Wastewater Treatment and Disposal Study

County of Lac Ste. Anne

53 Acre Development

Prepared for: AC Ltd.

COMMUNITIES

TRANSPORTATION

BUILDINGS

INFRASTRUCTURE

MMM GROUP

May 2008

WASTEWATER TREATMENT AND DISPOSAL STUDY

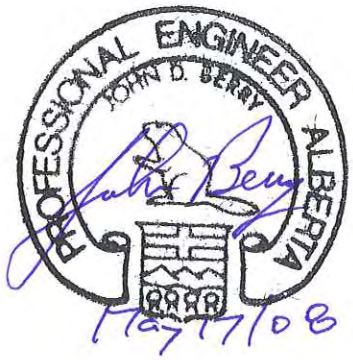
FOR

53 ACRE LAC STE ANNE DEVELOPMENT

LOCATED WITHIN: NE ¼ SEC 30, TWP 54, RGE 1 W5M.

PREPARED FOR:

AC LTD



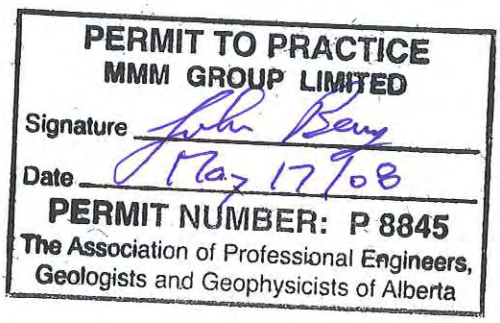
PREPARED BY:

MMM GROUP LIMITED

5151- 3rd Street S.E.

Calgary, Alberta

T2H 2X6



MAY 2008

EXECUTIVE SUMMARY

This report investigates the feasibility of constructing individual wastewater treatment and disposal systems on each lot located within the 53 acre Lac Ste Anne development. A total of nine (9) boreholes were advanced on the property to determine the subsoil conditions. The soils classification ranged from "Silt Loam" to "Loamy Sand", depending upon the borehole. No bedrock or water table issues were encountered.

Soil conditions were deemed suitable for disposal of treated effluent according to the Alberta Private Sewage System Standard of Practice 1999. Soil loading rates ranged from 13.72 to 30.87 litres per square metre per day.

Weeping tile field sizes were then calculated assuming 2 & 3 bedroom or 4 bedroom homes, using a conventional septic tank and weeping tile field system as a worst-case scenario. This approach, resulting in the largest possible weeping tile field size, was then plotted on the site plan to confirm that adequate land was available for construction of the tile fields. The site plan indicates that the weeping tile fields fit within each lot and still leave room for construction of the house, driveway, etc. without relaxing setbacks.

These weeping tile field sizes may be smaller than shown on the site plan depending upon the type of treatment and disposal system chosen by the house builder.

Based upon the soils investigation completed and calculations in this report, it is our opinion that the lands in this development are suitable for individual weeping tile fields on each lot.

If the development concept is approved in principle, we will be refining our sewage treatment/disposal plans and report/analysis to consider worst-case lot conditions including specific lot slope and soil types. As well, we will be exploring the application of "Advanced" and "Enhanced" systems and, where reductions in field size are needed, possible "Secondary Treatment Systems" (as discussed in Section 4.2 of this report). This will be done as part of the overall site planning and building development guidelines process and implementation.

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1.0 DESCRIPTION OF PROJECT

1.1 Introduction

MMM Group Limited (MMM) has been retained by AC Ltd. to undertake a Wastewater Treatment and Disposal Study for their 53 acre Lac Ste Anne Development. The site is located approximately 20 kilometres north west of Spruce Grove, Alberta. It is located within the County of Lac Ste. Anne. The legal description of the property is the NE ¼ Sec 30, Twp 54, Rge 1 W5M.

This Wastewater Treatment Report has been prepared to support the subdivision application as submitted by AC Ltd.

1.2 Background

The proposed Lac Ste Anne Residential Subdivision consists of approximately 53 acres of land. AC Ltd. proposes to develop the property into forty (40) single family country residential lots, plus the existing homestead. Lot sizes will vary from approximately 0.32 to 0.58 hectares. The attached site plan shows the proposed lot layout. One residence is located on the property near the eastern boundary. The balance of the property is primarily tree covered and used for grazing. The property is bounded on the north by a railroad track, on the east by a county road and on both the south and west by farmland. A high-pressure gas line, running approximately east-west, bi-sects the property.

1.3 Study Objective

The objective of this study is to confirm that individual septic tanks with weeping tile systems can be constructed on the lots.

2.0 DESIGN CRITERIA

2.1 Estimated Wastewater Flows

The estimated sewage flows for each of the single family lots is calculated as follows:

2.1.1 Two and Three Bedroom Houses

Number of Bedrooms = 3

Number of Persons per Bedroom = 1.5

Average Daily Flow = 340 litres per capita day

Allowance for Infiltration = 10%

Additional Load = 227 litres

Average Daily Flow (ADF) = (3 x 1.5 x 340 x 1.1 + 227) /1000 = 1.91 cubic metres per day

Maximum Daily Flow (MDF) = 1.5 x ADF = 2.86 cubic metres per day

2.1.2 Four Bedroom Houses

Number of Bedrooms = 4

Number of Persons per Bedroom = 1.5

Average Daily Flow = 340 litres per capita day

Allowance for Infiltration = 10%

Additional Load = 118 litres

ADF = (4 x 1.5 x 340 x 1.1 + 118) /1000 = 2.36 cubic metres per day

MDF = 1.5 x ADF = 3.54 cubic metres per day

2.2 Wastewater Strength

The anticipated raw sewage strengths are as follows:

- 80% of the time does not exceed
  - BOD of 220 mg/l

- TSS of 220 mg/l
- Oil and grease content of 50 mg/l

- Does not exceed maximum value of
  - BOD of 300 mg/l
  - TSS of 350 mg/l
  - Oil and grease content of 70 mg/l

3.0 FIELD INVESTIGATION AND SOIL TEXTURE CLASSIFICATION

A total of nine (9) subsurface investigation boreholes were advanced in proposed area of the property to check the existing ground conditions. The locations of these boreholes are shown on the site plan in Appendix A. Seven (7) boreholes were advanced to a depth of approximately 3 metres (Boreholes # 2, 3, 4, 5, 6, 7, and 8). The other two (2) holes were advanced to a depth of approximately 9.1 metres (Boreholes # 1 and 9) to check for both bedrock and near-surface groundwater. Soil samples were taken from Boreholes # 1, 3, 6, 8 & 9 at the 0.6 to 0.9 metre depth interval and forwarded to the laboratory for Grain Size Analysis.

The borehole logs and grain size analysis test results are attached to this report in Appendix B. The results of the grain size analysis were then plotted on a Soils Texture Classification Triangle. These are also attached to this report in an Appendix B. Borehole # 1 was classified as “Loamy Sand” and Borehole # 3 was classified as “Silt Loam”. Borehole # 6 was classified as “Loam”. Boreholes # 8 and 9 were classified as “Sandy Loam”. All boreholes are suitable for effluent disposal under the Alberta Private Sewage System Standard of Practice (APSSSP).

No bedrock was encountered in any of the nine (9) boreholes. Table 3.1 summarizes the groundwater level measurements taken approximately 12 days after drilling of the boreholes.

Table 3.1 Groundwater Measurements – February 5, 2008

Borehole	Depth to Groundwater
# 1	5.2 metres
# 2	Dry to Bottom of Hole @ 3.0 metres
# 3	Dry to Bottom of Hole @ 3.0 metres
# 4	Dry to Bottom of Hole @ 3.0 metres
# 5	Dry to Bottom of Hole @ 3.0 metres
# 6	Dry to Bottom of Hole @ 3.0 metres
# 7	Dry to Bottom of Hole @ 3.0 metres
# 8	2.1 metres
# 9	Dry to Bottom of Hole @ 9.1 metres

Borehole # 8, recorded a ground water level of 2.1 metres below the existing ground surface. Based upon the borehole information, this groundwater reading is believed to be a due to perched water table located above the underlying silty clay layer and not a regional condition.

3.1 Suitability of Site For Onsite Effluent Disposal

The Alberta Private Sewage Systems Standard of Practice (APSSSP) specifies that a minimum of 900 mm vertical separation be maintained from the point of effluent infiltration into the soil and either a water table or impermeable layer, in systems containing secondary treatment plants (1500 mm vertical separation in systems containing a septic tank). As the water table in the proposed area was found to be at least 2.1 metres below the surface and no bedrock or other impermeable surface was identified, this area appears suitable for tile fields.

3.2 Soil Loading Rates

To evaluate whether or not sufficient area is available for onsite effluent disposal, an evaluation of the soil loading rates was carried out using the APSSSP.

Table 3.2 Allowable Effluent Loading Rates According To The APSSSP

Borehole	Soil Classification	Allowable Loading Rate
# 1	Loamy Sand	30.87 litres per square metre per day
# 3	Silt Loam	13.72 litres per square metre per day
# 6	Loam	17.15 litres per square metre per day
# 8 & 9	Sandy Loam	22.05 litres per square metre per day

A 30% increase in the above noted loading rates is allowed when a Secondary Treatment System is constructed. Another 20% increase in the above noted loading rates is allowed when a Pressure Distribution System is constructed instead of a gravity system.

4.0 PROPOSED TREATMENT SYSTEM

Two wastewater treatment systems are discussed below; a conventional septic tank system and a NSF Standard 40, Class 1 residential wastewater treatment system.

4.1 Primary Treatment (Septic) Tank

Septic tanks are small, rectangular chambers, usually sited just below ground level, in which sewage is retained for 1 to 3 days. A three compartment septic includes a settling chamber, a septic tank chamber and either a siphon or pump-out chamber. During this time the solids settle to the bottom of the tank where they are digested anaerobically. Some sludge accumulates and the tank must be desludged at regular intervals. Septic tanks shall include the capacity to store accumulating sludge and scum for a minimum 3 year period.

4.1.1 Effluent Treatment Quality

Treated effluent from a septic tank should not exceed any of the following concentrations:

- BOD5 of 150 mg/l
- TSS of 100 mg/l
- Oil and grease content of 15 mg/l

4.1.2 Separation Distances

Septic tanks shall not be located within:

- 1m from a property line,
- 10 m from a water source,
- 10 m from a water course and
- 1 m from a building.

4.1.3 Working Capacity

The working capacity of a septic tank shall not be less than volume set out in Table 4.1.

Table 4.1 Minimum Working Capacities of Septic Tanks

Number of Bedrooms	Minimum Working Capacity
2 or 3 Bedrooms	3,400 litres
4 Bedrooms	4,500 litres
5 Bedrooms	5,600 litres

4.2 Secondary Treatment (Packaged Sewage Treatment Plants)

On some of the smaller lots it may be tight to fit in a conventional septic tank and weeping tile field, even with the “advanced or enhanced systems”. As such, consideration must be given to the installation of packaged sewage treatment plant that is certified as meeting the National Sanitation Foundation (NSF/ANSI) Standard 40, Class 1 for “Residential Wastewater Treatment Systems” (i.e. Secondary Treatment System under the APSSSP). Combined with a pressure distribution system, this will permit a 50% increase in loading rate for the weeping tile field thus reducing the total overall footprint.

4.2.1 Effluent Treatment Quality

Treated effluent from a NSF Standard 40, Class 1 packaged sewage treatment plant should not exceed any of the following concentrations:

- 80% of the time does not exceed
  - BOD of 25 mg/l
  - TSS of 30 mg/l
  - Oil and grease content of 10 mg/l

4.2.2 Separation Distances

A packaged sewage treatment plant shall not be located within

- 6 m from a property line,
- 10 m from a water source,
- 10 m from a water course and
- 1 m from a building.

5.0 PROPOSED DISPOSAL FIELDS

Disposal of the treated effluent to the sub-soil is possible by either a gravity or pressurized distribution system. A gravity distribution system usually includes a siphon in the last compartment of the septic tank that doses the tile field with treated effluent whenever the siphon compartment is full. The tile field usually consists of perforated pipe. A distribution box, located at the tile field permits dosing of a portion of the field at a time. Gravity distribution systems are explained in Sections 5.2 and 5.4. These systems are considered "Advance Sewage Systems" under the County standards.

