PROJECT: **Wastewater Treatment Lagoon Upgrade – Design Brief**

PREPARED FOR: **Town of Radisson**

PINTER & ASSOCIATES LTD

PINTER & ASSOCIATES LTD

7 August 2024 File: 24-3285-1

CONFIDENTIAL

Town of Radisson
P.O. Box 69
Radisson, SK S0K 3L0

tradisson@sasktel.net

Dear Ms. Norma Stumborg,

Re: Wastewater Treatment Lagoon Upgrade Design Brief, Radisson SK

Enclosed is the design brief for the Town of Radisson's Wastewater Treatment Lagoon upgrade project for review and comment.

If you have any questions, concerns or require further direction, please call the undersigned at 306-244-1710.

Yours Sincerely,
PINTER & Associates Ltd.

Enkhnyamaa Jalbuu, P. Eng.
Project Manager

710A 48th Street E
Saskatoon, SK S7K 5B4
Email: pinter.main@pinter.ca
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Town of Radisson
Wastewater Treatment Lagoon Upgrade
Design Brief

Prepared For:
Town of Radisson
P.O. Box 69
Radisson, SK S0K 3L0

Prepared By:
PINTER & Associates Ltd.
710A 48th Street East
Saskatoon, SK S7K 5B4

7 August 2024

PINTER & ASSOCIATES LTD

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1.0 INTRODUCTION

1.1. OVERVIEW

The Town of Radisson (the Town, Radisson) has retained PINTER & Associates Ltd. (PINTER) to conduct a review of the existing wastewater treatment lagoon (the Lagoon) and provide a design for the upgrade of the Lagoon. The Town is located on Highway 16, approximately 65 km northwest of the City of Saskatoon in the Province of Saskatchewan. The Lagoon is located south of Radisson, at SW-21-40-10-3, as shown in Drawing A-04 (Appendix A).

The Town currently treats its municipal sewage through a facultative lagoon system that includes a primary and secondary cell. The Lagoon is located approximately 3.5 km south of Radisson Lake (the Lake). Treated effluent is transferred from the secondary (storage) cell to the sump pumps, and then it's pumped through approximately 4,000 metres of force main piping, where it is discharged into the Lake. The entire Lake and surrounding shoreline are part of an Important Bird Area (IBA) of Canada.

Radisson has encountered issues with the Lagoon as it is undersized for its current and potentially expanding population. The Town wishes to remediate this problem by expanding its wastewater treatment capacity, as well as addressing any underlying issues with the Lagoon, to allow future developments that will support its economic growth.

Farmland borders the Lagoon to the south, east, and west, and a SaskTel Communications tower to the north. Due to the existing roads directly to the south and west, and SaskTel having ownership of the land to the north, expansion in these directions has been deemed non-viable by PINTER. Thus, the area where the Lagoon's capacity can feasibly be increased through footprint expansion alone can only be to the east. The Town explored several options for expansion and settled on a phased approach based on consultation from the Water Security Agency (WSA) along with monetary constraints. At the end of the final phase of the Lagoon expansion project, the Lagoon will meet the WSA's effluent requirements.

1.2. SCOPE OF WORK

In this phase of the project (Phase I – Secondary Cell Expansion), PINTER has designed an expansion to the secondary cell, or storage cell, which will begin the process of meeting the Town's effluent requirements. The expansion includes the introduction of a new, additional secondary cell located to the east of the existing secondary cell to increase the storage capacity prior to the pumping. In addition, a new power connection will be routed from an existing underground line to supply a sewage pump located within a new manhole in the middle of the northern side of the cell. The existing effluent force main will be rerouted to this manhole.

2.0 EXISTING LAGOON SYSTEM

2.1. EXISTING LAGOON LAYOUT

The existing sewage Lagoon is situated approximately half a kilometre south of the Town. The Lagoon was originally constructed in 1962 as a two-cell facultative lagoon intended to allow for a semi-annual release of treated effluent in early spring and late fall. The primary cell has an effective treatment area of 1.11 ha, and the secondary cell has a storage capacity of 15,031 m^3. Dense grasses surround the outside Lagoon berm slopes, and multiple types of vegetation are present on the inner slopes and on the water's edge. A 150 mm gravity drain connects the cells with an adjacent overflow drain located an estimated half a metre below the top of the berms.

A drainage ditch is present on the southern and western sides of the Lagoon. The western ditch slopes to the south, while the southern ditch slopes to the west until the approximate midpoint of the Lagoon, where it begins to slope to the east. The poor condition of the slope grades indicates that shifting has potentially occurred, and no remediation measures were in place for regrading.

Lagoon effluent is pumped north from a manhole adjacent to the secondary cell through a shallow buried line approximately 4,000 metres long to the Lake. Pumping occurs semi-annually via a pump located inside the manhole. The manhole pump is powered

through a modified three-phase power system using three separate single-phase power lines.

2.2. SEWAGE PUMPING STATION

The sewage pumping station in Radisson is a wet well/dry well style station. It receives all sewage generated in Radisson, pumping it through approximately 750 metres of 150 mm asbestos cement force main to the Lagoon. Sewage is pumped via two 3-phase 15 hp pumps.

2.3. RADISSON LAKE

Radisson Lake is an endorheic salt lake located to the north of Radisson. The Lake is subject to large fluctuations in water level. During the original construction of the effluent force main to the Lake, only Ducks Unlimited was known as a licensed water user, operating a duck nesting project at the upper end of the Lake. Due in part to the high saline content, there are no other known uses of water from the Lake.

2.4. FACULTATIVE TREATMENT PROCESS ISSUES

2.4.1. Setback Requirement

The WSA regulations require that any wastewater treatment facility should have a minimum setback distance from residences, roads, schools, and other infrastructure to help foster a living environment that is generally free of sewage odours and minimizes health concerns. It is good practice to construct the wastewater treatment facility in an isolated area and with respect to prevailing wind directions. The Lagoon was built approximately 450 metres south of a residential area, as shown in Drawing A-04 (Appendix A). The WSA requires any facultative lagoon to be located at a minimum 550 m setback. However, the WSA may approve a reduced buffer zone subject to certain terms and conditions. Based on the existing conditions of the Lagoon, the Town would likely qualify for this reduced buffer zone.

2.4.2. Sizing Issues

Due to the lack of any expansions since the original construction, the existing Lagoon requires additional primary treatment area and secondary treatment volume. The Lagoon's full-service level (FSL) is consistently above allowable limits., based on site

visits and previous reports provided to PINTER by the Town. During periods of high precipitation, there is a possibility of berm overtopping that would result in accidental cross-contamination from the release of partially treated wastewater effluent into the surrounding ditches.

2.4.3. Water Quality

The Town had effluent testing for the Lagoon conducted in November 2011 and October 2013. PINTER compared standards provided by the WSA's *Sewage Works Design Standard*s (EPB 503), and the federal *Wastewater Systems Effluent Regulations* (WSER) against the results of the testing. WSER applies to Radisson's wastewater treatment due to the system being designed to collect an average daily volume of over one hundred cubic metres per day of effluent. The results of the testing are in the table below; bolded values indicate parameters that did not meet standards for effluent quality.

Table 1: Effluent Quality Standards

Constituent	Secondary Effluent (Nov. 2011)	Secondary Effluent (Oct. 2013)	EPB Guidelines for Fall Discharge	WSER
BOD_5 (mg/L)	10.1		10-30	
c-BOD (mg/L)	-	11.00		≤25
TSS (mg/L)	25	**39**	10-40	≤25
Total N (mg/L)	7.30	5.50	5-20	
Total Coliforms (counts/100 mL)	**107,600**	**34,000**	200-20,000	
Total P (mg/L)	1.20	0.43	2-5	
Un-ionized Ammonia (mg/L)				≤1.25

When compared against the EPB Guidelines and WSER, both total suspended solids (TSS) and total coliforms were determined to exceed treated effluent limits. It is highly likely that the TSS and total coliforms are high due to incomplete treatment from overloading the Lagoon, as explained in the previous section.

3.0 LAGOON DESIGN AND SETUP

3.1. DESIGN CRITERIA

Prior to initiating the preliminary design, PINTER met with the Town of Radisson to discuss the engineering services agreement. On 22 May 2024, an agreement was signed between the Town and PINTER to proceed with the design process for an expansion of the facultative Lagoon. Due to monetary constraints, PINTER deemed simultaneous expansion of both lagoon cells infeasible. Instead, PINTER developed a three-phase approach. The agreement with the Town encapsulates the first phase of designing and constructing an additional lagoon cell as an expansion to the secondary storage cell.

3.1.1. Population

PINTER obtained population data from Statistics Canada, which indicates an average population change per year of 0.68% between 1996 and 2021. However, over the last five years an average change per year of -2.1% was recorded by the government. Despite census data showing this continuous population decrease in the Town, PINTER used a growth rate of 1% (Saskatchewan's annual population growth rate for the last ten years) for this analysis to account for potential population growth in the community. Production capacity is not determined using a negative growth rate as this could lead to an under-sizing of the system. Therefore, PINTER will design the new Lagoon to accommodate 586 people projected for 2044. Figure 1 below shows this projection.

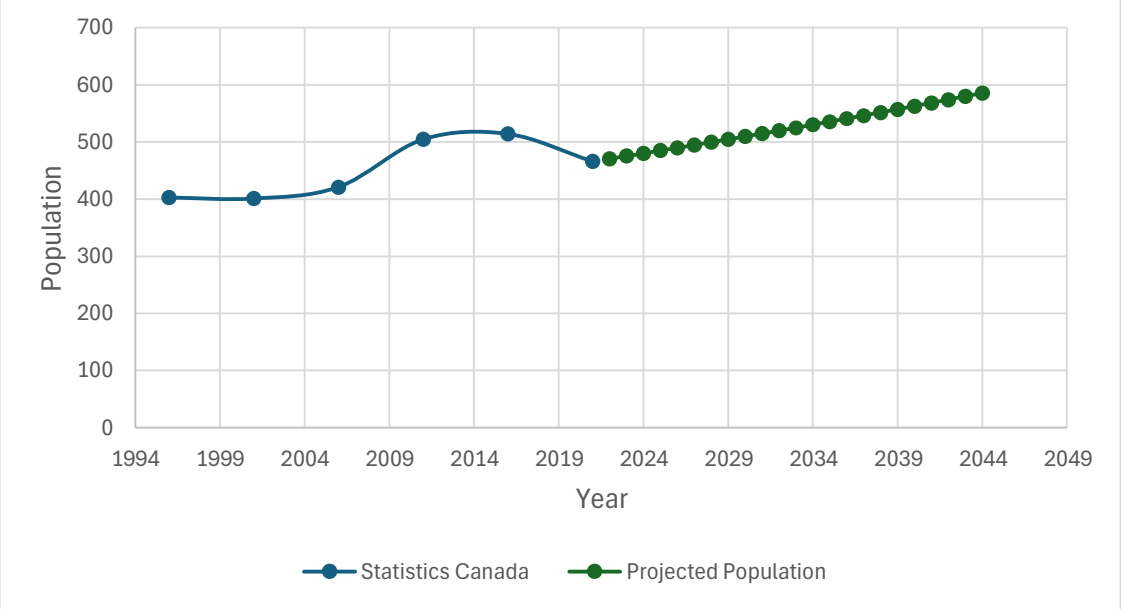

Figure 1 – Population Projection

3.1.2. Water Demand

PINTER conducted a desktop review based on the Town's current water use, as well as the projected water use by 2044. Estimated capacity requirements are based on the average day consumption in combination with census data. Figure 2 shows the historical and projected water demands. Table 2 and Table 3 both outline the current and projected area and volume requirements for the Town's Lagoon. Table 2 shows requirements when using effluent irrigation, while Table 3 shows requirements for pumping to the Radisson Lake.

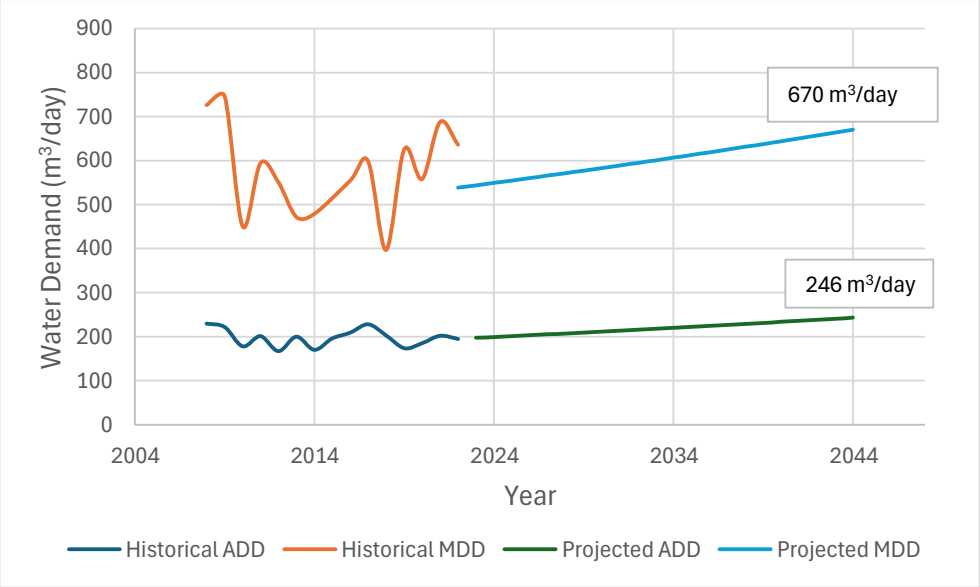

Figure 2 – Projected Water Demand

Table 2: Projected Lagoon Capacity Requirements with Effluent Irrigation

Cell	Capacities by Year					
	2023	Required	2027	2032	2037	2042
Population (1% Growth)	480	-	505	530	557	586
Primary Cell 1 (ha)*	1.11	1.23	1.30	1.36	1.43	1.50
Secondary Cell 2 (m^3) **	15,031	51,840	54,540	57,240	60,156	63,288

*30 kg/ha/day BOD loading and 0.077 kg/BOD_5 treatment
**240-day storage for the irrigation

The WSA requires design storage of 240 days of the projected average day sewage input to be served over a projected minimum 20-year design life for expanded, upgraded, or new facultative lagoons that discharge via effluent irrigation. Using the

data from the projected water demand and projected population, the average day sewage generated by the Town is estimated to be 419 litres per capita day (LCD) by PINTER. Using an additional 8% contingency in the event of a population surge over the next 20 years, PINTER sized the Lagoon using a design demand of 450 LCD. As noted in Table 2 above and based on these calculations, the primary cell will need an area expansion of 0.39 ha, and the secondary cell will need a volume expansion of 48,257 m^3. To put this into a better perspective, Primary Cell 1 requires a 28% increase in treatment area, while Secondary Cell 2 requires a 321% increase in treatment volume. This explains the process behind selecting the secondary cell first for expansion, and an expansion of the primary cell following once budget constraints have been amended by the Town.

