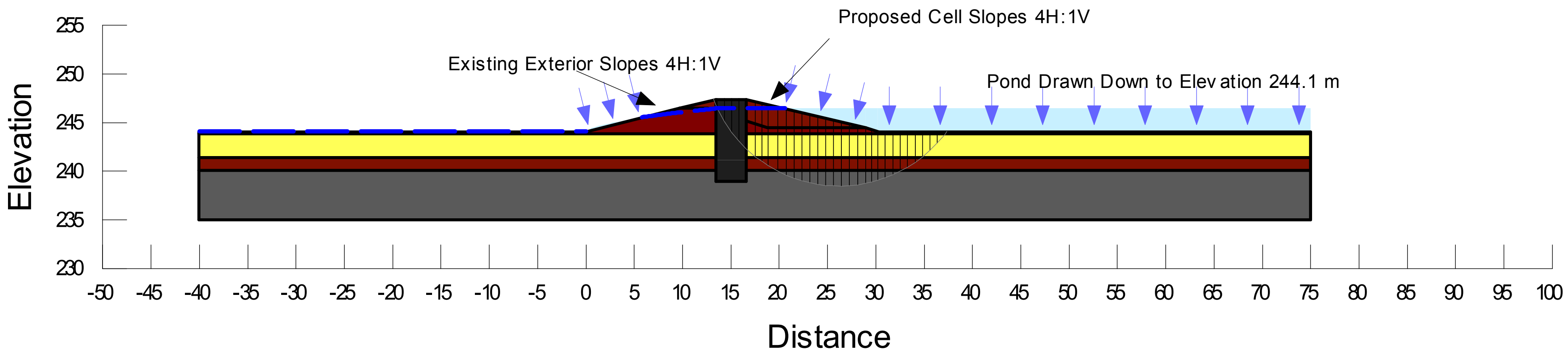
POND SLOPE STABILITY
CROSS SECTION #2
(PROPOSED SECONDARY CELL NO.2,
NORTH DYKE)

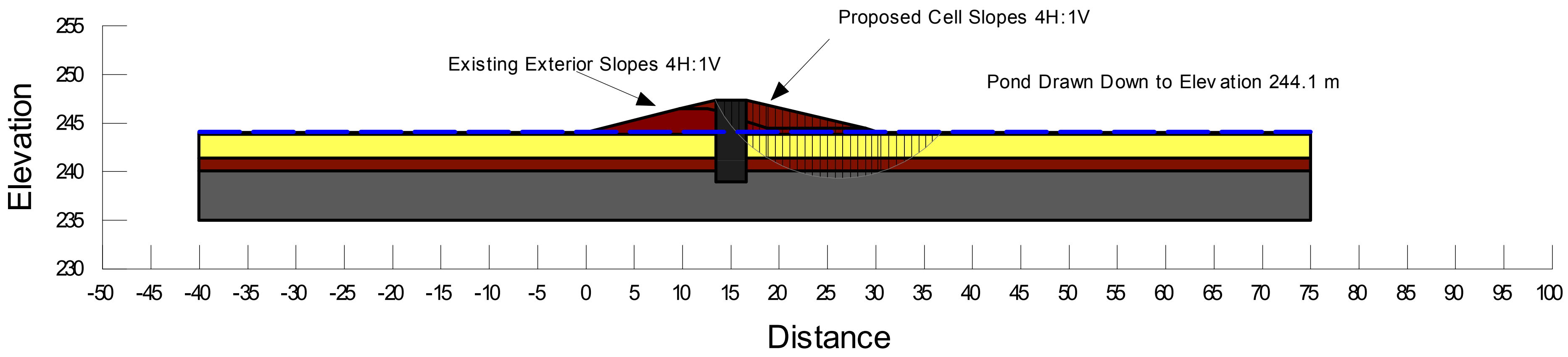
Drawn by: KWJ	Scale: As Shown	Date:14 May 2014	Proj. No.: WX17367	Figure: 6	**ALTONA WTF LAGOON UPDRAGES** **ALTONA, MANITOBA**



A) Normal Operating Condition (Pond Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 1.93



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.37



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.48

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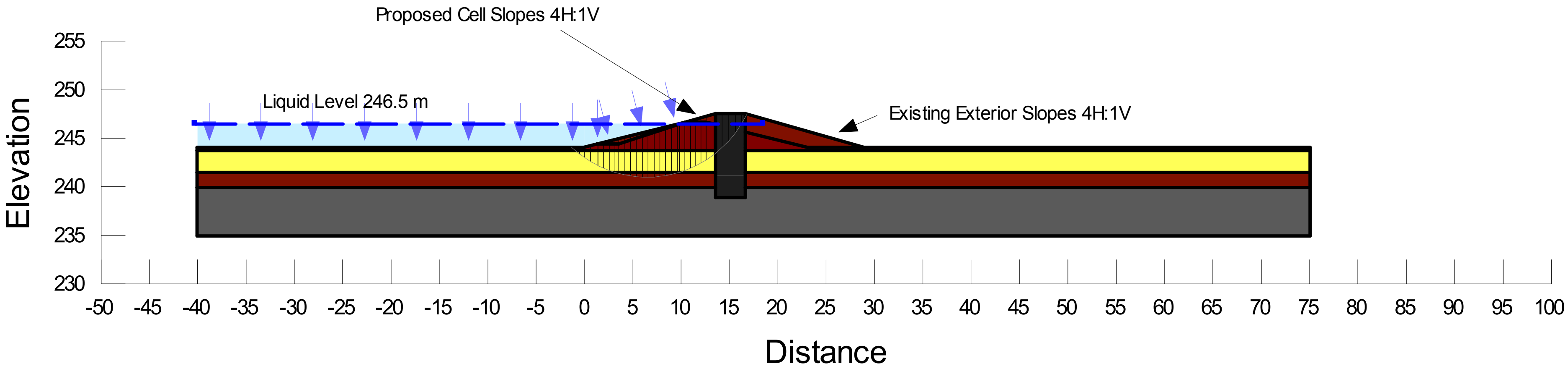
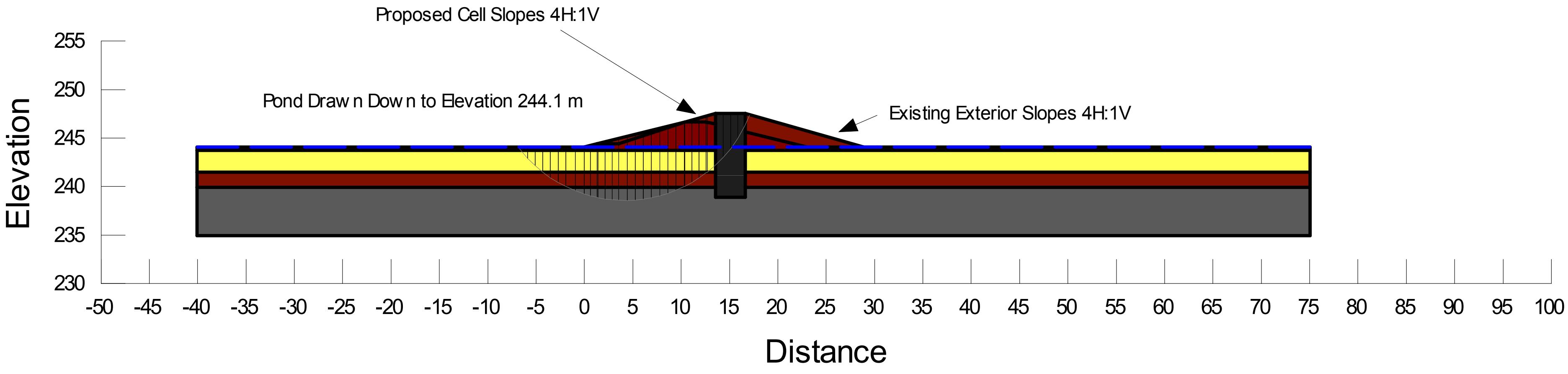
POND SLOPE STABILITY
CROSS SECTION #3
(PROPOSED SECONDARY CELL NO.2,
WEST AND SOUTH DYKE)

Drawn by: KWJ
Scale: As Shown
Date:14 May 2014
Proj. No.: WX17367
Figure: 7

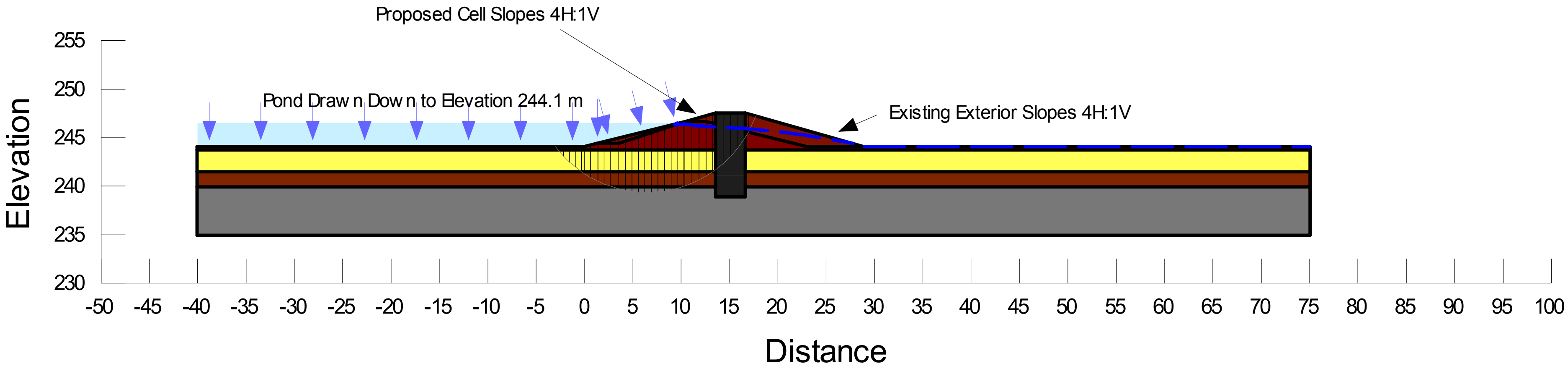
ALTONA WTF LAGOON UPDRAGES
ALTONA, MANITOBA



A) Normal Operating Condition (Pond Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 1.93



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.50



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.50

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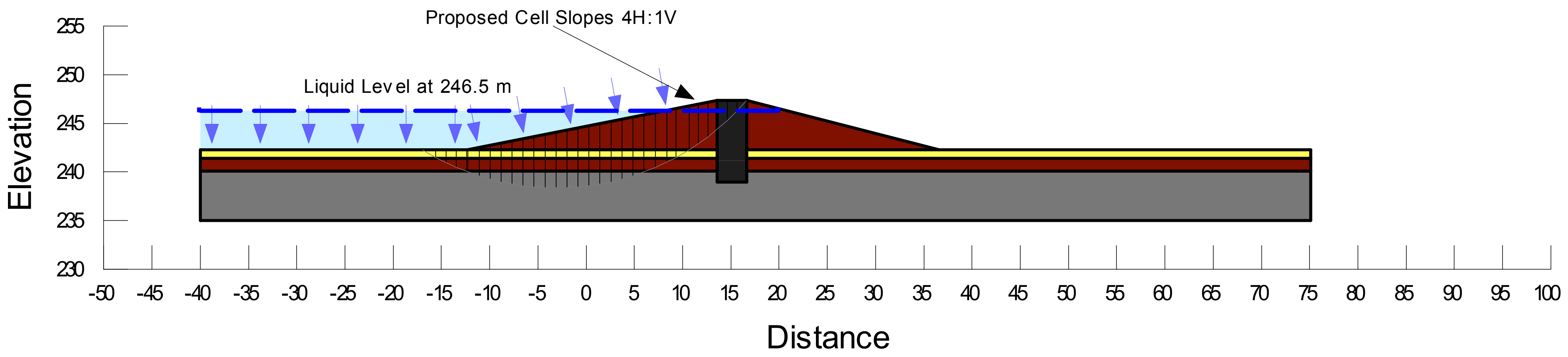
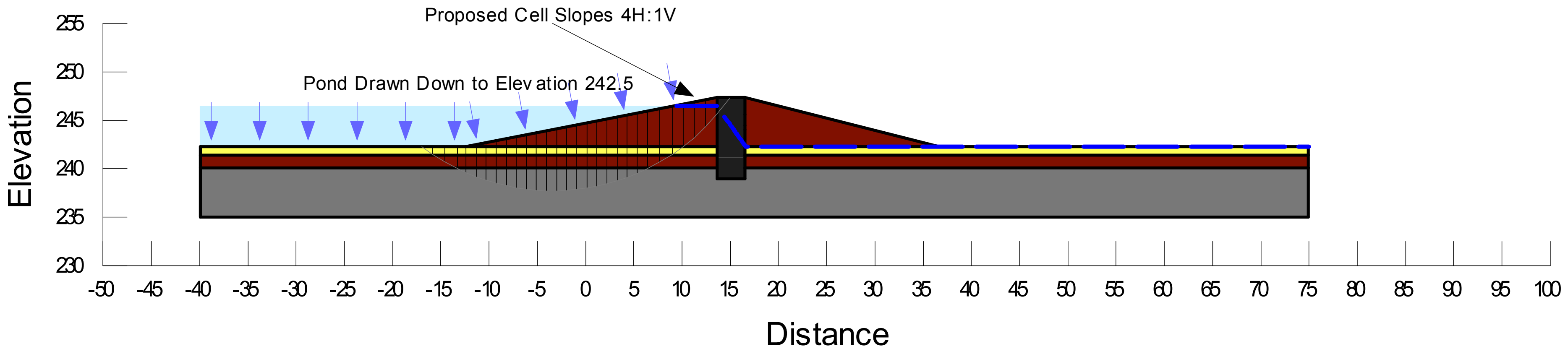
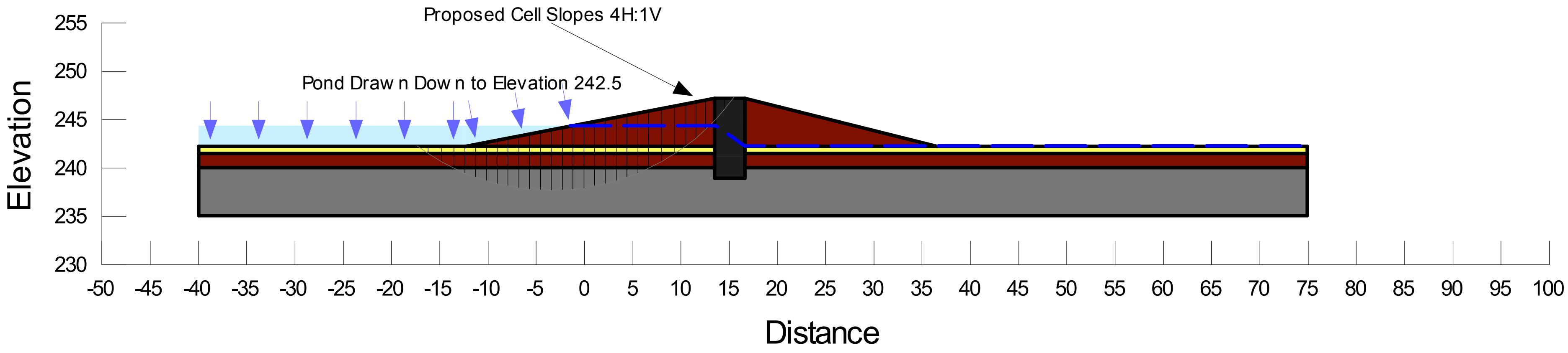
Drawn by: KWJ	Scale: As Shown	Date:14 May 2014	Proj. No.: WX17367	Figure: 8	**ALTONA WTF LAGOON UPDRAGES ALTONA, MANITOBA**



A) Normal Operating Condition (Pond Full to Maximum Liquid Level) – Internal Cell Slopes – Factor of Safety 1.75



B) Extreme Condition Case 1 – Rapid Drawdown of Proposed Cell (Undrained Conditions) – Factor of Safety 1.59



C) Extreme Condition Case 2 – Rapid Drawdown of Proposed Cell (Drained Conditions) – Factor of Safety 1.43

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POND SLOPE STABILITY
CROSS SECTION #5
(PROPOSED AERATION CELL)

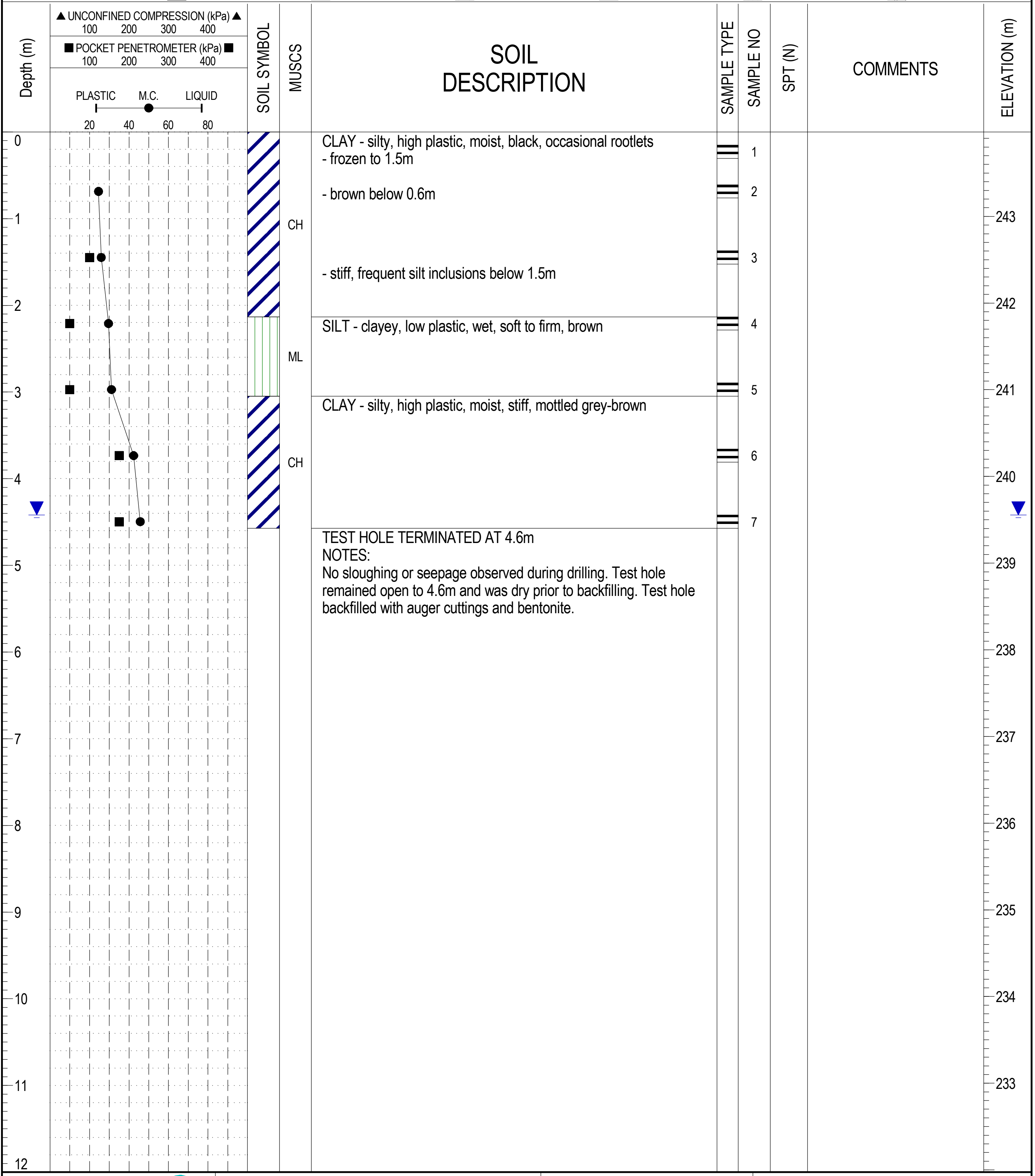
ALTONA WTF LAGOON UPDRAGES
ALTONA, MANITOBA

Drawn by: KWJ	Scale: As Shown	Date:14 May 2014	Proj. No.: WX17367	Figure: 9

APPENDIX A

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf Drilling	BORE HOLE NO: **TH01**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441575.5 E607103.9	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 243.97 m

SAMPLE TYPE	■ Shelby Tube	▨ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
BACKFILL TYPE	■ Bentonite	⁘ Pea Gravel	▨ Drill Cuttings	⁘ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY - silty, high plastic, moist, black, occasional rootlets
- frozen to 1.5m
- brown below 0.6m
- stiff, frequent silt inclusions below 1.5m

SILT - clayey, low plastic, wet, soft to firm, brown

CLAY - silty, high plastic, moist, stiff, mottled grey-brown

TEST HOLE TERMINATED AT 4.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

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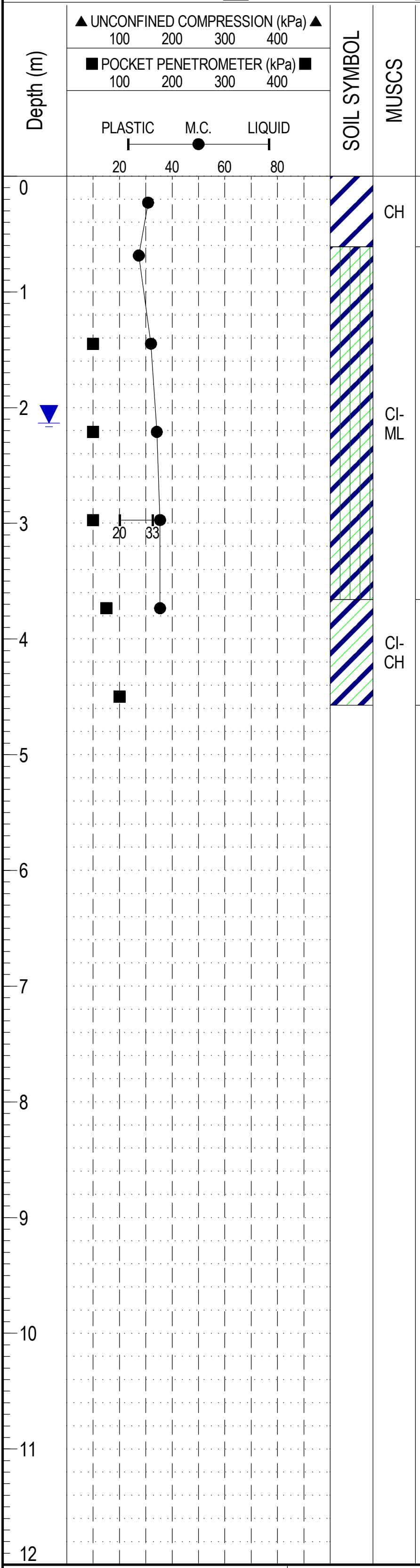
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
Figure No. A1	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH02**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441576.2 E607242.7	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 243.89 m

SAMPLE TYPE ▩ Shelby Tube ▨ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



SOIL DESCRIPTION

CLAY - silty, high plastic, moist, frozen, black, occasional rootlets

CLAY AND SILT - clayey, trace sand, low to medium plastic, moist, soft, tan-brown

- wet below 1.5m

- and clay below 2.1m

- clayey below 3.0m

CLAY - silty, medium to high plastic, moist, firm, mottled grey-brown

TEST HOLE TERMINATED AT 4.6m
NOTES:
Moderate sloughing observed below 2.1m during drilling. Slight seepage observed below 2.1m during drilling. Test hole remained open to 2.1m with water level at 2.1m prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

SAMPLE TYPE ☰ ☰ ☰ ☰ ☰ ☰ ☰

SAMPLE NO 1 2 3 4 5 6 7

SPT (N)

COMMENTS

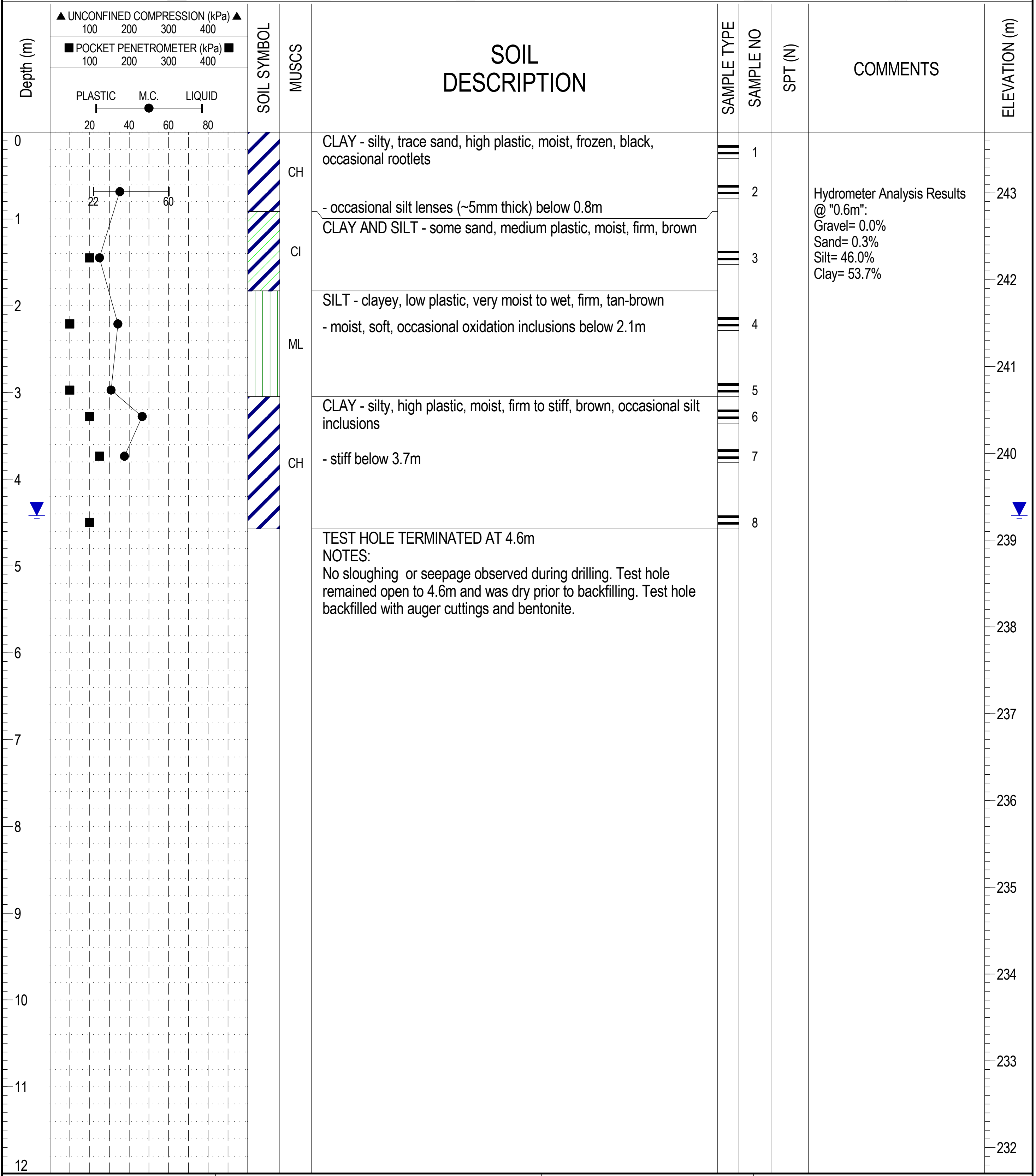
Hydrometer Analysis Results
@ "2.9m":
Gravel= 0.0%
Sand= 1.6%
Silt= 76.9%
Clay= 21.4%

ELEVATION (m)
243
242
241
240
239
238
237
236
235
234
233
232

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
	REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
	Figure No. A2	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH03**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441576.2 E607396.8	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 243.7 m

SAMPLE TYPE	▩ Shelby Tube	◿ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY - silty, trace sand, high plastic, moist, frozen, black, occasional rootlets