A pressurized distribution system uses a pump in the last compartment of the septic tank. A more even distribution of the treated effluent is possible because the disposal system is under pressure. As such, the entire field is usually dosed at a time. Several types of pressurized distribution systems are possible and these are explained in Sections 5.3 and 5.4. These systems are considered "Enhanced Sewage Systems" under the County standards.

5.1 Weeping Tile Field Design Parameters

To design a treatment field, the capacity of the soil and the daily amount of sewage generated needs to be determined. Only the infiltration area of the trench bottom is considered in the calculation and the sidewall area is not included. If infiltration into the side walls of the trench were relied on for infiltration surface, ponding of the effluent in the bottom of the trench would have to occur, thus setting up anaerobic conditions. These anaerobic conditions do not treat the sewage as efficiently.

5.1.1 Soil Loading Rate Restriction

A treatment field shall not be installed on soils that have a loading rate of less than 9.80 litres per square metre per day. As can be seen in Table 3.2, all loading rates exceed this value.

5.1.2 Separation Distances

A treatment field, measured from any part of a weeping lateral trench, shall not be located within:

- 1.5 m from a property line,
- 15 m from a water source,
- 15 m from water course,
- 10 m from basement,
- 1 m from a building that dose not have a permanent foundation,
- 5 m from a building that has a permanent foundation but does not have a basement and
- 5 m from a septic tank or packaged sewage treatment plant.

5.1.3 Monitoring Pipes

There shall be a minimum of two monitoring pipes per lateral, which extend from the surface of the ground to the depth of the infiltrative surface and are located within 4.5 m from each end of the trench.

5.2 Gravity Distribution Systems

A system totally reliant on gravity flow can be used when there is sufficient elevation difference between the outlet of a siphon in the effluent chamber and the final treatment component. A siphon provides a volume per flush that will prevent freezing in the effluent line and encourage equal distribution of effluent.

The effluent distribution system shall be designed to provide approximately equal effluent distribution to each weeping lateral trench.

Lateral pipes shall be laid nominally level at a maximum depth of 600 mm below the finished ground surface, as measured from the top of the pipe, and installed with the top of the pipe at the top of the drain media used in the trench.

5.3 Pressure Distribution Systems

Pressure distribution lateral systems use pressurized piping in the trench or infiltration area to discharge effluent from orifices along the piping. This method ensures that the entire infiltrative surface is provided with effluent. Thus the APSSSP allows a 20 percent increase in loading rate if this method is used.

5.3.1 Orifices

Orifices in a distribution lateral shall be spaced at a distance of not greater than:

- 1500 mm when distributing primary treated effluent
- 750 mm when distributing secondary treated effluent

5.3.2 Dosage Volume

The volume of an individual dose to be distributed over the infiltration surface area using a pressure distribution lateral system shall be at least 5 times the volume of the distribution lateral piping but shall not exceed the maximum individual dose volume needed to deliver the required number of doses per day.

5.3.3 Lateral Length

An individual lateral, as measured from the distribution header connection to the last orifice, shall not exceed 20 metres.

5.3.4 Pumps and Pressure Head

The pump used to supply effluent to the distribution system shall be capable of delivering the volume of effluent required to supply the orifices while maintaining not less than a 1.5 metre squirt height at all of the orifices.

5.3.5 Spacing Between Orifices and Infiltration Surface

Distribution lateral piping shall be installed so that each orifice opening is a minimum of 50 mm above the soil infiltration surface.

5.3.6 Piping Supports

Distribution lateral piping that is not encased in media shall be supported at intervals of 1200 mm or less, unless specified otherwise by the pipe manufacturer.

5.4 Chamber Systems

Chamber systems may be fed by either gravity or pressurized. The chamber provides the void space to allow the effluent to spread evenly along the trench bottom. A chamber treatment system is well suited to pressurized laterals as the open space they provide allows the spray of effluent to be deflected and splash over the soil surface.

The effective infiltration area of a trench using chambers is considered to be 1.6 times the actual width of the chamber.

In order to minimize the disturbance and erosion of soil at the trench bottom where the effluent is delivered, the following is used:

- A minimum of 50 mm of geotextile fabric in the most upstream 1.5 metre portion of all weeping lateral trenches or other area that receives effluent
- A minimum of 50 mm of gravel in the most upstream 1.5 metre portion of all weeping lateral trenches or other area that receives effluent.

5.4.1 Certification

All chambers shall be certified as meeting or exceeding the requirements of the American Association of State Highway and Transportation Officials H10 or H20 rating and the requirements established by IAPMO PS 063, “Plastic Leaching Chambers,”

6.0 WEEPING TILE FIELD SIZING

The following weeping tile field sizing is based upon the lowest allowable loading rate found at the site (Borehole # 3, Silt Loam @ 13.72 litres per square metre per day). Sizing of the weeping tile fields were calculated based upon the following parameters:

- Allowable effluent loading rate = 13.72 litres/sq. m. per day
- With pressure distribution system permitting a 20% increase in loading rate.
- With secondary wastewater treatment permitting a 30% increase in loading rate.
- When using chambers the infiltration area is considered to be 1.6 times the actual width of the chamber.

6.1 Two and Three Bedroom Houses

For two and three bedroom houses, the size of the weeping tile field will range from 140 square metres to 420 square metres depending upon the type of treatment and disposal system chosen.

- Primary treatment (septic tank) and siphon fed weeping tile laterals with gravel bedding = 420 sq.m.
- Primary treatment (septic tank) and pressure fed weeping tile laterals with gravel bedding = 338 sq.m.
- Primary treatment (septic tank) with siphon fed chamber system = 270 sq.m.
- Primary treatment (septic tank) with pressure fed chamber system = 210 sq.m.
- Secondary treatment and pressure fed weeping tile laterals with gravel bedding = 210 sq.m.
- Secondary treatment with pressure fed chamber system = 140 sq.m.

A detailed analysis is presented in Appendix C.

The site plan, shown in Appendix A, depicts the worst case scenario of the largest weeping tile field (420 sq.m.) for two and three bedroom houses.

6.2 Four Bedroom Houses

For four bedroom houses, the size of the weeping tile field will range from 170 square metres to 520 square metres depending upon the type of treatment and disposal system chosen.

- Primary treatment (septic tank) and siphon fed weeping tile laterals with gravel bedding = 520 sq.m.
- Primary treatment (septic tank) and pressure fed weeping tile laterals with gravel bedding = 420 sq.m.
- Primary treatment (septic tank) with siphon fed chamber system = 330 sq.m.
- Primary treatment (septic tank) with pressure fed chamber system = 270 sq.m.

- Secondary treatment and pressure fed weeping tile laterals with gravel bedding = 270 sq.m.
- Secondary treatment with pressure fed chamber system = 170 sq.m.

A detailed analysis is presented in Appendix C.

The site plan, shown in Appendix A, depicts the worst case scenario of the largest weeping tile field (520 sq.m.) for four bedroom houses.

6.3 Other Soil Loading Rates

The above calculations are based upon the lowest allowable soil loading rate found at the site. Other boreholes in the same development resulted in better soil conditions, thus higher allowable soil loading rates. A detailed analysis of all calculated tile field sizes for all four soil classifications found is presented in Appendix C.

The lowest allowable soil loading rate results in the largest tile field size. Thus this was used to prove that individual tile fields will fit on the lots. It is suggested that the home builders conduct their own soils investigation at each lot, because if better soil conditions are found then the size of the tile field may be reduced.

6.4 Homes With More Than 4 Bedrooms

If home builders construct houses with more than four bedrooms then the estimated wastewater flows must be recalculated as per Section 2.0. The additional flow will impact the tile field size.

7.0 CONCLUSIONS AND RECOMMENDATIONS

- Expected sewage flows generated by the development do not exceed the maximum flows regulated under the Alberta Private Sewage Systems Standard of Practice 1999.
- Given the type of soils present, the presence of a deep water table and no indication of bedrock, that the soils are suitable for disposal of treated effluent via weeping tile fields.
- The tile field size will also vary depending upon the type of disposal field chosen (weeping tile pipe, pressure distribution laterals or chamber design).
- The site plan in Appendix A presents the worst case scenario of the largest weeping tile field for 2&3 bedroom and 4 bedroom homes.
- This worst case scenario fits in each of the lots and still leaves room for construction of the house, driveway, etc. without relaxing setbacks.
- Based upon the soils investigation completed and the calculations in this report it is our opinion that the lands in this development are suitable for individual weeping tile fields on each lot.
- If the development concept is approved in principle, we will be refining our sewage treatment/disposal plans and report/analysis to consider worst-case lot conditions including specific lot slope and soil types. As well, we will be exploring the application of “Advanced” and “Enhanced” systems and, where reductions in field size are needed, possible “Secondary Treatment Systems” (as discussed in Section 4.2 of this report). This will be done as part of the overall site planning and building development guidelines process and implementation.

APPENDIX A – Site Plan

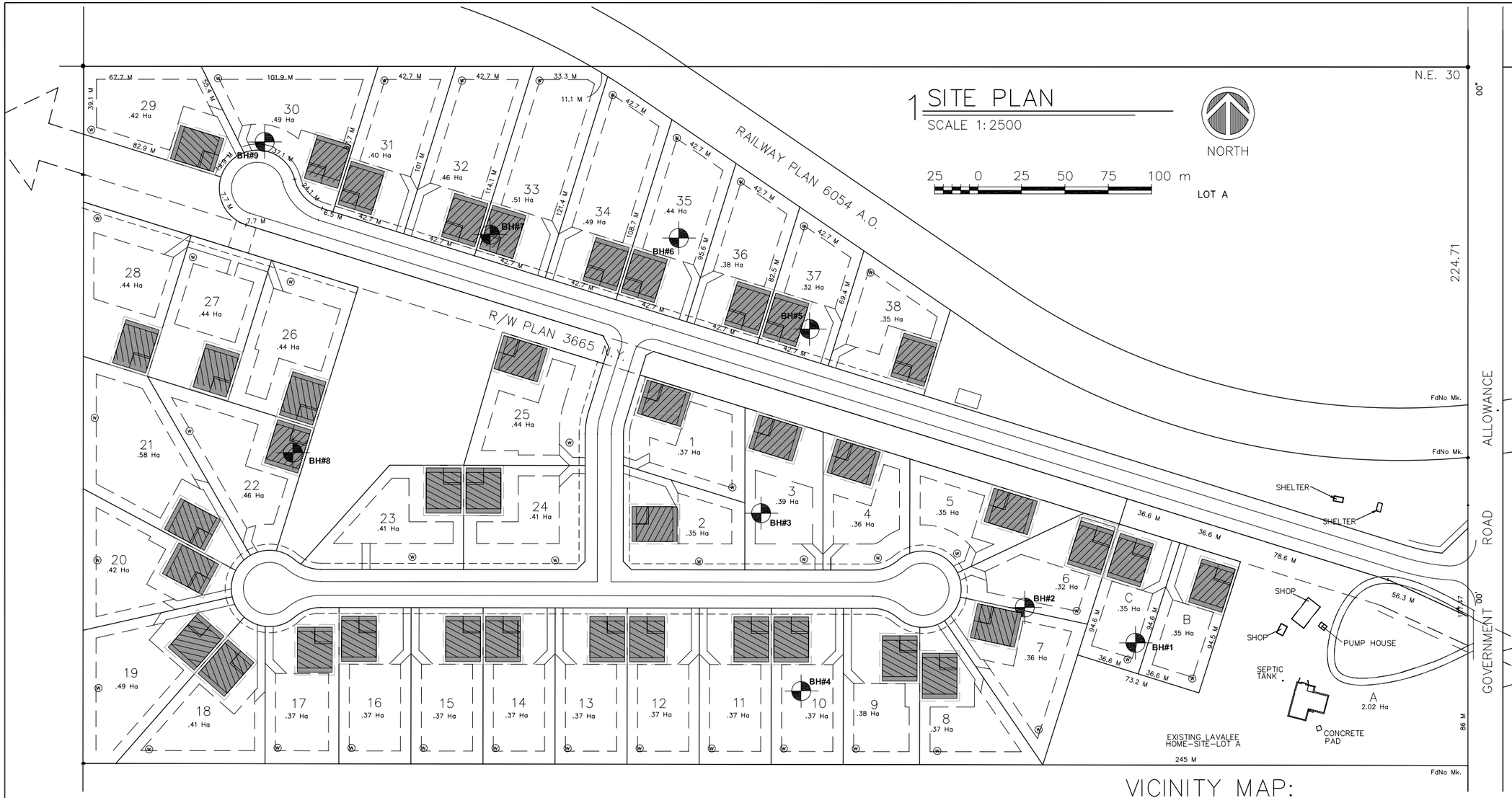
1 SITE PLAN

SCALE 1:2500

NORTH

25 0 25 50 75 100 m

LOT A



— PROPERTY LINE OFFSET

— 4 BEDROOM TILE FIELD
MIN. 10.00m x 8.50m
MAX. 20.00m x 6.00m

— 2 & 3 BEDROOM FIELD
MIN. 10.00m x 7.00m
MAX. 20.00m x 21.00m

— MINIMUM SIZED TILE FIELD

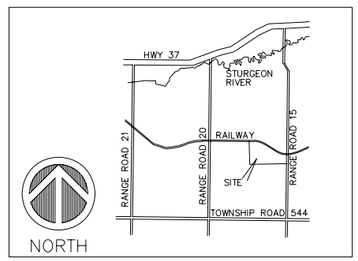
— MAXIMUM SIZED TILE FIELD

— COMMON LOT FOR MUNICIPAL RESERVE, COMMUNITY PARK AND DRAINAGE DETENTION AREAS. (8.05 ACRES)