For an expanded, upgraded, or new facultative lagoon that does not discharge via effluent irrigation, design storage of 220 days of the projected average day sewage input over 20 years is required by the WSA.

Table 3: Projected Lagoon Capacity Requirements with Discharge to Radisson Lake

Cell	Capacities by Year					
	2023	Required	2027	2032	2037	2042
Population (1% Growth)	480	-	505	530	557	586
Primary Cell 1 (ha)*	1.11	1.23	1.30	1.36	1.43	1.50
Secondary Cell 2 (m^3) **	15,031	47,520	49,995	52,470	55,143	58,014

*30 kg/ha/day BOD loading and 0.077 kg/BOD_5 treatment
**220 day storage

Table 3 shows the primary and secondary cell requirements for 220-day storage with typical bi-annual discharge. Again, using a design flow of 450 LCD obtained from an 8% contingency, the primary cell expansion remains unchanged at 0.39 ha, while the secondary cell needs a volume expansion of 44,983 m^3. This is approximately 5,300 m^3 less than the capacity requirements for using treated wastewater for effluent irrigation.

It is PINTER's understanding that the Town has special permission to construct a storage cell that gives the Town a total storage capacity of approximately 150 days. The additional cell is designed to provide approximately 24,000 m^3 of additional storage, bringing the total storage capacity to 39,160 m^3. This special permission was granted by the WSA after contractor bids came in at almost double what the Town had available. The WSA is willing to allow the Town of Radisson to build the additional storage cell at the reduced size of 50% of the original design, with the condition that this will be considered a phased approach to the required upgrade. Once this phase of the upgrade is operational, the WSA will work with the Town to develop the mentioned plan.

3.2. FIELD INVESTIGATIONS

3.2.1. Geotechnical Investigation

PINTER conducted a geotechnical investigation at the Lagoon site on 17 July 2024. Due to wet site conditions, drilling delays led to the geotechnical site investigation occurring much later than originally planned. Site-specific information was collected for the existing Lagoon area as well as the expansion cell area. The visual inspection of the soil testing confirmed the geotechnical investigation results of P. Machibroda Engineering Ltd. in 2009.

The recommendations from a geotechnical report completed by P. Machibroda Engineering Ltd. in 2009 on the proposed Lagoon site, as well as data from PINTER's geotechnical memorandum, were used for the detailed design and liner requirements. The data from the memo confirms the report.

3.2.2. Topographical Survey

PINTER conducted a topographical survey of the Lagoon site using a Hemisphere S631 GNSS GPS Survey Receiver system. The survey was completed over the course of two separate trips due to the size of the site and the wet conditions present at the time. The survey was started on 12 June 2024 and was completed on 24 June 2024. This survey data was used to develop the elevation contours of the area. All drawings presented in Appendix A are based on the topographical survey results, together with the available as-built drawings provided by the Town.

3.3. LAGOON CONFIGURATION

According to the Waterworks and Sewage Works Regulations in terms of lagoon design requirements along with the recommendations presented in the geotechnical investigations, PINTER recommends the following for the new expansion:

- The new storage cell will provide a new total holding capacity of 39,160 m^3. The cell will be constructed to the east of the existing storage cell with approximate dimensions of 110 m by 200 m.
- The top of the berm is 4 m wide with an interior slope 4:1 and an exterior slope 3:1.
- The exterior slope should be covered with topsoil and seeded.
- The water depth is designed to be 2.1 m with a 1 m freeboard above the full-service level (FSL).
- The existing primary and storage cells will not be upgraded except for the addition of a new overflow and equalization pipe from the existing storage cell to the new storage cell. The existing manhole on the south side of the storage cell will be replaced by a new manhole on the north side of the new cell.
- A gravity pipe and effluent force main connection will be constructed on the north side of the new cell. Treated water will be pumped from the manhole through a newly constructed effluent force main section. This section will be tied into the existing force main that leads to the Lake.

Drawings for the proposed expansion are located in Appendix A.

3.4. LAGOON LINER

The geotechnical investigation indicated the soil present at the site is suitable for a compacted liner with a recommended thickness of 1.0 m to control the seepage limit down to 15 cm/year. Typically, the compacted clay liner (CCL) is considered a cost-effective hydraulic barrier and recommended for use if the site has adequate onsite soils

to construct. Based on PINTER's own geotechnical investigation, if the clay is determined to have a lower saturated conductivity, a compacted liner with a thickness of 0.6 m will be considered in order to reduce cost and construction times.

3.5. EROSION CONTROL

Erosion can take place on either the inner slope due to wave action and effluent transfer between cells or on the outer slope due to wind action. Wave action erosion will be controlled at pipe connection areas using rip-rap, placing it 0.5 m vertically above the invert of the pipe and below the pipe, continuing until the cell floor. The rip-rap should be sized between 75 mm to 200 mm, and hand placed on the slope with an approximate depth of 300 mm. For interior berm areas not at pipe locations and all exterior berm areas, topsoil or soil material should be placed with appropriate grass seeding.

3.6. GROUNDWATER MONITORING

To monitor the lagoon operation on the groundwater, monitoring well installation will be required. Three monitoring wells will be installed around the Lagoon. They will be located on the north, east, and south of the Lagoon. The exact locations will be determined at the time of construction based on the existing water conditions.

3.7. SAFETY CONSIDERATIONS

For security and safety reasons, PINTER recommends the upgraded Lagoon has fencing, including gate and signage installed around the perimeter of the cells.

4.0 LAGOON CONSTRUCTION

4.1. CONSTRUCTION SEQUENCE

Minimum disruption to the operation of the lagoon system should be provided during the construction. The following is the proposed construction sequence:

- Strip and stockpile all existing topsoil and/or deleterious material from the surface of the proposed site.
- Excavate to the required depths and grades.
- Construct the new berms with a crest width of 4.5 metres and embankment slopes of 4:1 (H:V) on the interior surface and 3:1 on the exterior surface.
- Install the required piping and manhole during or after berm construction, based on the method of installation selected by the Contractor. As access to the original storage cell will be required for the installation of the equalization and gravity pipe, construction of a coffer dam may be required. Conditions during construction, as well as the construction timeframe in relation to the normally scheduled effluent release, will have to be observed and a plan worked out with the Contractor.
- Install the CCL or HDPE liner and associated materials to the required specifications.
- Install erosion protection on the inner and outer slopes.
- Temporarily close the valve connecting the primary cell and the existing storage cell and lower the volume in the existing storage cell via discharge, as allowed in the existing Permit to Operate.
- Construct a coffer dam at the location of the equalization pipe and install the new equalization pipe. After the installation of the pipe and backfilling of the existing berm, remove the coffer dam.
- Open the valve between the primary cell and the existing storage cell.

- Obtain a new Permit to Operate before opening the connection from the existing storage cell to the new storage cell.

- Install three (3) monitoring wells around the Lagoon.

4.2. CONSTRUCTION RECOMMENDATIONS

Based on the geotechnical investigation and PINTER's observations during the topographical survey, higher groundwater levels should be expected during or following periods of precipitation or post-winter thawing. Trafficability of the subgrade soils during site construction may be affected and should be monitored closely.

Low hydraulic conductivity of the in-situ soils at the proposed location of the new cell should ensure that seepage into excavations remains negligible over the period required to complete construction; however, there may be thin layers of high hydraulic conductivity soils that were not detected in the drilling investigation. If these layers are encountered, dewatering of the excavations may be required. Site supervision and adequate quality assurance and control (QA/QC) measures carried out by qualified personnel is recommended.

4.3. SLUDGE REMOVAL

Due to the nature of this project, no sludge disposal plan has been created. Sludge disposal will be accounted for during a later phase of the Lagoon upgrade.

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6.0 CLOSURE

We, the undersigned, hereby declare that to the best of our knowledge, the information contained herein and the information in support of this submission as completed by us is complete and accurate in accordance with my obligations under The Engineering and Geoscience Professions Act (2011) and its regulations. We further declare that this submission has been prepared in accordance with the published standard for this submission.

PINTER & Associates Ltd.

Reece Heffernan, B.Sc., E.I.T
Project Engineer

Enkhnyamaa Jalbuu, P.Eng
Project Manager

7 August 2024

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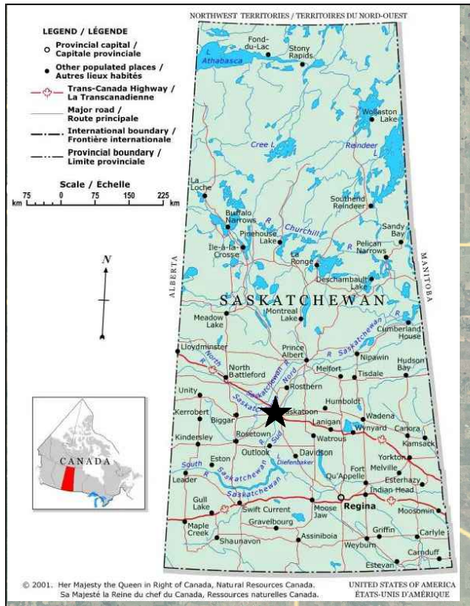
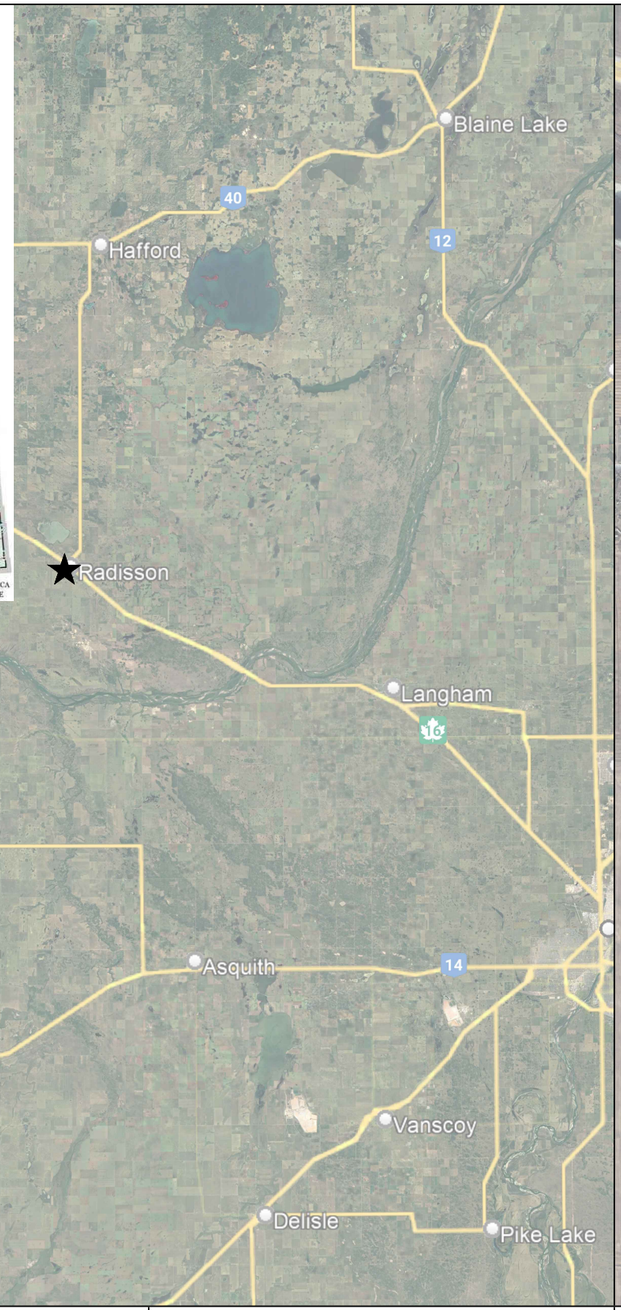
Appendix A

Detailed Design Drawings





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NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
2. ELEVATIONS ARE ABOVE SEA LEVEL (ASL)

LEGEND

SITE LOCATION ★

SITE AREA:

THIS DRAWING MAY HAVE BEEN REDUCED. ALL SCALE NOTATIONS INDICATED (i.e. 1:1000 etc.) ARE BASED ON 11" X 17" PRINTED DRAWINGS

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Association of Professional Engineers & Geoscientists of Saskatchewan
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PINTER & Associates Ltd.
Number C1232
Permission to Consult held by:

Discipline	Sk. Reg. No.	Signature
Municipal	6565	
Environmental	6565	
Geotechnical	6565	

REV	DD-MMM-YY	DESCRIPTION	DRFT	APR
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1	07-AUG-24	ISSUED FOR TENDER	BC	NJ
0	29-JUL-24	ISSUED FOR REVIEW	BC	NJ

PROJECT NUMBER: 3285-1
DRAWN BY: BC
APPROVED BY: NJ
SCALE: NTS

SHEET TITLE: SITE LOCATION

PROJECT NAME: WASTEWATER LAGOON UPGRADES
CLIENT NAME: TOWN OF RADISSON

REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-01
SHEET NUMBER: 0_ _ _

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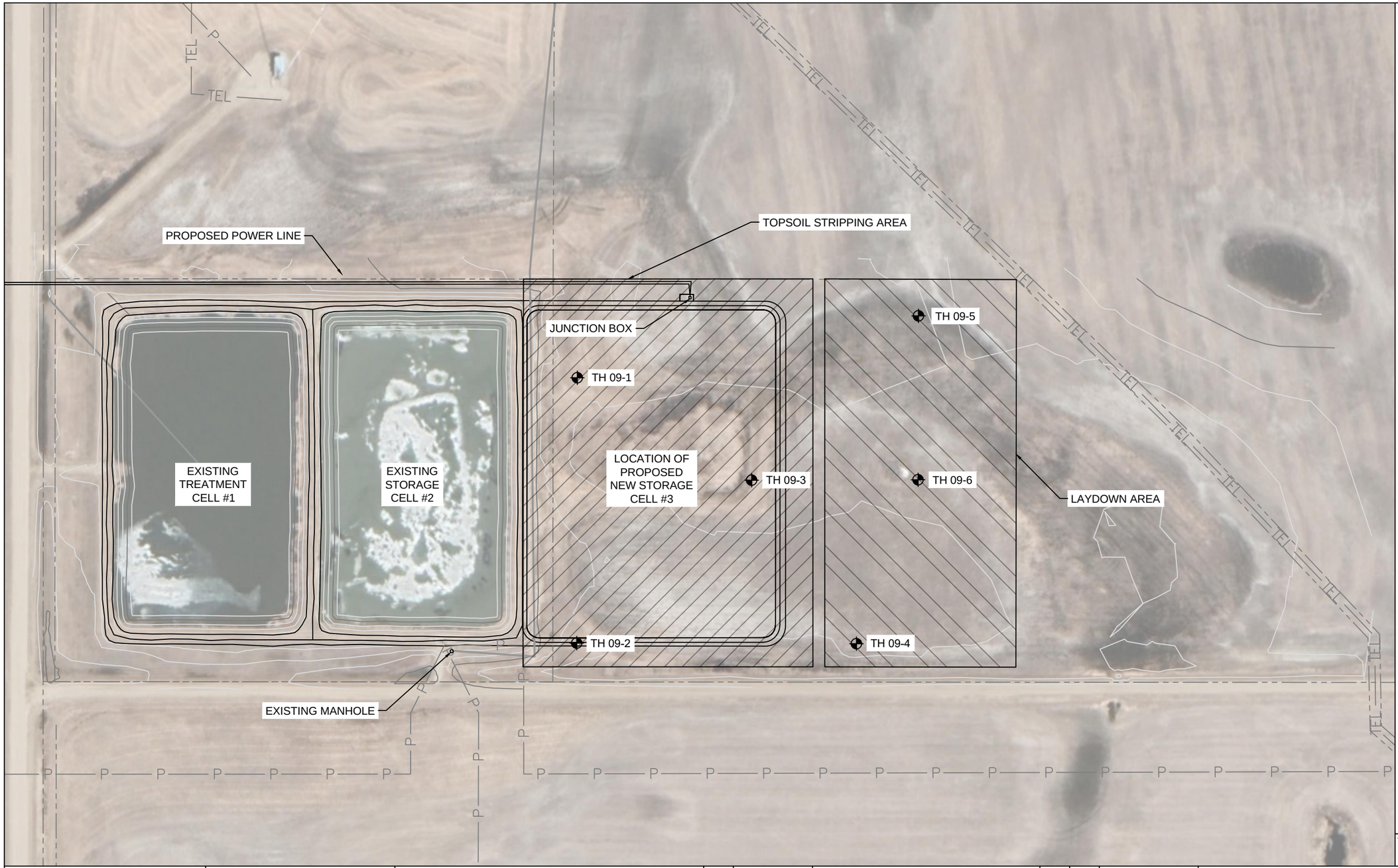