- occasional silt lenses (~5mm thick) below 0.8m

CLAY AND SILT - some sand, medium plastic, moist, firm, brown

SILT - clayey, low plastic, very moist to wet, firm, tan-brown

- moist, soft, occasional oxidation inclusions below 2.1m

CLAY - silty, high plastic, moist, firm to stiff, brown, occasional silt inclusions

- stiff below 3.7m

TEST HOLE TERMINATED AT 4.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

COMMENTS

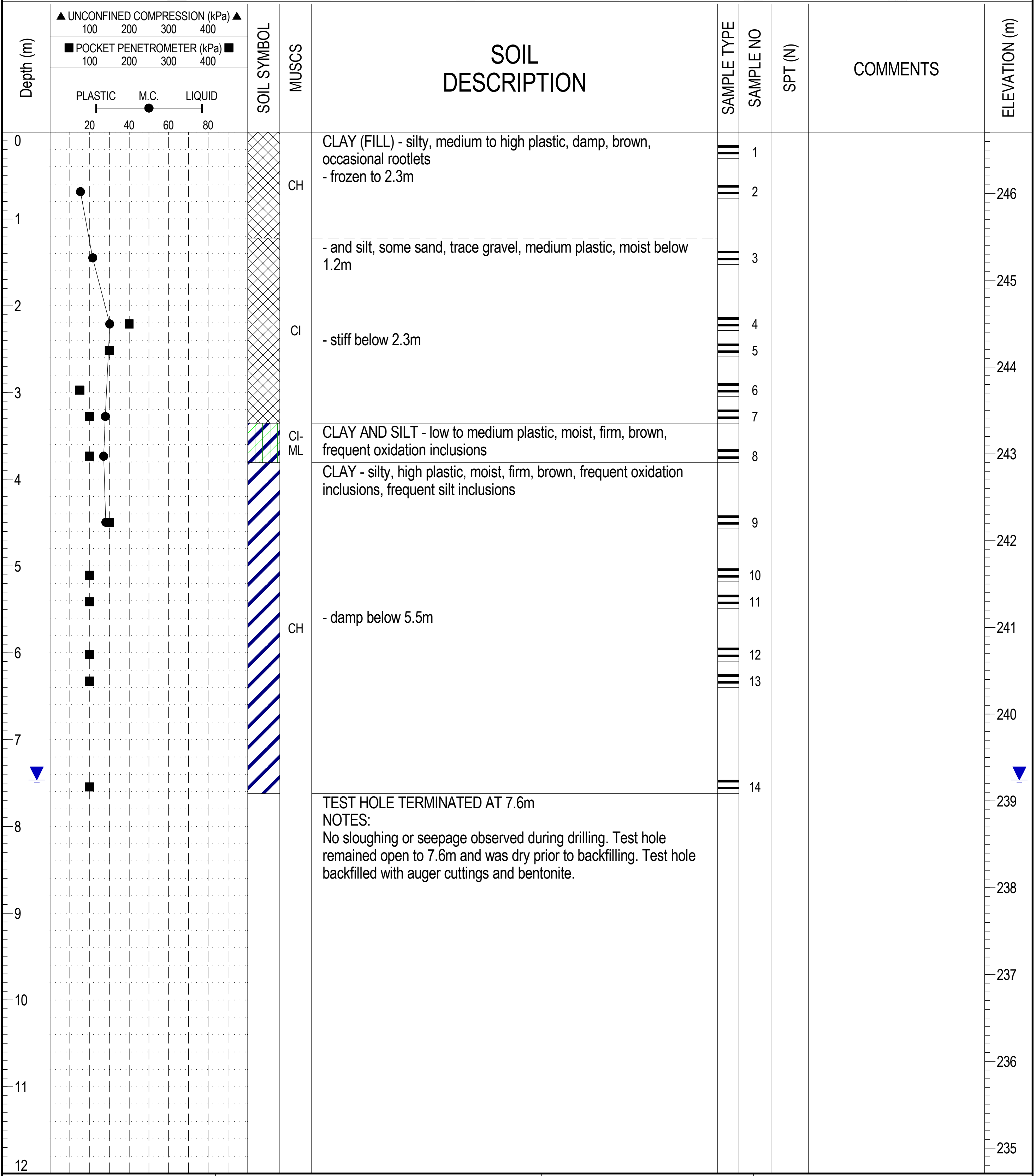
Hydrometer Analysis Results
@ "0.6m":
Gravel= 0.0%
Sand= 0.3%
Silt= 46.0%
Clay= 53.7%

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
Figure No. A3	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH04**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441217.4 E607364.7	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 246.71 m

SAMPLE TYPE	▩ Shelby Tube	▧ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
BACKFILL TYPE	■ Bentonite	⁘ Pea Gravel	▧ Drill Cuttings	⁘ Grout	▥ Slough	⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE NO
CH	CLAY (FILL) - silty, medium to high plastic, damp, brown, occasional rootlets - frozen to 2.3m	1 2
CI	- and silt, some sand, trace gravel, medium plastic, moist below 1.2m - stiff below 2.3m	3 4 5 6 7
CI-ML	CLAY AND SILT - low to medium plastic, moist, firm, brown, frequent oxidation inclusions	8
CH	CLAY - silty, high plastic, moist, firm, brown, frequent oxidation inclusions, frequent silt inclusions - damp below 5.5m	9 10 11 12 13 14

TEST HOLE TERMINATED AT 7.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 7.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 7.6 m
	REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
	Figure No. A4	Page 1 of 1

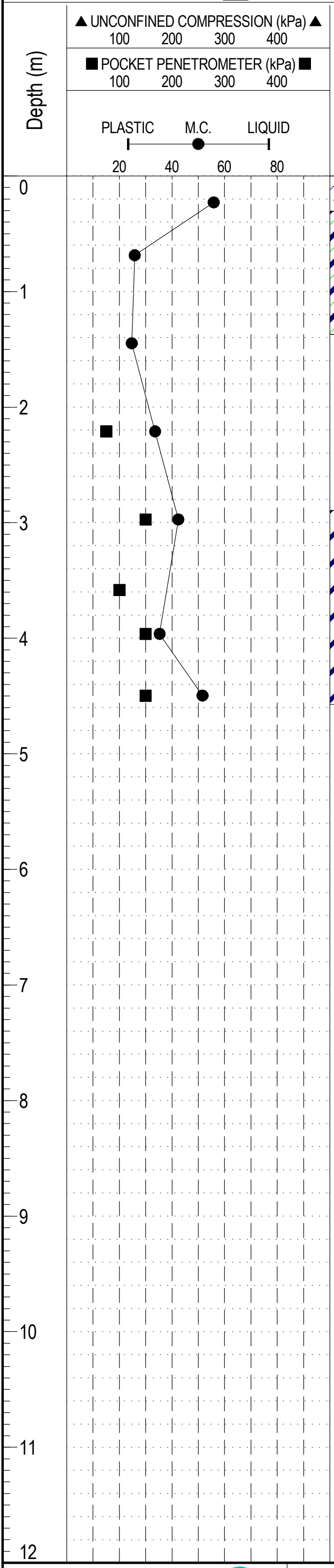
PROJECT: Altona Wastewater Treatment Facility
CLIENT: J.R. Cousin Consultants Ltd.
LOCATION: N5441422.6 E607396.8

DRILLED BY: Maple Leaf
DRILL TYPE: Track Mounted DR150
DRILL METHOD: 125mm Solid Stem Augers

BORE HOLE NO: **TH05**
PROJECT NO: WX17367.1000
ELEVATION: 244.04 m

SAMPLE TYPE: ▨ Shelby Tube ◺ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▌ Core

BACKFILL TYPE: ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OH	ORGANIC CLAY - silty, high plastic, moist, frozen, black, occasional rootlets to 10mm	☰	1		
CL-CI	CLAY AND SILT - sandy, low to medium plastic, moist, soft, brown	☰	2		
ML	SILT - sandy, trace clay, low plastic, moist, soft, tan-brown - wet below 1.5m - firm below 2.1m	☰ ▨ ☰	3 4 5		
CH	CLAY - silty, trace sand, medium to high plastic, moist, stiff, mottled brown-grey - occasional silt seams noted at approximately 0.2 to 0.3 interval in Shelby tube sample	☰ ☰ ▨ ☰	6 8 7 9		Hydrometer Analysis Results @ "3.0m": Gravel= 0.0% Sand= 0.5% Silt= 61.8% Clay= 37.7% Hydraulic Conductivity S7: k_{20}: 7.33x10^{-8} cm/s
	TEST HOLE TERMINATED AT 4.6m NOTES: No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.				

ELEVATION (m): 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

AMEC Environment & Infrastructure
Winnipeg, Manitoba

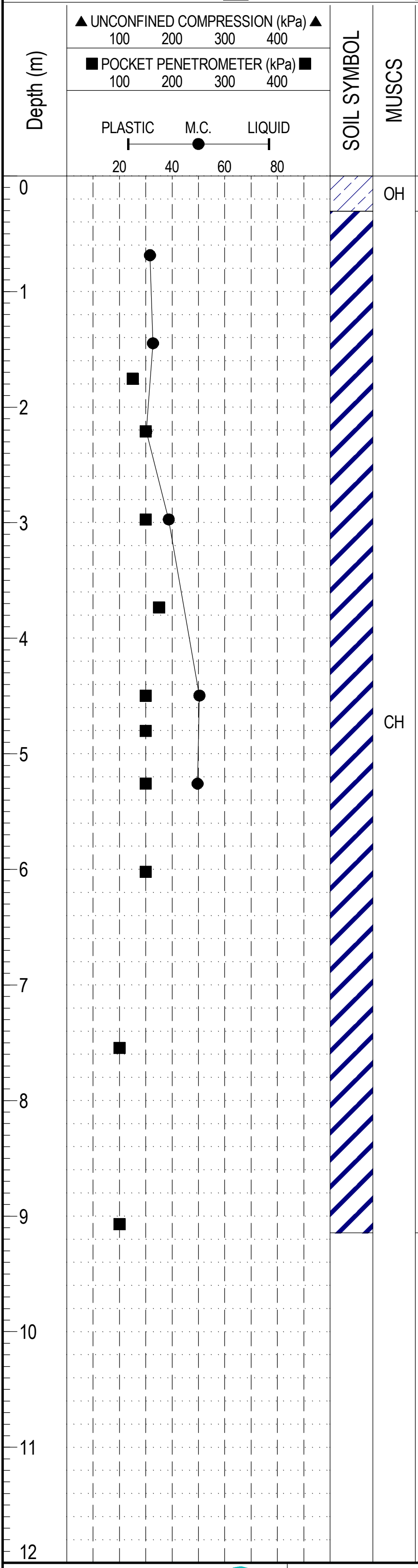
LOGGED BY: BK
REVIEWED BY: KJ
Figure No. A5

COMPLETION DEPTH: 4.6 m
COMPLETION DATE: 18 March 2014

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH06**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441285.4 E607362.3	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.9 m

SAMPLE TYPE ■ Shelby Tube ▨ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▌ Core

BACKFILL TYPE ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OH	ORGANIC CLAY - silty, high plastic, moist, frozen, black, occasional rootlets	☰	1		
	CLAY - silty, high plastic, moist, grey to black, occasional rootlets to 1.5m - frozen to 1.5m below grade	☰	2		
	- stiff, brown below 1.5m	☰	3		
		☰	4		
		☰	5		
		☰	6		
		☰	7		
		☰	8		
CH		☰	9		
	- grey below 4.9m	☰	10		
		☰	11		
		☰	12		
		☰	13		

TEST HOLE TERMINATED AT 9.1m

NOTES:

No sloughing or seepage observed during drilling. Test hole remained open to 9.1m and dry prior to backfilling.

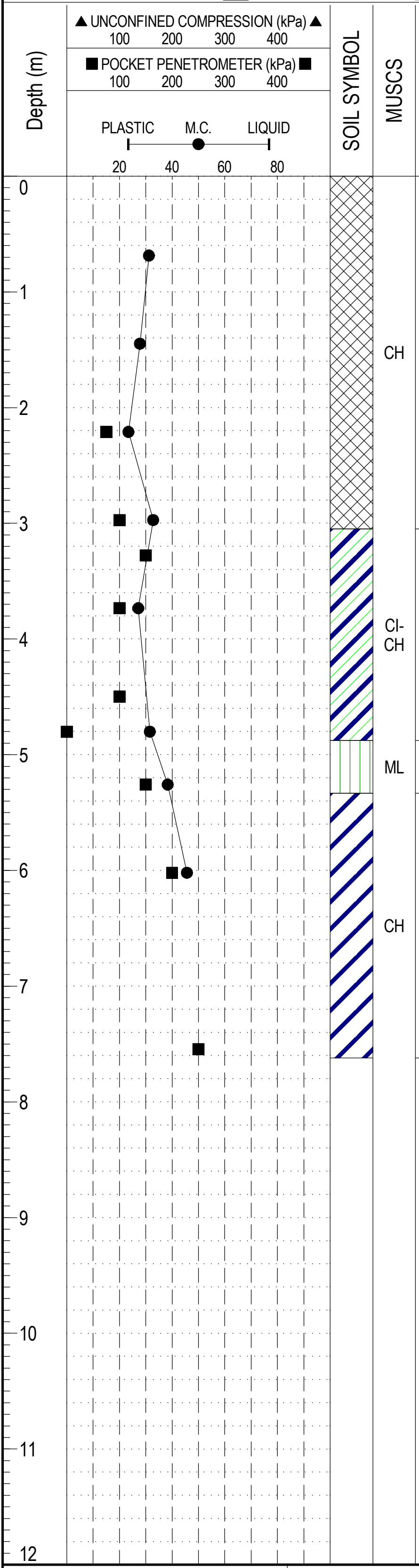
ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 9.1 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A6	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH07**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441216.7 E607051.6	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 247.3 m

SAMPLE TYPE	▨ Shelby Tube	◿ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY (FILL) - silty, high plastic, moist, frozen, black at surface becoming dark brown

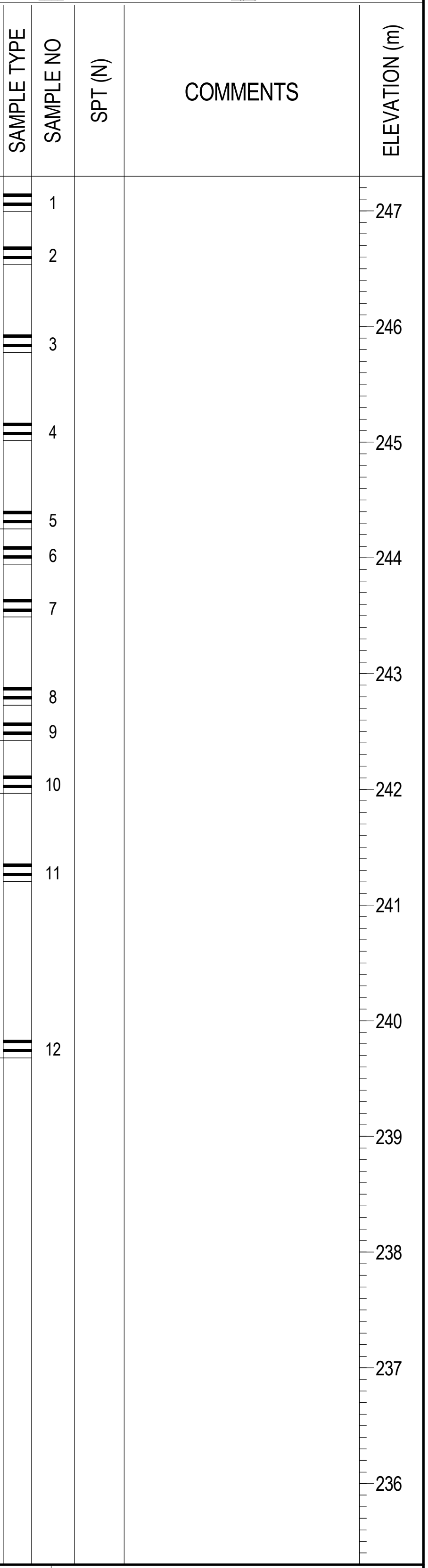
CLAY - silty, medium to high plastic, moist, stiff, black to dark brown, frequent silt inclusions
- grey below 3.4m

- frequent oxidation inclusions below 4.6m

SILT - some clay, low plastic, wet, soft, tan-brown

CLAY - silty, high plastic, damp, stiff to very stiff, brown

TEST HOLE TERMINATED AT 7.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 7.6m and dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

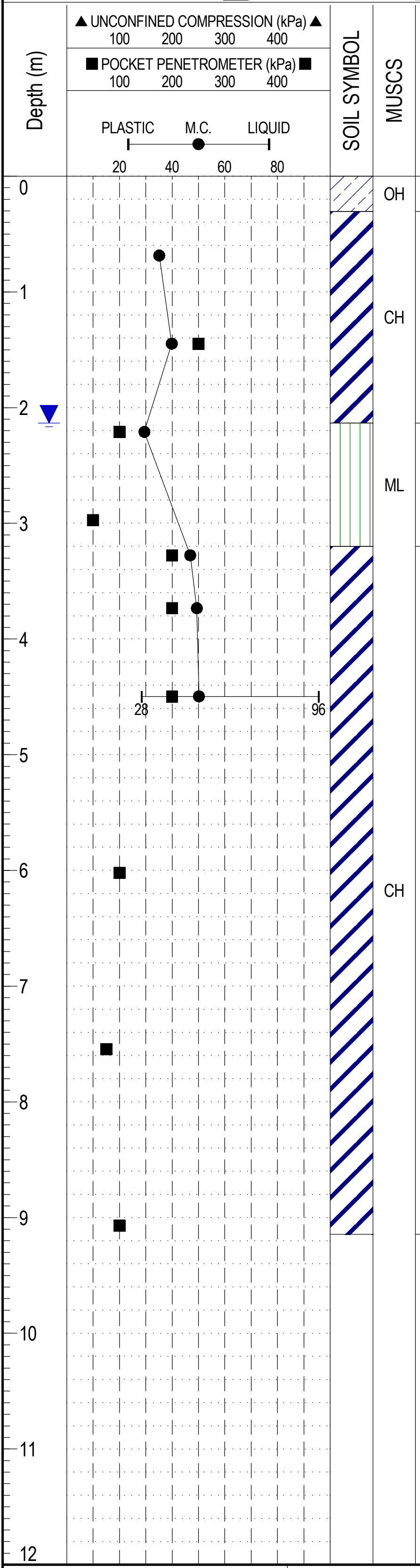


AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 7.6 m
	REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
	Figure No. A7	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH08**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441294.1 E607015	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.45 m

SAMPLE TYPE: ▨ Shelby Tube ◿ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE: ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE NO	SPT (N)	COMMENTS
OH	ORGANIC CLAY - silty, high plastic, moist, frozen, black, occasional rootlets	1		
CH	CLAY - silty, high plastic, moist, black to grey - frozen to 0.9m - very stiff, brown, occasional silt inclusions below 0.9m	2 3		
ML	SILT - clayey, low plastic, firm, moist, mottled grey-brown - wet, soft below 2.7m	4 5		
CH	CLAY - some silt to silty, trace sand, high plastic, moist, stiff to very stiff, mottled grey-brown - firm to stiff, grey below 5.5m	6 7 8 9 10 11		Hydrometer Analysis Results @ "4.4m": Gravel= 0.0% Sand= 3.8% Silt= 16.5% Clay= 79.7%

TEST HOLE TERMINATED AT 9.1m
NOTES:
Slight sloughing observed below 8.7m during drilling. Slight seepage observed below 2.1m during drilling. Test hole remained open to 8.7m with water level at 8.5m prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

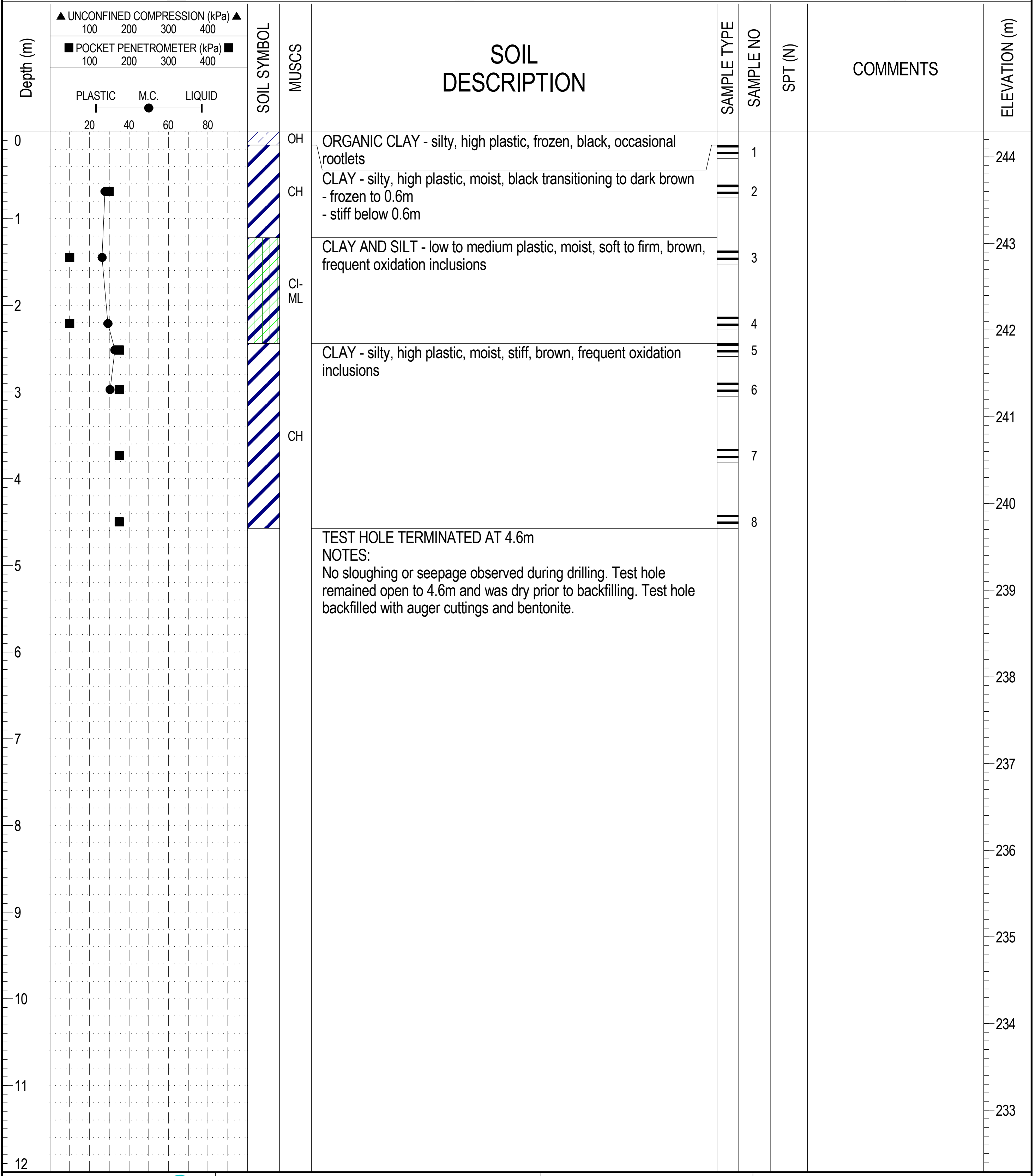
AMEC Environment & Infrastructure
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 9.1 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A8	

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH09**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441466.1 E607013.7	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.29 m

SAMPLE TYPE ▩ Shelby Tube ◿ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ◧ Core

BACKFILL TYPE ■ Bentonite ⁚ Pea Gravel ▨ Drill Cuttings ⁖ Grout ▥ Slough ⁘ Sand



SOIL DESCRIPTION

ORGANIC CLAY - silty, high plastic, frozen, black, occasional rootlets

CLAY - silty, high plastic, moist, black transitioning to dark brown
- frozen to 0.6m
- stiff below 0.6m

CLAY AND SILT - low to medium plastic, moist, soft to firm, brown, frequent oxidation inclusions

CLAY - silty, high plastic, moist, stiff, brown, frequent oxidation inclusions

TEST HOLE TERMINATED AT 4.6m

NOTES:

No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

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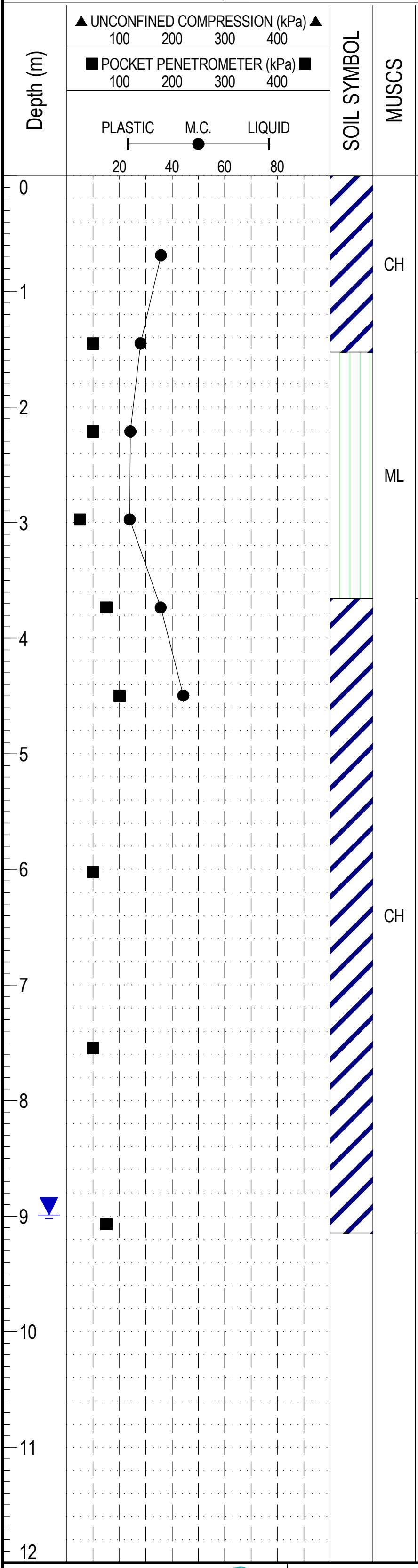
LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
Figure No. A9	

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH10**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441550.1 E607011.6	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.44 m

SAMPLE TYPE	▩ Shelby Tube	▨ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

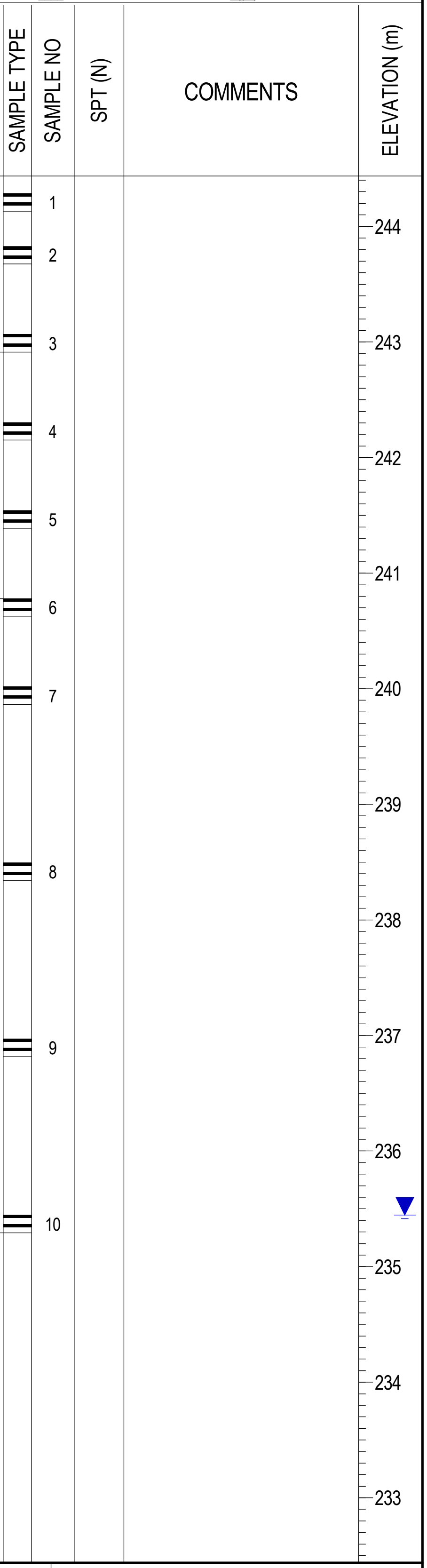
CLAY - silty, high plastic, frozen, brown
- frozen to 0.9m

- soft to firm below 0.9m

SILT - clayey, low plastic, wet, soft, tan-brown

CLAY - silty, high plastic, moist, firm, mottled grey-brown
- grey below 4m

TEST HOLE TERMINATED AT 9.1m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 9.1m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.