— BUILDABLE AREA

Ⓦ — PROPOSED WELL

VICINITY MAP:



LEGAL DESCRIPTION:

LOT B
PLAN 4722 T.R.

STAMPS

LEGEND

NO.	DATE	DESCRIPTION
5		
4		
3		
2		
1		
0	05/17/2008	PRELIMINARY

REVISIONS

JOB NO.: 4737.1	FILE: MMM-53-Acres-Lot-Plan	
SCALE: 1:1250		DATE
DRAWN BY: B.T.		2008/05
DESIGNED BY: M.I.		2008/05
CHECKED BY: M.I.		2008/05
APPROVED BY: J.B.		2008/05

MMM GROUP

MMM Group Limited
5151 - 3rd Street S.E.
Calgary, Alberta T2H 2X6
t.403 269 7440
f.403 269 7422
www.mmm.ca

PROJECT TITLE:

AC LTD.

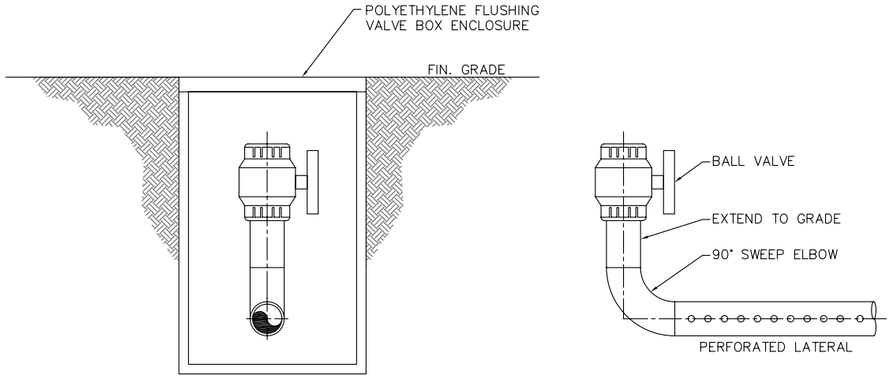
53 ACRE LAC STE. ANNE DEVELOPMENT

PROJECT # ACL-CDG-53ac-0002-EDMONT-2007

DRAWING TITLE:

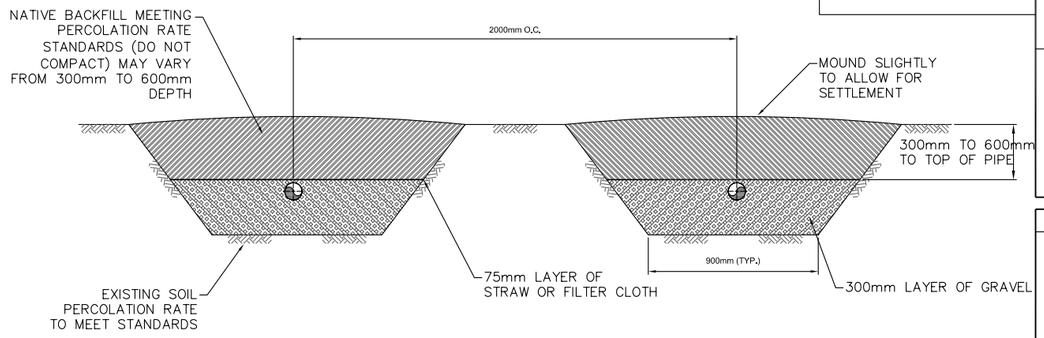
OVERALL LOT PLAN

DRAWING NUMBER:	REVISION
4737-C100	0

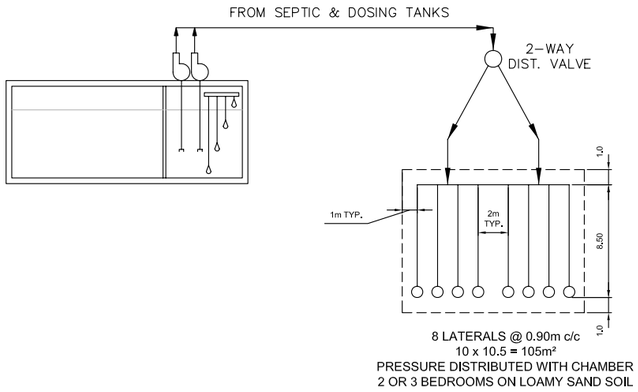


1 C200 FLUSHING VALVE DETAIL
SCALE: NTS

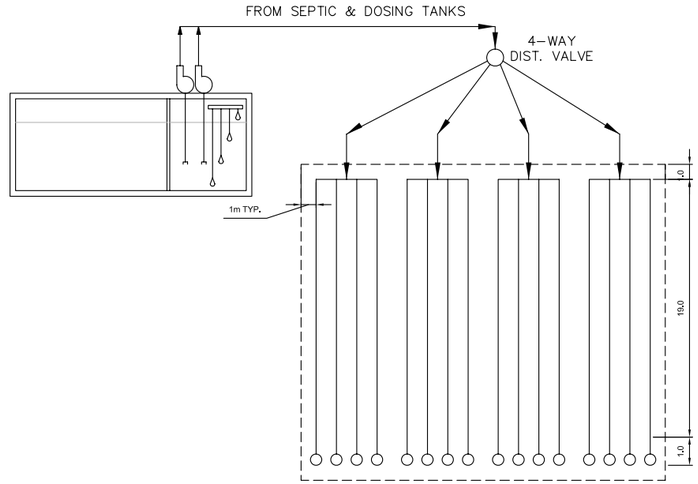
NOTE:
GRAVEL SHALL HAVE A PARTICLE SIZE BETWEEN 15mm AND 40mm



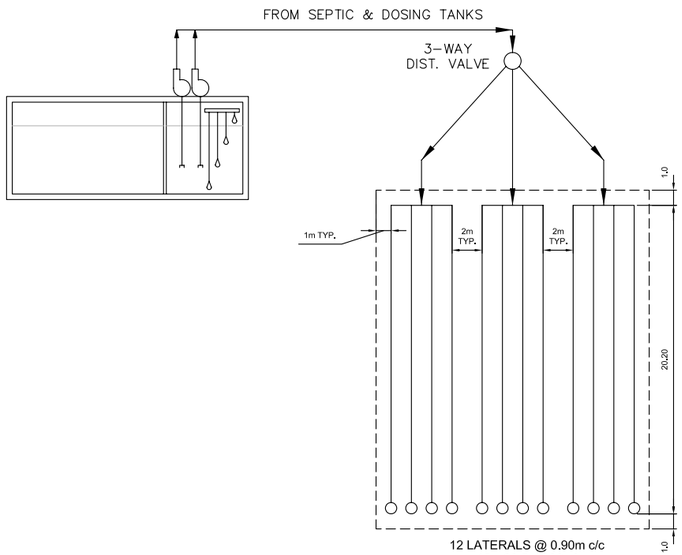
2 C200 TRENCH DETAIL
SCALE: NTS



8 LATERALS @ 0.90m c/c
10 x 10.5 = 105m²
PRESSURE DISTRIBUTED WITH CHAMBER
2 OR 3 BEDROOMS ON LOAMY SAND SOIL

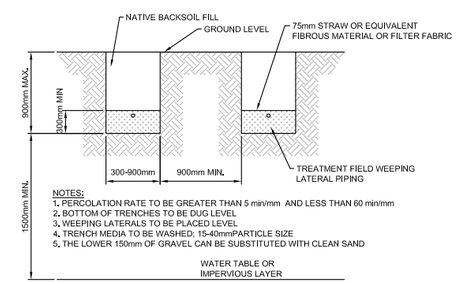


16 LATERALS @ 0.90m c/c
20 x 21 = 420m²
GRAVITY DISTRIBUTED WITH GRAVEL
2 OR 3 BEDROOM ON SILT LOAM SOIL

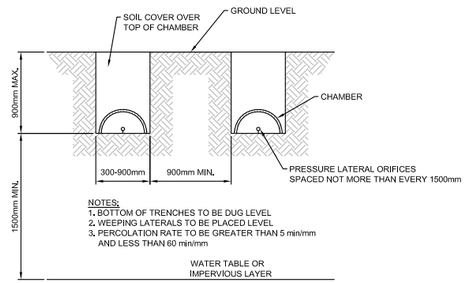


12 LATERALS @ 0.90m c/c
15 x 22.5 = 338m²
PRESSURE DISTRIBUTED WITH GRAVEL
4 BEDROOMS ON LOAM SOIL

3 C200 WEEPING TILE FIELD LAYOUTS
SCALE: N.T.S.



4 C200 PIPE AND GRAVEL TRENCHES
SCALE: N.T.S.



5 C200 TRENCH W/CHAMBERS & PRESSURE DISTRIBUTION
SCALE: N.T.S.

STAMPS

LEGEND

NO.	DATE	DESCRIPTION
2		
1		
0		
A		

REVISIONS

JOB NO.: 4737	DRAWING FILE.: 4737-M100

SCALE:	AS NOTED	DATE
DRAWN BY:	B.T.	2008/05
DESIGNED BY:	M.I.	2008/05
CHECKED BY:	M.I.	2008/05
APPROVED BY:	J.B.	2008/05

MMM GROUP
MMM Group Limited
5151 - 3rd Street S.E.
Calgary, AB T2H 2X6
t.403 269 7440
www.mmm.ca

PROJECT TITLE:
AC LTD.
53 ACRE LAC STE. ANNE DEVELOPMENT
PROJECT # ACL-CDG-53ac-0002-EDMONT-2007

DRAWING TITLE:
CIVIL
WEEPING TILE FIELD LAYOUT

DRAWING NUMBER:	REVISION
4737-M100	0

APPENDIX B – Borehole Logs, Grain Size Analysis and Soil Texture Classification Triangles

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:1
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:699.5

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		Topsoil-(Approx. 50mm Thick)			TPSL						699
		Sand- medium grain, damp, compact, medium brown.		1-1			16.3		Clay = 11% Silt = 7% Sand = 82%		
1											
		-moist.		1-2	SA	7-9-11					698
2				1-3			21.8				
		-water flowing.									697
3		-silty clay lenses, medium plastic, trace fine gravel, moist.		1-4	CI	3-3-6	21.0				
		-medium grain sand, damp.		1-5							696
4					SA						
				1-6		3-4-5					695
5		Silty Clay(Till)- low plastic, some sand, trace fine gravel, damp, stiff, dark grey.		1-7							
											694
6				1-8		6-8-12					
				1-9	CL-ML						693
7											
				1-10		4-5-7					692
8				1-11							
											691
9		END OF HOLE AT 9.1M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; 5.20M.									690