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3. CADASTRAL INFORMATION OUTSIDE OF TOWN LIMITS IS APPROXIMATE

LEGEND:

- PROPERTY LINES
- EXISTING SEWER FORCE MAIN
- EXISTING POWER LINE (SASKPOWER, 1-PHASE) — P —
- EXISTING SASKTEL LINE — TEL —
- BOREHOLE TH 09-1

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APPROVED BY: NJ
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CLIENT NAME: TOWN OF RADISSON

REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-02
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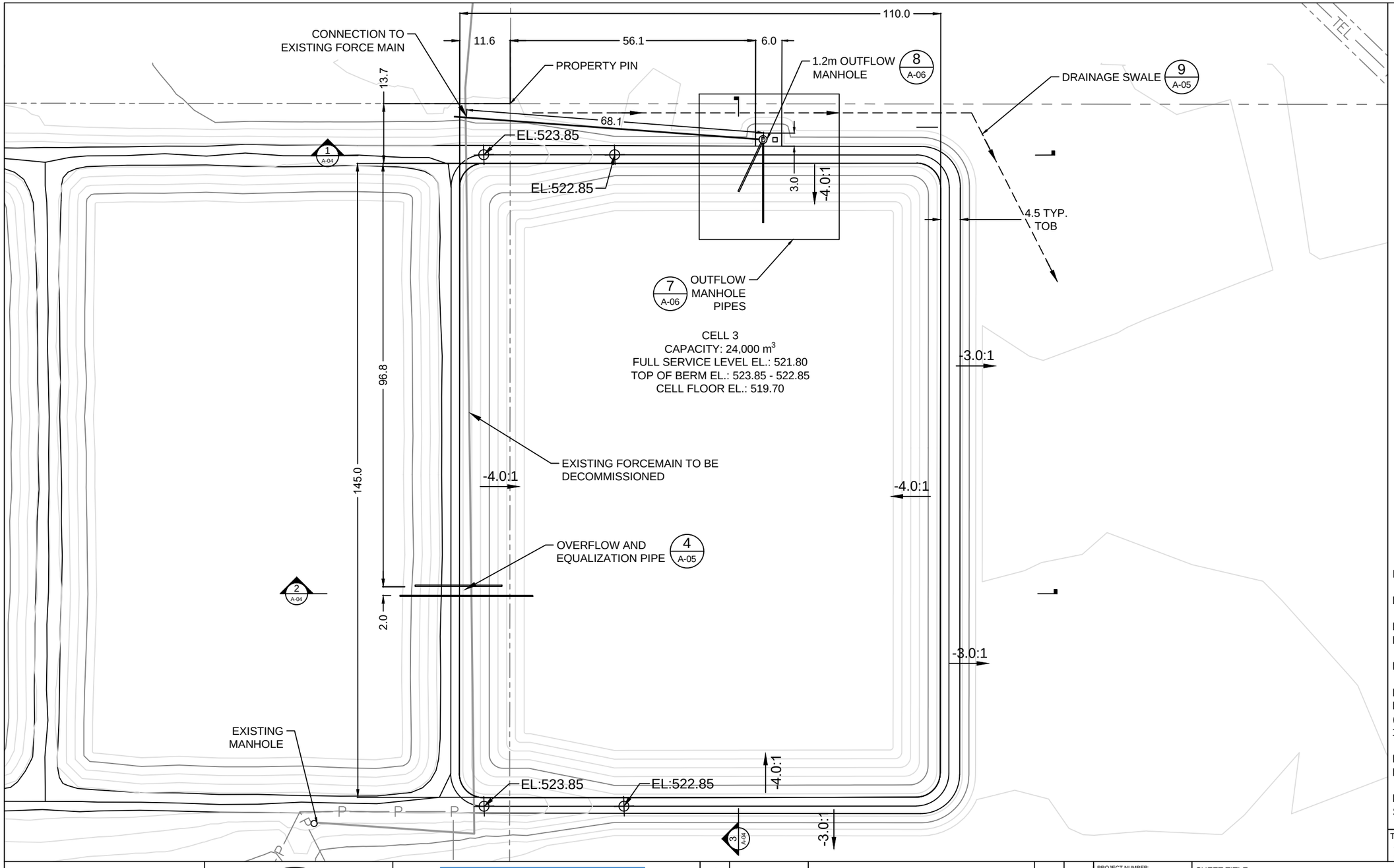

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3. CADASTRAL INFORMATION OUTSIDE OF TOWN LIMITS IS APPOXIMATE
4. AREA NORTH OF PROPOSED LAGOON MUST BE GRADED TO SWALE TO ALLOW FOR DRAINAGE

LEGEND:

- PROPERTY LINES
- EXISTING SEWER FORCE MAIN
- PROPOSED SEWER
- EXISTING POWER LINE (SASKPOWER, 1-PHASE) — P —
- PROPOSED POWER LINE — P —
- EXISTING SASKTEL LINE — TEL —

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DRAWING NUMBER: A-03
SHEET NUMBER: 03 OF 07

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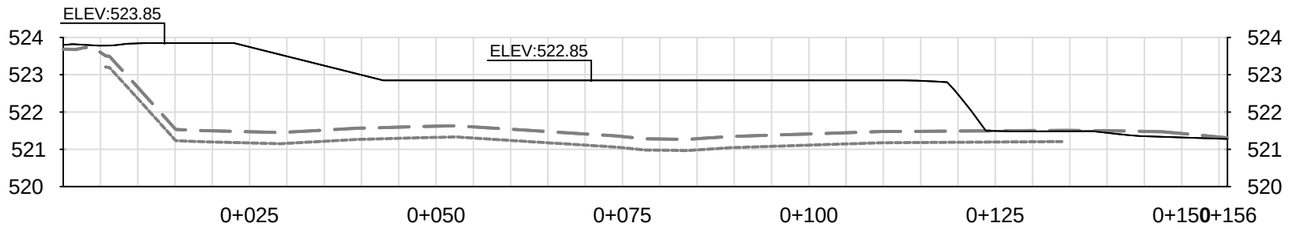

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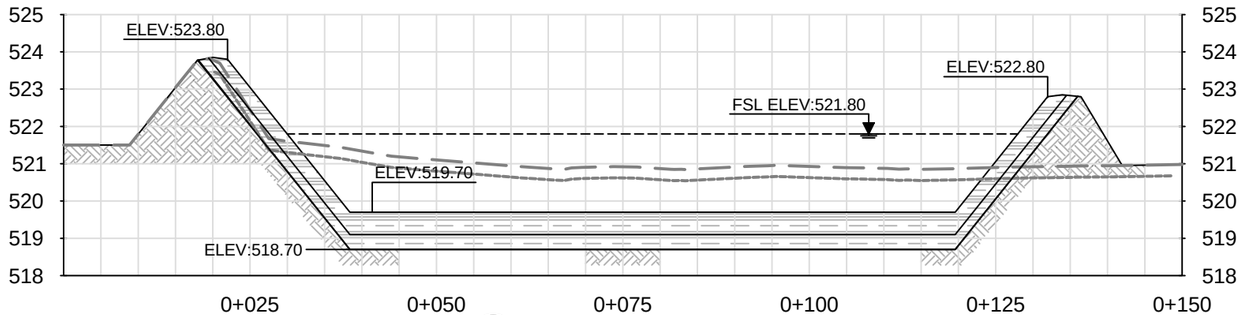
TOP OF NORTH BERM



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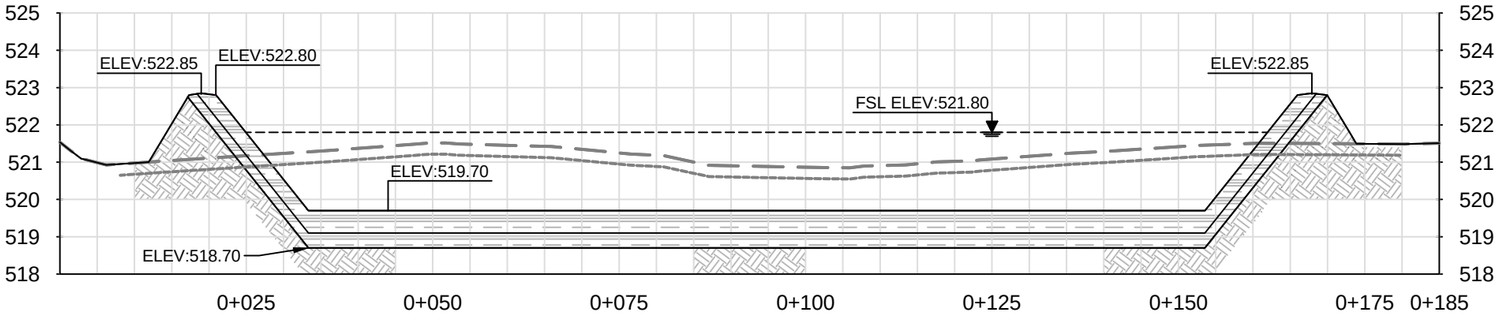

3 A-03 SECTION 1:800
SOUTH TO NORTH

N

NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
2. ELEVATIONS ARE ABOVE SEA LEVEL (ASL)
3.
4. VERTICAL EXAGGERATION OF 1:5

LEGEND:

EXISTING GROUND

TOPSOIL STRIPPING

COMPACTED CLAY (1 m)

PREPARED SUBGRADE (MIN 0.2m)

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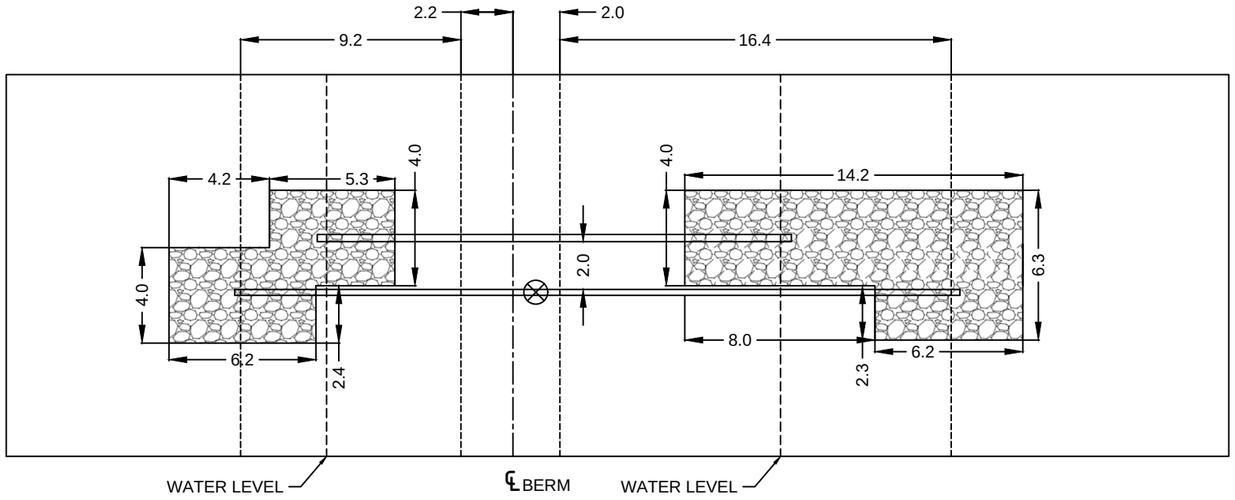
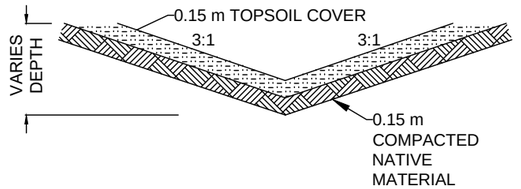
PROJECT NUMBER: 3285-1
DRAWN BY: BC
APPROVED BY: NJ
SCALE: 1:800

SHEET TITLE: CROSS SECTIONS
PROJECT NAME: WASTEWATER LAGOON UPGRADES
CLIENT NAME: TOWN OF RADISSON

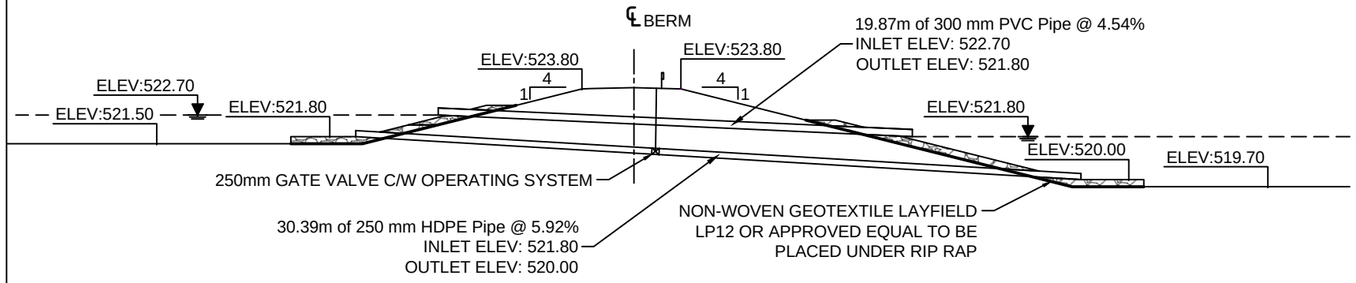
REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-04
SHEET NUMBER: 04 OF 07