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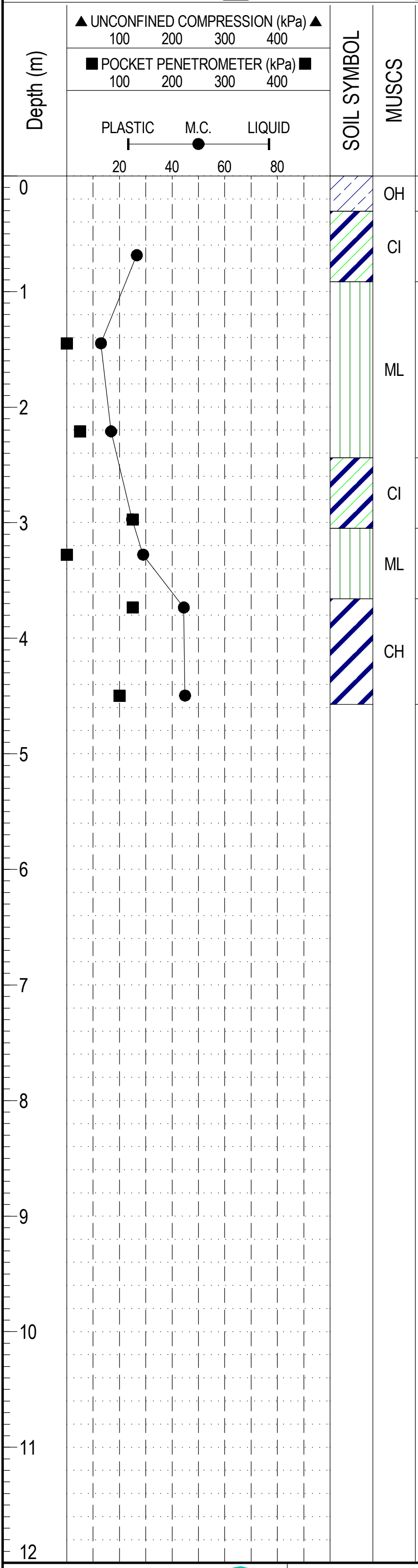
LOGGED BY: BK	COMPLETION DEPTH: 9.1 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A10	Page 1 of 1

17367 ALTONA WASTEWATER TREATMENT FACILITY.GPJ 14/05/27 02:42 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH11**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441478.6 E607123.2	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.16 m

SAMPLE TYPE: ■ Shelby Tube; ▨ No Recovery; ☒ SPT (N); ☰ Grab Sample; ▥ Split-Pen; ▮ Core

BACKFILL TYPE: ■ Bentonite; ⁘ Pea Gravel; ▨ Drill Cuttings; ⁘ Grout; ▥ Slough; ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OH	ORGANIC CLAY - silty, high plastic, moist, frozen, black, occasional rootlets	☰	1		
CI	CLAY - silty, medium plastic, frozen, grey to black	☰	2		
ML	SILT - some clay, low plastic, moist, soft, brown, occasional oxidation	☰ ☰	3 4		
CI	CLAY AND SILT - medium plastic, moist, stiff, brown, frequent oxidation inclusions	☰	5		
ML	SILT - some sand, some clay, low plastic, wet, soft, brown	☰	6		
CH	CLAY - silty, high plastic, moist, stiff, brown	☰ ☰	7 8		

TEST HOLE TERMINATED AT 4.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

amec

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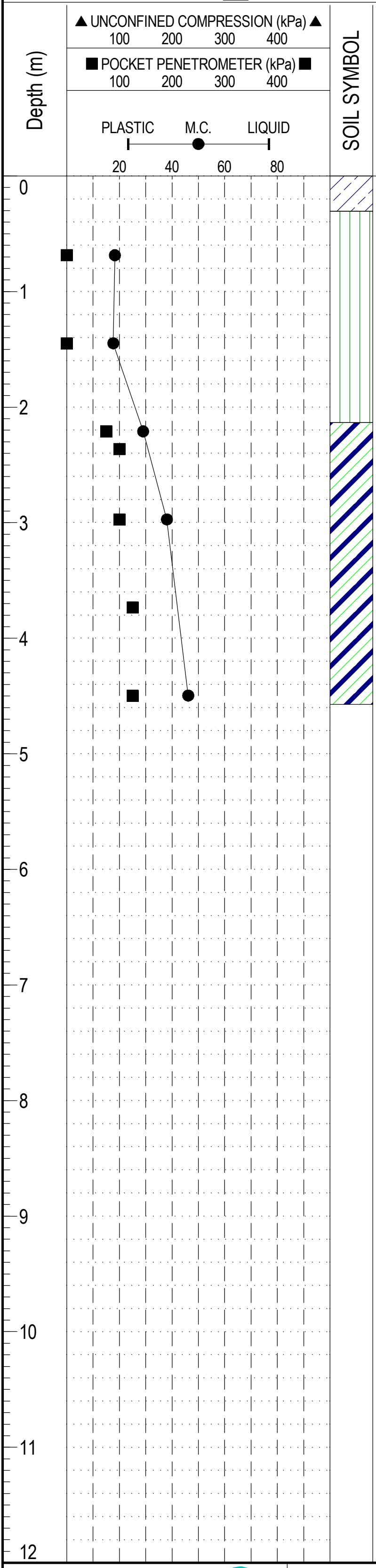
LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A11	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH12**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441410.6 E607268.4	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.31 m

SAMPLE TYPE: ▩ Shelby Tube ◺ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE: ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁖ Grout ▥ Slough ⁙ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OH	ORGANIC CLAY - silty, high plastic, moist, frozen, black, occasional rootlets	☰	1		
ML	SILT - sandy, some clay, low plastic, moist, soft, brown	☰ ☰	2 3		
CI-CH	CLAY - silty, trace sand, medium to high plastic, moist, firm to stiff, brown, frequent silt inclusions, frequent oxidation inclusions	☰ ☰ ☰ ☰ ☰	4 5 6 7 8		
	TEST HOLE TERMINATED AT 4.6m NOTES: No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.				

ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

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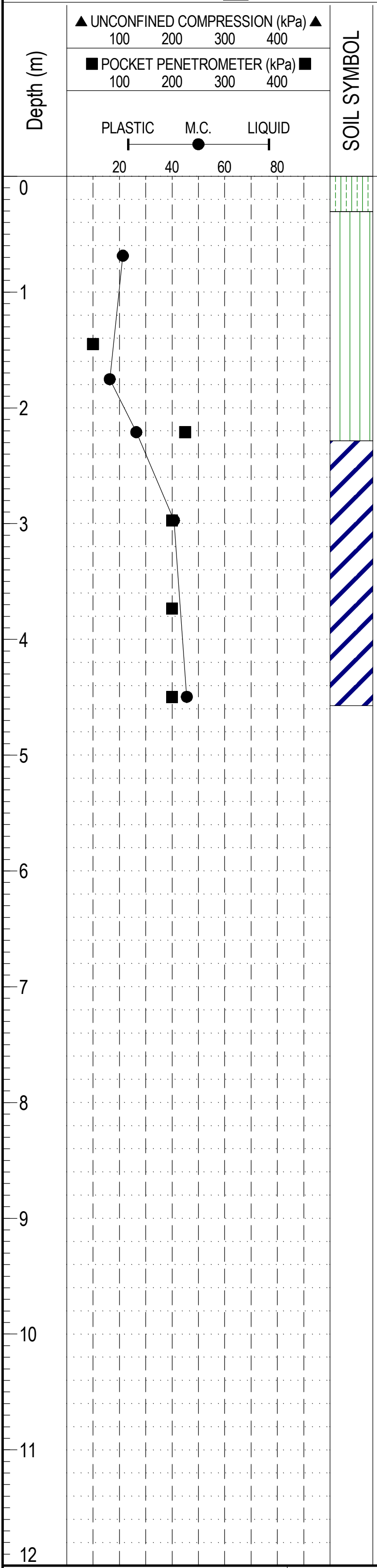
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A12	

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH13**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441308.5 E607136.6	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.47 m

SAMPLE TYPE ■ Shelby Tube ▨ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE ■ Bentonite ⁚ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE NO	SPT (N)	COMMENTS
OL	ORGANIC CLAY - silty, low plastic, moist, frozen, black, occasional rootlets	1		
ML	SILT - some clay, some sand, low plastic, moist, grey - frozen to 0.9m - soft, brown below 0.9m - sandy below 1.5m	2 3 4 5		
CH	CLAY - silty, high plastic, moist, stiff to very stiff, brown, occasional silt inclusions	6 7 8		

TEST HOLE TERMINATED AT 4.6m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 4.6m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

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LOGGED BY: BK	COMPLETION DEPTH: 4.6 m
REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
Figure No. A13	Page 1 of 1

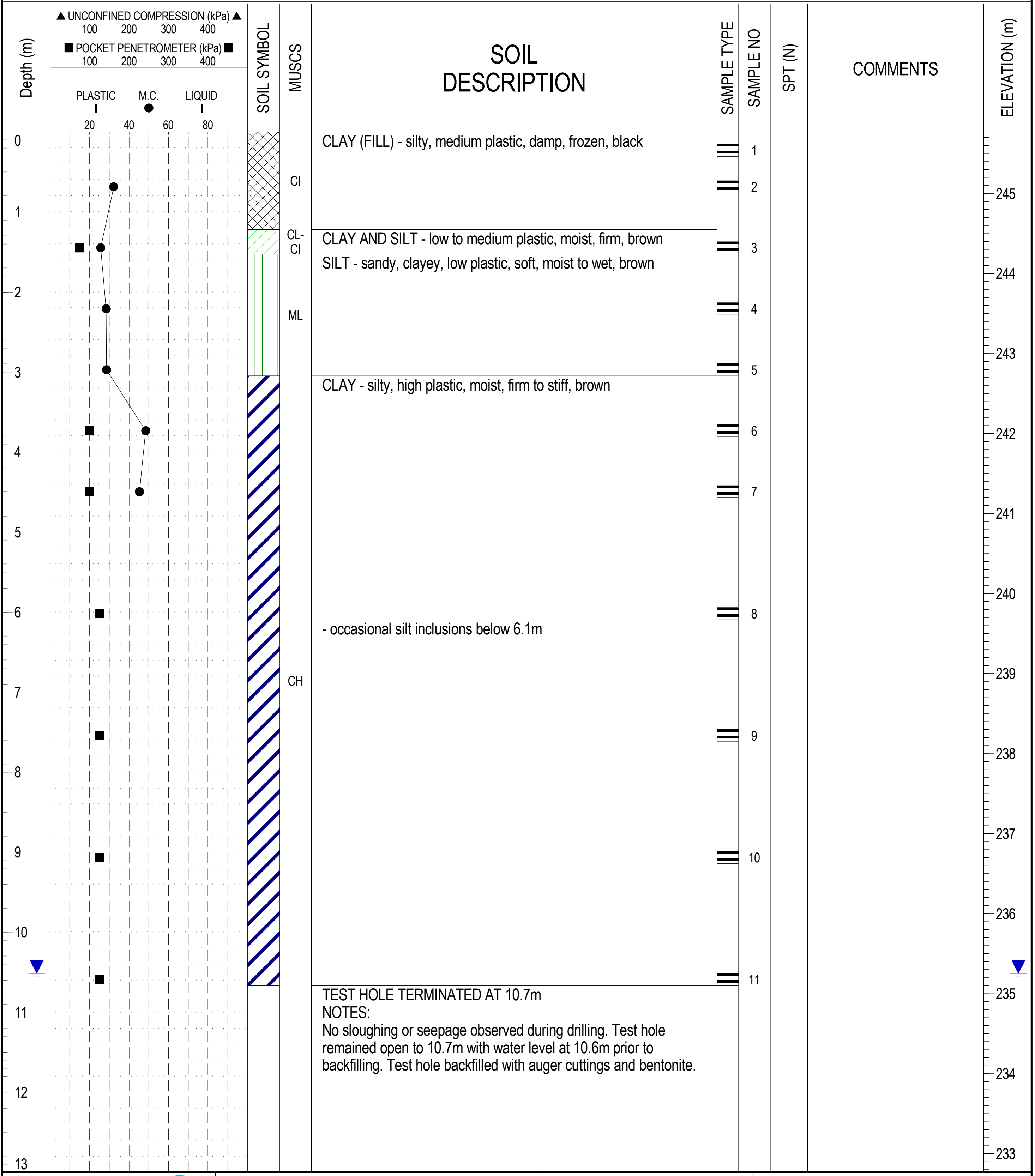
PROJECT: Altona Wastewater Treatment Facility
CLIENT: J.R. Cousin Consultants Ltd.
LOCATION: N5440834.6 E606923.3

DRILLED BY: Maple Leaf
DRILL TYPE: Track Mounted DR150
DRILL METHOD: 125mm Solid Stem Augers

BORE HOLE NO: **TH14**
PROJECT NO: WX17367.1000
ELEVATION: 245.77 m

SAMPLE TYPE: ▩ Shelby Tube ◺ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE: ■ Bentonite ⁚ Pea Gravel ▨ Drill Cuttings ⁛ Grout ▥ Slough ⁘ Sand



SOIL DESCRIPTION

CLAY (FILL) - silty, medium plastic, damp, frozen, black

CLAY AND SILT - low to medium plastic, moist, firm, brown

SILT - sandy, clayey, low plastic, soft, moist to wet, brown

CLAY - silty, high plastic, moist, firm to stiff, brown

- occasional silt inclusions below 6.1m

TEST HOLE TERMINATED AT 10.7m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 10.7m with water level at 10.6m prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

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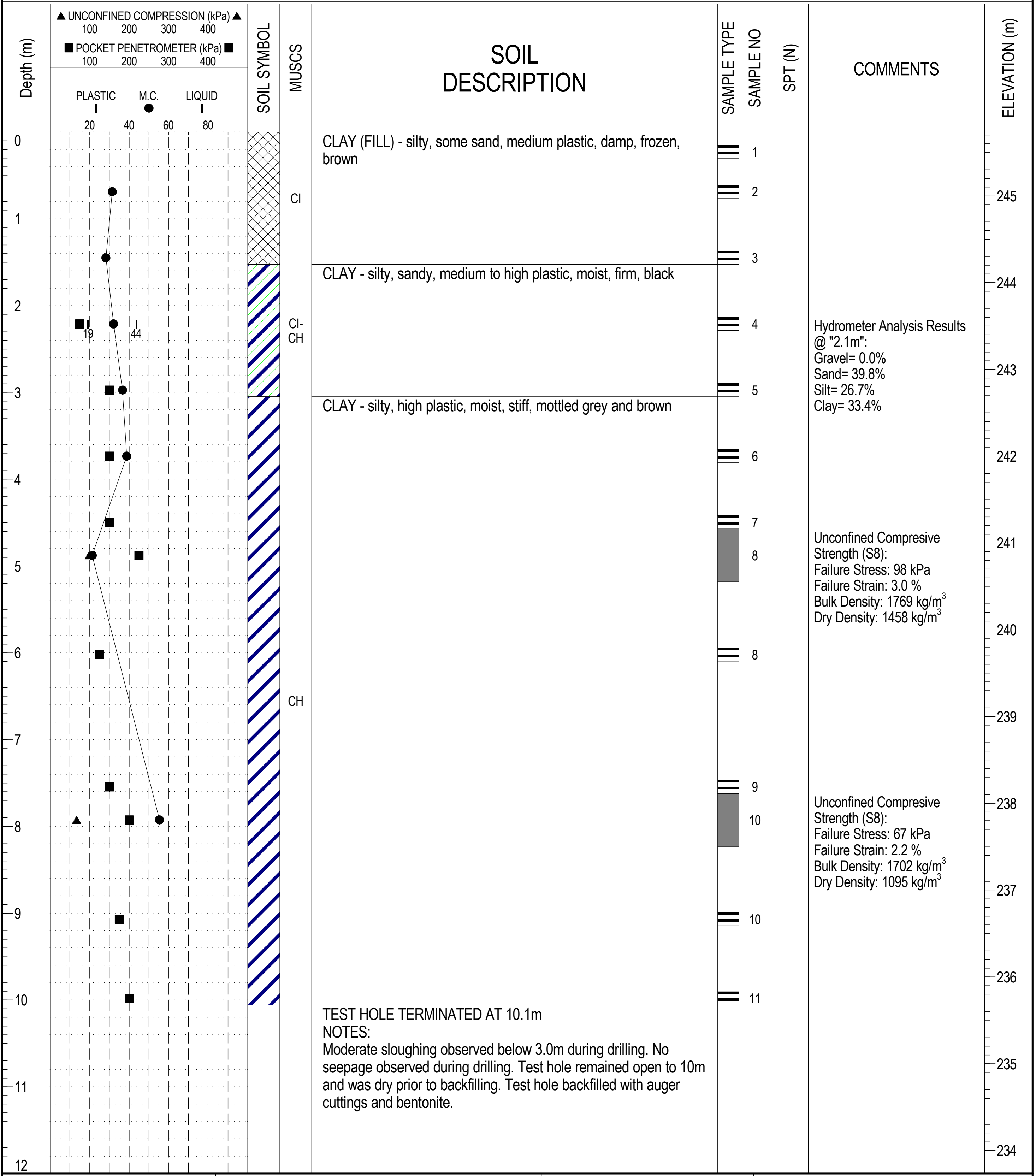
LOGGED BY: BK
REVIEWED BY: KJ
Figure No. A14

COMPLETION DEPTH: 10.7 m
COMPLETION DATE: 17 March 2014

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH15**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5440851.8 E606911.5	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 245.73 m

SAMPLE TYPE	▩ Shelby Tube	▱ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



CLAY (FILL) - silty, some sand, medium plastic, damp, frozen, brown

CLAY - silty, sandy, medium to high plastic, moist, firm, black

CLAY - silty, high plastic, moist, stiff, mottled grey and brown

TEST HOLE TERMINATED AT 10.1m
NOTES:
Moderate sloughing observed below 3.0m during drilling. No seepage observed during drilling. Test hole remained open to 10m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

Hydrometer Analysis Results @ "2.1m":
Gravel= 0.0%
Sand= 39.8%
Silt= 26.7%
Clay= 33.4%

Unconfined Compresive Strength (S8):
Failure Stress: 98 kPa
Failure Strain: 3.0 %
Bulk Density: 1769 kg/m^3
Dry Density: 1458 kg/m^3

Unconfined Compresive Strength (S8):
Failure Stress: 67 kPa
Failure Strain: 2.2 %
Bulk Density: 1702 kg/m^3
Dry Density: 1095 kg/m^3

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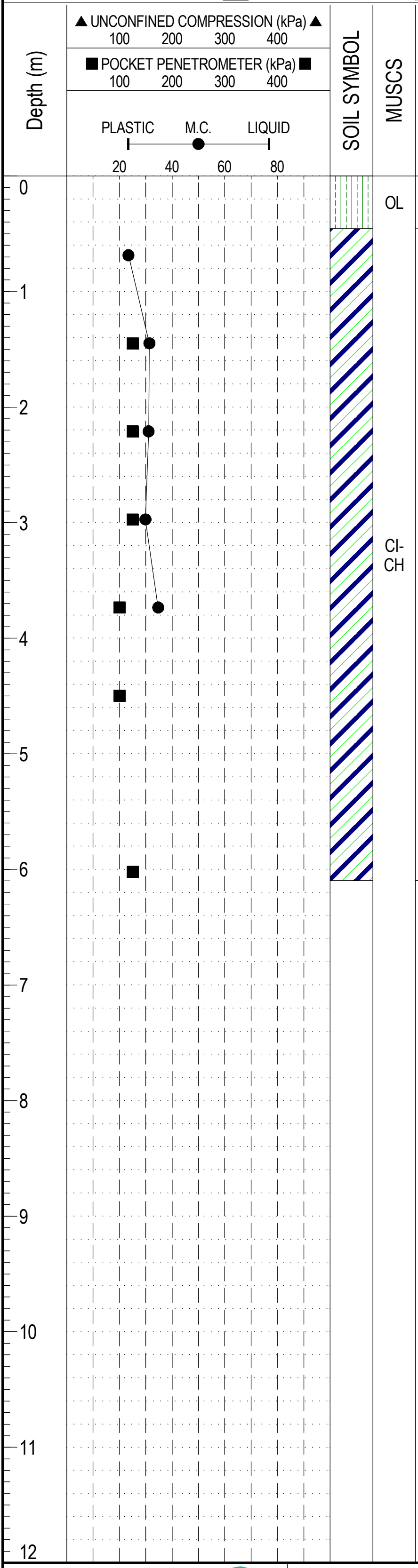
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 10.1 m
REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
Figure No. A15	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH16**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5440840.9 E606730.1	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.72 m

SAMPLE TYPE	▩ Shelby Tube	▨ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
BACKFILL TYPE	■ Bentonite	⁘ Pea Gravel	▨ Drill Cuttings	⁘ Grout	▥ Slough	⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OL	ORGANIC CLAY - silty, medium plastic, damp, frozen, black, occasional organic inclusions	☰	1		
CI-CH	CLAY - silty, high plastic, moist, mottled greyish brown, frequent silt inclusions - frozen to 0.9m - stiff below 0.9m - moist below 1.5m - occasional silt lenses between 3.1m and 4.6m below grade - high plastic below 3.6m	☰ ☰ ☰ ☰ ☰ ☰ ☰	2 3 4 5 6 7 8		

TEST HOLE TERMINATED AT 6.1m
NOTES:
Moderate sloughing observed below 1.5m during drilling. No seepage observed during drilling. Test hole remained open to 1.5m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

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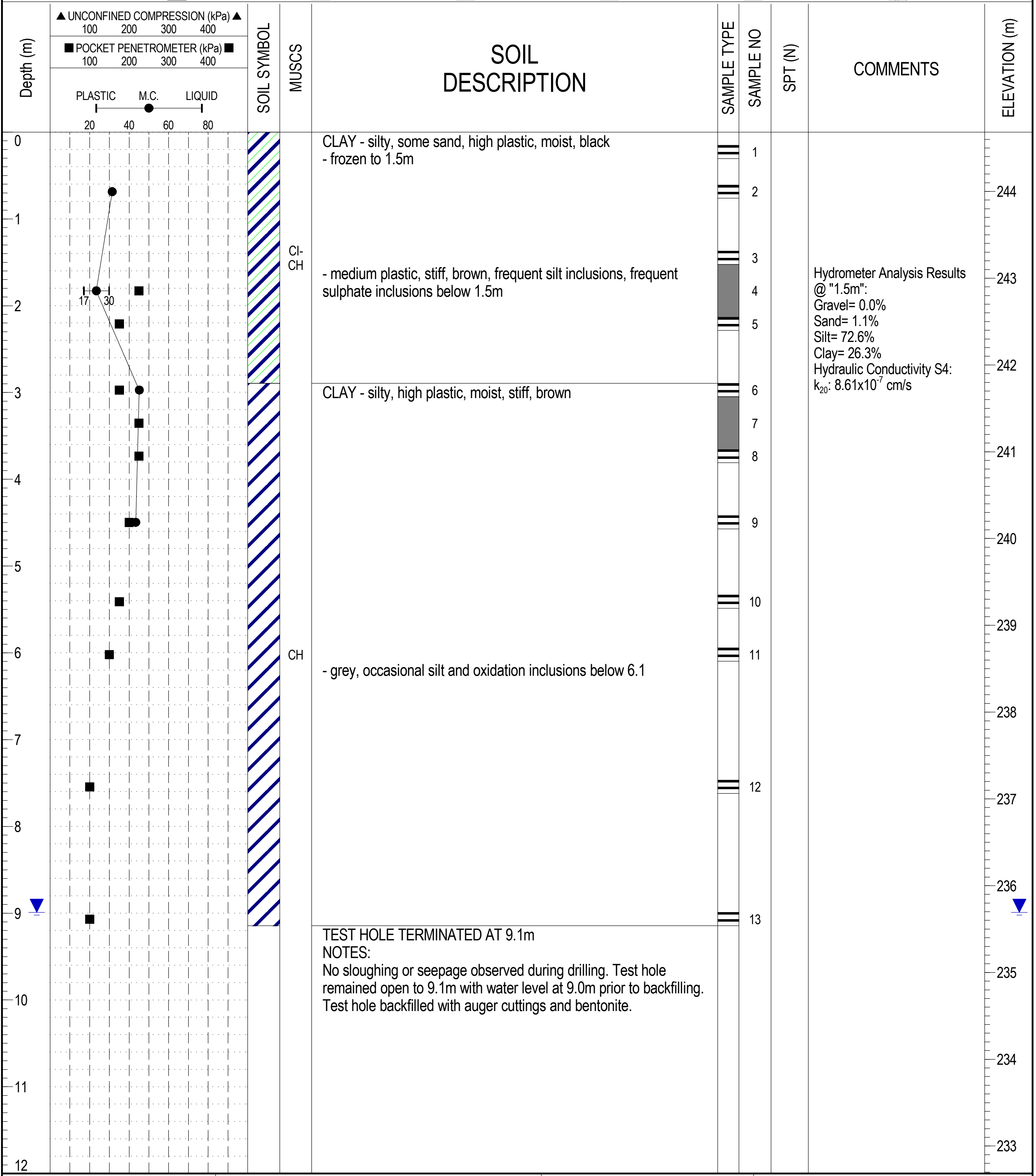
Winnipeg, Manitoba

LOGGED BY: BK	COMPLETION DEPTH: 6.1 m
REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
Figure No. A16	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH17**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5440918.5 E606691.7	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.68 m

SAMPLE TYPE	▨ Shelby Tube	◿ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
BACKFILL TYPE	■ Bentonite	⁛ Pea Gravel	▨ Drill Cuttings	⁛ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY - silty, some sand, high plastic, moist, black
- frozen to 1.5m

- medium plastic, stiff, brown, frequent silt inclusions, frequent sulphate inclusions below 1.5m

CLAY - silty, high plastic, moist, stiff, brown

- grey, occasional silt and oxidation inclusions below 6.1

TEST HOLE TERMINATED AT 9.1m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 9.1m with water level at 9.0m prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