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 30 ft
Reviewed By: Marty Ward	Drilled on: 1/23/2008
Groundwater Depth: 5.2 m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

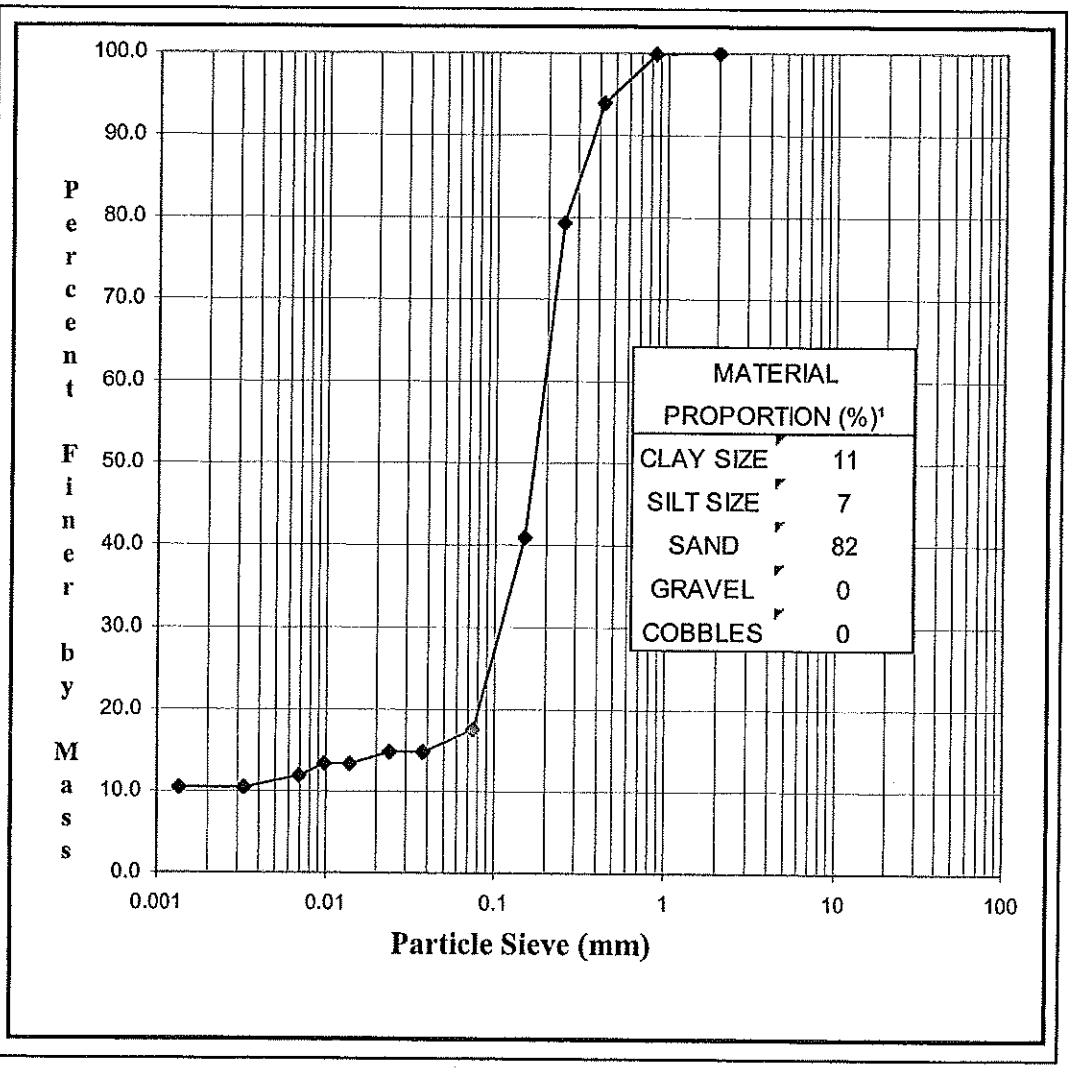
McINTOSH LALANI ENGINEERING LTD.

STANDARD TEST METHOD FOR PARTICLE SIZE

(Test Method ASTM D422)

PROJECT: **55 ACRE PARCEL**
CLIENT: AC LTD.
PROJECT NO.: ML-3861
LOCATION: BH 1-1
SAMPLE NO.: 11147
DEPTH:
DESCRIPTION: Sand, Trace Silt, & Clay

PARTICLE SIZE	PERCENT PASSING
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
12.5 mm	
10 mm	
5 mm	
2 mm	100.0
850 µm	99.9
425 µm	93.9
250 µm	79.3
150 µm	40.9
75 µm	17.6
38 µm	14.8
24 µm	14.8
14 µm	13.4
10 µm	13.4
7 µm	11.9
3 µm	10.5
1 µm	10.5



Reviewed by: _____ P.Eng.

Note 1: Classified by the Modified Unified Soil Classification System

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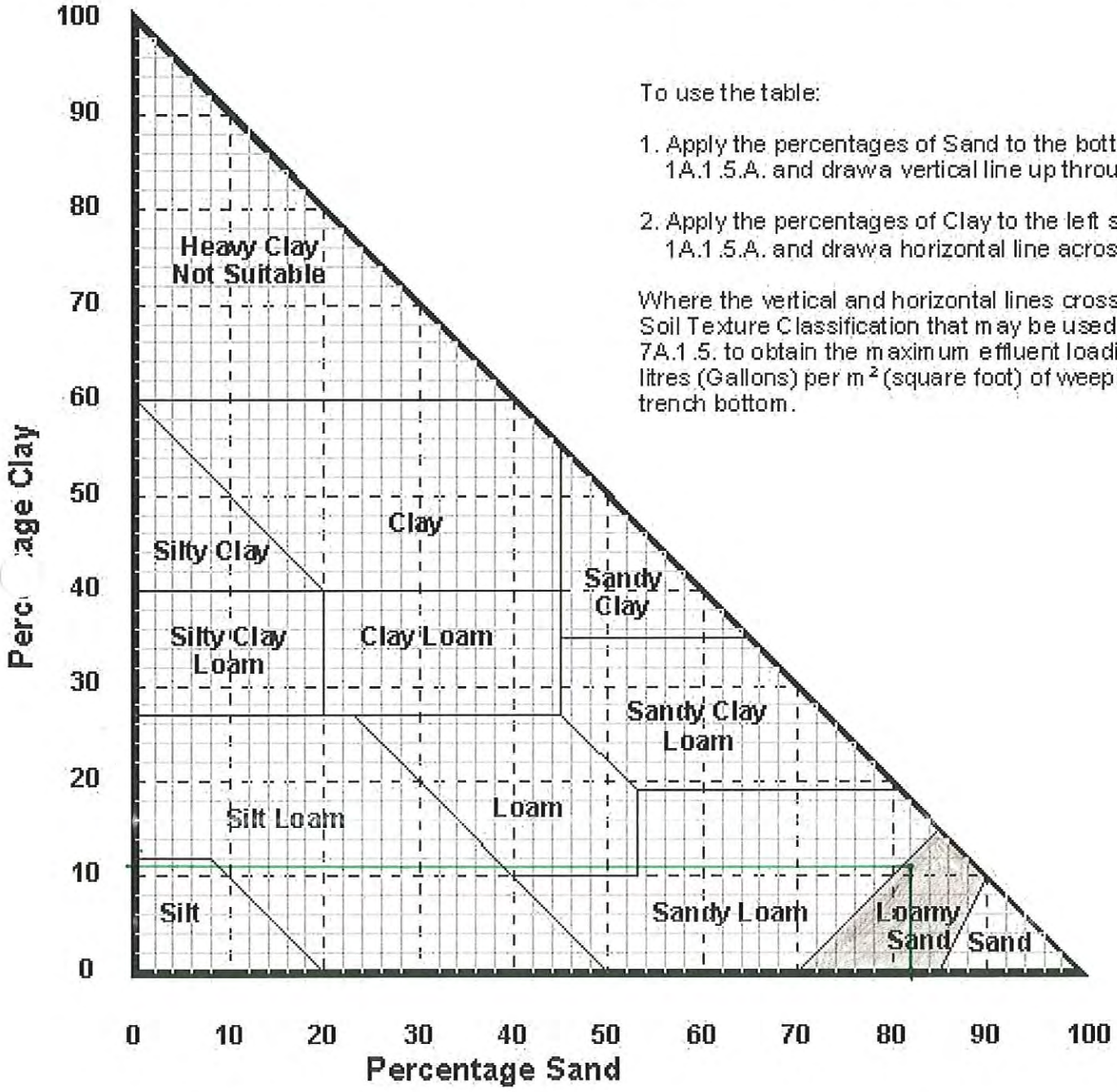
The testing services reported herein have been performed by an ML technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, ML will provide it upon written request.

Test Hole # BH 1-1
(Loamy Sand)

Figure 7A.1.5.A Soil Texture Classification Triangle



To use the table:

1. Apply the percentages of Sand to the bottom of Table 1A.1.5.A. and drawa vertical line up through the table,

2. Apply the percentages of Clay to the left side of Table 1A.1.5.A. and drawa horizontal line across the table.

Where the vertical and horizontal lines cross indicates a Soil Texture Classification that may be used with Article 7A.1.5. to obtain the maximum effluent loading rate in litres (Gallons) per m^2 (square foot) of weeping lateral trench bottom.

Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:2
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:703

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 75mm Thick)			TPSL					
		Sand- medium grain, damp, compact, medium brown.			SA					
		Silty Clay(Till)- low plastic, trace sand and gravel, damp, stiff, medium brown.		2-1						
1										702
					CL-ML					
2				2-2						701
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								700
4										699
5										698

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/23/2008
Groundwater Depth: m	Page 1 of 1

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:3
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:701

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 100mm Thick)			TPSL					
		Silt- some sand, trace clay, damp, compact, medium brown.								
				3-1			15.2		Clay = 19% Silt = 50% Sand = 31%	
1										700
		-low plastic.			ML					
2				3-2						699
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								698
4										697
5										696