H:\2) Projects\3285 Town of Radisson - WTP Upgrade\3285-1 Town of Radisson – Wastewater Lagoon Upgrade Options\3285-1 Drawings\3285 - Radisson Lagoon - Option #2 1-3 - 01Aug24 - BCJG.dwg - C-03 - OPTION 1 - Aug. 07, 2024 4:45pm - brad.clark

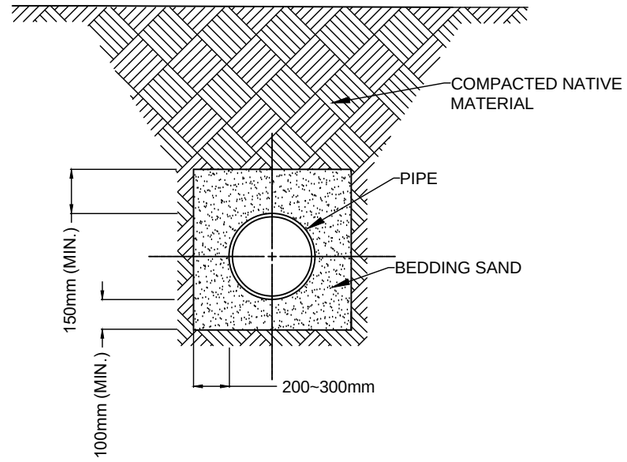




5 / A-03 SECTION NTS
TYPICAL SWALE



4 / A-03 PLAN & PROFILE 1:250
OVERFLOW AND EQUALIZATION



6 / A-03 SECTION NTS
TYPICAL PIPE BEDDING

N

NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
2. ELEVATIONS ARE ABOVE SEA LEVEL (ASL)

LEGEND:

RIP RAP (300mm)

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PROJECT NUMBER: 3285-1
DRAWN BY: BC
APPROVED BY: NJ
SCALE: 1:250

SHEET TITLE: CELL 2 TO CELL 3 AND DETAILS
PROJECT NAME: WASTEWATER LAGOON UPGRADES
CLIENT NAME: TOWN OF RADISSON

REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-05
SHEET NUMBER: 05 OF 07

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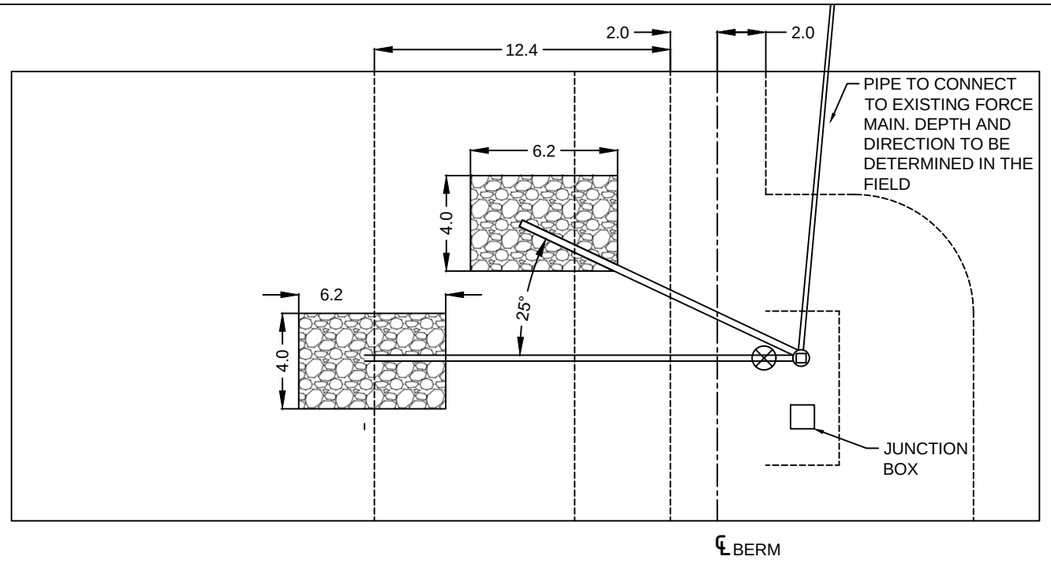
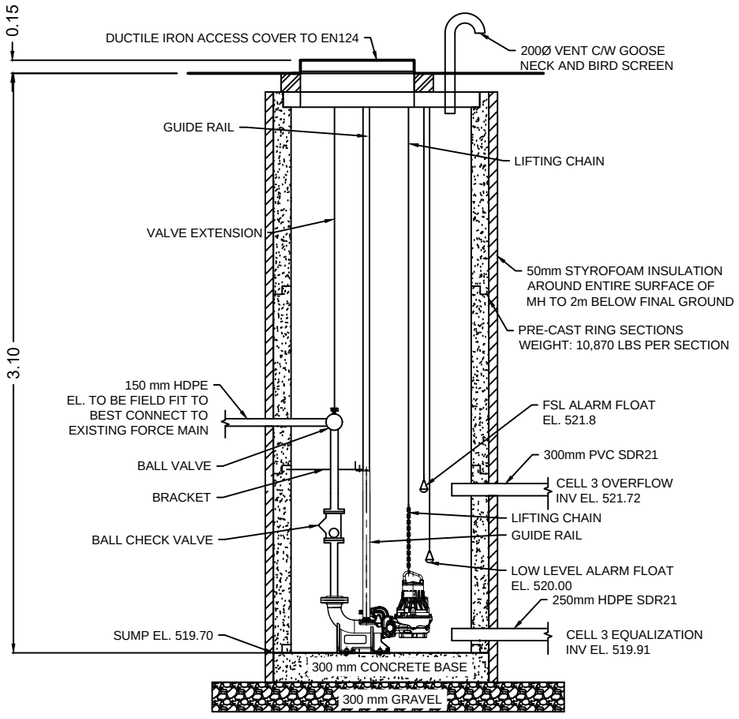
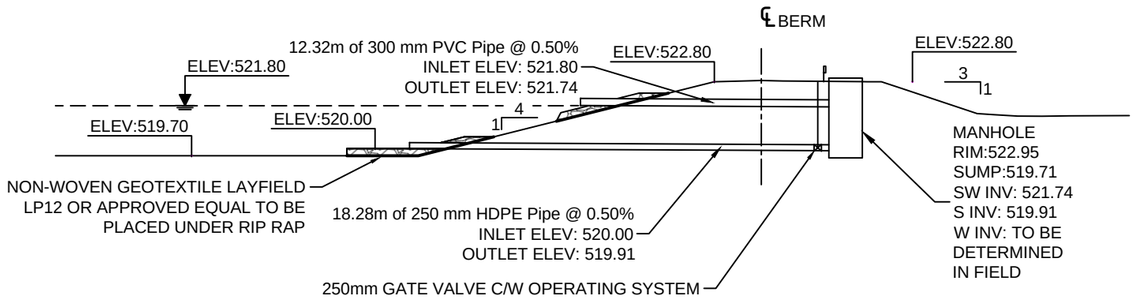
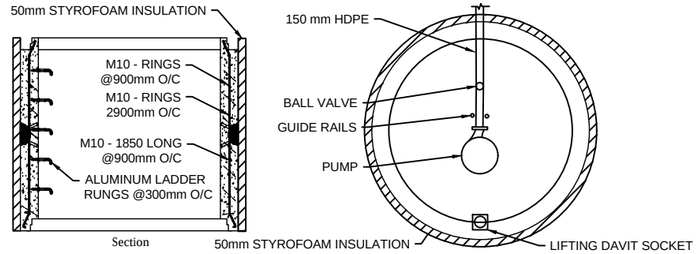






7 A-03 SECTION V 1:5
OUTFLOW MANHOLE PIPES



8 A-03 DETAIL NTS
OUTFLOW MANHOLE

NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
2. ELEVATIONS ARE ABOVE SEA LEVEL (ASL)

LEGEND:

RIP RAP (300mm)

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0	29-JUL-24	ISSUED FOR REVIEW	BC	NJ

PROJECT NUMBER: 3285-1
DRAWN BY: BC
APPROVED BY: NJ
SCALE: 1:250

SHEET TITLE: CELL 3 TO MANHOLE DETAILS
PROJECT NAME: WASTEWATER LAGOON UPGRADES
CLIENT NAME: TOWN OF RADISSON

REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-06
SHEET NUMBER: 06 OF 07

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N

NOTE:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
2. ELEVATIONS ARE ABOVE SEA LEVEL (ASL)
3. CADASTRAL INFORMATION OUTSIDE OF TOWN LIMITS IS APPROXIMATE

LEGEND:

PROPERTY LINES

EXISTING SEWER FORCE MAIN

EXISTING POWER LINE (SASKPOWER, 1-PHASE) — P —

EXISTING SASKTEL LINE — TEL —

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1	07-AUG-24	ISSUED FOR TENDER	BC	NJ
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PROJECT NUMBER: 3285-1
DRAWN BY: BC
APPROVED BY: NJ
SCALE: 1:1750

SHEET TITLE: POWER LAYOUT

PROJECT NAME: WASTEWATER LAGOON UPGRADES
CLIENT NAME: TOWN OF RADISSON

REVISION NO: 2
ISSUE DATE: 07-AUG-24
DRAWING NUMBER: A-02
SHEET NUMBER: 07 OF 07

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Appendix B

Geotechnical Investigation

P. MACHIBRODA ENGINEERING LTD.

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- Concrete Testing
- Asphalt Testing

GEOTECHNICAL INVESTIGATION
PROPOSED SEWAGE LAGOON EXPANSION AND SEWAGE LIFT STATION
RADISSON, SASKATCHEWAN
PMEL FILE NO. S09-6987
OCTOBER 30, 2009

SW-21-40-10-W3M
NEAR RADISSON, SASKATCHEWAN

PREPARED FOR:

TOWN OF RADISSON
P.O. BOX 69
RADISSON, SASKATCHEWAN
S0K 3L0

ATTENTION: MR. DARRIN BEAUDOIN

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1.0 INTRODUCTION

The following report has been prepared on the results of a geotechnical investigation performed to assess soil and groundwater conditions at the site of the proposed Sewage Lagoon Expansion and Sewage Lift Station located near the Town of Radisson, Saskatchewan. The subject site is located on the Southwest quarter of Section 21-Township 40-Range 10-West of the 3rd Meridian.

The Terms of Reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 0603-5546 dated June 4, 2009. Authorization to perform this investigation was provided verbally on June 18, 2009.

The field test drilling and soil sampling were performed between July 29 and September 17, 2009. Water level monitoring was performed on September 17 and October 21, 2009.

2.0 FIELD INVESTIGATION

Six test holes were drilled at the proposed Lagoon Expansion site while a seventh hole was drilled at the location of the proposed Sewage Lift Station. The Lagoon Expansion test holes are shown on the Site Plan, Drawing No. S09-6987-1. The test holes were dry drilled during this investigation using our solid stem continuous flight auger drill rig. The test holes were 150 mm in diameter and were extended to depths of 5.0 to 12.0 metres below existing ground surface.

Test Hole drill logs were compiled during test drilling to record the soil stratification, the groundwater conditions, the position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered.

Disturbed samples of auger cuttings were collected during test drilling and sealed in polyethylene plastic bags to minimize moisture loss. The soil samples were taken to our laboratory for analysis.

Standpipe piezometers (50-mm diameter PVC pipe with No.10 slotted well screen) were installed in Test Hole Nos. 09-2, 09-3 and 09-5 upon completion of test drilling for monitoring of static groundwater levels.

3.0 FIELD DRILL LOGS

Detailed descriptions of the site stratigraphy are presented on the Field Drill Logs, Drawing Nos. S09-6987-2 through 8, inclusive, while the inferred stratigraphy has been presented on Stratigraphic Section A-A, Drawing No. S09-6987-9.

The ground surface elevations at the Test Hole locations were referenced to the rim of the manhole located at the southeast corner of the existing sewage lagoon. The rim elevation of the manhole was provided by Tamarack Professional Services as 519.812 metres (Geodetic).

3.1 Soil Profile

3.1.1 Lagoon Expansion Site

Test Hole Nos. 09-1 to 09-6, inclusive were drilled at the proposed Lagoon Expansion site.

In general, the site stratigraphy consists of approximately 300 mm of topsoil overlying medium and highly plastic clay extending to depths of 5.9 to 7.2 metres below existing ground surface. The above soils were underlain by glacial till extending to a depth of at least 12 metres, the maximum depth penetrated by our test holes. An inter/intra till sand deposits was encountered within the glacial till stratum in Test Hole No. 09-01 from 8.8 to 10.5 metres.

3.1.2 Sewage Lift Station Site

Test Hole No. 09-7 was drilled at the proposed Lift Station site. The subsurface soil conditions consisted of sand extending to approximately 3.1 metres followed by highly plastic clay to about 7.3 metres then glacial till extending to at least 9 metres, the maximum depth drilled at this site.

3.2 Groundwater Conditions and Sloughing

Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the field drill logs.

A summary of the groundwater levels recorded during this investigation has been presented in Table I.

TABLE I. SUMMARY OF RECORDED GROUNDWATER LEVELS

Test Hole No.	Piezometer Rim Elevations (metres)	Ground Surface Elevation (metres)	Recorded Groundwater Elevation (metres)	
			September 17, 2009	October 21, 2009
09-2	520.4	519.4	519.3	519.4
09-3	520.5	519.5	512.3	518.9
09-5	520.1	519.1	509.8	517.9

The depth to groundwater recorded in the piezometers on October 21, 2009 ranged from 0 to 1.2 metres below existing grade while the apparent direction of groundwater flow was towards the northeast at an average gradient of 0.006. Higher static water levels should be expected during or following piezometer stabilization, during or following extended periods of precipitation and/or during or following spring snowmelt.

3.3 Cobblestones and Boulders

The glacial till encountered at the site consisted of a heterogeneous mixture of gravel, sand, silt and clay-sized particles. The glacial till also contained sorted deposits of the above particle sizes. In addition to the sorted deposits, a random distribution of larger particle sizes in the cobblestone range (60 to 200 mm) and boulder-sized range (larger than 200 mm) were encountered during test drilling.

It should be recognized that the statistical probability of encountering boulders in the seven small diameter test holes drilled at the site is low. Intertill deposits of cobblestones, boulder pavement, boulders and isolated deposits of saturated sand or gravel should be anticipated. The frequency of encountering such deposits will increase proportionately with the number of holes drilled or volume of soil excavated.