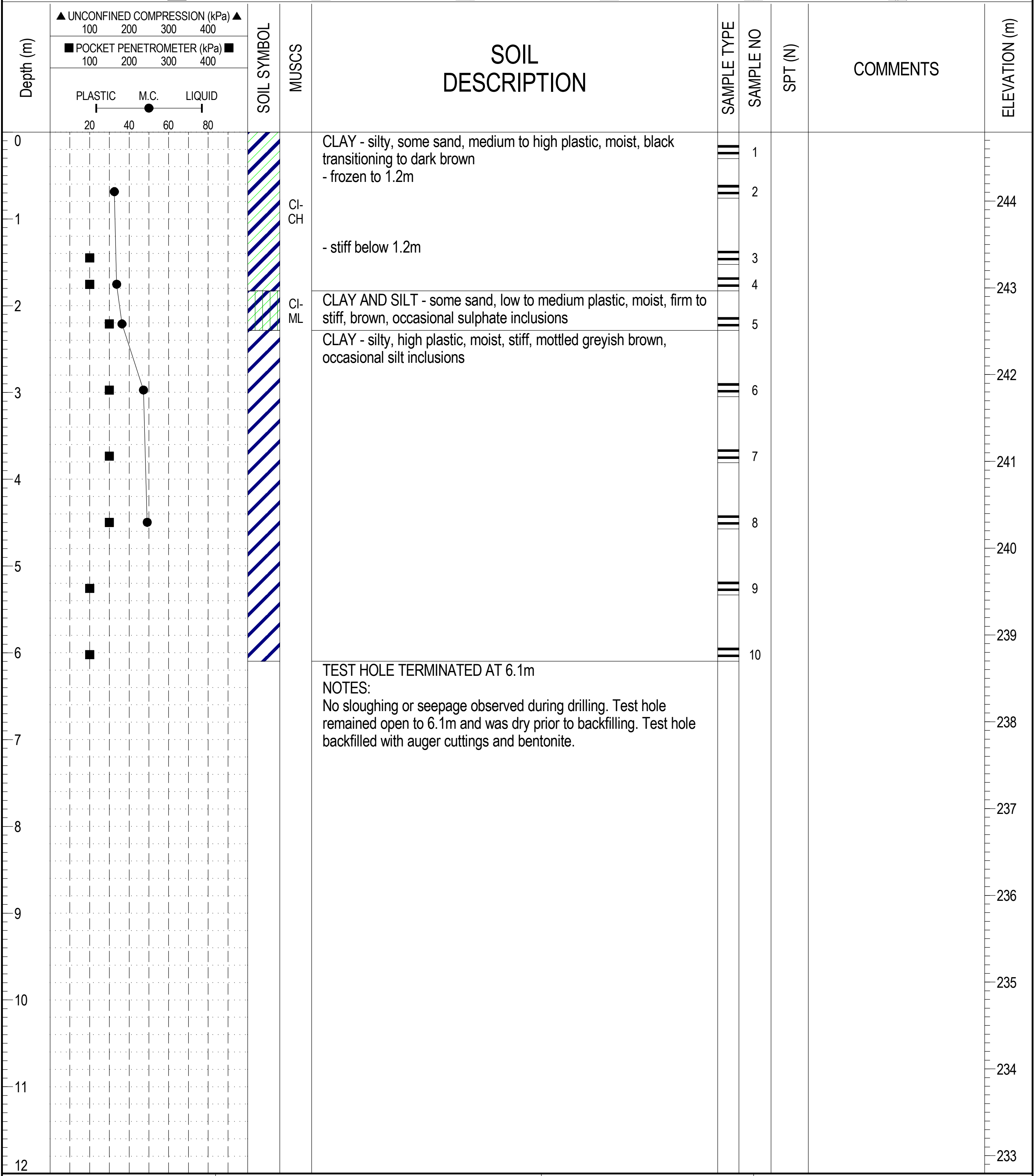
COMMENTS

Hydrometer Analysis Results @ "1.5m":
Gravel= 0.0%
Sand= 1.1%
Silt= 72.6%
Clay= 26.3%
Hydraulic Conductivity S4:
k_{20}: 8.61x10^{-7} cm/s

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 9.1 m
	REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
	Figure No. A17	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH18**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5440963.8 E606746.6	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.79 m

SAMPLE TYPE	▇ Shelby Tube	◿ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▮ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY - silty, some sand, medium to high plastic, moist, black transitioning to dark brown
- frozen to 1.2m

- stiff below 1.2m

CLAY AND SILT - some sand, low to medium plastic, moist, firm to stiff, brown, occasional sulphate inclusions

CLAY - silty, high plastic, moist, stiff, mottled greyish brown, occasional silt inclusions

TEST HOLE TERMINATED AT 6.1m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 6.1m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

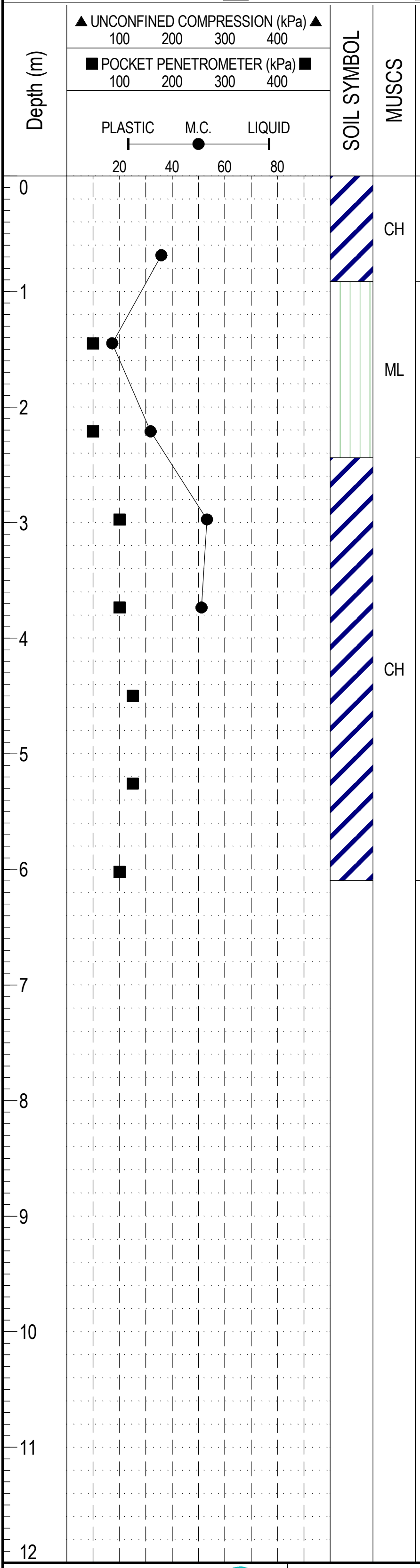
SAMPLE NO: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
	Figure No. A18	Page 1 of 1

17367 ALTONA WASTEWATER TREATMENT FACILITY.GPJ 14/05/27 02:42 PM (GEOTECHNICAL REVISED WITH UTM INPUTS)

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH19**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5440971.1 E606865.6	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 244.8 m

SAMPLE TYPE	▨ Shelby Tube	◿ No Recovery	☒ SPT (N)	☰ Grab Sample	▥ Split-Pen	▌ Core
BACKFILL TYPE	■ Bentonite	⁚ Pea Gravel	▨ Drill Cuttings	⁖ Grout	▥ Slough	⁘ Sand



SOIL DESCRIPTION

CLAY - silty, high plastic, stiff, black, frozen

SILT AND SAND - some clay, low plastic, moist, soft to firm, brown

- wet below 1.5m

CLAY - silty, high plastic, moist, firm to stiff, brown, occasional silt inclusions

- grey, frequent silt inclusions below 5.3m

TEST HOLE TERMINATED AT 6.1m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 6.1m and was dry prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
☰	1		
☰	2		
☰	3		
☰	4		
☰	5		
☰	6		
☰	7		
☰	8		
☰	9		

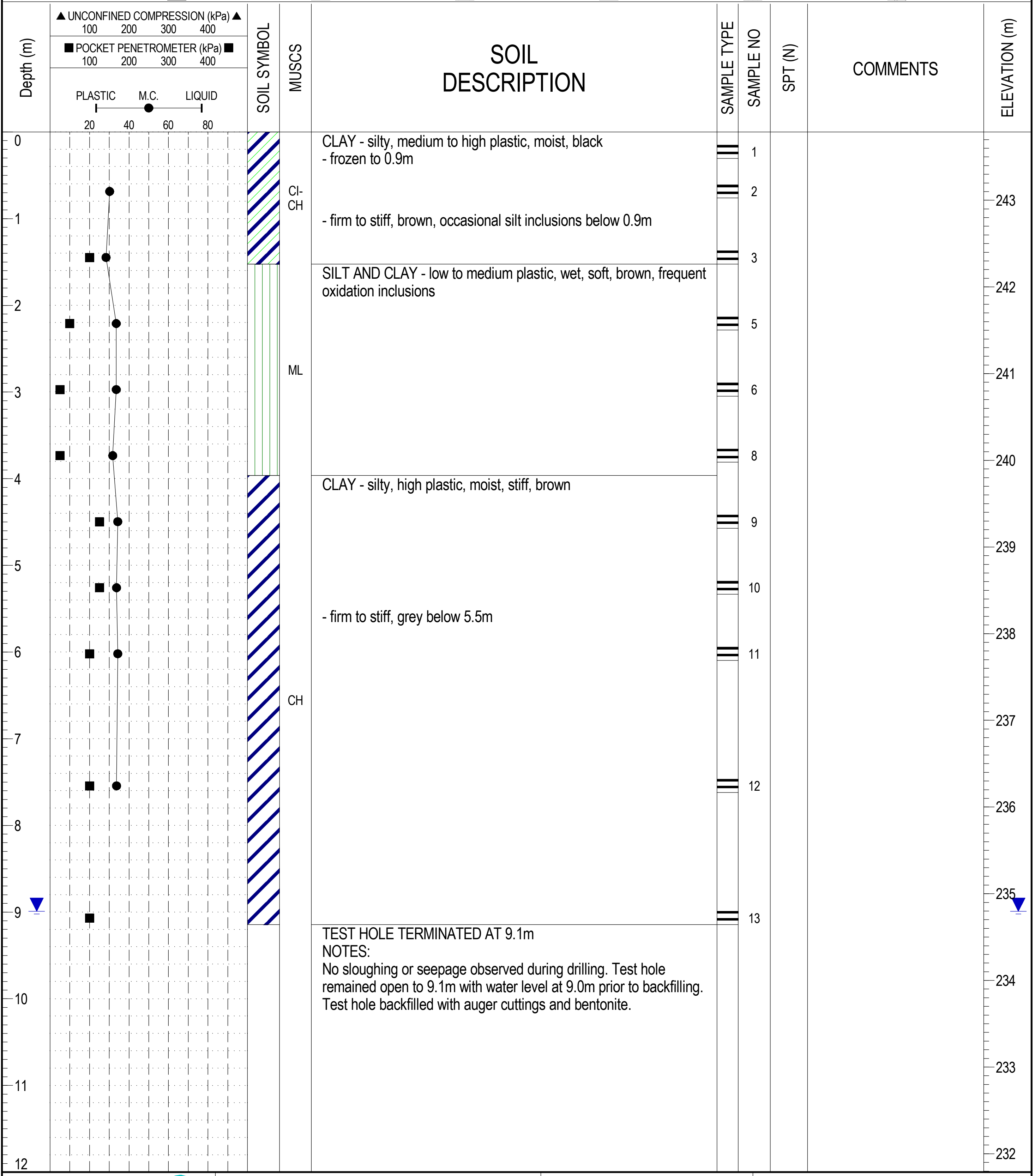
ELEVATION (m)
244
243
242
241
240
239
238
237
236
235
234
233

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 6.1 m
	REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
	Figure No. A19	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Maple Leaf	BORE HOLE NO: **TH20**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Track Mounted DR150	PROJECT NO: WX17367.1000
LOCATION: N5441577.2 E607313.1	DRILL METHOD: 125mm Solid Stem Augers	ELEVATION: 243.79 m

SAMPLE TYPE: ▩ Shelby Tube ◿ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▮ Core

BACKFILL TYPE: ■ Bentonite ⁚ Pea Gravel ▨ Drill Cuttings ⁖ Grout ▥ Slough ⁘ Sand



CLAY - silty, medium to high plastic, moist, black
- frozen to 0.9m

- firm to stiff, brown, occasional silt inclusions below 0.9m

SILT AND CLAY - low to medium plastic, wet, soft, brown, frequent oxidation inclusions

CLAY - silty, high plastic, moist, stiff, brown

- firm to stiff, grey below 5.5m

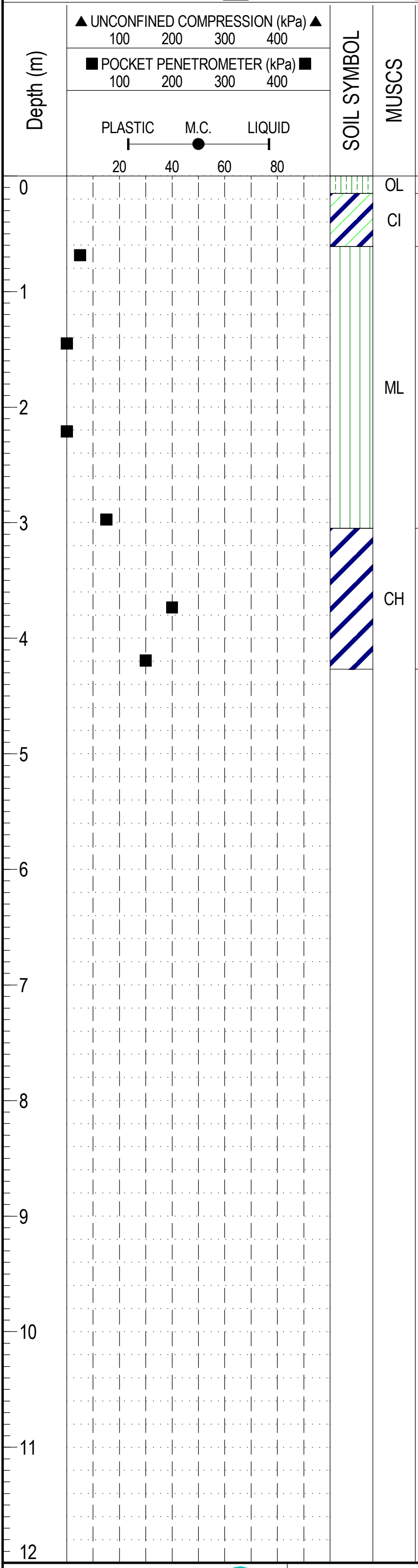
TEST HOLE TERMINATED AT 9.1m
NOTES:
No sloughing or seepage observed during drilling. Test hole remained open to 9.1m with water level at 9.0m prior to backfilling. Test hole backfilled with auger cuttings and bentonite.

AMEC Environment & Infrastructure **Winnipeg, Manitoba**	LOGGED BY: BK	COMPLETION DEPTH: 9.1 m
	REVIEWED BY: KJ	COMPLETION DATE: 17 March 2014
	Figure No. A20	Page 1 of 1

PROJECT: Altona Wastewater Treatment Facility	DRILLED BY: Giesbrecht Excavating Ltd.	BORE HOLE NO: **Trench 1**
CLIENT: J.R. Cousin Consultants Ltd.	DRILL TYPE: Backhoe	PROJECT NO: WX17367.1000
LOCATION: N5441473.7 E607007.5	DRILL METHOD: Test Pit	ELEVATION: 244.33 m

SAMPLE TYPE: ▨ Shelby Tube ◿ No Recovery ☒ SPT (N) ☰ Grab Sample ▥ Split-Pen ▌ Core

BACKFILL TYPE: ■ Bentonite ⁘ Pea Gravel ▨ Drill Cuttings ⁘ Grout ▥ Slough ⁘ Sand



MUSCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT (N)	COMMENTS
OL	ORGANIC CLAY - silty, low plastic, damp, frozen, black, occasional organic inclusions	☰	1		
CI	CLAY - silty, medium plastic, moist, frozen, brown				
ML	SILT - some clay, low plastic, damp, soft, grey, frequent oxidation inclusions - clayey below 1.5m	☰ ☰ ☰ ☰	2 3 4 5		
CH	CLAY - silty, high plastic, moist, firm, brown, frequent oxidation inclusions, frequent silt inclusions - stiff below 3.5m	☰ ☰	6 7		
	END OF HOLE @ 4.3m Trench open for 15 minutes upon completion, no groundwater accumulation observed. Test hole backfilled with auger cuttings.				

ELEVATION (m): 244, 243, 242, 241, 240, 239, 238, 237, 236, 235, 234, 233

AMEC Environment & Infrastructure Winnipeg, Manitoba	LOGGED BY: BK	COMPLETION DEPTH: 4.3 m
	REVIEWED BY: KJ	COMPLETION DATE: 18 March 2014
	Figure No. A21	Page 1 of 1

EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in these pages.

It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

*C	Consolidation test	*ST	Swelling test
D_R	Relative density	TV	Torvane shear strength
*k	Permeability coefficient	VS	Vane shear strength
*MA	Mechanical grain size analysis	w	Natural Moisture Content (ASTM D2216)
	and hydrometer test	w_l	Liquid limit (ASTM D 423)
N	Standard Penetration Test (CSA A119.1-60)	w_p	Plastic Limit (ASTM D 424)
N_d	Dynamic cone penetration test	E_f	Unit strain at failure
NP	Non plastic soil	γ	Unit weight of soil or rock
pp	Pocket penetrometer strength	γ_d	Dry unit weight of soil or rock
*q	Triaxial compression test	ρ	Density of soil or rock
q_u	Unconfined compressive strength	ρ_d	Dry Density of soil or rock
*SB	Shearbox test	C_u	Undrained shear strength
SO_4	Concentration of water-soluble sulphate	→	Seepage
		▼	Observed water level

* The results of these tests are usually reported separately

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual[2].

Relative Density and Consistency:

Cohesionless Soils

Relative Density	SPT (N) Value
Very Loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Cohesive Soils

Consistency	Undrained Shear Strength c_u (kPa)	Approximate SPT (N) Value
Very Soft	0-12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Standard Penetration Resistance ("N" value)
The number of blows by a 63.6kg hammer dropped 760 mm to drive a 50 mm diameter open sampler attached to "A" drill rods for a distance of 300 mm after an initial penetration of 150 mm.

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[1] "Unified Soil Classification System", Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army. Vol. 1 March 1953.

[2] "Canadian Foundation Engineering Manual", 3rd Edition, Canadian Geotechnical Society, 1992.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISIONS			SYMBOLS			TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
			USCS	GRAPH	COLOUR		
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75um)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW	▨	RED	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_u=D_{60}/D_{10}$ >4; $C_c=(D_{30})^2/(D_{10}xD_{60})$ = 1 to 3
			GP	▨	RED	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM	▨	YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			GC	▨	YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (TRACE OR NO FINES)	SW	▨	RED	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_u=D_{60}/D_{10}$ >6; $C_c=(D_{30})^2/(D_{10}xD_{60})$ = 1 to 3
			SP	▨	RED	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM	▨	YELLOW	SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR PI LESS THAN 4
			SC	▨	YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND PI MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75um)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML	▨	GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L > 50%	MH	▨	BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SAND OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL	▨	GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI	▨	GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH	▨	BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL	▨	GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH	▨	BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			PT	▨	ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

SPECIAL SYMBOLS

LIMESTONE	▦	OILSAND	○
SANDSTONE	⁘	SHALE	▤
SILTSTONE	⁘	FILL (UNDIFFERENTIATED)	▩

SOIL COMPONENTS

FRACTION	U.S. STANDARD METRIC SIEVE SIZE	
	PASSING	RETAINED
GRAVEL		
COARSE	76mm	19mm
FINE	19mm	4.75mm
SAND		
COARSE	4.75mm	2.00mm
MEDIUM	2.00mm	425μm
FINE	425μm	75μm
FINES (SILT OR CLAY BASED ON PLASTICITY)	75μm	

DEFINING RANGES OF PERCENT BY WEIGHT OF MINOR COMPONENTS	
PERCENT	DESCRIPTOR
35 - 50	AND
30 - 35	Y / EY
10 - 20	SOME
1 - 10	TRACE

OVERSIZED MATERIAL

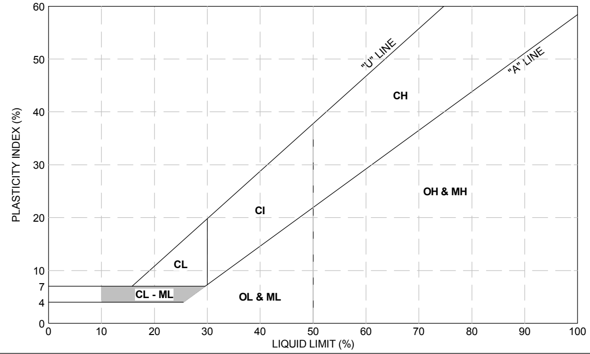
ROUNDED OR SUBROUNDED:

COBBLES 76mm to 200mm
BOULDERS > 200mm

NOT ROUNDED:

ROCK FRAGMENTS ? 76mm
ROCKS > 0.76 CUBIC METRE IN VOLUME

PLASTICITY CHART FOR SOILS PASSING 425μm SIEVE



NOTES:

1. ALL SIEVE SIZES MENTIONED ARE U.S. STANDARD ASTM E.11.
2. COARSE GRAINED SOILS WITH TRACE TO SOME FINES GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH TRACE TO SOME CLAY.
3. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited

APPENDIX B

HYDRAULIC CONDUCTIVITY REPORT

CSA CERTIFIED CONCRETE TESTING LABORATORY
IN ACCORDANCE WITH STD A 283

ASTM D 5084

TO: Jason Cousin
J. R. Cousin Consultants Ltd.
95 Scurfield Blvd.
Winnipeg MB R3Y 1G4

PROJECT NO: WX17367
CLIENT: J. R. Cousin Consultants Ltd.
DATE SUBMITTED: 02-Apr-14

PROJECT: Altona Wastewater Treatment Facility (AWTF) Upgrades

---

TEST HOLE: TH17
SAMPLE NO.: S04
SAMPLE DEPTH: 5-7ft

PERMEANT: De-Aired Tap Water
HYDRAULIC GRADIENT: 9.48

CONSTANT HEAD METHOD (K = cQL/thA)

	Sample Height, L (cm)	Sample Dia. (cm)	Water Content (%)	Dry Density (kg/m^3)	Degree of Saturation (%)	Cell Pressure (kPa)	Back Pressure (kPa)	Differential Pressure, h (kPa)
Initial	7.42	7.17	23.4%	1655	97.3%	241.4	203.4	6.9
Final	7.42	7.15	24.9%	1641	101.3%			

Date & Time		Time, t	Flow (Q)		Temp. Corr, c	Hyd. Cond. Corrected, K
Start	End	(seconds)	Influent (ml)	Effluent (ml)		(cm/s)
4/21/14 8:20 AM	4/21/14 10:00 AM	6000	7.85	1.85	1.262	2.67E-06
4/21/14 10:00 AM	4/21/14 12:02 PM	7320	1.95	1.95	1.029	7.17E-07
4/21/14 12:02 PM	4/21/14 2:20 PM	8280	1.90	1.90	1.029	6.17E-07
4/21/14 2:20 PM	4/21/14 5:02 PM	9720	2.05	2.10	1.029	5.74E-07
4/21/14 5:02 PM	4/21/14 6:28 PM	5160	2.10	2.15	1.029	1.11E-06
4/21/14 6:28 PM	4/21/14 8:53 PM	8700	3.15	3.25	1.029	9.89E-07
4/21/14 8:53 PM	4/21/14 10:21 PM	5280	1.90	1.70	1.029	9.17E-07
4/21/14 10:21 PM	4/21/14 11:39 PM	4680	1.40	1.60	1.029	8.62E-07
4/21/14 11:39 PM	4/22/14 1:06 AM	5220	1.65	1.70	1.029	8.63E-07
4/22/14 1:06 AM	4/22/14 2:27 AM	4860	1.45	1.45	1.029	8.02E-07

Soil Description: CLAY -and silt, trace sand, medium plastic, moist, firm, greyish brown, silt lenses (>0.5cm)

Average Temperature Corrected Value (cm/s): 8.61E-07

AMEC Environment & Infrastructure
A Division of AMEC Americals Limited

Per: Brad

Brad Wiebe, M.Sc., P.Eng.
Associate Geotechnical Engineer

Reporting of these results constitutes a testing service only.
Engineering interpretation or evaluation of the test results is provided only on written request.

HYDRAULIC CONDUCTIVITY REPORT

CSA CERTIFIED CONCRETE TESTING LABORATORY
IN ACCORDANCE WITH STD A 283

ASTM D 5084

TO: Jason Cousin
J. R. Cousin Consultants Ltd.
95 Scurfield Blvd.
Winnipeg MB R3Y 1G4

PROJECT NO: WX17367
CLIENT: J. R. Cousin Consultants Ltd.
DATE SUBMITTED: 02-Apr-14

PROJECT: Altona Wastewater Treatment Facility (AWTF) Upgrades

TEST HOLE: TH05
SAMPLE NO.: S07
SAMPLE DEPTH: 12-14ft

PERMEANT: De-Aired Tap Water
HYDRAULIC GRADIENT: 29.03

CONSTANT HEAD METHOD (K = cQL/thA)

	Sample Height, L (cm)	Sample Dia. (cm)	Water Content (%)	Dry Density (kg/m^3)	Degree of Saturation (%)	Cell Pressure (kPa)	Back Pressure (kPa)	Differential Pressure, h (kPa)
Initial	7.27	7.15	35.3%	1375	97.0%	241.4	196.5	20.7
Final	7.28	7.14	38.0%	1356	101.6%			

Date & Time		Time, t	Flow (Q)		Temp.	Hyd. Cond.
Start	End	(seconds)	Influent (ml)	Effluent (ml)	Corr, c	Corrected, K (cm/s)
4/21/14 7:41 AM	4/21/14 5:04 PM	33780	2.90	3.15	1.262	9.70E-08
4/21/14 5:04 PM	4/22/14 7:23 AM	51540	4.15	4.20	1.029	7.15E-08
4/22/14 7:23 AM	4/22/14 11:13 AM	13800	1.20	1.10	1.029	7.36E-08
4/22/14 11:13 AM	4/22/14 2:00 PM	10020	0.80	0.90	1.029	7.49E-08
4/22/14 2:00 PM	4/22/14 4:46 PM	9960	0.85	0.80	1.029	7.31E-08

Soil Description: CLAY -and silt, trace sand, medium plastic, moist, firm, greyish brown, silt lenses (>0.5cm)

Average Temperature Corrected Value (cm/s): 7.33E-08

AMEC Environment & Infrastructure
A Division of AMEC Americals Limited

Per: Brad W

Brad Wiebe, M.Sc., P.Eng.
Associate Geotechnical Engineer

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HYDRAULIC CONDUCTIVITY REPORT

CSA CERTIFIED CONCRETE TESTING LABORATORY
IN ACCORDANCE WITH STD A 283

amec

ASTM D 5084

TO:	Jason Cousin J. R. Cousin Consultants Ltd. 95 Scurfield Blvd. Winnipeg MB R3Y 1G4	**PROJECT NO:** **CLIENT:** **DATE SUBMITTED:**	WX17367 J. R. Cousin Consultants Ltd. 02-Apr-14

PROJECT: Altona Wastewater Treatment Facility (AWTF) Upgrades

---

TEST HOLE:	TH17	**PERMEANT:**	De-Aired Tap Water
SAMPLE NO.:	S5-13	**HYDRAULIC GRADIENT:**	28.33
SAMPLE DEPTH:	7-30ft		

CONSTANT HEAD METHOD (K = cQL/thA)

	Sample Height, L (cm)	Sample Dia. (cm)	Water Content (%)	Dry Density (kg/m^3)	Degree of Saturation (%)	Cell Pressure (kPa)	Back Pressure (kPa)	Differential Pressure, h (kPa)
Initial	7.44	7.14	34.3%	1375	94.5%	241.4	196.5	20.7
Final	7.45	7.18	37.4%	1357	100.1%			

Date & Time		Time, t (seconds)	Flow (Q)		Temp. Corr, c	Hyd. Cond. Corrected, K (cm/s)
Start	End		Influent (ml)	Effluent (ml)		
6/9/14 9:17 AM	6/10/14 8:10 AM	82380	0.65	0.60	1.250	8.36E-09
6/10/14 8:10 AM	6/11/14 7:36 AM	84360	0.45	0.40	1.005	4.46E-09
6/11/14 7:36 AM	6/12/14 7:47 AM	87060	0.50	0.40	1.005	4.58E-09
6/12/14 7:47 AM	6/13/14 8:10 AM	87780	0.50	0.45	1.005	4.79E-09
6/13/14 8:10 AM	6/16/14 7:41 AM	257460	1.35	1.40	1.005	4.73E-09

Soil Description: CLAY (REMOULD) - silty, trace sand,
high plastic, moist, firm, greyish brown

Standard Proctor Maximum Dry Density:	1368 kg/m^3
Optimum Moisture Content (OMC):	32.4 %
Percent of SPMDD Achieved:	100.5 %

Average Temperature Corrected Value (cm/s): 4.64E-09

AMEC Environment & Infrastructure

A Division of AMEC Americals Limited

Per:

Brad Wiebe, M.Sc., P.Eng.
Associate Geotechnical Engineer

Reporting of these results constitutes a testing service only.
Engineering interpretation or evaluation of the test results is provided only on written request.