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

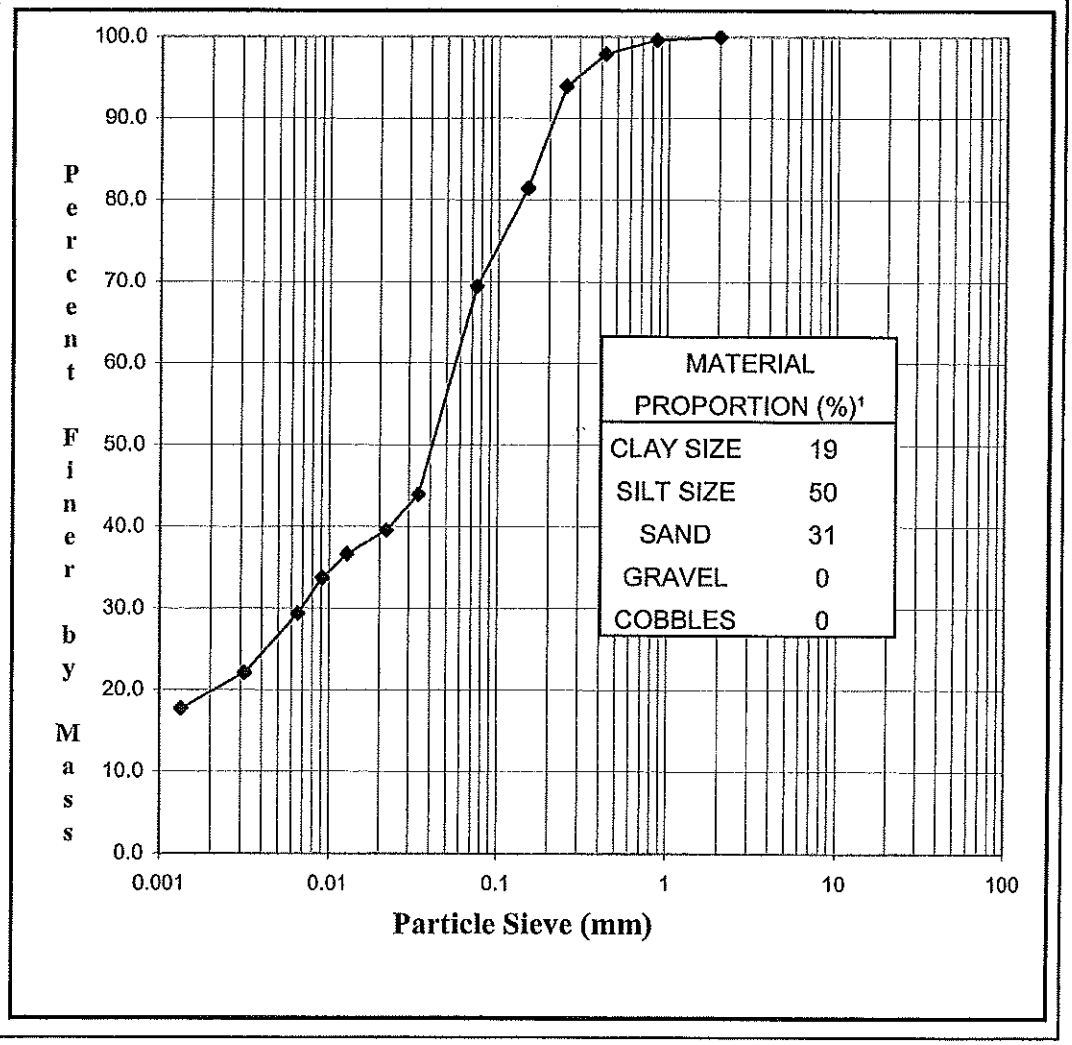
McINTOSH LALANI ENGINEERING LTD.

STANDARD TEST METHOD FOR PARTICLE SIZE

(Test Method ASTM D422)

PROJECT: **55 ACRE PARCEL**
CLIENT: AC LTD.
PROJECT NO.: ML-3861
LOCATION: BH 3-1
SAMPLE NO.: 11147
DEPTH:
DESCRIPTION: SILT, Some Sand & Clay

PARTICLE SIZE	PERCENT PASSING
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
12.5 mm	
10 mm	
5 mm	
2 mm	100.0
850 µm	99.6
425 µm	97.9
250 µm	93.9
150 µm	81.4
75 µm	69.5
34 µm	43.9
22 µm	39.6
13 µm	36.7
9 µm	33.8
7 µm	29.4
3 µm	22.1
1 µm	17.8



Reviewed by: _____ P.Eng.

Note 1: Classified by the Modified Unified Soil Classification System

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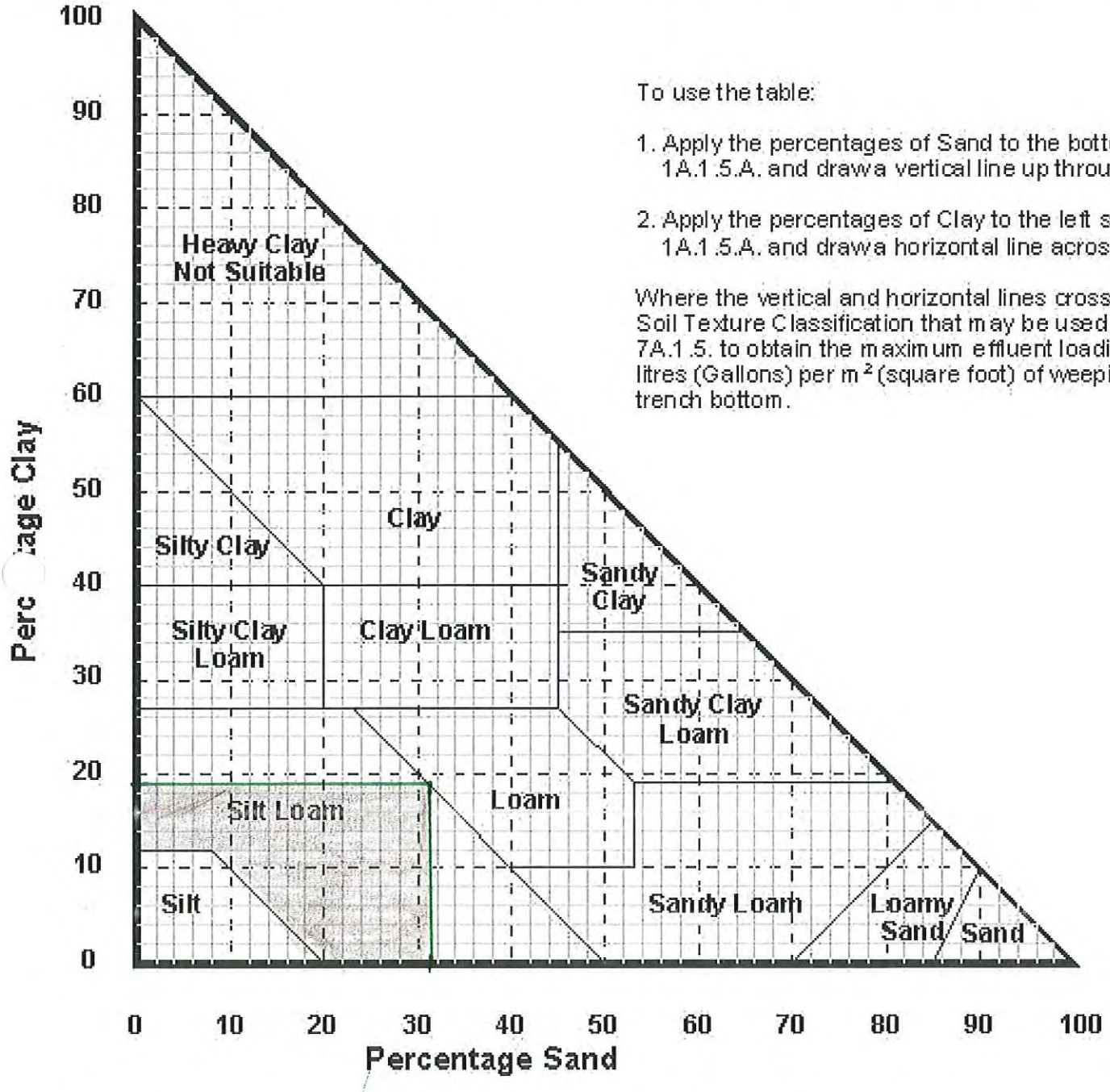
Test Hole # BH3-1
(Silt Loam)

Figure 7A.1.5.A Soil Texture Classification Triangle



To use the table:

1. Apply the percentages of Sand to the bottom of Table 1A.1.5.A. and drawa vertical line up through the table,

2. Apply the percentages of Clay to the left side of Table 1A.1.5.A. and drawa horizontal line across the table.

Where the vertical and horizontal lines cross indicates a Soil Texture Classification that may be used with Article 7A.1.5. to obtain the maximum effluent loading rate in litres (Gallons) per m^2 (square foot) of weeping lateral trench bottom.

Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:4
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:704.75

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 50mm Thick)			TPSL					704
		Sand- medium grain, damp, compact, medium brown.		4-1	SA					
1										
		Silty Clay(Till)- low plastic, some sand, trace gravel, moist, firm, medium brown.		4-2		6-7-7	13.7			703
2		-trace sand lenses.		4-3	CL-ML					
										702
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								
										701
4										
										700
5										
										699

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:5
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:698

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 75mm Thick)			TPSL					
		Sand- medium grain, damp, compact, medium brown.			SA					
		Silt- some sand, trace medium plastic clay lenses, damp, compact, medium brown.		5-1						
1										697
					ML					
2				5-2						696
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								695
4										694
5										693

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:6
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:699.7

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC / M.C. / LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 50mm Thick)			TPSL					699
		Silty Sand- damp, compact, medium brown.		6-1	SM		15.9		Clay = 15% Silt = 38% Sand = 47%	
1										
		Silty Clay(Till)- low plastic, some sand lenses throughout, trace gravel, damp, stiff, medium brown.		6-2		4-4-4				698
2				6-3	CL-ML					
										697
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								
										696
4										
										695
5										
										694

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

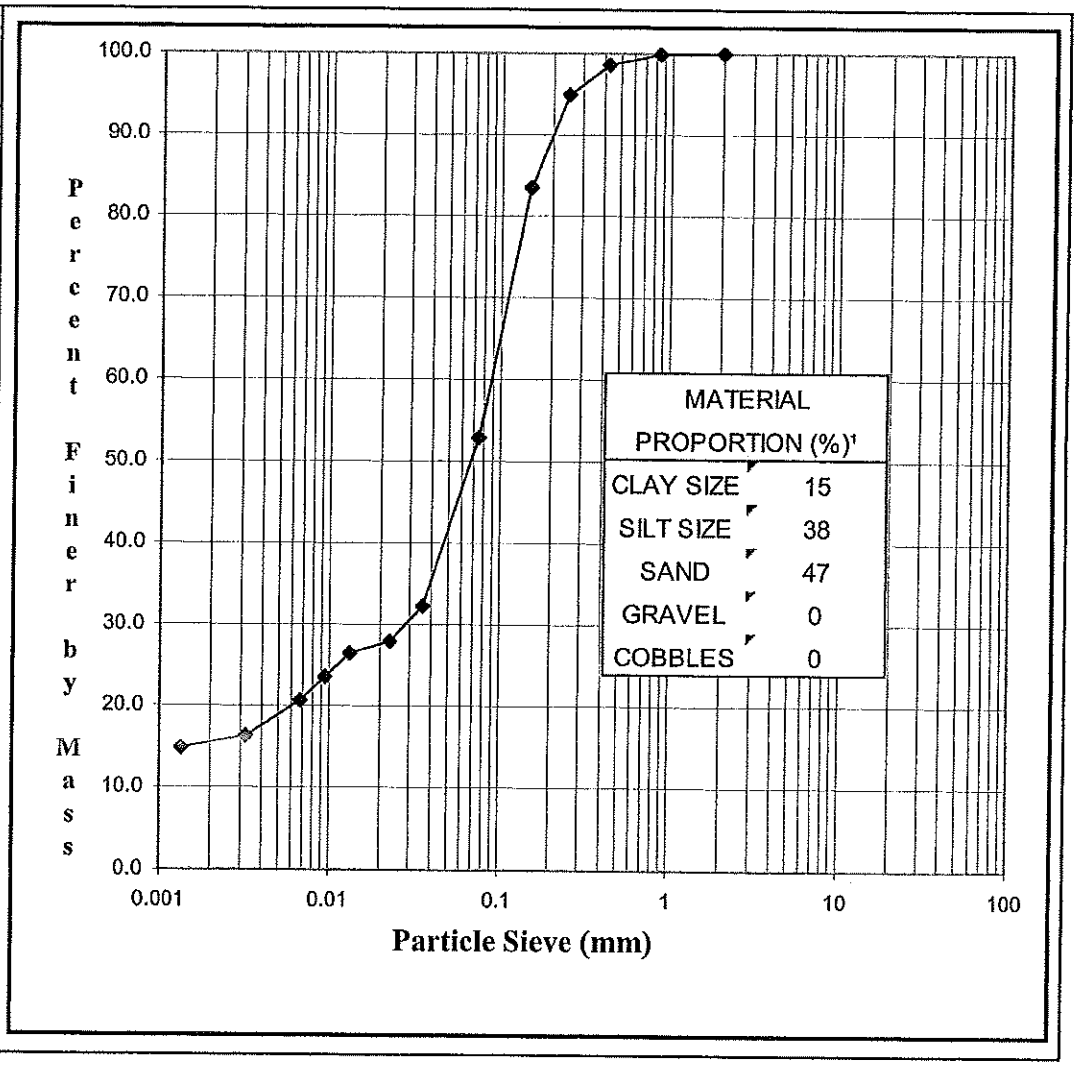
McINTOSH LALANI ENGINEERING LTD.