4.0 SOIL CLASSIFICATION AND INDEX TEST RESULTS

The soil classification and index tests consisted of a visual classification of the soil; water contents; Atterberg limits; and grain size distribution analysis.

The results of the soil classification and index tests conducted on samples of soil are plotted alongside the corresponding field logs opposite the depth at which the samples were recovered as shown on Drawings Nos. S09-6987-2 through 8, inclusive.

The results of the grain size distribution analyses are shown plotted on Drawing Nos. S09-6987-10 through 17, inclusive.

5.0 SITE CHARACTERIZATION

5.1 Site Location and Surrounding Land Use

The existing Town of Radisson sewage lagoon is located on the property legally described as SW 21-40-10-W3M. Saskatchewan, Surrounding land use consists of (predominantly) farmland.

5.2 Site Topography

The land surface elevation at the proposed Lagoon Expansion site ranged from approximately 519.1 to 519.8 metres (Geodetic).

5.3 Site Development

The existing Town of Radisson sewage lagoon (approximately 3.5 hectares) is located on the subject site. The proposed Lagoon Expansion is to be constructed to the east of the existing lagoon. The site of the proposed expansion is presently undeveloped (grassland).

5.4 Physiography

The subject property lies in the physiographic region known as the Saskatchewan Rivers Plain, which is characterized as gently undulating to rolling glacial lacustrine-alluvial plains (dunes) and till plains (Acton et. al., 1960). The surficial soil deposits consist of variable textured lacustrine and alluvial sands silts, clays, aeolian sands and glacial till (Acton et.al, 1960).

5.5 Geology

The geological deposits at this site consisted of approximately 70 metres of glacial till and stratified drift overlying the silty clay-shale of the Lea Park Formation - Upper Colorado Group (Christiansen, 1967).

5.6 Hydrogeology

An examination of hydrogeological data, (Christiansen, 1979), for this region revealed the following observations:

1. The primary source of water in this region is drift aquifers above or between glacial till strata and the Empress Group between the base of the glacial till and the surface of the bedrock.

2. The North Saskatchewan River is a discharge receptor for many of the aquifer systems in the Radisson area. The inferred regional groundwater flow would be in a northeast-easterly direction towards Shepards Creek.

3. The nearest Empress Group aquifer is located over 5 km north of the site.

4. A large surficial sand and silt aquifer is located to the northeast of the site.

5. The subject property overlies the southern edge of the Fielding Aquifer. The surface of the aquifer is located approximately 30 m below grade.

5.7 Soil and Groundwater Conditions

The subsurface soil conditions at the site consisted of topsoil underlain by medium and highly plastic clay followed by glacial till extending to a depth of at least 12 metres, the maximum depth penetrated by our test holes. Inter/intra till sand deposits were encountered within the glacial till stratum in Test Hole No. 09-1.

The depth to groundwater recorded in the piezometers on October 21, 2009 ranged from 0.1 to 1.2 metres below existing grade while the apparent direction of groundwater flow was towards the northeast at an average gradient of 0.006. Higher static water levels should be expected during or following piezometer stabilization, during or following extended periods of precipitation and/or during or following spring snowmelt.

5.8 Water Well Records

A review of Saskatchewan Water Corporation (SaskWater) Water Well Database revealed that there are at least thirty-five (35) registered groundwater wells located within an approximate two kilometre radius of the study site. About half of the registered water wells consist of large diameter (greater than 200 mm) wells completed at depths less than 30 metres below ground surface. Saskatchewan Water Corporation (SaskWater) Water Well records have been presented in Appendix B.

5.9 Surface Water Receptors

The closest major body of water to the site is Radisson Lake, located at its closest point, approximately 3 km to the north of the subject property. However, the inferred regional groundwater flow is northeast to east towards Shepards Creek and the North Saskatchewan River.

6.0 DESIGN RECOMMENDATIONS

Based on the foregoing outline of soil test results, the following considerations and recommendations have been presented.

6.1 Design Considerations

It is understood that the proposed Lagoon Expansion will be approximately 2.7 hectares in size.

The subgrade soil conditions in the area of the proposed Lagoon Expansion consists of medium and highly plastic clay overlying glacial till extending to a depth of at least 12 metres, the maximum depth penetrated by our test holes. An inter/intra till sand layer was encountered in Test Hole No. 09-1 from 8.8 to 10.5 metres.

The water levels recorded in the piezometers installed at the completion of test drilling were measured at approximately 0.1 to 1.2 metres below ground surface on October 21, 2009. Higher groundwater levels should be expected during or following spring thaw or periods of precipitation. The potentially high groundwater conditions encountered in this area could affect the trafficability of the subgrade soils during site construction. In this case, excavation in some areas may require the use of backhoe excavation equipment or dragline excavators.

The clay deposits at the Lagoon Expansion site have an average fines (combined silt and clay) content of 95 percent; an average clay content of 30 percent; an average sand content of 6 percent; an average Plasticity Index (PI) of 32, and an average Liquid Limit (LL) of 48 percent. In light of the above, the clay soils are considered acceptable for use as compacted soil liner if maintained in a saturated condition. This should be confirmed by a hydraulic conductivity test of a sample of the prepared liner material.

Recommendations have been prepared for site preparation; dyke construction; liner requirements; slope protection; control structures; level control monitors; traffic accommodation; site drainage; shrinkage; quality control testing; and, environmental monitoring.

6.2 Site Preparation

All existing topsoil (organics) and/or deleterious material (i.e., sand) should be stripped from the surface of the site of the proposed Sewage Lagoon Expansion. The topsoil should be stockpiled and replaced on the exterior surface of the perimeter dykes following construction of the Sewage Lagoon.

6.3 Dyke Construction

The clay soils encountered at this site should perform satisfactorily for the construction of the earthen dykes. The dykes should be constructed with a crest width of 4.0 metres (minimum) and embankment slopes of 4 (H) to 1 (V) on the interior and exterior surface. The minimum design freeboard should be one metre.

The dykes should be constructed in thin lifts not exceeding 150 mm in thickness (loose) and compacted to 95 percent of standard Proctor density at optimum moisture content. The surface of the subgrade beneath the dykes should be scarified to a depth of at least 150 mm and compacted to 95 percent of standard Proctor density at optimum moisture content.

6.4 Liner Requirements

The clay soils encountered at the subject site are considered acceptable for use as compacted soil liner if maintained in a saturated condition. The base of the liner should have a minimum compacted thickness of 0.6 metres while the sides of the liner should have a minimum compacted thickness of 1.0 metres as measured normal to the slope of the structure. The liner should extend up to the full supply plus free board. The liner material should be compacted to 95 percent of standard Proctor density between optimum moisture content and 2% wet of the optimum moisture content.

The thickness of each uncompacted lift shall be at least 25 mm less than the foot length of the compaction roller to a maximum of 150 millimetres loose. Each compacted lift shall be protected from drying out to prevent cracking due to shrinkage. The compacted liner system should be protected from freezing and/or drying prior to in-service operation by flooding of the sewage lagoon basin upon completion of construction.

As an alternate, a synthetic liner could be installed and should perform satisfactorily. The liner should be at least 40 mil thickness and covered with at least 150 mm of sand fill to minimize the potential for puncture. The liner should be installed as per manufacturer's instructions. The base of the synthetic liner should be located at least 0.6 metres above the static water level. Installation of a HDPE liner would require subgrade preparation (i.e., bedding sand).

6.5 Slope Protection

The interior surface of the dykes (i.e. liner cover) should be protected against surface erosion above the design full supply level. Slope protection should consist of riprap or manufactured erosion protection such as geotextiles or erosion control blankets. The exterior surface of the dykes should be covered with organic topsoil and seeded to provide slope protection from surface runoff erosion.

6.6 Control Structures

It is anticipated that control structures may be required on the newly constructed dykes due to anticipated long-term settlement of the dyke soil and underlying subgrade. The design of control structures should accommodate long-term differential movement of approximately 150 millimetres. Riprap should be placed around the openings of control structures to minimize the potential for surface erosion.

6.7 Level Control Monitors

Level control monitors should be installed to prevent overtopping of the dykes. The elevation of the level control monitors should reflect the minimum design freeboard of one metre.

6.8 Traffic Accommodation

The top of the dykes should be of sufficient width (minimum four metres) to accommodate service vehicle access and practical construction equipment. The top surface of the dykes should have a crown with a minimum cross-slope of 3 percent and a granular surface wearing course to permit all season vehicular traffic.

6.9 Site Drainage

A collector ditch should be excavated adjacent the toe of the perimeter dykes. The collector ditch should be connected to the local natural surface drainage system.

6.10 Shrinkage Factor

A shrinkage factor of 25 percent is recommended for common borrow. The above shrinkage factor assumes that the organic topsoil will be removed and will not be included in volume calculations to which the shrinkage factor will be applied.

6.11 Quality Control Testing

Quality control testing should be performed on a continuous basis during construction to monitor compliance with the placement and compaction requirements outlined in previous sections of this report.

6.12 Environmental Monitoring

Piezometer development and sampling should be performed in accordance with "Guidelines for Groundwater Monitor Wells at Wastewater Disposal Sites" (November, 1987) and "Protocols for the Installation and Sampling of Monitor Wells" (April, 1989) published by Water Quality Branch, Saskatchewan Environment. It is recommended that the piezometers be encased in lockable protective steel casings for optimization of long-term performance.

7.0 SEWAGE LIFT STATION

It is understood that the proposed Sewage Lift Station (SLS) will involve construction of a deep wet well extending approximately 6 to 9 metres below existing ground surface.

The subsurface soils at the site of the proposed Sewage Lift Station consisted of sand followed by medium to highly plastic clay overlying glacial till. The glacial till extended to a depth of at least 9.0 metres below existing ground surface.

Groundwater seepage and sloughing conditions were encountered during test drilling. Based on the depth at which groundwater seepage was encountered, the groundwater level at the subject site appeared to be situated at approximately 1.8 metres below existing ground level on July 29, 2009.

A raft foundation constructed over the naturally deposited, undisturbed clay or glacial till should perform satisfactorily for the proposed wet well. The walls of the proposed wet well should be designed to accommodate lateral earth pressure exerted by saturated, local sand, clay, glacial till or imported granular backfill material and any surcharge loading. The wet well should also be designed to resist buoyancy forces.

Design recommendations have been prepared for excavation and dewatering; raft foundation; uplift hydrostatic pressure (buoyancy); lateral earth pressure; backfill of excavation; and foundation concrete.

7.1 Excavation and Dewatering

It is anticipated that the proposed excavation at this site may be completed with unbraced, sloped excavation walls.

The recommended minimum side slopes for the excavation at this site have been presented in Table II.

TABLE II. RECOMMENDED MINIMUM EXCAVATION SIDESLOPES

Soil Type	*Minimum Excavation Side Slopes	
	Horizontal	Vertical
Sand (Dry)	1.5	1.0
Sand (Saturated)	4.0	1.0
Clay	3.0	1.0
Glacial Till	1.0	1.0

* - The slopes should be flattened where groundwater seepage is encountered.

The long-term stability of the excavation walls will be affected by wetting and drying of the exposed excavation walls, the length of time that the excavation remains open and the consistency of the structure (degree of fracturing, slickensiding, etc.) of the subgrade soils.

Dewatering of the excavation will be required where the excavation extends below the static groundwater table. Groundwater seepage and precipitation runoff should be collected in a perimeter drainage system at the base of the excavation. The drainage system should drain positively to a collection sump equipped with a sump pump.

Surcharge loads (such as stockpiled soil and equipment) should be kept away from the unsupported excavation face a distance equal to the intersection of a 1.0 horizontal to 1.0 vertical slope projected from the base of the excavation to the natural ground surface to minimize potential sloughing of the excavation sidewalls.

7.2 Raft Foundation

The following minimum recommendations should be incorporated into the design of a raft foundation on clay or glacial till.

1. The raft foundation should be founded on naturally deposited, undisturbed clay or glacial till.

2. If the subgrade soil below the design depth is disturbed during excavation, then the disturbed soil should be removed to an undisturbed, level surface. Fill, required to bring the excavation to the underside of the raft elevation, should be concrete. A mud slab (lean mix concrete) could be placed on the surface of the subgrade to minimize the potential for soil disturbance. The mud slab should be 80 mm in thickness and should have a minimum concrete compressive strength of 15 MPa.

3. A raft foundation founded on the naturally deposited, undisturbed clay or glacial till at a depth of 6 to 9 metres below existing grade, or on a mud slab, as recommended above, may be designed to exert an allowable bearing pressure of 100 kPa.

4. The raft foundation should be reinforced.

5. A representative of the Geotechnical Consultant should inspect the excavation prior to the placement of the mud slab and the construction of the raft.

6. The raft should not be constructed on desiccated, frozen or wet subgrade soil.

7. Frost should not be allowed to penetrate beneath the raft prior to, during or after construction.

8. The finished grade should be landscaped to provide for positive drainage away from the structure.

7.3 Uplift Hydrostatic Pressure (Buoyancy)

The raft foundation should be designed to resist uplift forces due to buoyancy. The uplift unit pressure acting on the base of the proposed Sewage Lift Station should be calculated as the depth of the structure below the groundwater table multiplied by the unit weight of water (9.81 kN/m^3).

Based on the depth at which groundwater seepage was encountered, the groundwater level at the subject site appeared to be situated at approximately 1.8 metres below existing ground level on July 29, 2009.

7.4 Lateral Earth Pressure

It is anticipated that the proposed Sewage Lift Station (i.e. wet well) will be designed without a subsurface drainage system and the existing soil or imported granular fill will be utilized as backfill material. The existing soils consist of sand, clay and glacial till. Subsurface foundation walls should be designed to resist lateral earth pressure exerted by the backfill as well as the horizontal pressure induced by any surcharge loading. The lateral earth pressure may be calculated on the basis of an equivalent fluid pressure distribution of 16.0 kN/m^3. The surcharge loading should be calculated on the basis of actual loads.

7.5 Backfill of Excavation

The backfill should be placed in thin lifts (300 mm loose maximum) equally around the perimeter of the structure and each lift should be compacted to 96 percent of standard Proctor density. Field density tests should be conducted during fill placement to ensure that the specified density is achieved prior to placement of the next lift of fill. Prior to placement of backfill material, the excavation should be dewatered.

7.6 Foundation Concrete

Water soluble sulphate salts (gypsum crystals) exist in the geologic deposits in this region. Sulphate resistant cement should be used for all concrete in contact with the subgrade soil. All concrete at this site should be manufactured in accordance with current CSA standards.

It should be recognized that water soluble sulphate salts combined with moist soil conditions or low pH soils, could render the soil highly corrosive to some types of metal water lines, elbows, connectors, etc., in contact with the soil.