MOISTURE - DENSITY RELATIONSHIP

TO: JR Cousin Consultants
91A Scurfield Blvd
Winnipeg, Manitoba
R3Y 1G4

PROJECT NO.: WX17367
C.C.:

ATTN: Jason Cousin

PROJECT: AWTF Upgrades

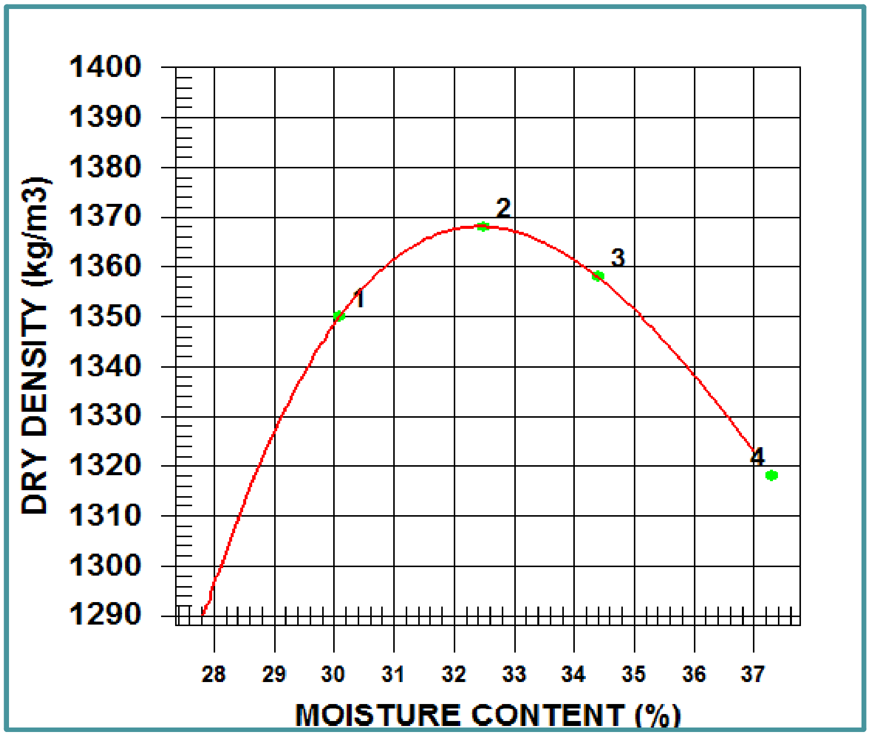
COMPACTION STANDARD: Standard Proctor, ASTM D698

COMPACTION PROCEDURE: A: 101.6mm Mold, Passing 4.75mm

DRY DENSITY kg/m3	1350	1368	1358	1318
MOISTURE CONTENT %	30.1	32.5	34.4	37.3
Trial #:	1	2	3	4

Maxium Dry Density kg/m3: 1368
Optimum Moisture Content %: 32.4

CORRECTED: kg/m3
%



TEST NO.: 1
SOURCE: TH17
SUPPLIER: Not Provided
DATE TESTED: 30-May-2014
DATE SAMPLED: 29-May-2014
DATE RECEIVED: 29-May-2014
SAMPLED BY: AMEC (AL)
TESTED BY: VM

RAMMER TYPE: Automatic
PREPARATION: Moist
OVERSIZE CORRECTION METHOD: None
RETAINED 4.75mm SCREEN %

MAJOR DESCRIPTION: Grab

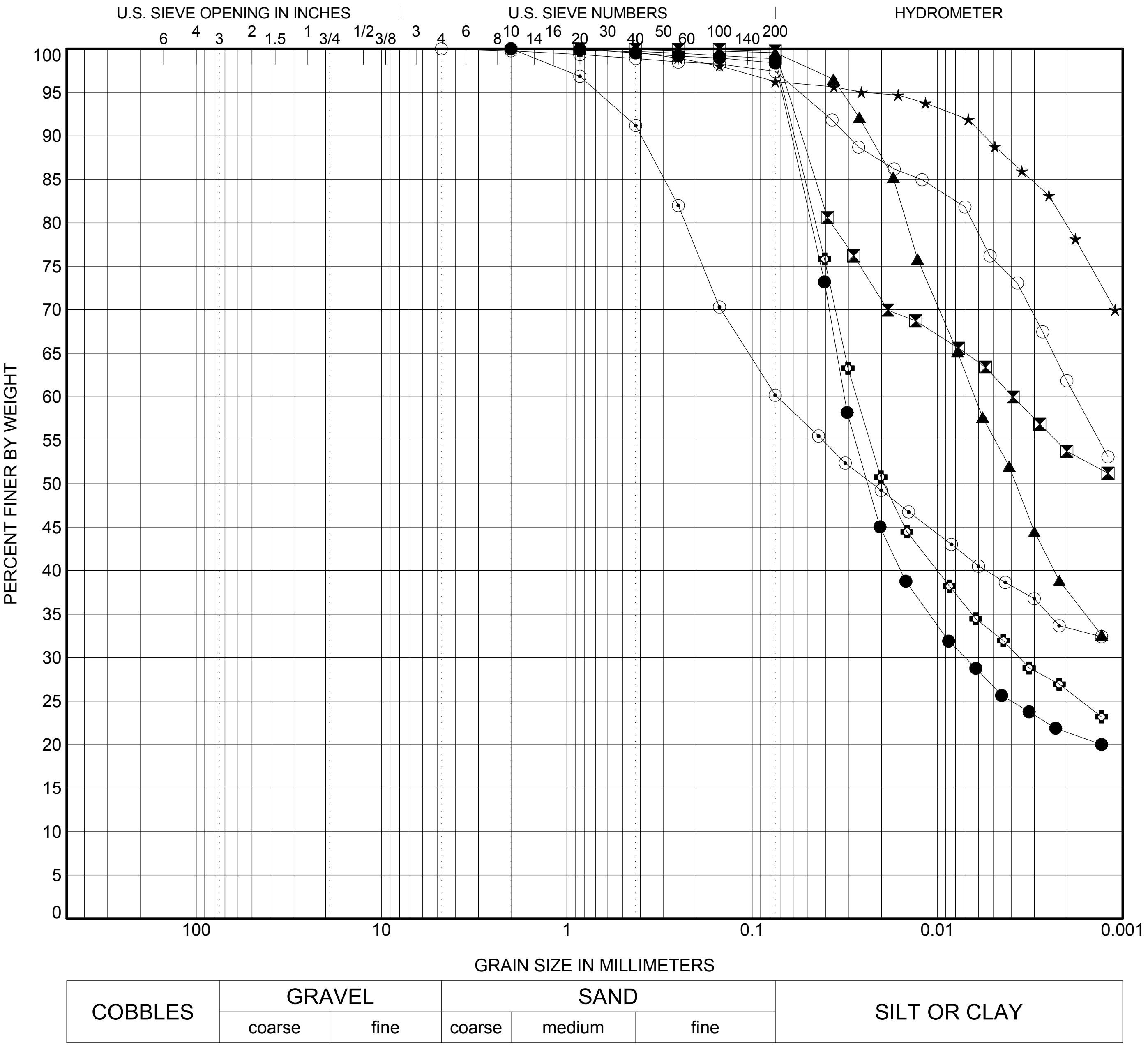
AMEC Environment & Infrastructure

COMMENTS:

PER.

For technical questions please contact;
Trevor Gluck, P. Eng. - Manager; Technical Services

Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of test results is provided only on written request.



	Sample ID	Depth	MC	LL	PL	PI	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH02**	**2.9 m**	**35.4**	**33**	**20**	**13**	**2**	**0.032**	**0.007**		**0.0**	**1.6**	**76.9**	**21.4**
⧗	**TH03**	**0.6 m**	**35.3**	**60**	**22**	**38**	**0.85**	**0.004**			**0.0**	**0.3**	**46.0**	**53.7**
▲	**TH05**	**3 m**		**42**	**20**	**22**	**0.85**	**0.006**			**0.0**	**0.5**	**61.8**	**37.7**
★	**TH08**	**4.4 m**	**50.2**	**96**	**28**	**68**	**0.85**				**0.0**	**3.8**	**16.5**	**79.7**
⊙	**TH15**	**2.1 m**	**32.1**	**44**	**19**	**25**	**2**	**0.074**			**0.0**	**39.8**	**26.7**	**33.4**
✿	**TH17**	**1.5 m**	**23.4**	**30**	**17**	**13**	**2**	**0.027**	**0.004**		**0.0**	**1.1**	**72.6**	**26.3**
○	**TH17**	**4.4 m**	**43.3**	**66**	**18**	**48**	**4.75**	**0.002**			**0.0**	**2.6**	**35.6**	**61.8**

AMEC Environment & Infrastructure
440 Dovercourt Drive
Winnipeg, MB. R3Y 1N4
PHONE: (204) 488-2997 FAX: (204) 489-8261

CLIENT LOGO:

CLIENT:
J.R. Cousin Consultants Ltd.

PROJECT: Altona Wastewater Treatment Facility

TITLE: PARTICLE SIZE DISTRIBUTION
& MOISTURE CONTENT & ATTERBERG LIMIT RESULTS

DRAWN BY: KWJ
DATUM: N/A
DATE: 24 June 2014
CHK'D BY: KWJ
REV. NO.: 0
PROJECT No.: WX17367.1000
PROJECTION: N/A
SCALE: AS SHOWN
FIGURE No.: **1.1**

17367 ALTONA WASTEWATER TREATMENT FACILITY.GPJ 14/06/24 09:58 AM (WPG - GRAIN SIZE WITH ATTERBERG & MC)

Appendix C

Sewage Sample Data

Town of Altona
ATTN: STEVE WIEBE
Box 1630
Altona MB R0G 0B0

Date Received:	06-MAR-14
Report Date:	14-MAR-14 15:29 (MT)
Version:	FINAL

Client Phone: 204-324-6439

Certificate of Analysis

Lab Work Order #:	**L1429490**
Project P.O. #:	NOT SUBMITTED
Job Reference:	BUNGE 3
C of C Numbers:	
Legal Site Desc:	

Paul Nicolas

Paul Nicolas
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1429490-1 TOWN OF ALTONA							
Sampled By: CLIENT							
Matrix: Water							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	0.309		0.050	mg/L		07-MAR-14	R2802373
Nitrate+Nitrite							
Nitrate and Nitrite as N	0.309		0.071	mg/L		11-MAR-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		07-MAR-14	R2802373
Miscellaneous Parameters							
Biochemical Oxygen Demand	240		6.0	mg/L		06-MAR-14	R2802896
Chemical Oxygen Demand	1310	DLA	100	mg/L		07-MAR-14	R2801306
Chloride	22.8		0.50	mg/L		07-MAR-14	R2802373
Mercury (Hg)-Total	<0.000020		0.000020	mg/L	13-MAR-14	13-MAR-14	R2804594
Oil and Grease, Total	557		2.0	mg/L	11-MAR-14	11-MAR-14	R2803890
Orthophosphate-Dissolved (as P)	0.338		0.010	mg/L		11-MAR-14	R2802997
Phosphorus (P)-Total	1.35		0.010	mg/L		10-MAR-14	R2802383
Phosphorus (P)-Total Dissolved	0.515		0.010	mg/L		13-MAR-14	R2804458
Sulfate	58.0		0.50	mg/L		07-MAR-14	R2802373
Total Kjeldahl Nitrogen	9.8	DLA	1.0	mg/L	08-MAR-14	11-MAR-14	R2802876
Total Suspended Solids	330		5.0	mg/L		07-MAR-14	R2802075
pH	10.52		0.10	pH units		07-MAR-14	R2801316
Alkalinity							
Alkalinity, Total (as CaCO3)	291		20	mg/L		07-MAR-14	R2801316
Bicarbonate (HCO3)	39		24	mg/L		07-MAR-14	R2801316
Carbonate (CO3)	155		12	mg/L		07-MAR-14	R2801316
Hydroxide (OH)	<6.8		6.8	mg/L		07-MAR-14	R2801316
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.285		0.020	mg/L	08-MAR-14	10-MAR-14	R2802626
Antimony (Sb)-Total	0.0039		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Arsenic (As)-Total	0.0214		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Barium (Ba)-Total	0.0502		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Bismuth (Bi)-Total	0.00131		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Boron (B)-Total	0.077		0.030	mg/L	08-MAR-14	10-MAR-14	R2802626
Cadmium (Cd)-Total	<0.00020		0.00020	mg/L	08-MAR-14	10-MAR-14	R2802626
Calcium (Ca)-Total	33.6		0.20	mg/L	08-MAR-14	10-MAR-14	R2802626
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Chromium (Cr)-Total	0.0078		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Cobalt (Co)-Total	0.0106		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Copper (Cu)-Total	0.0177		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Iron (Fe)-Total	1.94		0.10	mg/L	08-MAR-14	10-MAR-14	R2802626
Lead (Pb)-Total	0.0017		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Lithium (Li)-Total	0.0390		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Magnesium (Mg)-Total	15.4		0.050	mg/L	08-MAR-14	10-MAR-14	R2802626
Manganese (Mn)-Total	0.0436		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Molybdenum (Mo)-Total	0.00263		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Nickel (Ni)-Total	0.0435		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Phosphorus (P)-Total	1.19		0.50	mg/L	08-MAR-14	10-MAR-14	R2802626
Potassium (K)-Total	10.3		0.10	mg/L	08-MAR-14	10-MAR-14	R2802626
Rubidium (Rb)-Total	0.00432		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Selenium (Se)-Total	<0.0050		0.0050	mg/L	08-MAR-14	10-MAR-14	R2802626
Silicon (Si)-Total	5.62		0.30	mg/L	08-MAR-14	10-MAR-14	R2802626
Silver (Ag)-Total	<0.0010		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1429490-1 TOWN OF ALTONA							
Sampled By: CLIENT							
Matrix: Water							
Total Metals by ICP-MS							
Sodium (Na)-Total	241		0.050	mg/L	08-MAR-14	10-MAR-14	R2802626
Strontium (Sr)-Total	0.158		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	08-MAR-14	10-MAR-14	R2802626
Thorium (Th)-Total	<0.0010		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Tin (Sn)-Total	0.00099		0.00060	mg/L	08-MAR-14	10-MAR-14	R2802626
Titanium (Ti)-Total	0.0123		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Tungsten (W)-Total	<0.0020		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Uranium (U)-Total	<0.00050		0.00050	mg/L	08-MAR-14	10-MAR-14	R2802626
Vanadium (V)-Total	0.0023		0.0020	mg/L	08-MAR-14	10-MAR-14	R2802626
Zinc (Zn)-Total	0.251		0.020	mg/L	08-MAR-14	10-MAR-14	R2802626
Zirconium (Zr)-Total	<0.0010		0.0010	mg/L	08-MAR-14	10-MAR-14	R2802626
Un-ionized Ammonia at 15C WSER							
Ammonia by colour							
Ammonia, Total (as N)	3.8	DLA	1.0	mg/L		11-MAR-14	R2803352
Un-ionized Ammonia at 15C, WSER							
Ammonia, Un-ionized (as N), 15C, WSER	3.20		0.85	mg/L		12-MAR-14	
pH in Water (at 15C)							
pH at 15C, WSER	10.31		0.10	pH		08-MAR-14	R2801621

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-WP	Water	Alkalinity	APHA 2320B

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B

The sample is incubated for 5 days at 20 degrees Celcius. Comparison of dissolved oxygen content at the beginning and end of incubation provides a measure of biochemical oxygen demand. If carbonaceous BOD is requested, TCMP is added to the sample to chemically inhibit nitrogenous oxygen demand. If soluble BOD is requested, the sample is filtered prior to analysis. Surface waters have a DL of 1 mg/L. Effluents are diluted according to their history and will have a sample DL of 6 mg/L or greater, depending on the dilutions used.

CL-IC-WP	Water	Chloride by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

COD-WP	Water	Chemical Oxygen Demand	APHA 5220 D

The Chemical Oxygen Demand (COD) test is used to estimate the amount of organic matter in the water. The sample is added to HACH brand COD tubes, which contain a premixed volume of reagents. The sample is then heated for two hours on the COD reactor with a strong oxidizing agent, potassium dichromate. The COD reagents also contain silver and mercury ions. Silver is used as a catalyst and mercury is used to complex chloride interference. Oxidizable organic compounds react, reducing the dichromate ion to green chromic ion.

For the 10 - 150 mg/L range the remaining Cr6+ is measured colormetrically and a decrease in absorbance at 420 nm is proportional to the COD. For the 100 - 1500 mg/L range the amount of Cr3+ produced is measured colormetrically and an increase in absorbance at 620 nm is proportional to the COD. Samples with concentrations > 1500 mg/L can be diluted into either linear range.

HG-T-CVAF-WP	Water	Mercury Total	EPA245.7 V2.0

Mercury in filtered and unfiltered waters is oxidized with Bromine monochloride and analyzed by cold-vapour atomic fluorescence spectrometry.

MET-T-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-T

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen	Quickchem method 10-107-06-2-E Lachat

Samples are digested with a sulphuric acid solution, cooled, diluted with water, and analyzed for ammonia. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulphate through this digestion process. Analysis is performed by Flow Injection
Analysis (FIA). The pH of the digested sample is raised to a known, basic pH by neutralization with a concentrated buffer solution. This neutralization converts the ammonium cation to ammonia. The ammonia produced is heated with saliclyate and hypochlorite to produce blue colour which is proportional to the ammonia concentration.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NH3-UNION-15-CALC-WP	Water	Un-ionized Ammonia at 15C, WSER	WSER 29June2012

Un-ionized Ammonia at 15C is calculated from test results for Total Ammonia and for pH at 15C, as per the federal Wastewater Systems Effluent Regulation, and is expressed in units of mg/L "as N".

NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

Reference Information

Test Method References:

<table>
<tr><th>ALS Test Code</th><th>Matrix</th><th>Test Description</th><th>Method Reference**</th></tr>
<tr><td>OGG-TOT-WT</td><td>Water</td><td>Oil and Grease, Total</td><td>APHA 5520 B</td></tr>
<tr><td colspan="4">Sample is extracted with hexane, extract is then evaporated and the residue is weighed to determine total oil and grease.</td></tr>
<tr><td>P-T-COL-WP</td><td>Water</td><td>Phosphorus, Total</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.</td></tr>
<tr><td>P-TD-COL-WP</td><td>Water</td><td>Phosphorus, Total Dissolved</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.</td></tr>
<tr><td>PH-15C-MAN-WP</td><td>Water</td><td>pH in Water (at 15C)</td><td>APHA 4500-H+ B (2000)</td></tr>
<tr><td colspan="4">pH at 15C is determined by the electrometric method after equilibration of test samples and pH buffer solutions to 15 +/- 1 C, and is used to calculate Un-Ionized Ammonia for the federal Wastewater Systems Effluent Regulation. A 5 day recommended hold time is based on the trout acute lethality test, which pH at 15C is intended to represent.</td></tr>
<tr><td>PH-WP</td><td>Water</td><td>pH</td><td>APHA 4500H</td></tr>
<tr><td colspan="4">The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.</td></tr>
<tr><td>PO4-DO-COL-WP</td><td>Water</td><td>Phosphate Ortho Dissolved in Water</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.</td></tr>
<tr><td>SO4-IC-WP</td><td>Water</td><td>Sulfate by Ion Chromatography</td><td>EPA 300.1 (modified)</td></tr>
<tr><td colspan="4">Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.</td></tr>
<tr><td>SOLIDS-TOTSUS-WP</td><td>Water</td><td>Total Suspended Solids</td><td>APHA 2540 D (modified)</td></tr>
<tr><td colspan="4">Total suspended solids in aquesous matrices is determined gravimetrically after drying the residue at 103 105°C.</td></tr>
</table>

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS
Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Town of Altona
ATTN: STEVE WIEBE
Box 1630
Altona MB R0G 0B0

Date Received:	26-MAR-14
Report Date:	04-APR-14 07:20 (MT)
Version:	FINAL

Client Phone: 204-324-6439

Certificate of Analysis

Lab Work Order #:	**L1436515**
Project P.O. #:	NOT SUBMITTED
Job Reference:	
C of C Numbers:	
Legal Site Desc:	

Judy Dalmaijer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1436515-1 TOWN OF ALTON							
Sampled By: Clint							
Matrix: Water							
Nitrate + Nitrite							
Nitrate as N by Ion Chromatography							
Nitrate-N	1.31		0.25	mg/L		26-MAR-14	R2811662
Nitrate+Nitrite							
Nitrate and Nitrite as N	1.59		0.35	mg/L		27-MAR-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	0.27		0.25	mg/L		26-MAR-14	R2811662
Miscellaneous Parameters							
Biochemical Oxygen Demand	301		6.0	mg/L		26-MAR-14	R2813244
Chemical Oxygen Demand	809		20	mg/L		28-MAR-14	R2812223
Chloride	1930		2.5	mg/L		26-MAR-14	R2811662
Mercury (Hg)-Total	<0.00020	DLM	0.00020	mg/L	01-APR-14	01-APR-14	R2814602
Oil and Grease, Total	94.5		2.0	mg/L	01-APR-14	01-APR-14	R2815432
Orthophosphate-Dissolved (as P)	0.397		0.010	mg/L		01-APR-14	R2813754
Phosphorus (P)-Total	3.20		0.010	mg/L		01-APR-14	R2813828
Phosphorus (P)-Total Dissolved	0.510		0.010	mg/L		01-APR-14	R2813828
Sulfate	315		2.5	mg/L		26-MAR-14	R2811662
Total Kjeldahl Nitrogen	15.8	DLA	2.0	mg/L	27-MAR-14	28-MAR-14	R2812043
Total Suspended Solids	28.0		5.0	mg/L		27-MAR-14	R2812083
pH	7.52		0.10	pH units		26-MAR-14	R2811240
Alkalinity							
Alkalinity, Total (as CaCO3)	384		20	mg/L		26-MAR-14	R2811240
Bicarbonate (HCO3)	469		24	mg/L		26-MAR-14	R2811240
Carbonate (CO3)	<12		12	mg/L		26-MAR-14	R2811240
Hydroxide (OH)	<6.8		6.8	mg/L		26-MAR-14	R2811240
Total Metals by ICP-MS							
Aluminum (Al)-Total	0.557		0.020	mg/L	28-MAR-14	28-MAR-14	R2813017
Antimony (Sb)-Total	0.0017		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Arsenic (As)-Total	0.0033		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Barium (Ba)-Total	0.251		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Beryllium (Be)-Total	<0.0010		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Bismuth (Bi)-Total	0.00394		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Boron (B)-Total	0.103		0.030	mg/L	28-MAR-14	28-MAR-14	R2813017
Cadmium (Cd)-Total	0.00033		0.00020	mg/L	28-MAR-14	28-MAR-14	R2813017
Calcium (Ca)-Total	193		0.20	mg/L	28-MAR-14	28-MAR-14	R2813017
Cesium (Cs)-Total	<0.00050		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Chromium (Cr)-Total	0.0043		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Cobalt (Co)-Total	0.00215		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Copper (Cu)-Total	0.0777		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Iron (Fe)-Total	3.79		0.10	mg/L	28-MAR-14	28-MAR-14	R2813017
Lead (Pb)-Total	0.0042		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Lithium (Li)-Total	0.0706		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Magnesium (Mg)-Total	47.6		0.050	mg/L	28-MAR-14	28-MAR-14	R2813017
Manganese (Mn)-Total	0.0720		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Molybdenum (Mo)-Total	0.00436		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Nickel (Ni)-Total	0.0072		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Phosphorus (P)-Total	4.68		0.50	mg/L	28-MAR-14	28-MAR-14	R2813017
Potassium (K)-Total	20.6		0.10	mg/L	28-MAR-14	28-MAR-14	R2813017
Rubidium (Rb)-Total	0.00966		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Selenium (Se)-Total	<0.0050		0.0050	mg/L	28-MAR-14	28-MAR-14	R2813017
Silicon (Si)-Total	8.04		0.30	mg/L	28-MAR-14	28-MAR-14	R2813017
Silver (Ag)-Total	<0.0010		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1436515-1 TOWN OF ALTON							
Sampled By: Clint							
Matrix: Water							
Total Metals by ICP-MS							
Sodium (Na)-Total	1070		0.050	mg/L	28-MAR-14	28-MAR-14	R2813017
Strontium (Sr)-Total	0.706		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Tellurium (Te)-Total	<0.0010		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Thallium (Tl)-Total	<0.0050		0.0050	mg/L	28-MAR-14	28-MAR-14	R2813017
Thorium (Th)-Total	<0.0010		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Tin (Sn)-Total	0.00241		0.00060	mg/L	28-MAR-14	28-MAR-14	R2813017
Titanium (Ti)-Total	0.0097		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Tungsten (W)-Total	<0.0020		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Uranium (U)-Total	0.00615		0.00050	mg/L	28-MAR-14	28-MAR-14	R2813017
Vanadium (V)-Total	0.0047		0.0020	mg/L	28-MAR-14	28-MAR-14	R2813017
Zinc (Zn)-Total	0.710		0.020	mg/L	28-MAR-14	28-MAR-14	R2813017
Zirconium (Zr)-Total	0.0014		0.0010	mg/L	28-MAR-14	28-MAR-14	R2813017
Un-ionized Ammonia at 15C WSER							
Ammonia by colour							
Ammonia, Total (as N)	13.2	DLA	1.0	mg/L		26-MAR-14	R2811282
Un-ionized Ammonia at 15C, WSER							
Ammonia, Un-ionized (as N), 15C, WSER	0.113		0.0086	mg/L		03-APR-14	
pH in Water (at 15C)							
pH at 15C, WSER	7.50		0.10	pH		29-MAR-14	R2815498

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-WP	Water	Alkalinity	APHA 2320B

Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.

BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B

The sample is incubated for 5 days at 20 degrees Celcius. Comparison of dissolved oxygen content at the beginning and end of incubation provides a measure of biochemical oxygen demand. If carbonaceous BOD is requested, TCMP is added to the sample to chemically inhibit nitrogenous oxygen demand. If soluble BOD is requested, the sample is filtered prior to analysis. Surface waters have a DL of 1 mg/L. Effluents are diluted according to their history and will have a sample DL of 6 mg/L or greater, depending on the dilutions used.

CL-IC-WP	Water	Chloride by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

COD-WP	Water	Chemical Oxygen Demand	APHA 5220 D

The Chemical Oxygen Demand (COD) test is used to estimate the amount of organic matter in the water. The sample is added to HACH brand COD tubes, which contain a premixed volume of reagents. The sample is then heated for two hours on the COD reactor with a strong oxidizing agent, potassium dichromate. The COD reagents also contain silver and mercury ions. Silver is used as a catalyst and mercury is used to complex chloride interference. Oxidizable organic compounds react, reducing the dichromate ion to green chromic ion.

For the 10 - 150 mg/L range the remaining Cr6+ is measured colormetrically and a decrease in absorbance at 420 nm is proportional to the COD. For the 100 - 1500 mg/L range the amount of Cr3+ produced is measured colormetrically and an increase in absorbance at 620 nm is proportional to the COD. Samples with concentrations > 1500 mg/L can be diluted into either linear range.

HG-T-CVAF-WP	Water	Mercury Total	EPA245.7 V2.0

Mercury in filtered and unfiltered waters is oxidized with Bromine monochloride and analyzed by cold-vapour atomic fluorescence spectrometry.

MET-T-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-T

This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

N-TOTKJ-WP	Water	Total Kjeldahl Nitrogen	Quickchem method 10-107-06-2-E Lachat

Samples are digested with a sulphuric acid solution, cooled, diluted with water, and analyzed for ammonia. Total Kjeldahl nitrogen is the sum of free-ammonia and organic nitrogen compounds which are converted to ammonium sulphate through this digestion process. Analysis is performed by Flow Injection Analysis (FIA). The pH of the digested sample is raised to a known, basic pH by neutralization with a concentrated buffer solution. This neutralization converts the ammonium cation to ammonia. The ammonia produced is heated with saliclyate and hypochlorite to produce blue colour which is proportional to the ammonia concentration.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NH3-UNION-15-CALC-WP	Water	Un-ionized Ammonia at 15C, WSER	WSER 29June2012

Un-ionized Ammonia at 15C is calculated from test results for Total Ammonia and for pH at 15C, as per the federal Wastewater Systems Effluent Regulation, and is expressed in units of mg/L "as N".

NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)

Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.

NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)

Reference Information

Test Method References:

<table>
<tr><th>ALS Test Code</th><th>Matrix</th><th>Test Description</th><th>Method Reference**</th></tr>
<tr><td colspan="4">Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.</td></tr>
<tr><td>OGG-TOT-WT</td><td>Water</td><td>Oil and Grease, Total</td><td>APHA 5520 B</td></tr>
<tr><td colspan="4">Sample is extracted with hexane, extract is then evaporated and the residue is weighed to determine total oil and grease.</td></tr>
<tr><td>P-T-COL-WP</td><td>Water</td><td>Phosphorus, Total</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.</td></tr>
<tr><td>P-TD-COL-WP</td><td>Water</td><td>Phosphorus, Total Dissolved</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.</td></tr>
<tr><td>PH-15C-MAN-WP</td><td>Water</td><td>pH in Water (at 15C)</td><td>APHA 4500-H+ B (2000)</td></tr>
<tr><td colspan="4">pH at 15C is determined by the electrometric method after equilibration of test samples and pH buffer solutions to 15 +/- 1 C, and is used to calculate Un-Ionized Ammonia for the federal Wastewater Systems Effluent Regulation. A 5 day recommended hold time is based on the trout acute lethality test, which pH at 15C is intended to represent.</td></tr>
<tr><td>PH-WP</td><td>Water</td><td>pH</td><td>APHA 4500H</td></tr>
<tr><td colspan="4">The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.</td></tr>
<tr><td>PO4-DO-COL-WP</td><td>Water</td><td>Phosphate Ortho Dissolved in Water</td><td>APHA 4500 P PHOSPHORUS</td></tr>
<tr><td colspan="4">This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.</td></tr>
<tr><td>SO4-IC-WP</td><td>Water</td><td>Sulfate by Ion Chromatography</td><td>EPA 300.1 (modified)</td></tr>
<tr><td colspan="4">Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.</td></tr>
<tr><td>SOLIDS-TOTSUS-WP</td><td>Water</td><td>Total Suspended Solids</td><td>APHA 2540 D (modified)</td></tr>
<tr><td colspan="4">Total suspended solids in aquesous matrices is determined gravimetrically after drying the residue at 103 105°C.</td></tr>
</table>

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Town of Altona
ATTN: STEVE WIEBE
Box 1630
Altona MB R0G 0B0

Date Received:	22-APR-14
Report Date:	29-APR-14 14:34 (MT)
Version:	FINAL REV. 2

Client Phone: 204-324-6439

Certificate of Analysis

Lab Work Order #:	**L1445654**
Project P.O. #:	NOT SUBMITTED
Job Reference:	4.00
C of C Numbers:	
Legal Site Desc:	

Comments: ADDITIONAL 23-APR-14 12:57

Chantal Bouchard

Chantal Bouchard
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1445654-1 TOWN OF ALTON Sampled By: Clint Derksen on 22-APR-14 @ 09:30 Matrix: Sewage/Waste Water							
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	25.4	DLA	1.0	mg/L		28-APR-14	R2829421
Temperature supplied by Client							
Temperature, Client Provided	2.1		0.1	Degree C		23-APR-14	R2826397
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.099		0.010	mg/L		29-APR-14	
pH supplied by Client							
pH, Client Supplied	7.60		0.10	pH		23-APR-14	R2826397

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Town of Altona
ATTN: STEVE WIEBE
Box 1630
Altona MB R0G 0B0

Date Received:	02-JUN-14
Report Date:	10-JUN-14 15:58 (MT)
Version:	FINAL REV. 2

Client Phone: 204-324-6439

Certificate of Analysis

Lab Work Order #:	**L1463620**
Project P.O. #:	NOT SUBMITTED
Job Reference:	
C of C Numbers:	
Legal Site Desc:	

Comments:

10-JUN-2014 AMENDED REPORT - Report Re-issued with Un-ionized Ammonia calculated with field temp of 19 deg C (instead of 66.2 F)

Craig Riddell

Craig Riddell
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1463620-1 LAGOON DISCHARGE CELL 4 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Miscellaneous Parameters							
Biochemical Oxygen Demand	<6.0		6.0	mg/L		02-JUN-14	R2856043
L1463620-2 LAGOON DISCHARGE CELL 4 - BACTI 1 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	4		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							
Total Coliforms	93		3	MPN/100mL		07-JUN-14	R2856702
L1463620-3 LAGOON DISCHARGE CELL 4 - BACTI 2 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	15		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							
Total Coliforms	150		3	MPN/100mL		07-JUN-14	R2856702
L1463620-4 LAGOON DISCHARGE CELL 4 - BACTI 3 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	43		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							
Total Coliforms	230		3	MPN/100mL		07-JUN-14	R2856702
L1463620-5 LAGOON DISCHARGE CELL 3 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Miscellaneous Parameters							
Biochemical Oxygen Demand	<6.0		6.0	mg/L		02-JUN-14	R2856043
L1463620-6 LAGOON DISCHARGE CELL 3 - BACTI 1 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	4		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							
Total Coliforms	23		3	MPN/100mL		07-JUN-14	R2856702
L1463620-7 LAGOON DISCHARGE CELL 3 - BACTI 2 Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30 Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	4		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							

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

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1463620-7 LAGOON DISCHARGE CELL 3 - BACTI 2							
Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30							
Matrix: WW							
Total Coliform							
Total Coliforms	9		3	MPN/100mL		07-JUN-14	R2856702
L1463620-8 LAGOON DISCHARGE CELL 3 - BACTI 3							
Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30							
Matrix: WW							
Total and Fecal Coliform by MPN							
Fecal Coliform							
Fecal Coliforms	9		3	MPN/100mL		06-JUN-14	R2856702
Total Coliform							
Total Coliforms	23		3	MPN/100mL		07-JUN-14	R2856702
L1463620-9 JR COUSINS WIER 3							
Sampled By: CLINT DERKSEN on 02-JUN-14 @ 09:30							
Matrix: WW							
Un-ionized ammonia							
Ammonia by colour							
Ammonia, Total (as N)	11.5	DLA	1.0	mg/L		04-JUN-14	R2852777
Temperature supplied by Client							
Temperature, Client Provided	19		0.1	Degree C		02-JUN-14	R2850539
Un-ionized ammonia							
Ammonia, Un-ionized (as N)	0.569		0.010	mg/L		10-JUN-14	
pH supplied by Client							
pH, Client Supplied	8.15		0.10	pH		02-JUN-14	R2850539

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

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BOD-WP	Water	Biochemical Oxygen Demand (BOD)	APHA 5210 B

The sample is incubated for 5 days at 20 degrees Celcius. Comparison of dissolved oxygen content at the beginning and end of incubation provides a measure of biochemical oxygen demand. If carbonaceous BOD is requested, TCMP is added to the sample to chemically inhibit nitrogenous oxygen demand. If soluble BOD is requested, the sample is filtered prior to analysis. Surface waters have a DL of 1 mg/L. Effluents are diluted according to their history and will have a sample DL of 6 mg/L or greater, depending on the dilutions used.

ALS Test Code	Matrix	Test Description	Method Reference**
FC-MPN-WP	Water	Fecal Coliform	APHA 9221E

The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

ALS Test Code	Matrix	Test Description	Method Reference**
NH3-UNION-CALC-WP	Water	Un-ionized ammonia	Calculation
PH-CLIENT-WP	Water	pH supplied by Client	Supplied by client
TC-MPN-WP	Water	Total Coliform	APHA 9221B

The Most Probable Number (MPN) method is based on the Multiple Tube Fermentation technique. The results of examination of replicate tubes and dilutions of a sample are reported after confirmations specific to total coliform, fecal coliform and E. coli are performed. Results are reported in MPN/100 mL for water and MPN/gram for food and solid samples.

ALS Test Code	Matrix	Test Description	Method Reference**
TEMP-CLIENT-WP	Water	Temperature supplied by Client	Result supplied by Client

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

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Test results reported relate only to the samples as received by the laboratory.
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Appendix D

Cost Estimates

Operation and Maintenance Costs

Cost Estimates

Item #	Description	Unit	Quantity	Unit Price	Amount
	Storage Cell 5 Construction - 3.0m operating level				
1	Lagoon Excavation	cubic metre	124,000	$7.00	$868,000.00
2	Lagoon Excavation -Keyway Construction	cubic metre	24,500	$9.00	$220,500.00
3	Lagoon Slope Rip-Rap	sq. metre	16,250	$28.00	$455,000.00
4	Top Soil and Seeding	lump sum	1	$37,000.00	$37,000.00
5	Discharge Piping	lump sum	1	$15,000.00	$15,000.00
6	Extend Weeping Tile Manhole	lump sum	1	$5,000.00	$5,000.00
7	Extend Weeping Tile Lift Station	lump sum	1	$45,000.00	$45,000.00
8	Weeping Tile Piping from MH to Lift Sation	lineal metre	145	$160.00	$23,200.00
9	Weeping Tile Lift Sation Discharge Piping	lineal metre	50	$160.00	$8,000.00
10	Relocate Compost Site	lump sum	1	$200,000.00	$200,000.00
11	Remove Portion of Existing Fence	lineal metre	905	$12.00	$10,860.00
12	Perimeter Fence	lineal metre	905	$12.00	$10,860.00
13	Lagoon Signage	lump sum	1	$3,000.00	$3,000.00
	Aeration System Upgrades and Phosphorous Removal				
14	Aeration Cell Excavation	cubic metre	72,000	$7.00	$504,000.00
15	Aeration Cell Lagoon Slope Rip-Rap	sq. metre	3,460	$28.00	$96,880.00
16	Intercell Piping and Valve to Existing Aeration Cell	lump sum	1	$35,000.00	$35,000.00
17	Top Soil and Seeding	lump sum	1	$20,000.00	$20,000.00
18	Relocate existing 200 mm FM	lump sum	1	$5,500.00	$5,500.00
19	Relocate existing 350 mm FM	lump sum	1	$11,500.00	$11,500.00
20	200 mm Forcemain Meter Chamber	lump sum	1	$25,000.00	$25,000.00
21	350 mm Forcemain Meter Chamber	lump sum	1	$35,000.00	$35,000.00
22	Aeration Piping Trenching	lineal metre	280	$60.00	$16,800.00
23	Effluent Piping to Sewage Treatment Building	lineal metre	485	$250.00	$121,250.00
24	Effluent Piping to Storage Cells	lineal metre	670	$250.00	$167,500.00
25	Effluent Piping to Discharge	lineal metre	60	$250.00	$15,000.00
26	Building Sewer to Aeration Cell 4	lineal metre	40	$200.00	$8,000.00
27	Aeration Cell 4 Level Pipe	lineal metre	75	$150.00	$11,250.00
28	Sewage Treatment Building Civil Works	lump sum	1	$1,222,400.00	$1,222,400.00
29	Sewage Treatment Building Mechanical Works	lump sum	1	$1,068,400.00	$1,068,400.00
30	Sewage Treatment Building Electrical Works	lump sum	1	$491,600.00	$491,600.00
31	Aeration and Filter Equipment	lump sum	1	$1,236,400.00	$1,236,400.00
32	Site Grading Around Building	lump sum	1	$12,500.00	$12,500.00
33	Regrade Existing South Ditch for Continuous Discharge	lineal metre	630	$20.00	$12,600.00
34	Remove Portion of Existing Fence	lineal metre	470	$12.00	$5,640.00
35	Perimeter Fence	lineal metre	500	$12.00	$6,000.00
36	Truck Dump Station Control Gate	lump sum	1	$15,000.00	$15,000.00
37	Decomission Existing Aeration Building	lump sum	1	$15,000.00	$15,000.00
38	38 mm Water Service Line	lineal metre	690	$150.00	$103,500.00
39	Connect to Existing Watermain (include Curbstop and Corp)	lump sum	1	$4,500.00	$4,500.00
40	Mobilization/Demobilization, Insurance & Bonding	lump sum	1	$286,700.00	$286,700.00
41	Material Testing Cash Allowance	lump sum	1	$25,000.00	$25,000.00
42	Hydro/MTS Cash Allowance	lump sum	1	$15,000.00	$15,000.00
	Subtotal Aeration Upgrades and Phosphorous Removal				**$7,494,340.00**
				GST 5%	$374,700.00
				Contigency 15%	$1,124,200.00
				Engineering 15%	$1,124,200.00
	Aeration System Upgrades and Phosphorous Removal Class C Cost Estimate				**$10,117,440.00**

Operation and Maintenance Costs

Altona Sewage Treatment Facility A-677.02

Average kWh cost on April 2014 Altona Lagoon Hydro Bill	0.062	kWh

Power Consumption	kW	kWh	Annual Cost
Aeration Cell Blower 1 - Duty	56	490560	30410
Aeration Cell Blower 2 - Duty	56	490560	30410
Aeration Cell Blower 3 - Duty	44.8	196224	12170
Aeration Cell Blower 4 - Standby	56		0
UV	8	44680	2770
Sand Filter Compressor	3.7	32412	2010
Filter Feed Pump - Duty	14.9	83216	5160
Filter Feed Pump - Standby			0
Discharge Pump - Duty	14.9	83216	5160
Discharge Pump - Standby			0
Building Lights	4	11680	720
Building Heat	80	172800	10710
Misc Building Electricity	10	43800	2720
Power Consumption Subtotal			**$ 102,240.00**

Treatment Equipment Maintenance	Units	Replacement Life	Unit Cost	Annual Cost
Diffuser Replacement	252	12	$ 300	$ 6,300
Blower Belts	4	2	$ 250	$ 500
Blower Oil	4	1	$ 80	$ 320
Blower Filters	4	0.5	$ 120	$ 960
UV Lamp Replacement	64	1.5	$ 370	$ 15,787
Sand Filter Air Lift	4	2	$ 2,500	$ 5,000
pH Probe	1	2	$ 1,000	$ 500
DO Probe	2	2	$ 1,000	$ 1,000
Filter Feed Pump	2	10	$ 20,000	$ 4,000
Discharge Pump	2	10	$ 20,000	$ 4,000
Chemical Feed Pumps	2	5	$ 3,500	$ 1,400
Misc Equipment	1	1	$ 5,000	$ 5,000
Replacement Subtotal				**$ 44,767**
Chemical Addition				
Ferric Chloride	428	365	$ 0.36	**$ 56,240**
Labour				Annual Cost
Daily	2		$ 35	$ 25,550
Testing	12		$ 500	$ 6,000
				$ 31,550
Annual Operating Cost - Year 2 (2016) Design Flow				**$ 234,800.00**

Altona Sewage Treatment Facility A-677.02

Average kWh cost on April 2014 Altona Lagoon Hydro Bill	0.062	kWh

Power Consumption	kW	kWh	Annual Cost
Aeration Cell Blower 1 - Duty	56	490560	30410
Aeration Cell Blower 2 - Duty	56	490560	30410
Aeration Cell Blower 3 - Duty	44.8	392448	24330
Aeration Cell Blower 4 - Standby	56		0
UV	8	58400	3620
Sand Filter Compressor	3.7	32412	2010
Filter Feed Pump - Duty	14.9	108770	6740
Filter Feed Pump - Standby	14.9		0
Discharge Pump - Duty	14.9	108770	6740
Discharge Pump - Standby	14.9		0
Building Lights	4	11680	720
Building Heat	80	172800	10710
Misc Building Electricity	10	43800	2720
Power Consumption Subtotal			**$ 118,410.00**

Treatment Equipment Maintenance	Units	Replacement Life	Unit Cost	Annual Cost
Diffuser Replacement	252	12	$ 300	$ 6,300
Blower Belts	4	2	$ 250	$ 500
Blower Oil	4	1	$ 80	$ 320
Blower Filters	4	0.5	$ 120	$ 960
UV Lamp Replacement	64	1.5	$ 370	$ 15,787
Sand Filter Air Lift	4	2	$ 2,500	$ 5,000
pH Probe	1	2	$ 1,000	$ 500
DO Probe	2	2	$ 1,000	$ 1,000
Filter Feed Pump	2	10	$ 20,000	$ 4,000
Discharge Pump	2	10	$ 20,000	$ 4,000
Chemical Feed Pumps	2	5	$ 3,500	$ 1,400
Misc Equipment	1	1	$ 5,000	$ 5,000
Replacement Subtotal				**$ 44,767**
Chemical Addition				
Ferric Chloride	560	365	$ 0.36	**$ 73,590**
Labour				Annual Cost
Daily	2		$ 35	$ 25,550
Testing	12		$ 500	$ 6,000
				$ 31,550
Annual Operating Cost - Year 25 (2039) Design Flow				**$ 268,320.00**

Appendix E

Plan 1: Lagoon Test Holes and Existing Ground Contours
Plan 2: Proposed Lagoon Cells
Plan 3: Pipe Layout Plan
Plan 4: Lagoon Sections - Storage Cell 5 Dikes at Existing Cells
Plan 5: Lagoon Sections - Storage Cell 5 Dike
Plan 6: Lagoon Sections - Aeration Cell 4 Dike
Plan 7: Sewage Treatment - Process Diagram
Plan 8: Sewage Treatment Building - South and West Elevation
Plan 9: Sewage Treatment Building - North and East Elevation
Plan 10: Sewage Treatment Building - Overall Layout

SCALE BAR
(IN METRES)
40 0 20 40 80 120 160 200
1:2000

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.

ENGINEER'S SEAL

PRELIMINARY

JR Cousin Consultants Ltd.
91A Scurfield Blvd. Winnipeg MB R3Y 1G4
p. (204) 489-0474
f. (204) 489-0487
www.jrcc.ca
ENGINEERING CONSULTANTS
ENGINEERING EXCELLENCE SINCE 1981

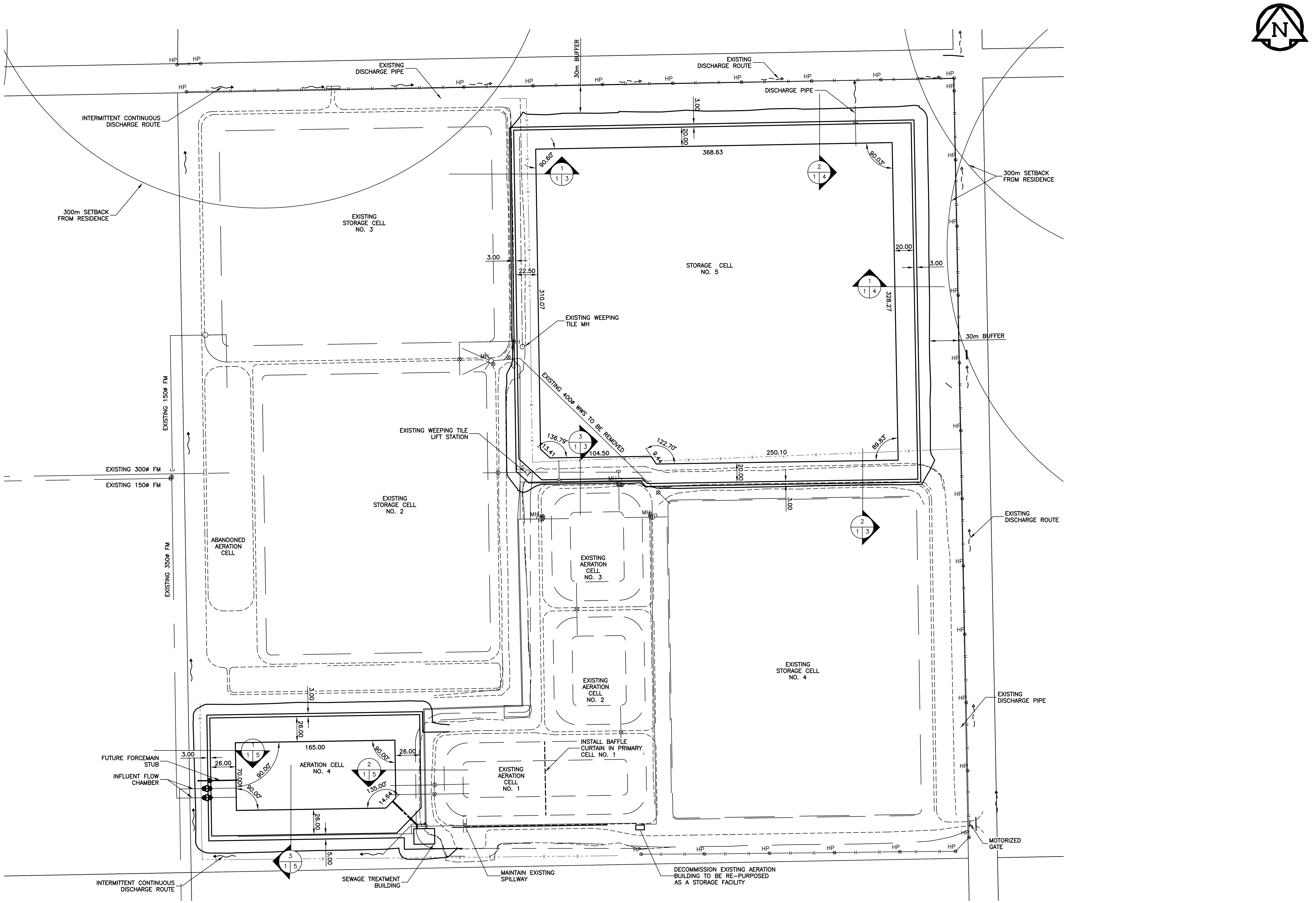
CODE: A–677.02
DESIGNED BY: JRC
DRAWN BY: DK
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

TITLE:
LAGOON TEST HOLES
AND EXISTING GROUND CONTOURS

SCALE: 1:2000
DATE: 14/05/21
PLAN: EX1
SHEET: 1 of 10

Jun 12, 2014 – 9:31am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\EX1.dwg



SCALE BAR
(IN METRES)
40 0 20 40 80 120 160 200
1:2000

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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ENGINEERING EXCELLENCE SINCE 1981

CODE: A-677.02
DESIGNED BY: JRC
DRAWN BY: DK
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

TITLE:
PROPOSED LAGOON CELLS

SCALE: 1:2000
DATE: 14/05/20
PLAN: L1
SHEET: 2 of 10

Jun 12, 2014 – 9:37am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\L1 L2.dwg

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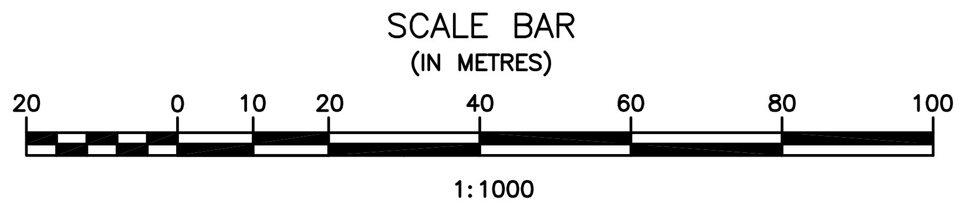

No.	REVISIONS	DATE	INITIALS

B.M. EL.

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CODE: A–677.02
DESIGNED BY: JRC
DRAWN BY: DK
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

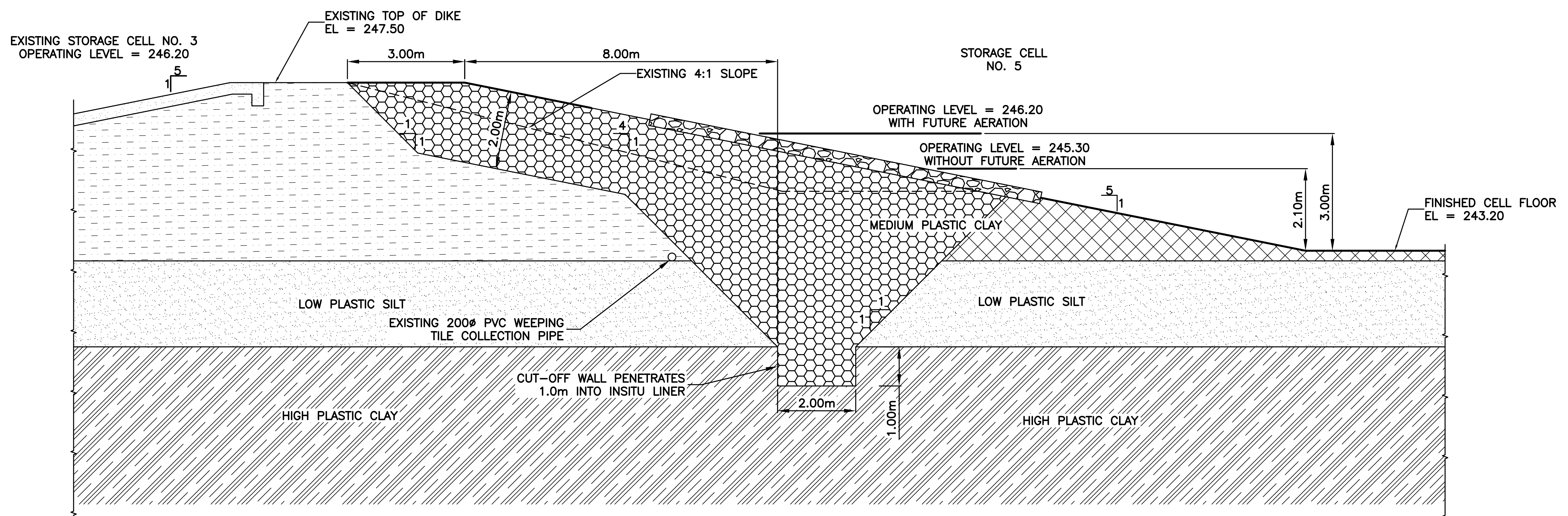
TITLE:
PIPE LAYOUT PLAN

SCALE: 1:1000
DATE: 14/05/20
PLAN: L2
SHEET: 3 of 10

LEGEND:

▦ EXCAVATED AND COMPACTED HIGH PLASTICITY CLAY TYPE SOIL
░ LOW PLASTICITY SILT TYPE SOIL
▤ EXCAVATED AND COMPACTED COVER MATERIAL
▨ HIGH PLASTICITY CLAY TYPE SOIL
▨ LOW PLASTICITY ORGANIC CLAY TYPE SOIL
▨ MEDIUM TO HIGH PLASTICITY CLAY TYPE SOIL

▨ LOW PLASTICITY SILTY CLAY TYPE SOIL
▦ RIP RAP
☐ EXISTING DIKE
▩ LOW TO MEDIUM PLASTICITY SILTY CLAY TYPE SOIL
▩ MEDIUM PLASTICITY CLAY TYPE SOIL
▨ MEDIUM PLASTICITY ORGANIC CLAY TYPE SOIL

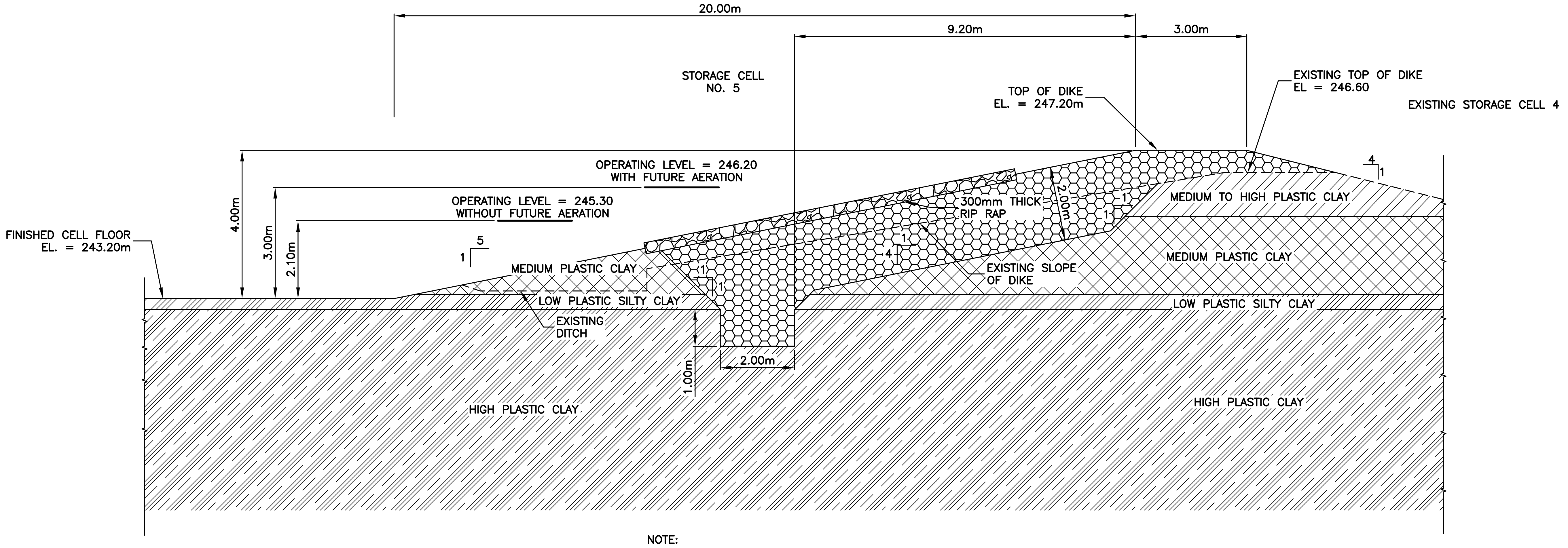


NOTE:

- SECTION MATERIAL IS BASED ON AMEC-TH10 (14/03/18).