STANDARD TEST METHOD FOR PARTICLE SIZE

(Test Method ASTM D422)

PROJECT: **55 ACRE PARCEL**
CLIENT: AC LTD.
PROJECT NO.: ML-3861
LOCATION: BH 6-1
SAMPLE NO.: 11147
DEPTH:
DESCRIPTION: Silty Sand, Some Clay

PARTICLE SIZE	PERCENT PASSING
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
12.5 mm	
10 mm	
5 mm	
2 mm	100.0
850 µm	99.9
425 µm	98.6
250 µm	94.9
150 µm	83.5
75 µm	52.9
36 µm	32.3
23 µm	27.9
13 µm	26.5
9 µm	23.6
7 µm	20.7
3 µm	16.3
1 µm	14.8



Reviewed by: _____ P.Eng.

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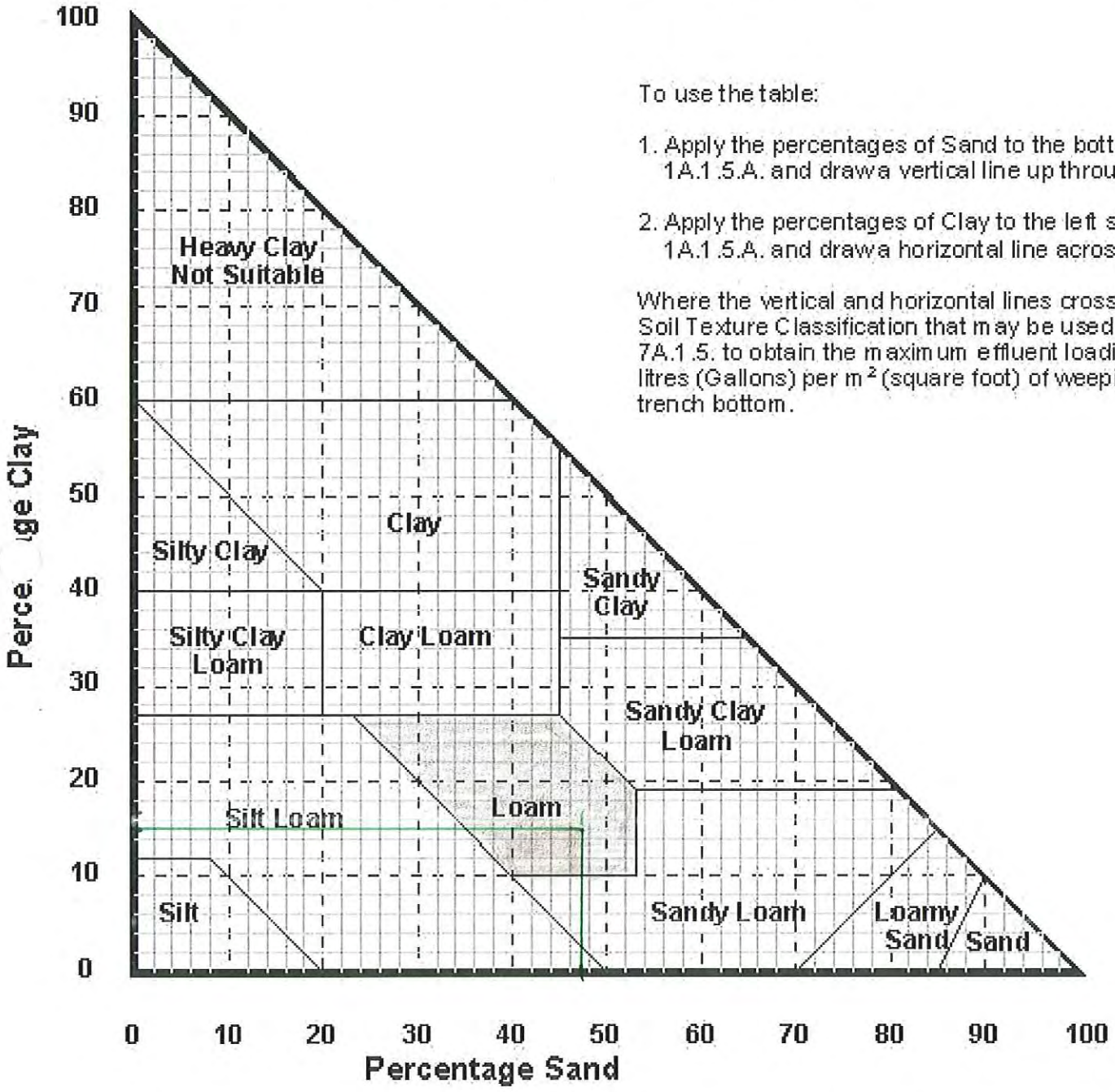
Test Hole # 6-1

(Loam)

Figure 7A.1.5.A Soil Texture Classification Triangle



To use the table:

1. Apply the percentages of Sand to the bottom of Table 1A.1.5.A. and drawa vertical line up through the table,

2. Apply the percentages of Clay to the left side of Table 1A.1.5.A. and drawa horizontal line across the table.

Where the vertical and horizontal lines cross indicates a Soil Texture Classification that may be used with Article 7A.1.5. to obtain the maximum effluent loading rate in litres (Gallons) per m^2 (square foot) of weeping lateral trench bottom.

Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:7
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:699

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 75mm Thick)			TPSL					
		Sand- medium grain, some silt, damp, compact, medium brown.								
				7-1	SA					
1										698
		Silty Clay(Till)- medium plastic, trace sand, moist, very stiff, medium brown.								
2										697
				7-2	CI					
3										696
		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.								
4										695
5										694

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:8
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:697

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC M.C. LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	Elevation (m)
0		Topsoil-(Approx. 600mm Thick)			TPSL					
		Sand- trace silt, moist, compact, dark grey.		8-1			22.3		Clay = 14% Silt = 31% Sand = 55%	
1		-dilatent.			SA					696
2 ▼		Silty Clay(Lacusterine)- low plastic with trace medium plastic lenses, trace sand, moist, soft, medium grey.		8-2	CL-ML					695
3		END OF HOLE AT 3.0M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; 2.10M.								694
4										693
5										692

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 10 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: 2.1 m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

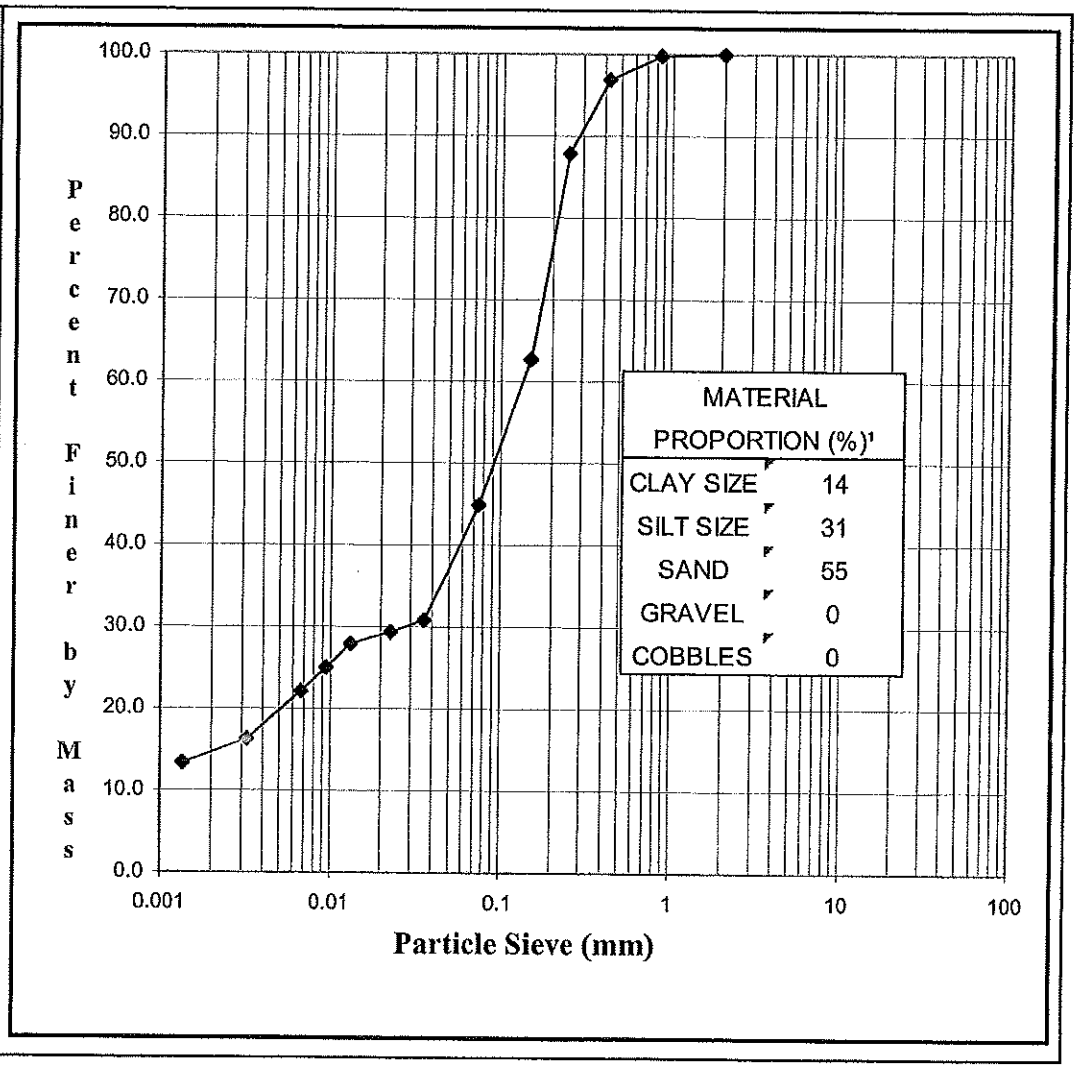
McINTOSH LALANI ENGINEERING LTD.

STANDARD TEST METHOD FOR PARTICLE SIZE

(Test Method ASTM D422)

PROJECT: **55 ACRE PARCEL**
CLIENT: AC LTD.
PROJECT NO.: ML-3861
LOCATION: BH 8-1
SAMPLE NO.: 11147
DEPTH:
DESCRIPTION: Sand, Some Silt & Clay

PARTICLE SIZE	PERCENT PASSING
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
12.5 mm	
10 mm	
5 mm	
2 mm	100.0
850 µm	99.8
425 µm	96.9
250 µm	87.8
150 µm	62.7
75 µm	44.9
36 µm	30.8
23 µm	29.4
13 µm	27.9
9 µm	25.0
7 µm	22.1
3 µm	16.3
1 µm	13.4



Reviewed by: _____ P.Eng.