8.0 LIMITATIONS

The presentation of the summary of the field logs and design recommendations for the proposed Sewage Lagoon Expansion and Sewage Pumping Lift Station has been completed as authorized. Seven test holes were dry drilled during this investigation using our solid stem, continuous flight auger drill rig. A field log was compiled for each Test Hole which, we believe, was representative of the subsurface conditions at the Test Hole locations at the time of drilling. Variations in the subsurface conditions from that shown on the field logs at locations other than the exact Test Hole locations should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

The subsurface investigation necessitated the drilling of deep test holes. Please be advised that some settlement of the backfill materials will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect each Test Hole location and backfill, as required, to ensure that the ground surface at each Test Hole location is maintained level with the existing grade.

This report has been prepared for the exclusive use of the Town of Radisson, JBS Engineering Inc. and their agents for the proposed Sewage Lagoon Expansion and New Sewage Pumping Lift Station, located near Radisson, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made.

Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. P. Machibroda Engineering Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

The acceptance of responsibility for the design/construction recommendations presented in this report with respect to the site preparation and sewage lagoon construction are contingent on adequate and/or full time inspection (as required, based on site conditions at the time of construction) by a representative of the Geotechnical Consultant. P. Machibroda Engineering Ltd. (PMEL) will not accept any responsibility on this project for any unsatisfactory performance if adequate and/or full time inspection is not performed by a representative of PMEL.

If this report has been transmitted electronically, it has been digitally signed and secured with personal passwords to lock the document. Due to the possibility of digital modification, only originally signed reports and those reports sent directly by PMEL can be relied upon without fault.

We trust that the report fulfills your requirements for this project. Please call if additional information or clarification is required.

P. MACHIBRODA ENGINEERING LTD.

Terry Werbovetski, P. Eng.

R. Machibroda, P.Eng., M.Sc.

TW:RM:clb

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
P. MACHIBRODA ENGINEERING LTD.
Number 172
Permission to Consult held by:

Discipline	SK. Reg. No.	Signature
Geotechnical	4955	T. Werbovetski 09-11-04

PROFESSIONAL ENGINEER
T. WERBOVETSKI
SASKATOON
09-11-04
SASKATCHEWAN

9.0 REFERENCES

Acton, D.F., Clayton, J.S., Ellis, J.G., Christiansen, E.A., and Kupsch, W.O., 1960. Physiographic Divisions of Saskatchewan. Saskatchewan Research Council, Map No. 1.

Christiansen, E. A. 1979. Geology of the Saskatoon Region, Saskatchewan. Report 0016-002. For Part A Regional Studies Program. Saskatchewan Municipal Affairs. March 15, 1979.

P. MACHIBRODA
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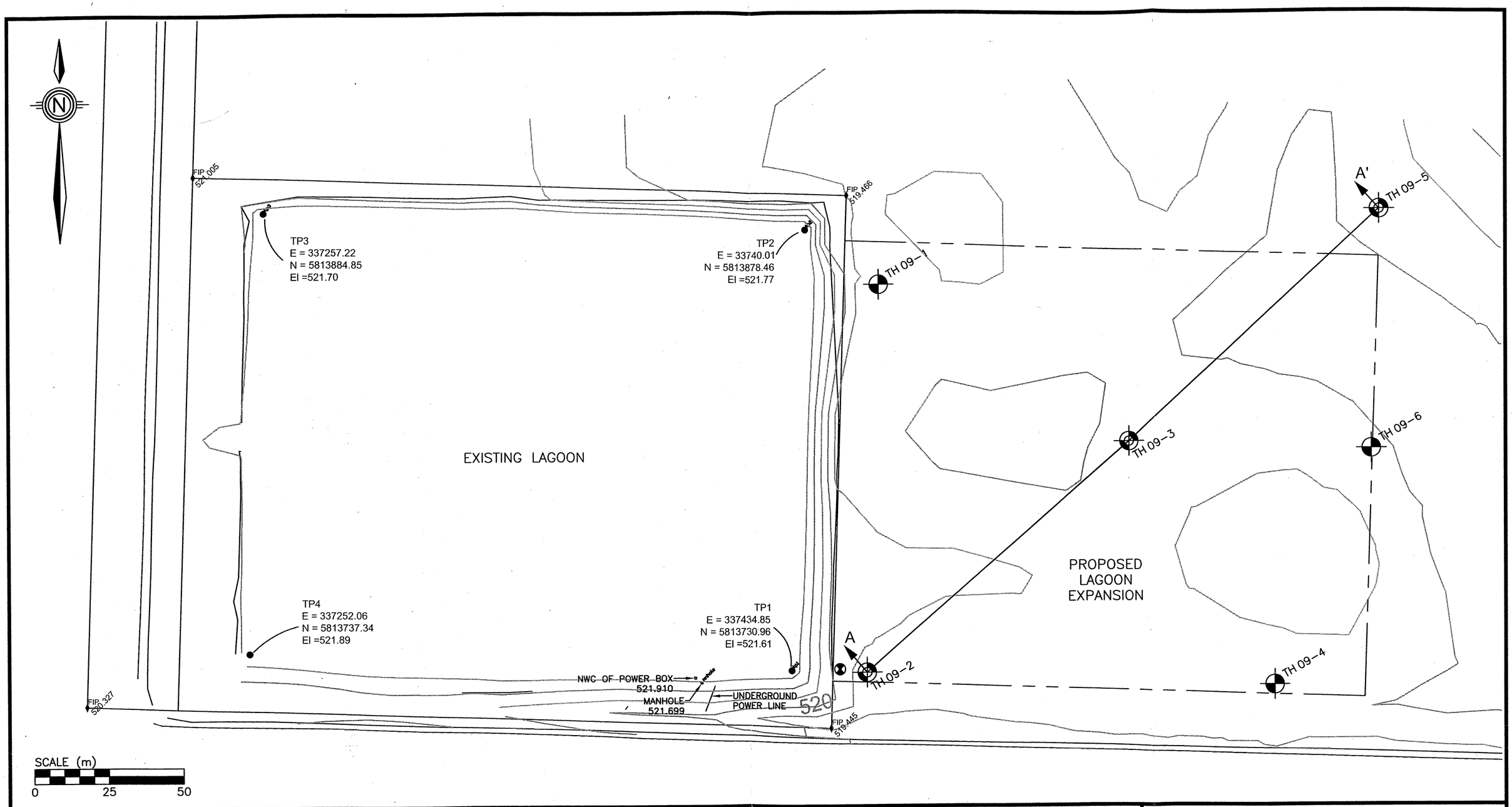
GEOTECHNICAL/GEOENVIRONMENTAL
ENGINEERS

DRAWINGS



NOTE:
1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.
2. THIS DRAWING WAS COMPILED USING PROVIDED DRAWING FILE: ElevPtsContoursRadissonSLagoonAcadV2004Jun20_09.
3. BENCHMARK DESCRIPTION: TOP OF MANHOLE LOCATED EAST OF SOUTHEAST CORNER OF EXISTING LAGOON. PROVIDED DATUM ELEVATION = 519.812 m.

LEGEND

- –PMEL TEST HOLE
- –BENCHMARK
- –PMEL TEST HOLE (PIEZOMETER INSTALLED)
- FIP –FOUND IRON PIN

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

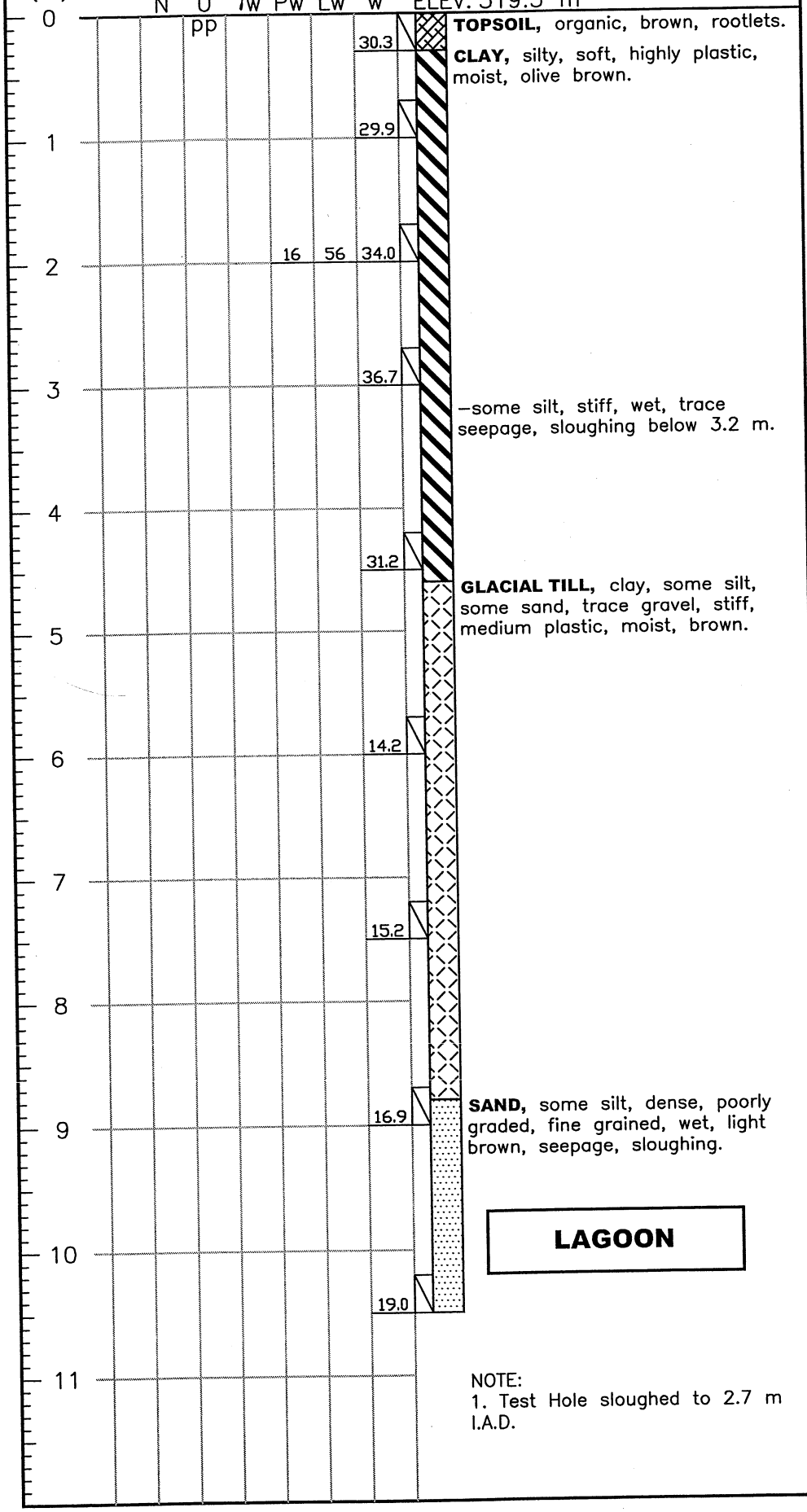
806 – 48th STREET EAST
SASKATOON, SK
S7K 3Y4

DRAWING TITLE:
SITE PLAN - TEST HOLE LOCATIONS

PROJECT:
PROPOSED SEWAGE LAGOON EXPANSION
SW-21-40-10-W3M, RADISSON, SK

APPROVED BY: T. WERBOVETSKI	DRAWN BY: G. SOLTYS
DATE: SEPTEMBER, 2009	DRAWING NUMBER: S09-6987-1
SCALE: 1:1250	

TEST HOLE 09-1



NOTE:
1. Test Hole sloughed to 2.7 m I.A.D.

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 17/09	S09-6987-2

PIEZO. ELEV.= 520.4 m

TEST HOLE 09-2

ELEV: 519.4 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
$Q_{99.6\ m}$ OCT 21/09							
		pp					
						37.8	**TOPSOIL,** organic, brown, rootlets.
							CLAY, silty, soft, medium plastic, very moist, brown.
						29.1	
1							–firm, moist, mottled brown/grey, oxide stained below 1.0 m.
							–some silt, highly plastic, stiff, brown below 1.6 m.
2						36.4	
							–silty, medium plastic, firm below 2.3 m.
3						36.1	
	18			43			
							–some silt, firm to stiff below 3.5 m.
4						32.2	
5							
6							
7							
8							
9							
10							
11							

BENTONITE SEAL

50 mm diam. SCH 40, PVC RISER PIPE

CUTTINGS

SAND PACKED ANNULUS

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

SLOUGH

NOTE:
1. Test Hole sloughed to 3.0 m I.A.D.

LAGOON

LEGEND:

FILL, SAND, CLAY, TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
JULY 29/09	S09-6987-3

PIEZO. ELEV.= 520.5 m

TEST HOLE 09-3

ELEV: 519.5 m

N U γ_w Pw Lw w

pp

DEPTH (m)

0 1 2 3 4 5 6 7 8 9 10 11

99.1 m OCT 21/09

BENTONITE SEAL

50 mm diam. SCH 40 PVC RISER PIPE

SLOUGH

50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

30.2 — **TOPSOIL,** organic, brown, rootlets.

CLAY, some silt, stiff, medium plastic, dark brown.

27.9 — –silty, firm, olive brown below 1.3 m.
–oxide stained below 1.5 m.

33.0 — –trace silt, stiff, highly plastic below 2.4 m.

32.3 — –silty, soft, medium plastic below 3.3 m.

39.5 — –some silt, stiff below 4.5 m.

34.5 — –wet, seepage, sloughing below 5.4 m.

GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown.

16.5

18.8

16.3

LAGOON

NOTE:
1. Test Hole sloughed to 1.5 m I.A.D.