1/1|3 STORAGE CELL 5 DIKE AT STORAGE CELL 3

SCALE = 1:100

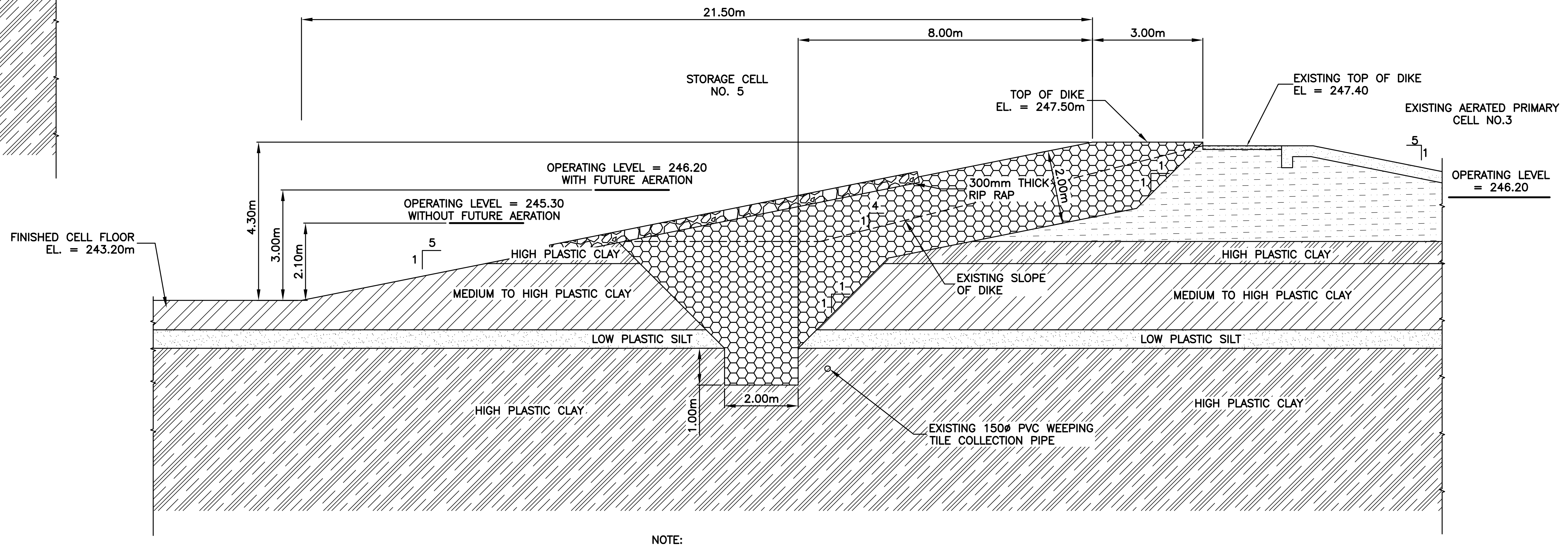


NOTE:

- SECTION MATERIAL IS BASED ON AMEC-TH4 (14/03/18).

2/1|3 STORAGE CELL 5 DIKE AT STORAGE CELL 4

SCALE = 1:100



NOTE:

- SECTION MATERIAL IS BASED ON AMEC-TH7 (14/03/18).

3/1|3 STORAGE CELL 5 DIKE AT AERATION CELL 3

SCALE = 1:100

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REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

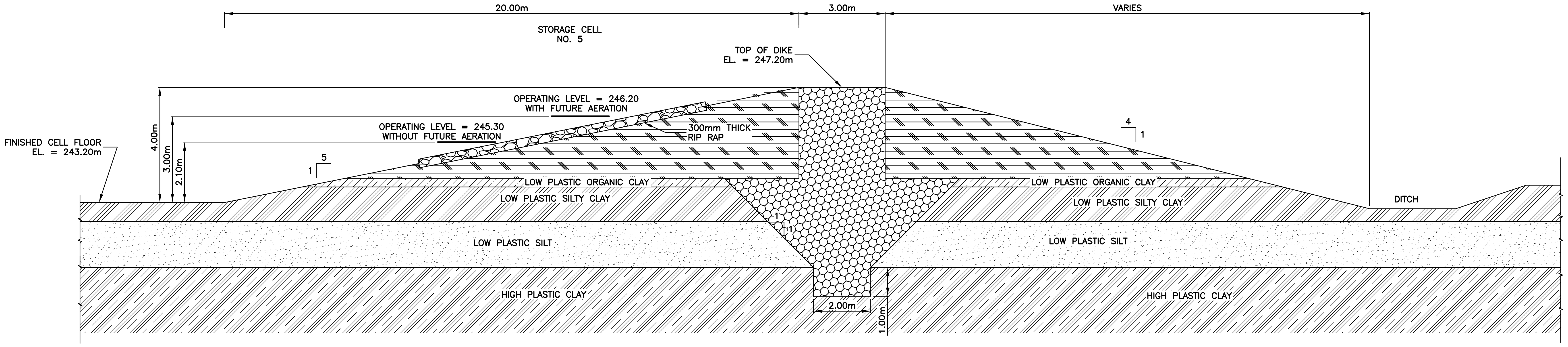
TITLE:
LAGOON SECTIONS
STORAGE CELL 5 DIKES
AT EXISTING CELLS

SCALE: 1:100
DATE: 14/05/13
PLAN: L3
SHEET: 4 of 10

Jun 12, 2014 - 9:40am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\L3 L4 L5 - Dike details.dwg

LEGEND:

▦ EXCAVATED AND COMPACTED HIGH PLASTICITY CLAY TYPE SOIL	▨ LOW PLASTICITY SILTY CLAY TYPE SOIL
░ LOW PLASTICITY SILT TYPE SOIL	▩ RIP RAP
▤ EXCAVATED AND COMPACTED COVER MATERIAL	☐ EXISTING DIKE
▨ HIGH PLASTICITY CLAY TYPE SOIL	▩ LOW TO MEDIUM PLASTICITY SILTY CLAY TYPE SOIL
▨ LOW PLASTICITY ORGANIC CLAY TYPE SOIL	▦ MEDIUM PLASTICITY CLAY TYPE SOIL
▨ MEDIUM TO HIGH PLASTICITY CLAY TYPE SOIL	▨ MEDIUM PLASTICITY ORGANIC CLAY TYPE SOIL

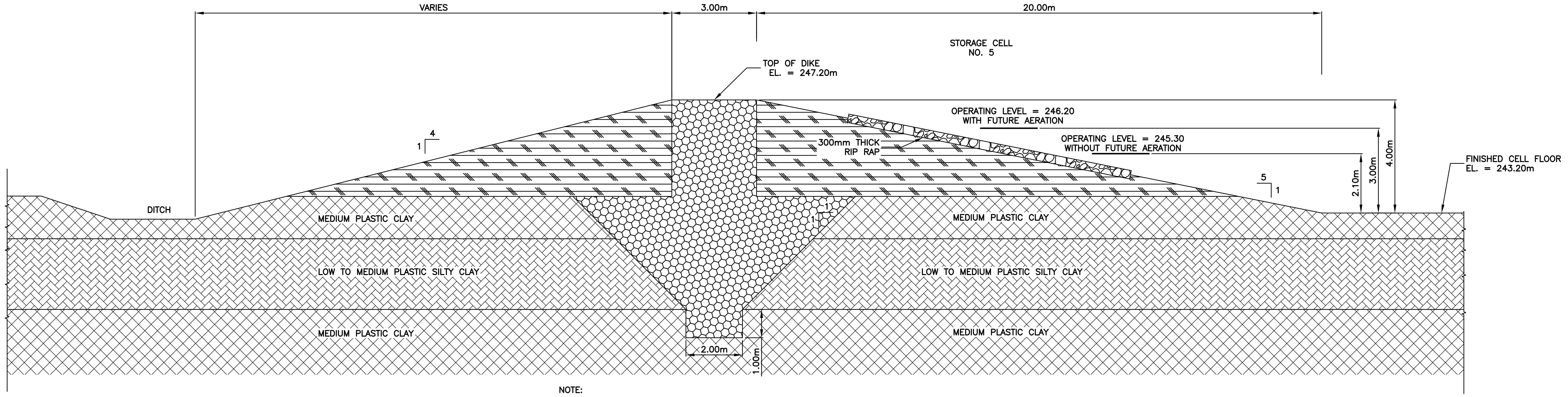


NOTE:

- SECTION MATERIAL IS BASED ON AMEC–TH5 (14/03/18).

(1 / 1 4) STORAGE CELL 5 EAST EXTERIOR DIKE

SCALE = 1:100



NOTE:

- SECTION MATERIAL IS BASED ON AMEC–TH20 (14/03/17).

(2 / 1 4) STORAGE CELL 5 EXTERIOR NORTH DIKE

SCALE = 1:100

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PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

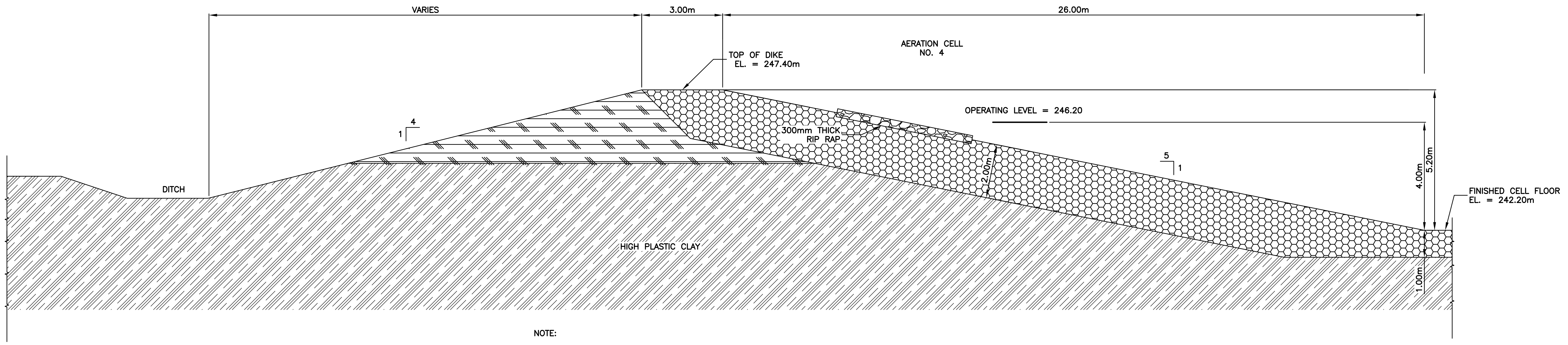
TITLE:
LAGOON SECTIONS
STORAGE CELL 5 DIKE

SCALE:	DATE:	PLAN:	SHEET:
1:100	14/05/13	L4	5 of 10

Jun 12, 2014 – 9:41am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\L3 L4 L5 – Dike details.dwg

LEGEND:

▨	EXCAVATED AND COMPACTED HIGH PLASTICITY CLAY TYPE SOIL
▨	LOW PLASTICITY SILT TYPE SOIL
▨	EXCAVATED AND COMPACTED COVER MATERIAL
▨	HIGH PLASTICITY CLAY TYPE SOIL
▨	LOW PLASTICITY ORGANIC CLAY TYPE SOIL
▨	MEDIUM TO HIGH PLASTICITY CLAY TYPE SOIL
▨	LOW PLASTICITY SILTY CLAY TYPE SOIL
▨	RIP RAP
▨	EXISTING DIKE
▨	LOW TO MEDIUM PLASTICITY SILTY CLAY TYPE SOIL
▨	MEDIUM PLASTICITY CLAY TYPE SOIL
▨	MEDIUM PLASTICITY ORGANIC CLAY TYPE SOIL

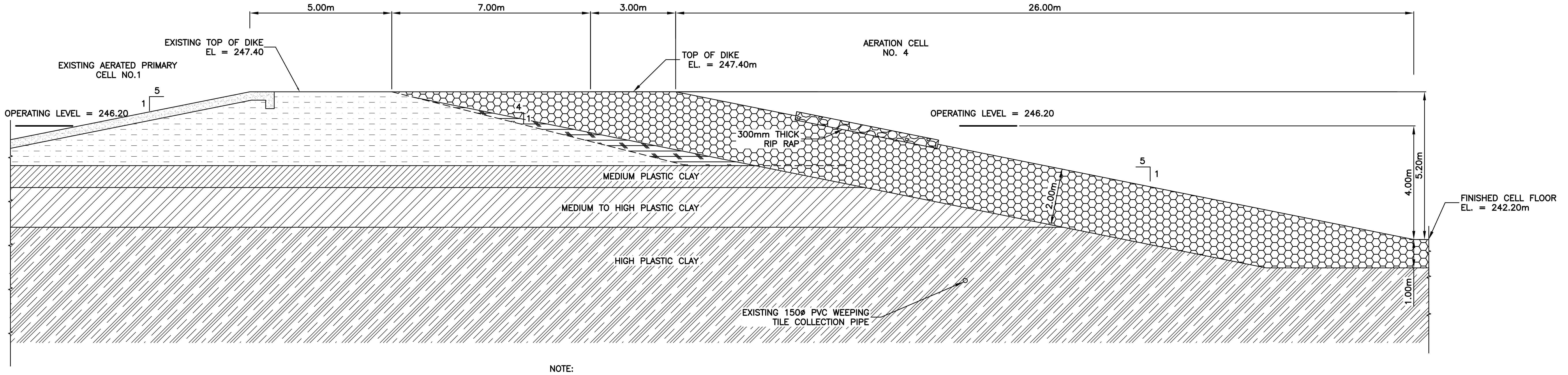


NOTE:

- SECTION MATERIAL IS BASED ON AMEC–TH17 (14/03/17).

1 / 1 5 AERATION CELL 4 EXTERIOR DIKE NORTH AND WEST SIDE

SCALE = 1:100

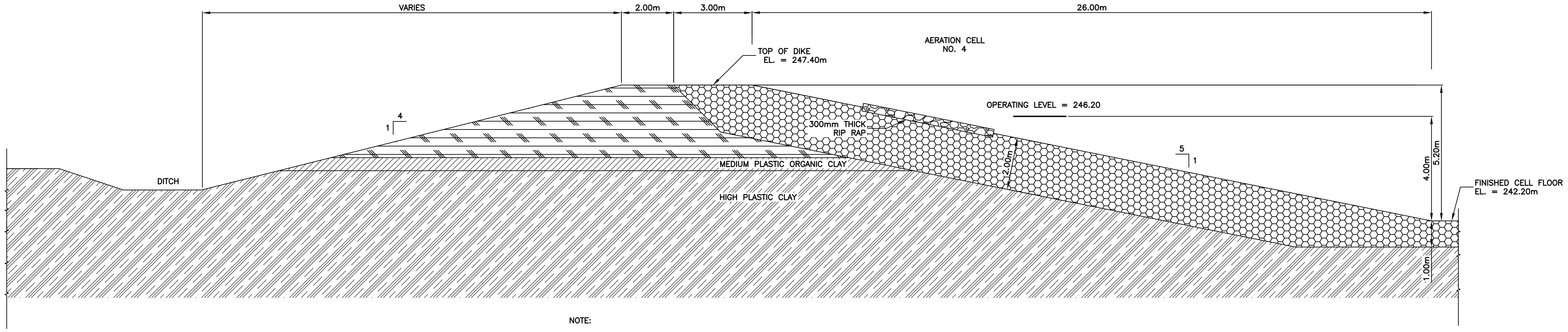


NOTE:

- SECTION MATERIAL IS BASED ON AMEC–TH15 (14/03/17).

2 / 1 5 AERATION CELL 4 DIKE AT AERATION CELL 1

SCALE = 1:100



NOTE:

- SECTION MATERIAL IS BASED ON AMEC–TH16 (14/03/17).

3 / 1 5 AERATION CELL 4 EXTERIOR DIKE SOUTH SIDE

SCALE = 1:100

No.	REVISIONS	DATE	INITIALS

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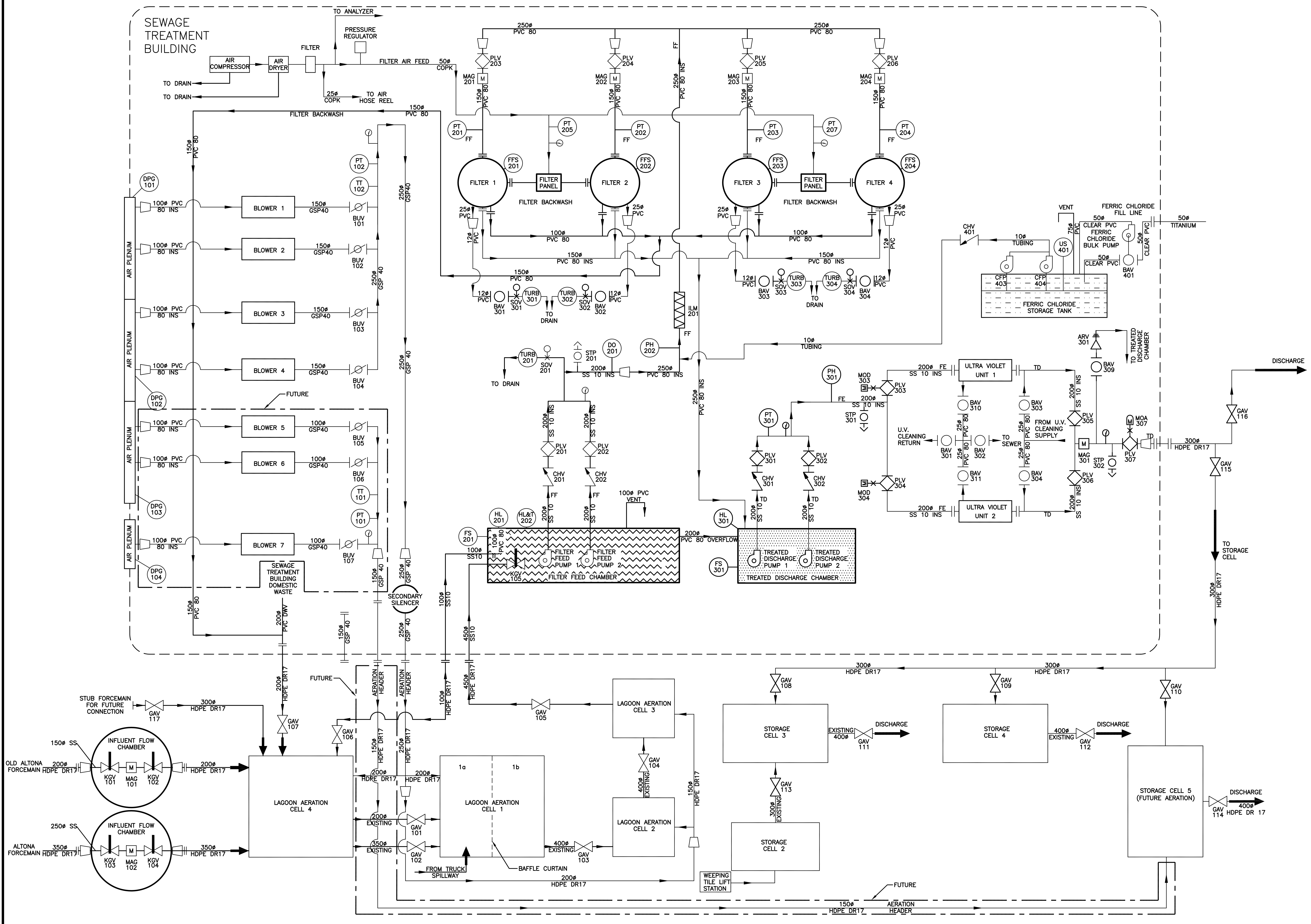
PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

TITLE:
LAGOON SECTIONS
AERATION CELL 4 DIKE

SCALE: 1:100
DATE: 14/05/13
PLAN: L5
SHEET: 6 of 10

Jun 12, 2014 – 9:41am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\L3 L4 L5 – Dike details.dwg



LEGEND

PUMP	PUMP
MAG	MAG METER
GAV	GATE VALVE (GENERAL)
PLV	PLUG VALVE
KGV	KNIFE GATE VALVE
BAV	BALL VALVE
BUV	BUTTERFLY VALVE
STP	SAMPLE TAP
►	FLOW DIRECTION
=	FLANGE CONNECTION
≡	UNION
CHV	CHECK VALVE
ARV	AIR RELEASE
	PRESSURE GAUGE
SOV	SOLENOID VALVE
MOD	MOTORIZED VALVE (DIGITAL – OPEN/CLOSED)
MOA	MOTORIZED VALVE (ANALOG – CONTROL)
	REDUCER
	PLC INTERFACE
DEV.ID	DEVICE IDENTIFIER
ILM	INLINE MIXER
	FUTURE DEVELOPMENT

PIPE MATERIAL CODE

CODE	PIPE MATERIAL AND RATING
SS10	STAINLESS STEEL SCHEDULE 10
ST40	STEEL PIPE, ANSI 150 # FLANGE RATING
GSP	GALVANIZED STEEL PIPE, ANSI 150 # FLANGE RATING
PVC40	PVC PIPE, SCHEDULE 40
PVC80	PVC PIPE, SCHEDULE 80
TUBING	TEFLON TUBING IN PVC SCH 40 CARRIER PIPE
CI	CAST IRON–DRAIN WASTE VENT PIPE
COPK	TYPE K COPPER PIPE
COPL	TYPE L COPPER PIPE
INS	INSULATED PIPE
HDPE DR17	HIGH DENSITY POLYETHYLENE DR17
CLEAR PVC	CLEAR PVC PIPE SCHEDULE 40

FE – FILTER EFFLUENT
FF – FILTER FEED
TD – TREATED DISCHARGE EFFLUENT
FR – FILTER BACKWASH

TT	TEMPERATURE TRANSMITTER
PT	PRESSURE TRANSDUCER
DO	DISSOLVED OXYGEN UNIT
PH&R	COMBINED PH & ORP SENSOR
HL&T	HYDROSTATIC LEVEL SENSOR WITH TEMPERATURE
FFS	FILTER FLOOD SWITCH
BFS	BUILDING FLOOD SWITCH
US	ULTRASONIC TRANSDUCER
FS	FLOAT SWITCH
TURB	TURBIDITY METER
M	MOTOR
DPG	DIFFERENTIAL PRESSURE GAUGE
PH	PH SENSOR
HL	HYDROSTATIC LEVEL SENSOR

No.	REVISIONS	DATE	INITIALS

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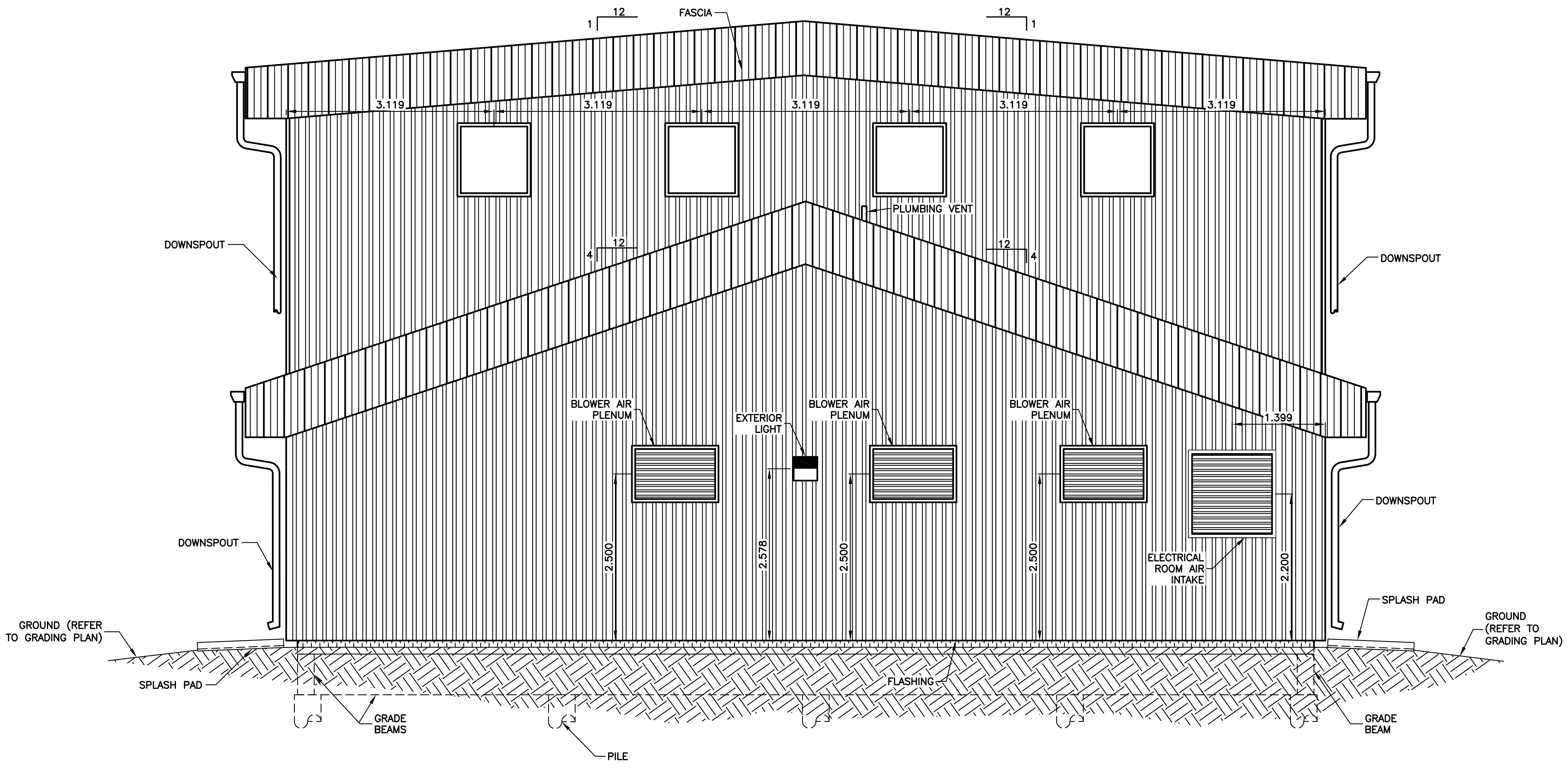
DRAWN BY: OT
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
SEWAGE TREATMENT UPGRADE