Note 1: Classified by the Modified Unified Soil Classification System

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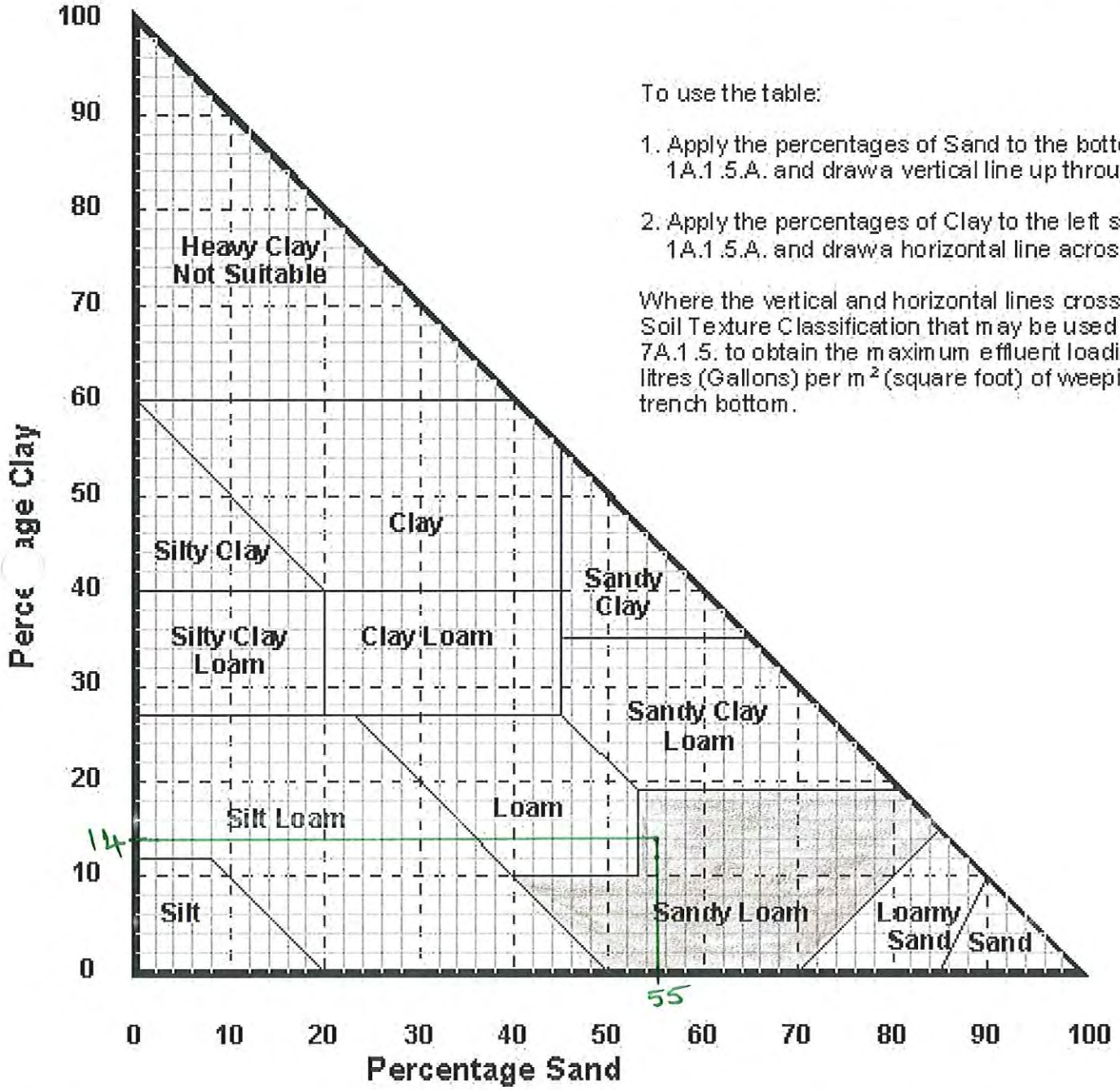
Test Hole # BH8-1
(Sandy Loam)

Figure 7A.1.5.A Soil Texture Classification Triangle



To use the table:

1. Apply the percentages of Sand to the bottom of Table 1A.1.5.A. and drawa vertical line up through the table,

2. Apply the percentages of Clay to the left side of Table 1A.1.5.A. and drawa horizontal line across the table.

Where the vertical and horizontal lines cross indicates a Soil Texture Classification that may be used with Article 7A.1.5. to obtain the maximum effluent loading rate in litres (Gallons) per m^2 (square foot) of weeping lateral trench bottom.

Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

Project: 55 Acre Residential Development	Drilling Information:	Borehole No.:9
	Mobile Augers & Research Ltd.	Project No.:ML-3861
Client: AC Ltd.	M10 SS-Auger	Elevation:699.6

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | AUGER SAMPLE | NO RECOVERY

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

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	USCS	BLOWS /150 mm	PLASTIC / M.C. / LIQUID (10 20 30 40)	BLOW COUNT (10 20 30 40) / POCKETPEN (kPa) (80 160 240 320)	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		Topsoil-(Approx. 50mm Thick)			TPSL						
		Silt- some sand, frozen, medium brown.			ML						
1		Silty Clay(Till)- medium plastic, trace sand and gravel, trace oxides, damp, stiff, medium brown.		9-1			15.4		Clay = 14% Silt = 31% Sand = 55%		699
				9-2	CI	4-6-8					
2				9-3			15.4		$[SO_4]$ = 0.014%		698
		-some gravel and cobbles, very stiff.									
3											697
		Sand- medium grain, damp, compact, medium brown.		9-4		4-5-6					
				9-5			7.5				696
4											
				9-6		4-4-5					695
5				9-7							
											694
6					SA						
				9-8		3-3-4					693
				9-9							
7											
											692
8				9-10		4-5-8					
				9-11							691
9											
		END OF HOLE AT 9.1M. Dry upon completion. 25mm PVC standpipe installed. Groundwater Readings: February 5,2008; Dry.									690

McIntosh Lalani Engineering
Calgary, AB
(403) 291-2345

Logged By: Ryan Stickel	Completion Depth: 30 ft
Reviewed By: Marty Ward	Drilled on: 1/24/2008
Groundwater Depth: m	Page 1 of 1

ML STANDARD AUGER 3861.ONOWAY.GPJ M-L STANDARD.GDT 2/20/08

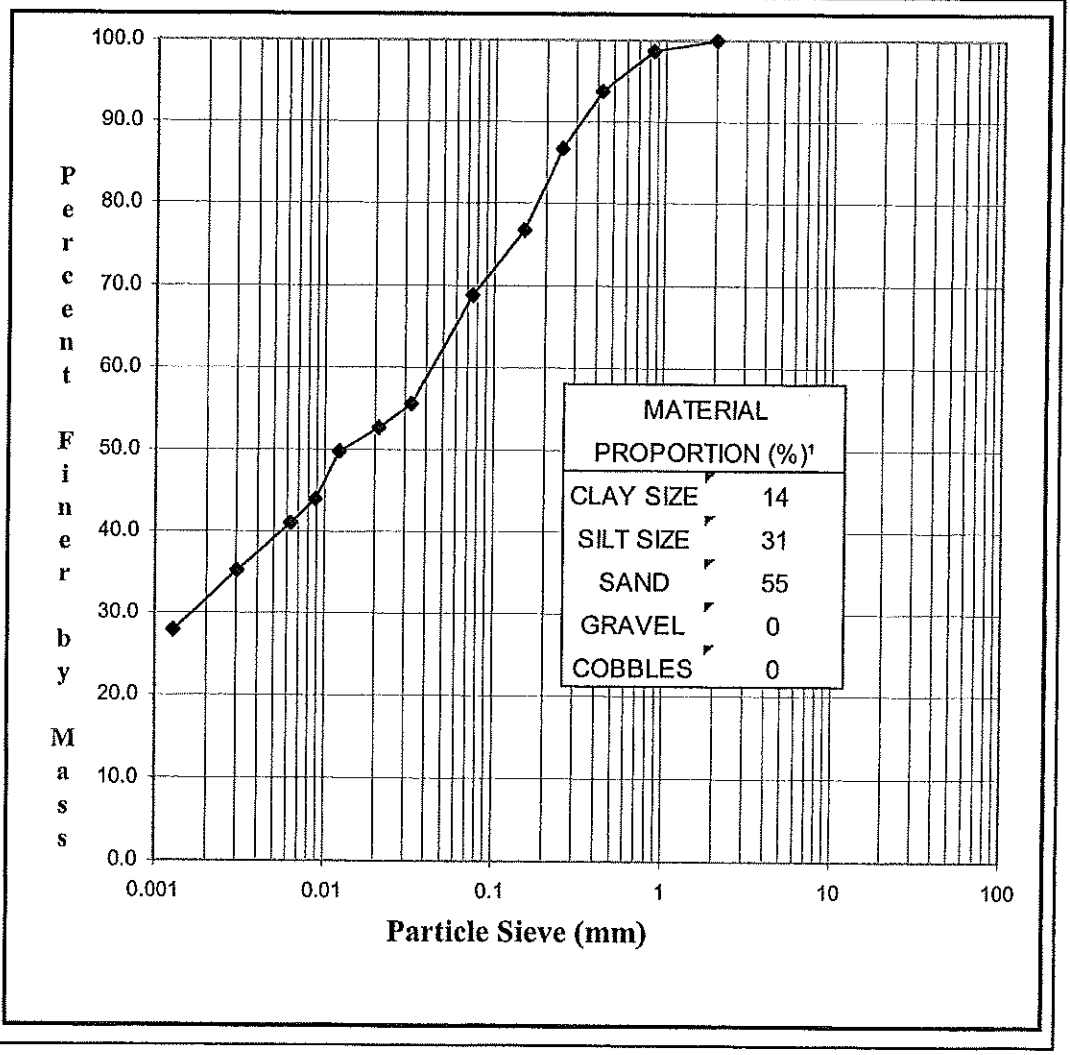
McINTOSH LALANI ENGINEERING LTD.

STANDARD TEST METHOD FOR PARTICLE SIZE

(Test Method ASTM D422)

PROJECT: **55 ACRE PARCEL**
CLIENT: AC LTD.
PROJECT NO.: ML-3861
LOCATION: BH 9-1
SAMPLE NO.: 11147
DEPTH:
DESCRIPTION: Sand, Some Silt & Clay

PARTICLE SIZE	PERCENT PASSING
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
12.5 mm	
10 mm	
5 mm	
2 mm	100.0
850 µm	98.7
425 µm	93.7
250 µm	86.7
150 µm	76.7
75 µm	68.8
33 µm	55.6
21 µm	52.7
12 µm	49.8
9 µm	43.9
6 µm	41.0
3 µm	35.2
1 µm	27.9



Reviewed by: _____ P.Eng.

Note 1: Classified by the Modified Unified Soil Classification System

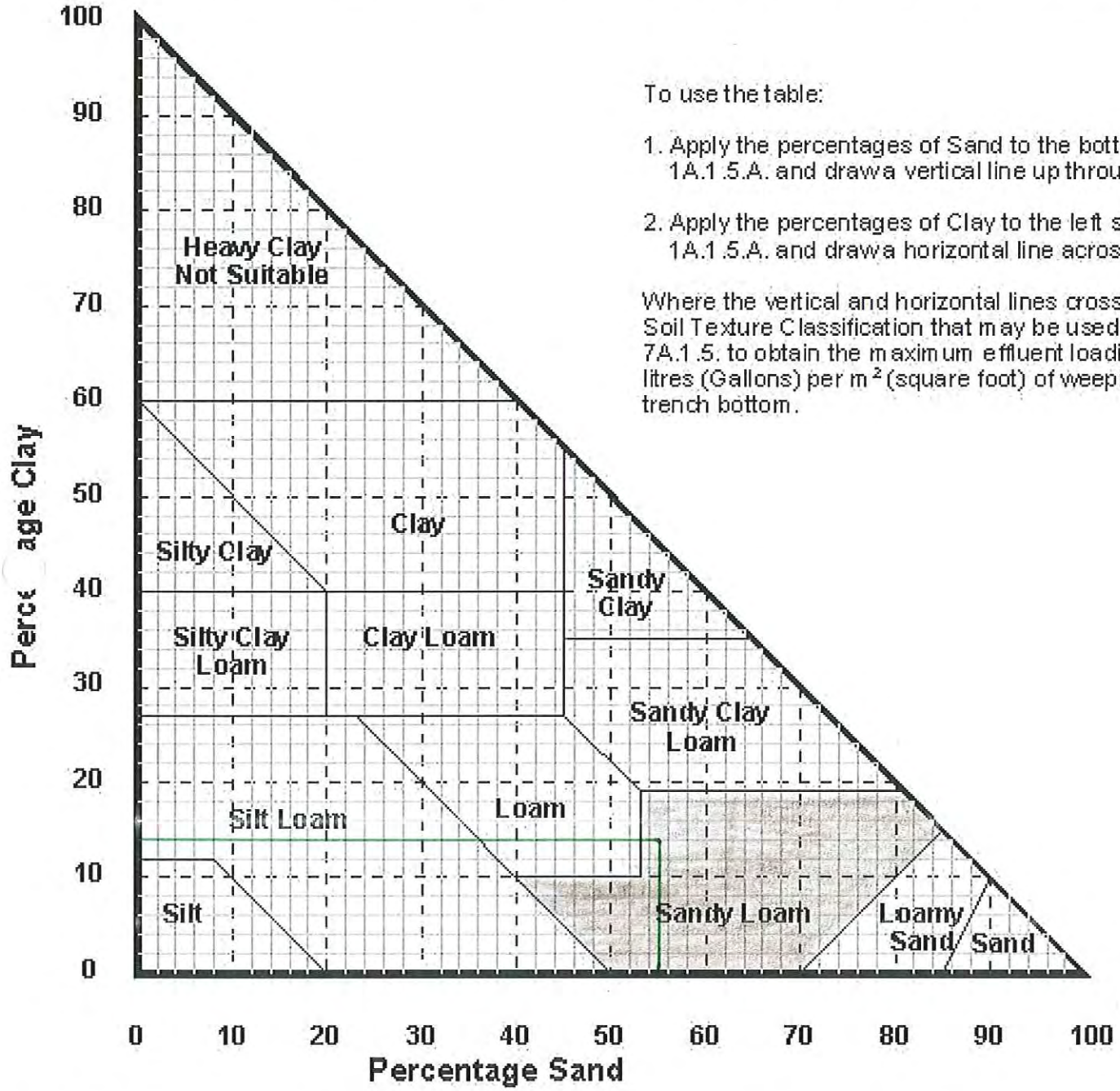
AM-L

Data presented hereon is for the sole use of the stipulated client. ML is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of ML.