LEGEND:

TOPSOIL, FILL, GRAVEL, SAND, SILT, CLAY, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

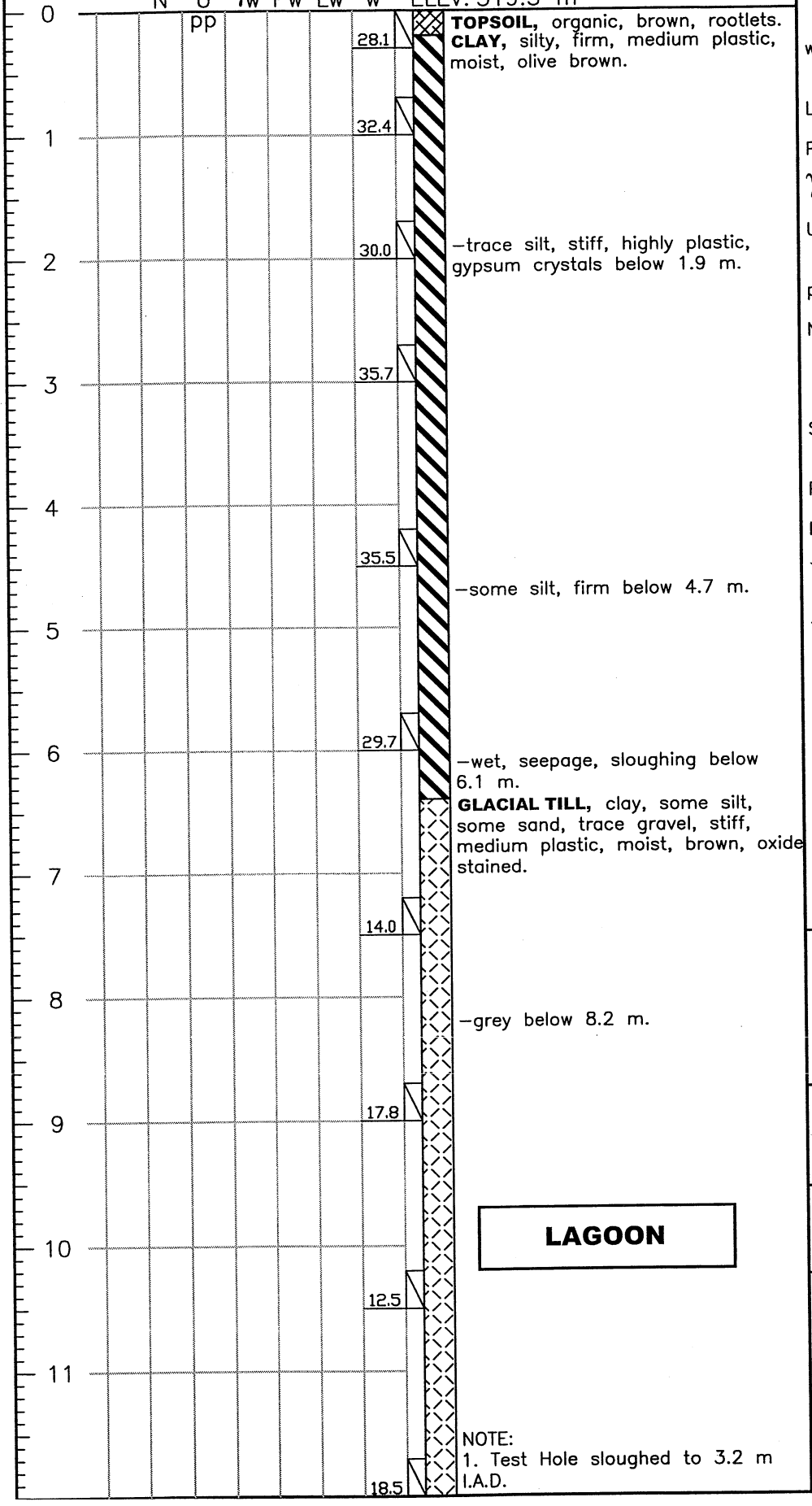
LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 17/09	S09-6987-4

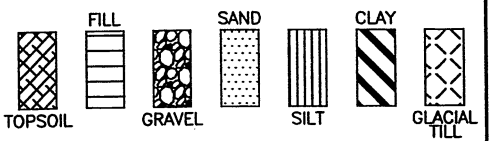
TEST HOLE 09-4



LAGOON

NOTE:
1. Test Hole sloughed to 3.2 m I.A.D.

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 17/09	S09-6987-5

PIEZO. ELEV.= 520.1 m

TEST HOLE 09-5

ELEV: 519.1 m

DEPTH (m)	N	U	γ_w	Pw	Lw	w	
0			pp			27.8	**TOPSOIL,** organic, brown, rootlets.
							BENTONITE SEAL
							CLAY, some silt, stiff, medium plastic, moist, olive brown.
1						27.8	
							98.1 m OCT 21/09
							–silty, firm below 1.2 m.
2						37.1	
							–trace silt, stiff, highly plastic below 2.0 m.
3						37.3	
							CUTTINGS
4							
						36.5	
							50 mm diam. SCH 40, PVC RISER PIPE
							–some silt, firm, medium plastic below 4.6 m.
5							
							–wet, seepage, sloughing below 5.2 m.
6						14.9	
							GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown.
7							
						14.3	
							SAND PACKED ANNULUS
8							–grey below 7.9 m.
9						18.5	
							50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN
10							
							SLOUGH
						16.4	
11							

LAGOON

NOTE:
1. Test Hole sloughed to 8.3 m I.A.D.

LEGEND:

FILL, SAND, CLAY, TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

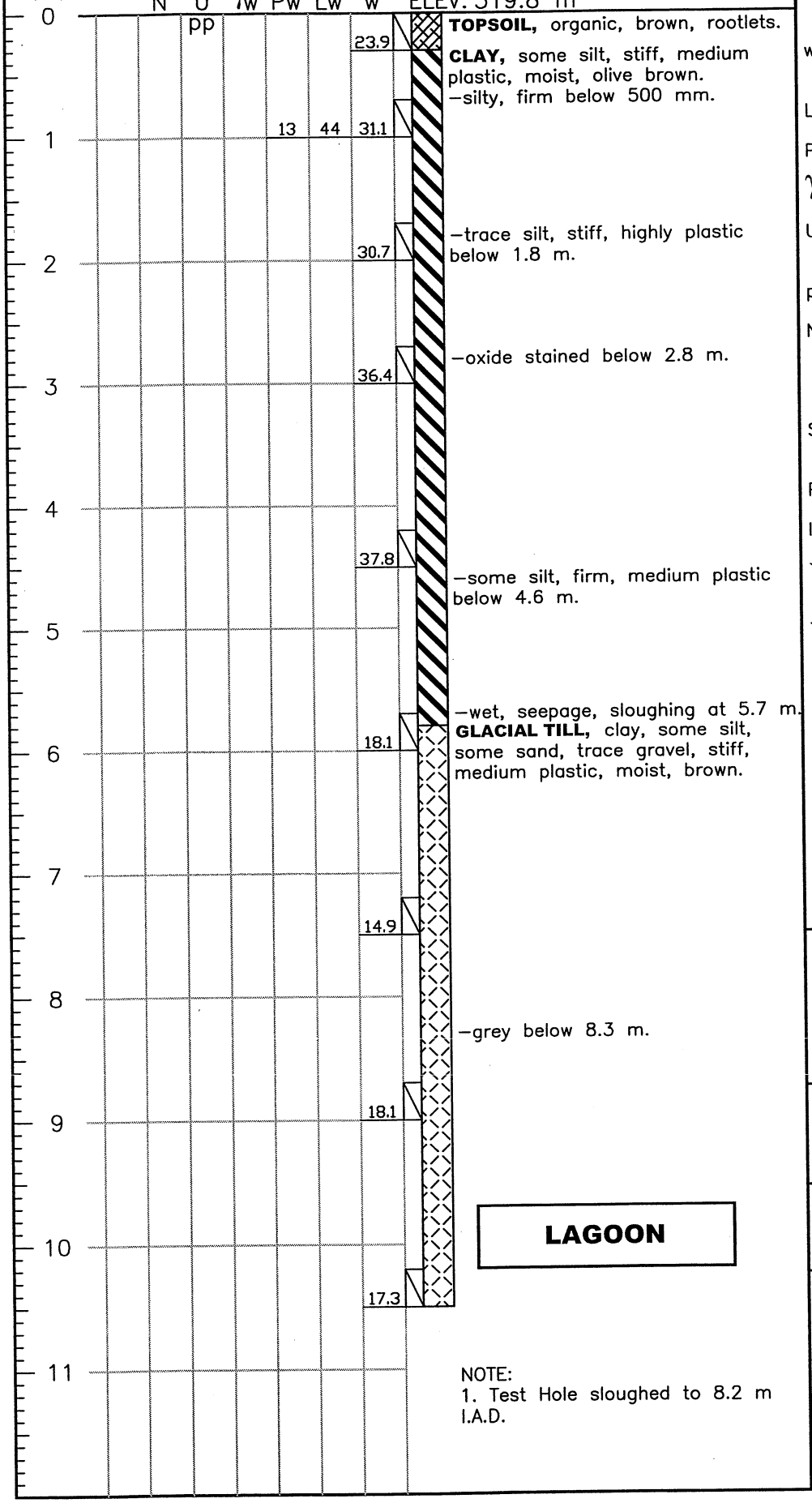
LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 17/09	S09-6987-6

TEST HOLE 09-6



NOTE:
1. Test Hole sloughed to 8.2 m I.A.D.

LEGEND:

FILL, SAND, CLAY, TOPSOIL, GRAVEL, SILT, GLACIAL TILL

w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE–CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

SHELBY TUBE, SPLIT SPOON, CUTTINGS

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

PROJECT:

SEWAGE LAGOON EXPANSION

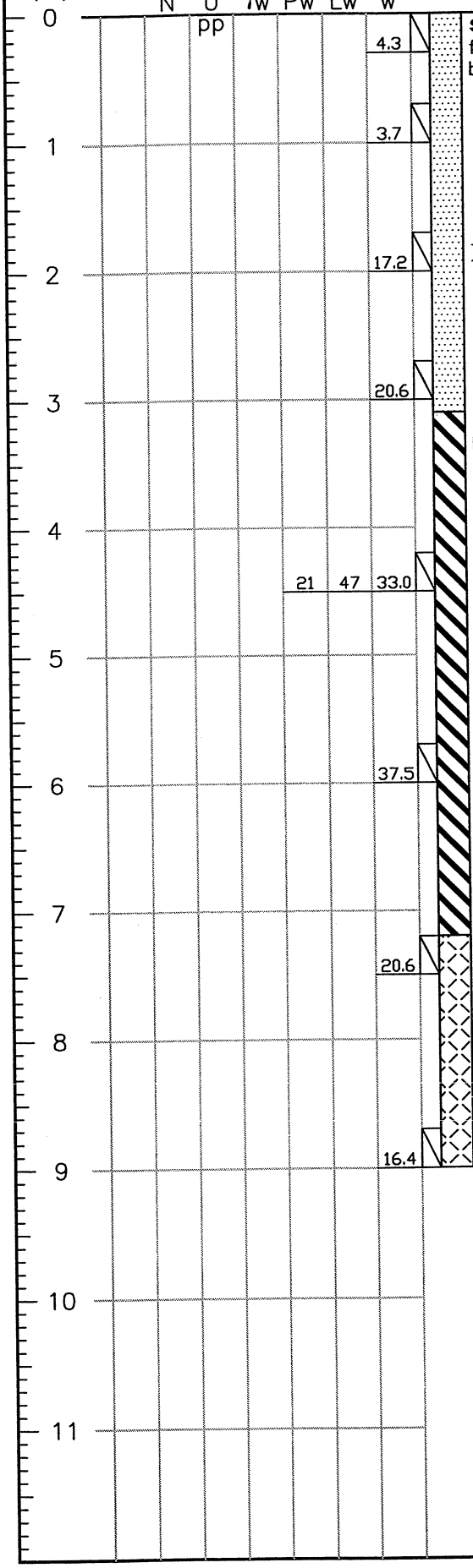
LOCATION:

RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
SEPT 17/09	S09-6987-7

TEST HOLE 09-7



SAND, trace silt, loose, well graded fine to medium grained, damp, brown.

—wet, seepage, sloughing below 1.8 m.

CLAY, some silt, firm, highly plastic, moist, grey.
—stiff below 3.5 m.

—firm below 4.2 m.

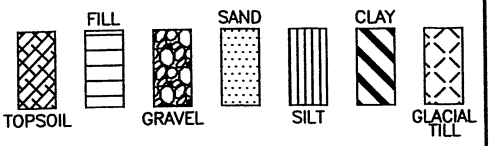
GLACIAL TILL, clay, some silt, trace sand, trace gravel, firm, highly plastic, moist, grey.

—some sand, medium plastic, very stiff below 8.0 m.

NOTE:
1. Test Hole sloughed to 2.0 m I.A.D.

LIFT STATION

LEGEND:



w.....WATER CONTENT (PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

γ_w...WET UNIT WEIGHT (kN/m^3)

U.....UNCONFINED COMPRESSIVE STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm^2)

N.....STANDARD PENETRATION TEST (ROPE—CATHEAD & DONUT HAMMER) (50/125 = BLOWS/SAMPLER PENETRATION [mm])

SO_4 .....SULPHATE CONTENT (PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL (TEST HOLE I.A.D.)

▼...RECORDED WATER LEVEL (PIEZO)

LIMITATIONS: THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.

P. MACHIBRODA ENGINEERING LTD.

FIELD DRILL LOG AND SOIL TEST RESULTS

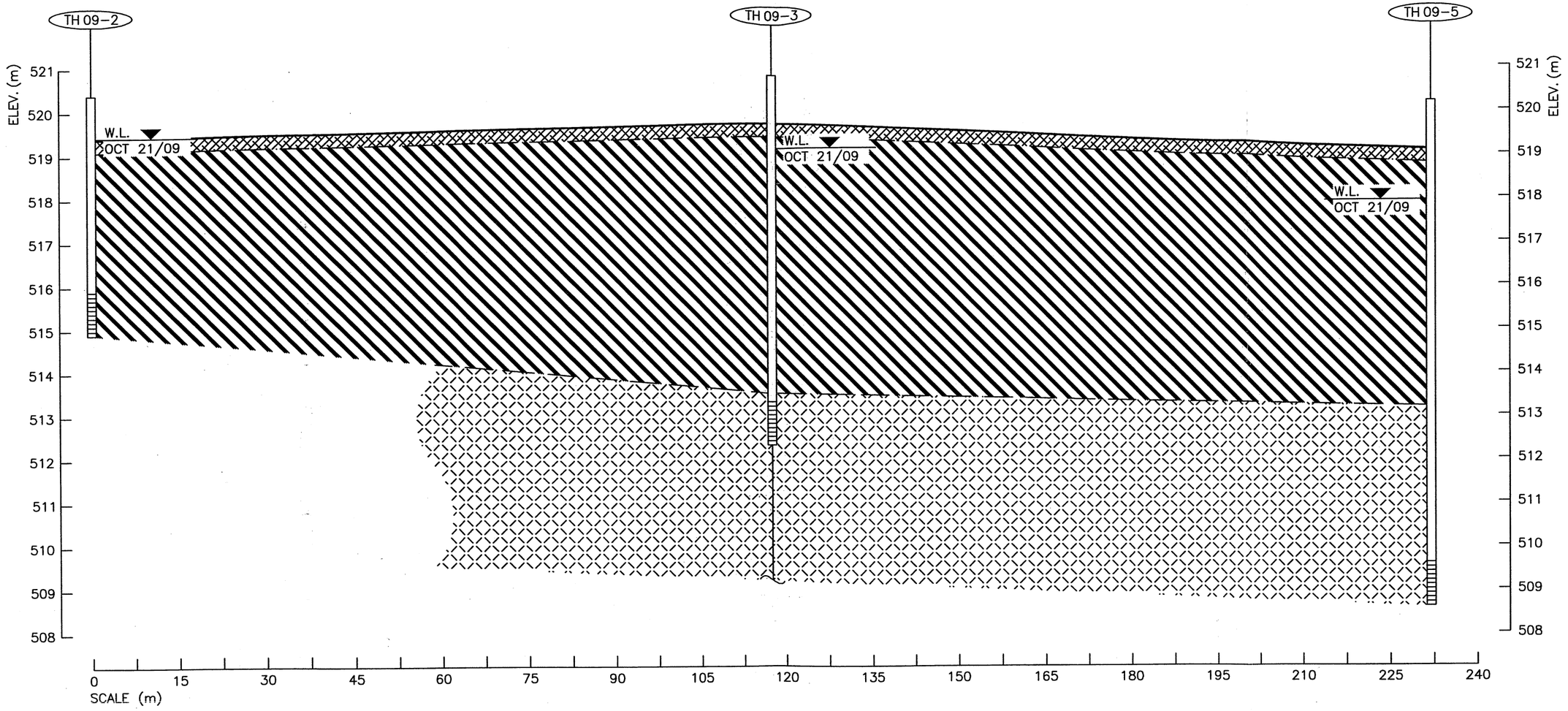
PROJECT:
SEWAGE LAGOON EXPANSION

LOCATION:
RADISSON, SK

NORTHING: **EASTING:**

DATE DRILLED:	**DRAWING NUMBER:**
JULY 29/09	S09-6987-8

STRATIGRAPHIC SECTION A–A'



LEGEND

TOPSOIL
SAND
GLACIAL TILL
FILL
SILT
W.L. ▼ OCT 21/09 — RECORDED WATER LEVEL
GRAVEL
CLAY

LIMITATIONS

THIS STRATIGRAPHIC SECTION IS A SUMMARY OF SUBSURFACE FIELD CONDITIONS INFERRED FROM DATA ENCOUNTERED AT SPECIFIC TEST HOLE LOCATIONS AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS AND, IN TIME, MAY CHANGE AT THE SPECIFIC LOCATION OF ANY TEST HOLE.