TITLE:
SEWAGE TREATMENT
PROCESS DIAGRAM

SCALE: NTS
DATE: 14/03/11
PLAN: P1
SHEET: 7 of 10

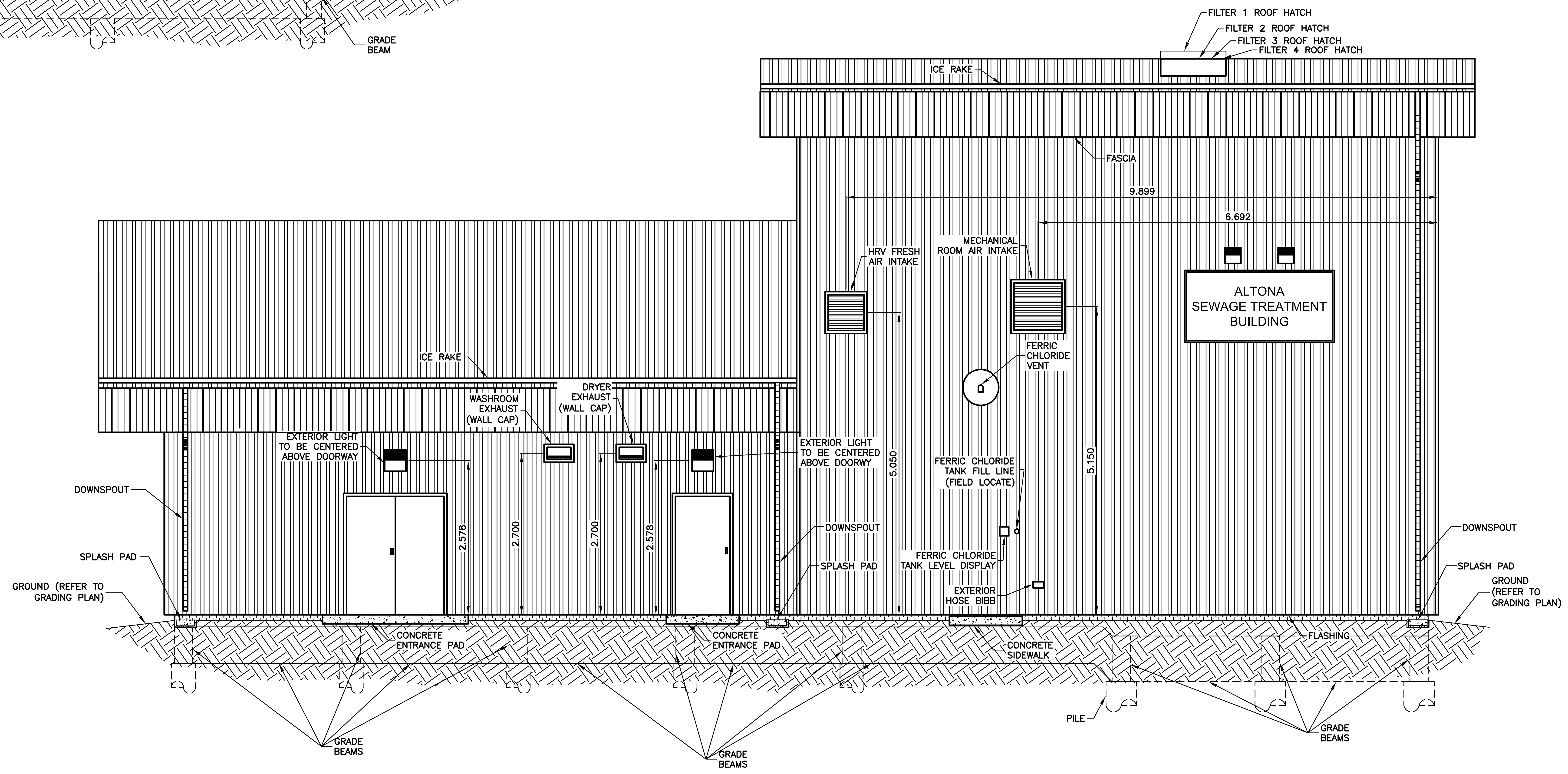
Jun 12, 2014 – 9:43am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\ST–P1.dwg



NOTE:

REFER TO SPECIFICATION FOR ALL ROOF LOUVRES AND VENTS

① WEST ELEVATION
1



② SOUTH ELEVATION
1

NOTES:

- SUBMIT COLOUR SAMPLES FOR APPROVAL
- FINAL COLOURS TO BE DETERMINED BY OWNER DURING SHOP DRAWING REVIEW PROCESS.
- COORDINATE PLACEMENT OF ALL LOUVRES WITH BUILDING SHOP DRAWINGS. ENSURE LOUVRE OPENINGS DO NOT INTERFERE WITH BUILDING COLUMN, BEAM, ETC.
- REFER TO SPECIFICATION FOR ALL ROOF LOUVERS AND VENTS.

No.	REVISIONS	DATE	INITIALS

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REVIEWED BY: JC

PROJECT:
TOWN OF ALTONA
SEWAGE TREATMENT UPGRADE

TITLE:
SEWAGE TREATMENT BUILDING
SOUTH AND WEST ELEVATION

SCALE: 1:50
DATE: 14/05/22
PLAN: S1
SHEET: 8 of 10

1/2 NORTH ELEVATION

2/2 EAST ELEVATION

NOTES:

- SUBMIT COLOUR SAMPLES FOR APPROVAL
- FINAL COLOURS TO BE DETERMINED BY OWNER DURING SHOP DRAWING REVIEW PROCESS.
- COORDINATE PLACEMENT OF ALL LOUVRES WITH BUILDING SHOP DRAWINGS. ENSURE LOUVRE OPENINGS DO NOT INTERFERE WITH BUILDING COLUMN, BEAM, ETC.
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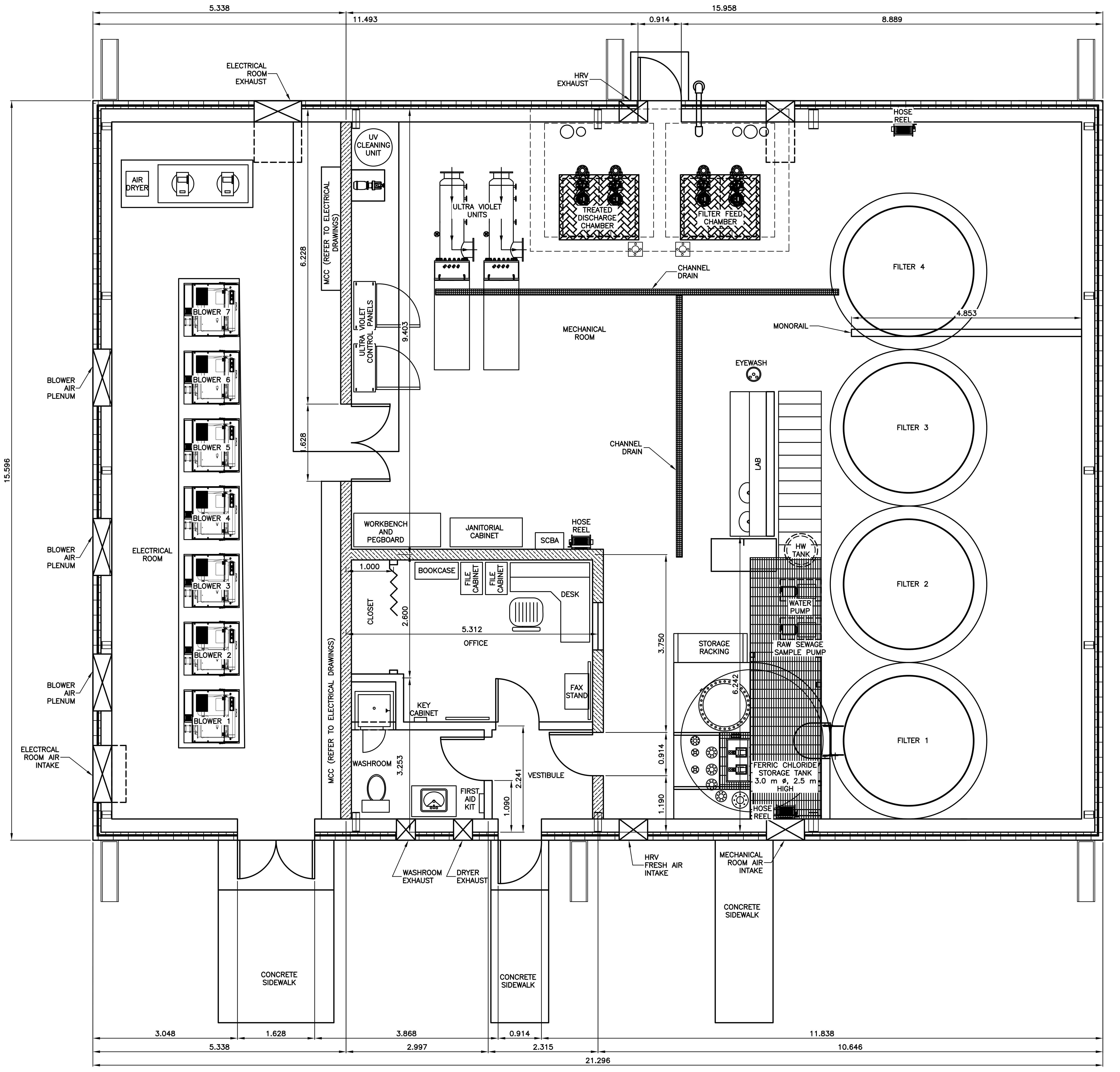
REVIEWED BY: JC

PROJECT:
TOWN OF ALTONA
SEWAGE TREATMENT UPGRADE

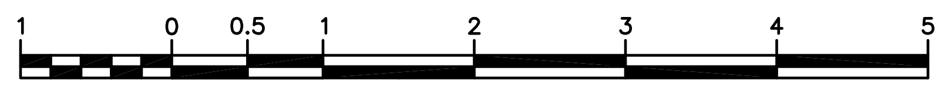
TITLE:
SEWAGE TREATMENT BUILDING
NORTH AND EAST ELEVATION

SCALE: 1:50
DATE: 14/05/22
PLAN: S2
SHEET: 9 of 10

Jun 12, 2014 – 9:45am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\ST–S1–S2.dwg



SCALE BAR
(IN METRES)



1:50

No.	REVISIONS	DATE	INITIALS

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PROJECT:
TOWN OF ALTONA
SEWAGE TREATMENT UPGRADE

TITLE:
SEWAGE TREATMENT BUILDING
OVERALL LAYOUT

SCALE: 1:50
DATE: 14/05/20
PLAN: S3
SHEET: 10 of 10

Jun 12, 2014 - 9:46am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\Design\ST-S3.dwg

Addendum to Geotechnical Investigation, AMEC, August 2014

Memorandum

To	**Jason Cousin, P.Eng.**	From	**Kelly Johnson, P.Eng.**
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Email:	**jrcousin@jrcc.ca**	Fax	**+1 (204) 489-8261**
Project No.	**WX17367**	Pages	**4 (including this page)**
		Date	**11 August 2014**
Copies			
Subject	**Hydraulic Conductivity Testing of Re-moulded Silty Clay / Clay and Silt Altona Wastewater Treatment Facility (AWTF) Upgrades Altona, Manitoba**		

1 INTRODUCTION

The following Addendum No. 1 is in follow up to AMEC's geotechnical report for the proposed upgrades to the Altona Wastewater Treatment Facility (AWTF) "Geotechnical Investigation Altona Wastewater Treatment Facility (AWTF) upgrades, Altona, Manitoba" AMEC File No. WX17367, dated 24 June 2014. Specifically, the following memorandum outlines the scope of work undertaken by AMEC and the results of additional sampling and hydraulic conductivity testing of a re-moulded sample of the upper medium plastic silty clay collected from Trench 2 located near test hole TH17 of the original field investigation. The purpose of the test was to demonstrate and validate the following statements made in Section 5.3.1, page 10, paragraph 1 of AMEC's geotechnical report:

1. Based on evaluation of the results, 'suitable' clay borrow meeting the performance criterion of 1.0x10^{-7} cm/s shall have a liquid limit of 30 percent or higher, and a clay fraction of 30 percent or greater; and

2. When reworked and re-compacted to a minimum 95% of Standard Proctor Maximum Dry Density (SPMDD), the upper silty medium plastic clay would achieve a maximum hydraulic permeability design criterion of 1.0x10-7 cm/s.

2 SCOPE OF WORK

On 3 July 2014, AMEC supervised excavation of one test pit (Trench 2) approximately located at TH17 illustrated in Figure 1 of AMEC's geotechnical report. The test pit was excavated to approximately 3.1 m below grade using a backhoe owned and operated by JKW Construction Ltd. During excavation, AMEC field personnel visually classified the soil stratigraphy within the test pit in accordance with the Modified Unified Soil Classification System (MUSCS); as well as noted any observed seepage and/or sloughing conditions. Bulk samples were collected at selected depths from the excavated soil for review and testing in AMEC's Winnipeg laboratory.

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The in-situ relative consistency of cohesive overburden was evaluated within the test holes using pocket penetrometer readings.

A detailed log summarizing the sampling, field testing, laboratory test results, and subsurface conditions encountered at Trench 2 is enclosed.

3 TEST RESULTS

Bulk soil samples collected from Trench 2 and returned to Winnipeg were reviewed for general agreement in soil composition with the in-situ Shelby tube sample collected from TH17 at about 2.1 m below grade (i.e. the sample for which a hydraulic conductivity result of 8.61×10^{-7} cm/s was determined and reported by AMEC in the 24 June 2014 geotechnical report and which failed to achieve the maximum hydraulic conductivity performance criterion of 1.0×10^{-7} cm/s when tested in its in-situ state). For the current testing program, the selected sample consisted of low to medium plastic clay obtained from Trench 2 between about 0.9 m and 1.2 m below grade.

Laboratory testing on the selected sample consisted of one Standard Proctor (Moisture-Density Relationship) to determine the maximum dry density of the clay, one set of Liquid Limit and Plastic Limit (i.e. Atterberg Limit) determinations, one particle size analysis by hydrometer method, and hydraulic conductivity testing (Flexible Wall Permeameter) on a re-moulded sample compacted to about 95% of the SPMDD. The cell pressure, backpressure, and hydraulic gradient used in the hydraulic conductivity test are summarized on the enclosed hydraulic conductivity test report, and were selected in accordance with typical test procedures for Winnipeg clays and liner applications. Liquid Limit, Plastic Limit, and particle size analysis results in terms of gravel, sand, silt, and clay fractions are summarized on the test pit log. All Atterberg Limit, particle size analysis, and hydraulic conductivity test results; inclusive of those presented in the geotechnical report; are summarized in Table 1 here-in.

Table 1: Atterberg Limit Results and Estimated Optimum Moisture Contents

Test Series No.	Sample ID and Depth	In-situ Moisture Content (%)	Liquid Limit	Plastic Limit	Particle Size Analysis				Liquidity Index	Constructability of in-situ Moisture Condition[1]	Hydraulic Conductivity (cm/s)
					Gravel (%)	Sand (%)	Silt (%)	Clay (%)			
1	TH02, 3.0 m	34.1	33	20	0.0	1.6	76.9	21.4	1.08	Unsuitable, Wet	n/a
2	TH03, 0.6 m	35.3	60	22	0.0	0.3	46.0	53.7	0.35	Suitable, Slightly Wet of OMC	n/a
3	TH05, 3.6 m	36.6	42	20	0.0	0.5	61.8	37.7	0.75	Unsuitable, Wet	7.33×10^{-8} (Shelby Tube)
4	TH08, 4.6 m	50.2	96	28	0.0	3.8	16.5	79.7	0.33	Suitable, Slightly Wet of OMC	n/a
5	TH15, 2.1 m	32.1	44	19	0.0	39.8	26.7	33.4	0.52	Marginal, Very Moist	n/a
6	TH17, 2.1 m	23.4	30	17	0.0	1.1	72.6	26.3	0.49	Marginal, Very Moist	8.61×10^{-7} (Shelby Tube)[2]
7	TH17, Samples 5 to 13	34.3	66	18	0.0	2.6	35.6	61.8	0.53	Marginal, Very Moist	4.64×10^{-9} (Remolded to 100% SPMDD[3])
8	Trench 2, Clay and Silt, 0.9 m to 1.2 m	23.7	45	15	0.0	6.4	61.6	32.1	0.29	Suitable, Slightly Wet of OMC	1.17×10^{-8} (Remolded to 95% SPMDD[3])

1. Classification based on liquidity index. See AMEC's geotechnical report for details.
2. In-situ test sample does not meet hydraulic conductivity performance criterion of 1.0 x 10-7 cm/s.
3. SPMDD = Standard Proctor Maximum Dry Density

4 DISCUSSION

In considering the layer formations as a whole, the silty clay samples selected from Trench 2 for re-mould and hydraulic conductivity testing is considered representative of the medium plastic silty clay soil encountered at TH17. This is not readily evident based on the comparatively different liquid limits (i.e. 30 percent for TH17 in-situ samples versus 45 percent for Trench 2 re-mould); however, the samples are similar in particle size analysis and clay fraction, with only a slightly higher clay content result of about 32 percent for Trench 2 versus 26 for TH17. Contrary to TH17, however, Trench 2 indicated frequent sand and silt layers of about 0.6 to 0.75 m thick layered within the clay.

The lower liquid limit result for TH17 is considered representative of unintentionally biased sampling of a clayey silt pocket or layer within the in-situ soil sample. The liquid limit result is not considered representative of a blended soil (i.e. re-mould) mass. Review of a photograph of the TH17 sample illustrates silt layers and a layered structure; both of which would serve to increase the permeability of the sample. Although a photograph of the sample is not available, review of the bulk sample collected from Trench 2 confirms the presence of these silt layers or pockets within the soil which were subsequently incorporated by the drying, blending, and re-compaction process of the re-mould test sample. In other words, re-moulding serves to decrease the permeability of the in-situ silty clays.

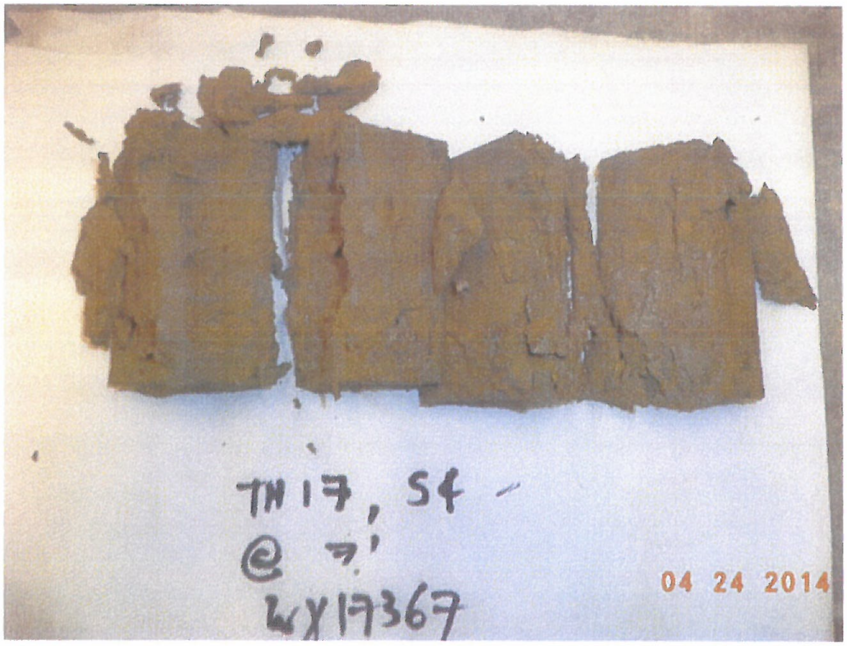

Photo 1: TH17, 2.1 m Hydraulic Conductivity Sample.

Test results on a remould sample of silty clay from Trench 2 demonstrate that when remoulded to 95% of SPMDD, massive silty clay having a liquid limit of 30 percent or higher, and a clay fraction of 30 percent or greater will likely achieve the performance criterion of 1.0x10^{-7} cm/s. The benefits of soil re-moulding on reducing permeability is further evident in comparing hydraulic conductivity results for Test 3 and 8, which essentially demonstrated the same liquid limit, plastic limit, and particle size index results. Test 8, which comprised the re-mould sample from Trench 2, had a hydraulic conductivity result of 1.17 x 10^{-8} cm/s compared to 7.33 x 10^{-8} cm/s for the in-situ sample from TH05.

5 CONCLUSION

With respect to the suitability of the upper medium plastic clays for re-use, the following conclusions are made:

- Based on evaluation of all laboratory test results, 'suitable' clay borrow meeting the performance criterion of 1.0x10^{-7} cm/s shall have a liquid limit of 30 percent or higher, and a clay fraction of 30 percent or greater. This remains unchanged from the geotechnical report.

- When reworked and re-compacted to a minimum 95% of Standard Proctor Maximum Dry Density (SPMDD), the upper silty medium plastic clay will achieve a maximum hydraulic permeability design criterion of 1.0x10-7 cm/s. This is contingent on the massive/blended soil meeting the liquid limit and particle size analysis parameters above.

- Sandy silt, silty sand, and clay and silt layers not meeting the recommended liquid limit and clay fraction index parameters outlined above are not recommended for use, and are unlikely to achieve the performance criterion of 1.0x10^{-7} cm/s at any level of compaction.

- Silt layers and pockets within the silty clay overburden provide for preferential flow paths and increased permeability, as evidence by TH17. Trench 2 further indicates abundant sand and silt layers within the clay deposits, which would not meet the performance criterion of 1.0x10^{-7} cm/s in the current condition. In this regard, quality control monitoring and careful separation of suitable versus unsuitable soils during excavation will be required.

- Remoulding of excavated silty clay borrow will be required to blend low plastic silt and sand pockets in order to provide a massive fill material without preferential seepage paths capable of achieving the performance criterion of 1.0x10^{-7} cm/s.

6 CLOSURE

The findings, discussion, and conclusions presented in this memorandum were based on geotechnical evaluation of the subsurface conditions observed during the site investigation described in this report, as well as additional sampling and laboratory testing undertaken following the original geotechnical investigation. If conditions other than those reported in this report are noted during subsequent phases of the project, or if the assumptions stated herein are not in keeping with the design, this office should be notified immediately in order that the recommendations can be verified and revised as required. Recommendations presented herein may not be valid if an adequate level of inspection is not provided during construction, or if relevant building code requirements are not met.

Soil conditions, by their nature, can be highly variable across a site. The placement of fill and prior construction activities on a site can contribute to the variability especially in near surface soil conditions. A contingency should always be included in any construction budget to allow for the possibility of variation in soil conditions, which may result in modification of the design and construction procedures.

This report has been prepared for the exclusive use of J.R. Cousin Consultants Ltd., and their agents, for specific application to the project described in this report. The data and recommendations provided herein should not be used for any other purpose, or by any other parties, without review and written advice from AMEC. Any use that a third party makes of this report, or any reliance or decisions made based on this report, are the responsibility of those parties. AMEC accepts no responsibility for damages suffered by a third party as a result of decisions made or actions based on this report.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, either expressed or implied, is made.

Respectfully Submitted,

AMEC Environment and Infrastructure
a Division of AMEC Americas Limited

Reviewed By:

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No. 555 Date: 11 Aug 2014

Brad Wiebe, M.Sc., P.Eng
Associate Geotechnical Engineer
Manager of Geotechnical Services
APEGGA Permit to Practice No. P-04546

Encl: Borehole Log for Trench 2
Moisture – Density Relationship - Trench 2, 3 to 4 feet
Hydraulic Conductivity Report – Trench 2, 3 to 4 feet

Appendix D

Plan 1: Lagoon Layout Plan with Setbacks to Existing Residences

Plan 2: Lagoon Drainage Route

Jul 31, 2014 - 1:50pm F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\EAP\Lagoon layout with setbacks.dwg

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.

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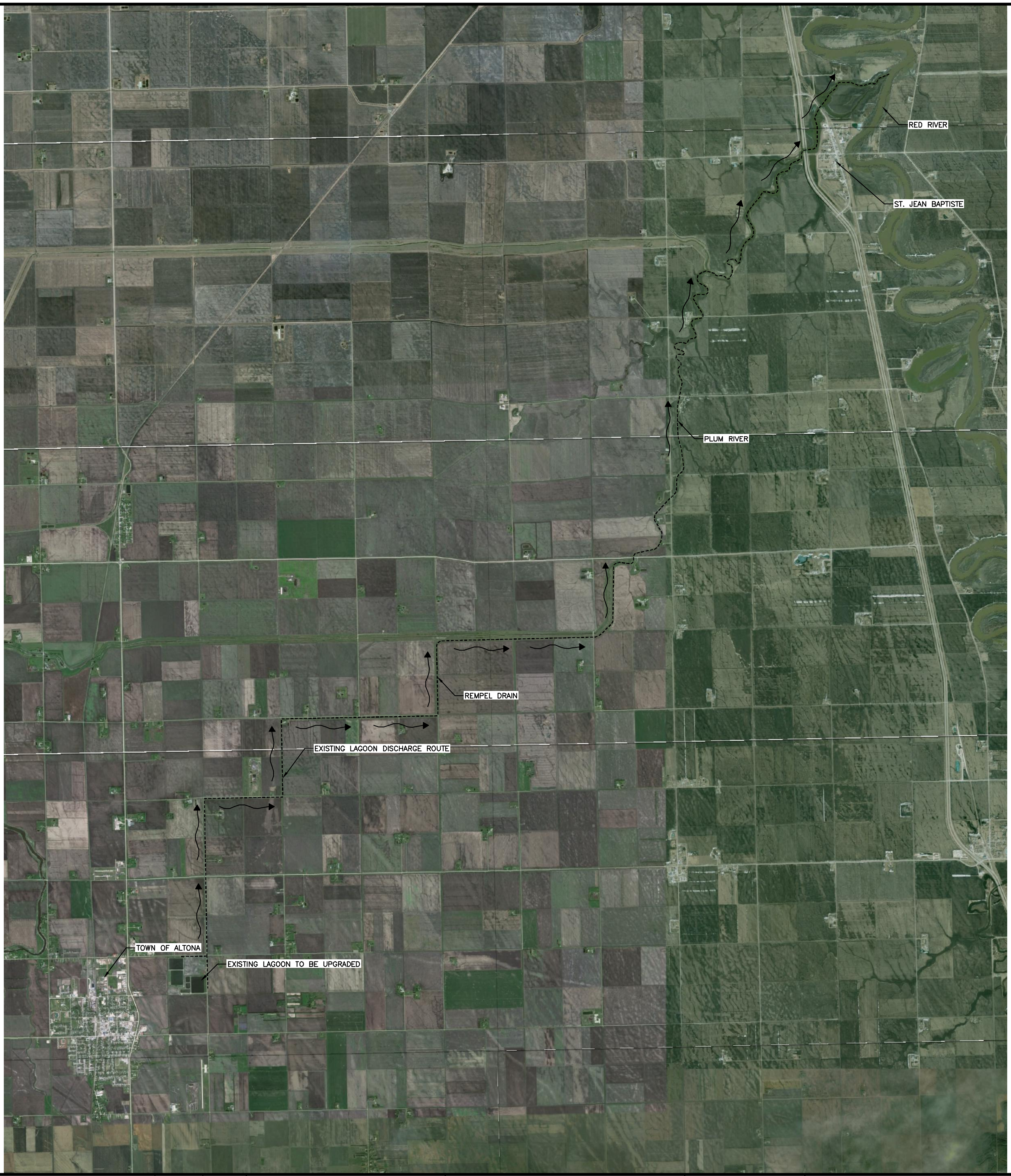
CODE: A-677.02
DESIGNED BY: JRC
DRAWN BY: DK
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON EXPANSION UPGRADE

TITLE:
LAGOON LAYOUT PLAN WITH SETBACKS TO EXISTING RESIDENCES

SCALE: 1:4000
DATE: 14/07/31
PLAN: 1
SHEET: 1 of 2



SCALE BAR
(IN METRES)
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No.	REVISIONS	DATE	INITIALS

B.M. EL.

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CODE: A−677.02
DESIGNED BY: DK
DRAWN BY: DK
REVIEWED BY: JRC

PROJECT:
TOWN OF ALTONA
LAGOON UPGRADE

TITLE:
EFFLUENT DISCHARGE ROUTE

SCALE: 1:50000
DATE: 14/07/31
PLAN: 2
SHEET: 2 of 2

Jul 31, 2014 − 10:56am F:\600\677 Altona, Town\677.02 Lagoon Upgrade\04 Drawings\dwg\EAP\Lagoon drainage route.dwg