The testing services reported herein have been performed by an ML technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, ML will provide it upon written request.

Test Hole # 9-1
(Sandy Loam)

Figure 7A.1.5.A Soil Texture Classification Triangle



To use the table:

1. Apply the percentages of Sand to the bottom of Table 1A.1.5.A. and drawa vertical line up through the table,

2. Apply the percentages of Clay to the left side of Table 1A.1.5.A. and drawa horizontal line across the table.

Where the vertical and horizontal lines cross indicates a Soil Texture Classification that may be used with Article 7A.1.5. to obtain the maximum effluent loading rate in litres (Gallons) per m^2 (square foot) of weeping lateral trench bottom.

Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

APPENDIX C – Land Requirements

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 2 or 3 Bedrooms Lot A1

Area Test Hole # 1 Loamy Sand Loading Rates 30.87 L/sq.m 0.63 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	667	Sq. ft	62	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	45	ft	136	m	
Total Actual Land Requirement	2153	Sq. ft	200	Sq. m	10 x20 = 200 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	667	Sq. ft	62	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	278	ft	85	m	
Total Actual Land Requirement	1292	Sq. ft	120	Sq. m	10 x 12 = 120 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	534	Sq. ft	50	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	356	ft	109	m	
Total Actual Land Requirement	1668	Sq. ft	155	Sq. m	10 x 15.5 = 155 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	534	Sq. ft	50	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	222.5	ft	68	m	
Total Actual Land Requirement	1130	Sq. ft	105	Sq. m	10 x 10.5 = 105 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	334	Sq. ft	31	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	223	ft	68	m	
Total Actual Land Requirement	1130	Sq. ft	105	Sq. m	10 x 10.5 = 105 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	334	Sq. ft	31	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	139	ft	42	m	
Total Actual Land Requirement	753	Sq. ft	70	Sq. m	10 x 7 = 70 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 4 Bedrooms Lot

A2

Area Test Hole # 1 Loamy Sand Loading Rates 30.87 L/sq.m 0.63 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	825	Sq. ft	77	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	550	ft	168	m	
Total Actual Land Requirement	2476	Sq. ft	230	Sq. m	10 x23 = 230 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	825	Sq. ft	77	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	344	ft	105	m	
Total Actual Land Requirement	1615	Sq. ft	150	Sq. m	10 x 15 = 150 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	660	Sq. ft	61	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	440	ft	134	m	
Total Actual Land Requirement	2045	Sq. ft	190	Sq. m	10 x 19 = 190 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	660	Sq. ft	61	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	275	ft	84	m	
Total Actual Land Requirement	1345	Sq. ft	125	Sq. m	10 x 12.5 = 125 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	413	Sq. ft	38	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	275	ft	84	m	
Total Actual Land Requirement	1345	Sq. ft	68	Sq. m	10 x 12.5 = 125 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	413	Sq. ft	38	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	172	ft	52	m	
Total Actual Land Requirement	915	Sq. ft	85	Sq. m	10 x8.5 = 85 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 2 & 3 Bedrooms Lot B1

Area Test Hole # 3 Silt Loam Loading Rates 13.72 L/sq.m 0.28 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	1500	Sq. ft	140	Sq. m	16 Lateral @ 0.90 m c/c
Required Length of Lateral	1000	ft	305	m	
Total Actual Land Requirement	4521	Sq. ft	420	Sq. m	20 x21 = 420 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	1500	Sq. ft	140	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	625	ft	191	m	
Total Actual Land Requirement	2906	Sq. ft	270	Sq. m	15 x 18 = 270 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	1200	Sq. ft	112	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	800	ft	244	m	
Total Actual Land Requirement	3638	Sq. ft	338	Sq. m	15 x 22.5 = 338 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	1200	Sq. ft	112	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	500	ft	153	m	
Total Actual Land Requirement	2260	Sq. ft	210	Sq. m	10 x 21 = 210 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	750	Sq. ft	70	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	500	ft	153	m	
Total Actual Land Requirement	2260	Sq. ft	210	Sq. m	10 x 21 = 210 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	750	Sq. ft	70	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	313	ft	95	m	
Total Actual Land Requirement	1507	Sq. ft	140	Sq. m	10 x 14 = 85 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 4 Bedrooms Lot B2

Area Test Hole # 3 Silt Loam Loading Rates 13.72 L/sq.m 0.28 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	1857	Sq. ft	173	Sq. m	16 Lateral @ 0.90 m c/c
Required Length of Lateral	1238	ft	378	m	
Total Actual Land Requirement	5598	Sq. ft	520	Sq. m	20 x26 = 520 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	1857	Sq. ft	173	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	774	ft	236	m	
Total Actual Land Requirement	3552	Sq. ft	330	Sq. m	15 x 22 = 330 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	1486	Sq. ft	138	Sq. m	16 Lateral @ 0.90 m c/c
Required Length of Lateral	990	ft	302	m	
Total Actual Land Requirement	4521	Sq. ft	420	Sq. m	20 x 21 = 420 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	1486	Sq. ft	138	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	619	ft	189	m	
Total Actual Land Requirement	2906	Sq. ft	270	Sq. m	15 x 18 = 270 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	929	Sq. ft	86	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	619	ft	189	m	
Total Actual Land Requirement	2906	Sq. ft	270	Sq. m	15 x 18 = 270 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	929	Sq. ft	89	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	387	ft	118	m	
Total Actual Land Requirement	1830	Sq. ft	170	Sq. m	10 x17 = 170 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 2 & 3 Bedrooms Lot C1

Area Test Hole # 6 Loam **Loading Rates 17.15 L/sq.m 0.35 lg/sq.ft**

A. Distributed with Gravel					
Required Trench Bottom Area	1200	Sq. ft	112	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	800	ft	244	m	
Total Actual Land Requirement	3714	Sq. ft	345	Sq. m	15 x23 = 345 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	1200	Sq. ft	112	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	500	ft	153	m	
Total Actual Land Requirement	2282	Sq. ft	212	Sq. m	10 x 21.2 = 212 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	960	Sq. ft	89	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	640	ft	195	m	
Total Actual Land Requirement	3068	Sq. ft	285	Sq. m	15 x 19 = 285 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	960	Sq. ft	89	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	400	ft	122	m	
Total Actual Land Requirement	1862	Sq. ft	173	Sq. m	10 x 17.25 = 173 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	600	Sq. ft	56	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	400	ft	122	m	
Total Actual Land Requirement	1862	Sq. ft	173	Sq. m	10 x 17.25 = 173 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	600	Sq. ft	56	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	250	ft	76	m	
Total Actual Land Requirement	1238	Sq. ft	115	Sq. m	10 x 11.5 = 115 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 4 Bedrooms Lot C2

Area Test Hole # 6 Loam **Loading Rates 17.15 L/sq.m 0.35 lg/sq.ft**

A. Distributed with Gravel					
Required Trench Bottom Area	1486	Sq. ft	138	Sq. m	16 Lateral @ 0.90 m c/c
Required Length of Lateral	990	ft	302	m	
Total Actual Land Requirement	4519	Sq. ft	420	Sq. m	20 x 21 = 420 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	1486	Sq. ft	138	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	619	ft	189	m	
Total Actual Land Requirement	2905	Sq. ft	270	Sq. m	15 x 18 = 270 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	1189	Sq. ft	111	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	792	ft	242	m	
Total Actual Land Requirement	3637	Sq. ft	338	Sq. m	15 x 22.5 = 338 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	1189	Sq. ft	111	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	495	ft	151	m	
Total Actual Land Requirement	2421	Sq. ft	225	Sq. m	15 x 15 = 225 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	743	Sq. ft	69	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	495	ft	151	m	
Total Actual Land Requirement	2421	Sq. ft	225	Sq. m	15 x 15 = 225 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	743	Sq. ft	69	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	310	ft	94	m	
Total Actual Land Requirement	1506	Sq. ft	140	Sq. m	10 x 14 = 140 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 2 & 3 Bedrooms Lot D1

Area Test Hole # 8 & 9 Sandy Loam Loading Rates 22.05 L/sq.m 0.45 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	933	Sq. ft	87	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	622	ft	190	m	
Total Actual Land Requirement	2325	Sq. ft	216	Sq. m	15 x 18 = 216 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	933	Sq. ft	87	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	389	ft	119	m	
Total Actual Land Requirement	1830	Sq. ft	170	Sq. m	10 x 17 = 170 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	747	Sq. ft	69	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	498	ft	152	m	
Total Actual Land Requirement	2260	Sq. ft	210	Sq. m	10 x 21 = 210 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	747	Sq. ft	69	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	311	ft	95	m	
Total Actual Land Requirement	1507	Sq. ft	140	Sq. m	10 x 14 = 140 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	467	Sq. ft	43	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	311	ft	95	m	
Total Actual Land Requirement	1507	Sq. ft	140	Sq. m	10 x 14 = 140 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	467	Sq. ft	43	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	194	ft	59	m	
Total Actual Land Requirement	311	Sq. ft	95	Sq. m	10 x 9.5 = 95 Sq. m

Lac Ste Anne Development - Weeping Tile Field Design

Land requirement for 4 Bedrooms Lot D2

Area Test Hole # 8 & 9 Sandy Loam Loading Rates 22.05 L/sq.m 0.45 lg/sq.ft

A. Distributed with Gravel					
Required Trench Bottom Area	933	Sq. ft	87	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	622	ft	190	m	
Total Actual Land Requirement	3551	Sq. ft	330	Sq. m	15 x 22 = 330 Sq. m
B. Distributed with Chamber					
Required Trench Bottom Area	933	Sq. ft	87	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	389	ft	119	m	
Total Actual Land Requirement	2206	Sq. ft	205	Sq. m	10 x 20.5 = 205 Sq. m
C. Pressure Distributed with Gravel					
Required Trench Bottom Area	747	Sq. ft	69	Sq. m	12 Lateral @ 0.90 m c/c
Required Length of Lateral	498	ft	152	m	
Total Actual Land Requirement	2905	Sq. ft	270	Sq. m	15 x 18 = 270 Sq. m
D. Pressure Distributed with Chamber					
Required Trench Bottom Area	747	Sq. ft	69	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	311	ft	95	m	
Total Actual Land Requirement	1829	Sq. ft	170	Sq. m	10 x 17 = 170 Sq. m
E. Treated & Pressure with Gravel					
Required Trench Bottom Area	467	Sq. ft	43	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	311	ft	95	m	
Total Actual Land Requirement	1829	Sq. ft	170	Sq. m	10 x 17 = 170 Sq. m
F. Treated & Pressure with Chamber					
Required Trench Bottom Area	467	Sq. ft	43	Sq. m	8 Lateral @ 0.90 m c/c
Required Length of Lateral	194	ft	59	m	
Total Actual Land Requirement	968	Sq. ft	90	Sq. m	10 x 9 = 90 Sq. m