P. MACHIBRODA ENGINEERING LTD.

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

806 – 48th STREET EAST
SASKATOON, SK
S7K 3Y4

DRAWING TITLE: STRATIGRAPHIC SECTION A - A'	
PROJECT: PROPOSED SEWAGE LAGOON ADDITION SE21-40-10-W3M, RADISSON, SK	
APPROVED BY: T. WERBOVETSKI	DRAWN BY: G. SOLTYS
DATE: OCTOBER, 2009	DRAWING NUMBER: S09-6987-9
SCALE: AS SHOWN	

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: SEPTEMBER 28, 2009

Test Hole No.: 09-1

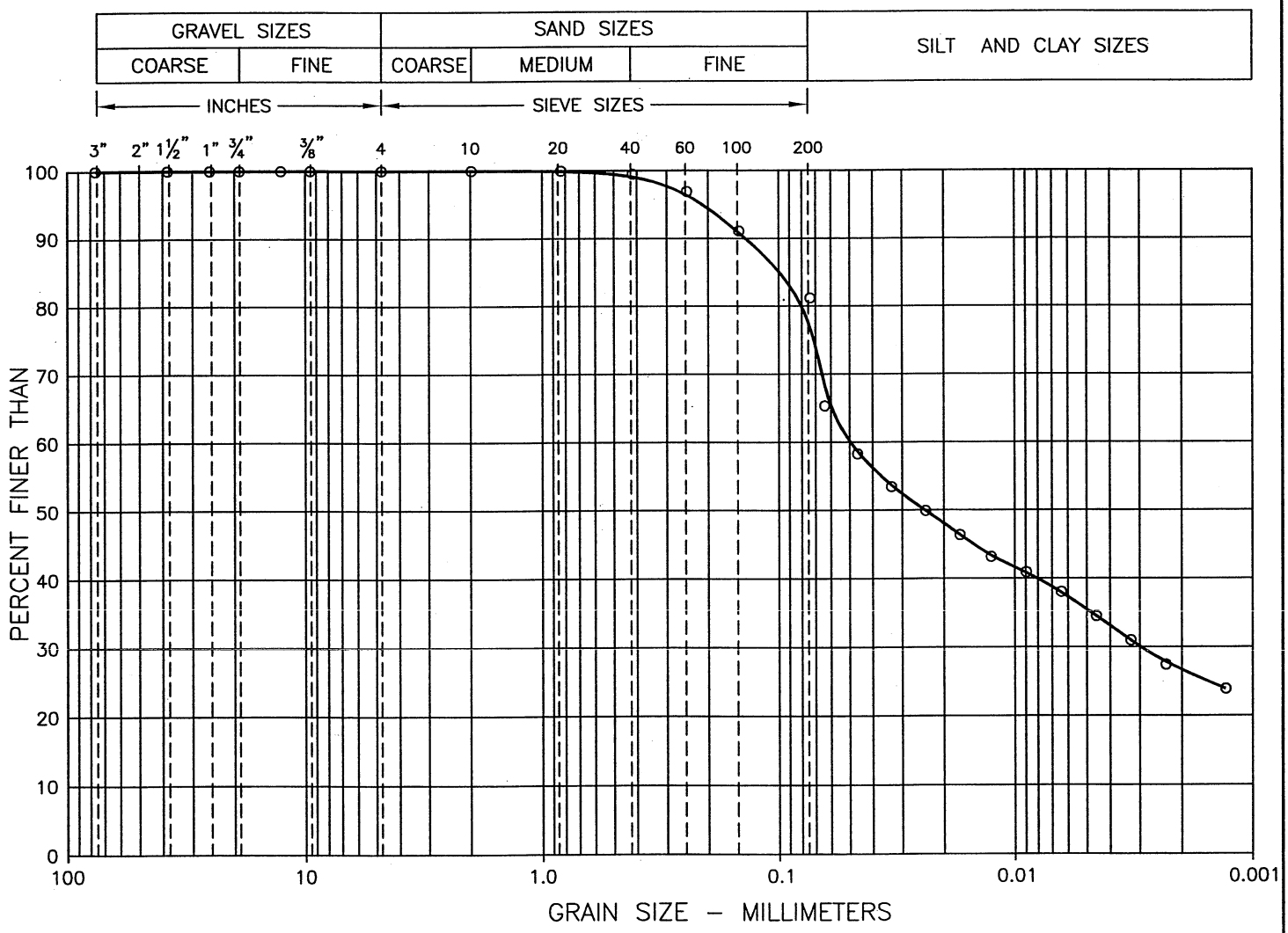
Sample No.: 52

Depth (m): 1.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	19	55	26



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-10

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: OCTOBER 16, 2009

Test Hole No.: 09-1

Sample No.: 58

Depth (m): 9.0

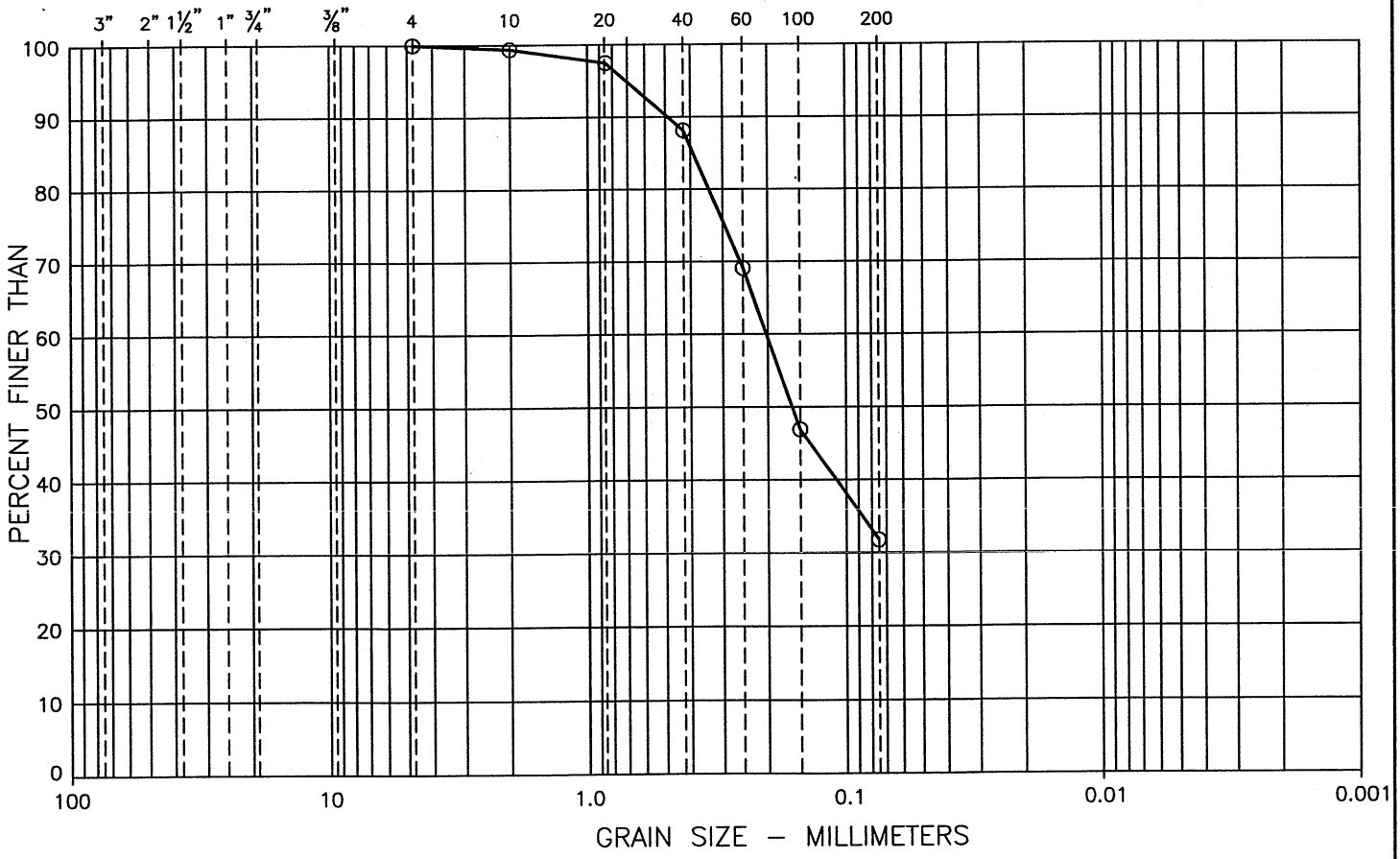
Remarks:

SIEVE SIZE	PERCENT PASSING
No. 4	100.0
No. 10	99.4
No. 20	97.5
No. 40	88.1
No. 60	69.1
No. 100	46.9
No. 200	31.8

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	68	32

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	
← INCHES →		← SIEVE SIZES →			



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-11

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: AUGUST 4, 2009

Test Hole No.: 09-2

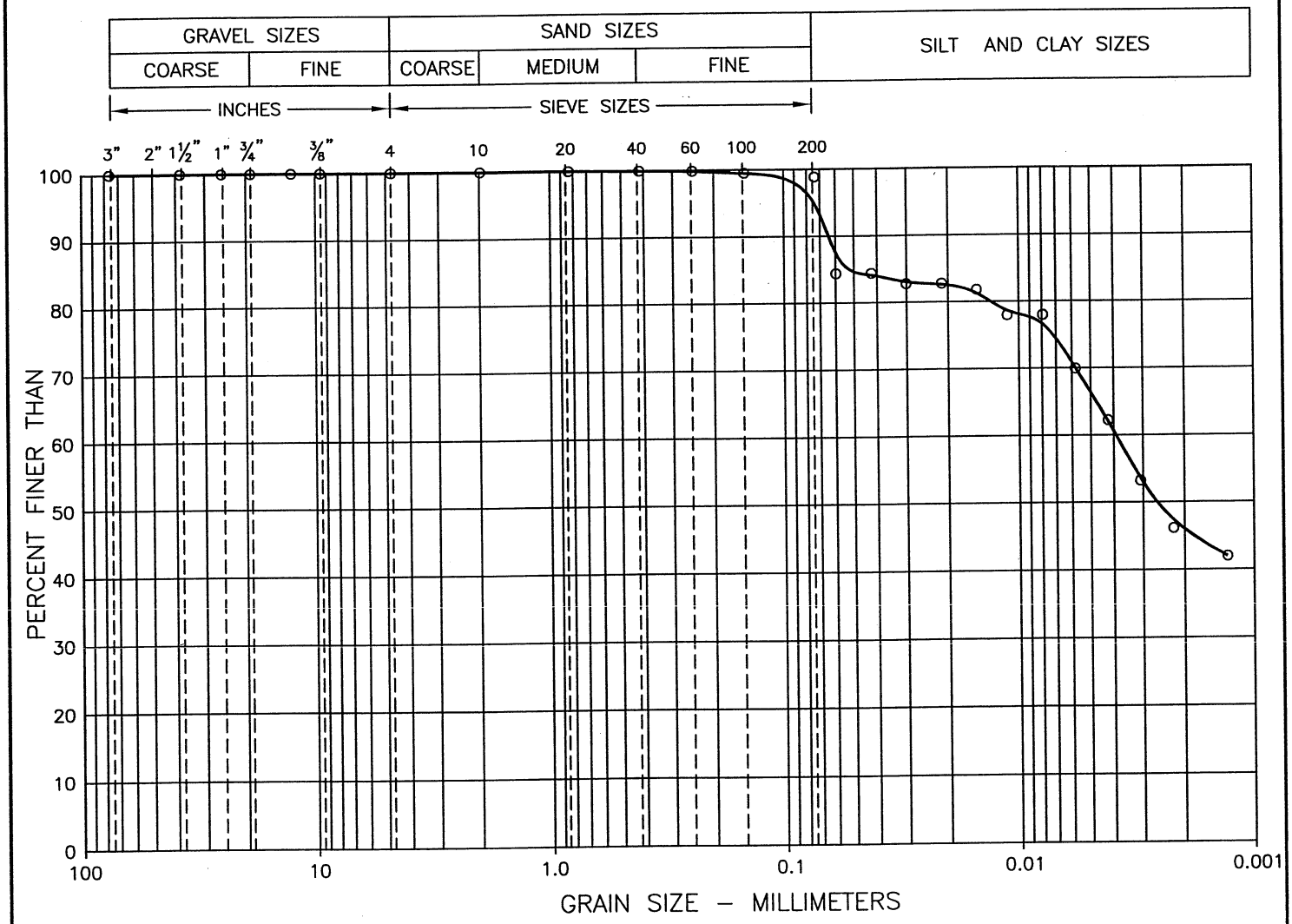
Sample No.: 3

Depth (m): 1.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	1	54	45



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-12

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: SEPTEMBER 28, 2009

Test Hole No.: 09-3

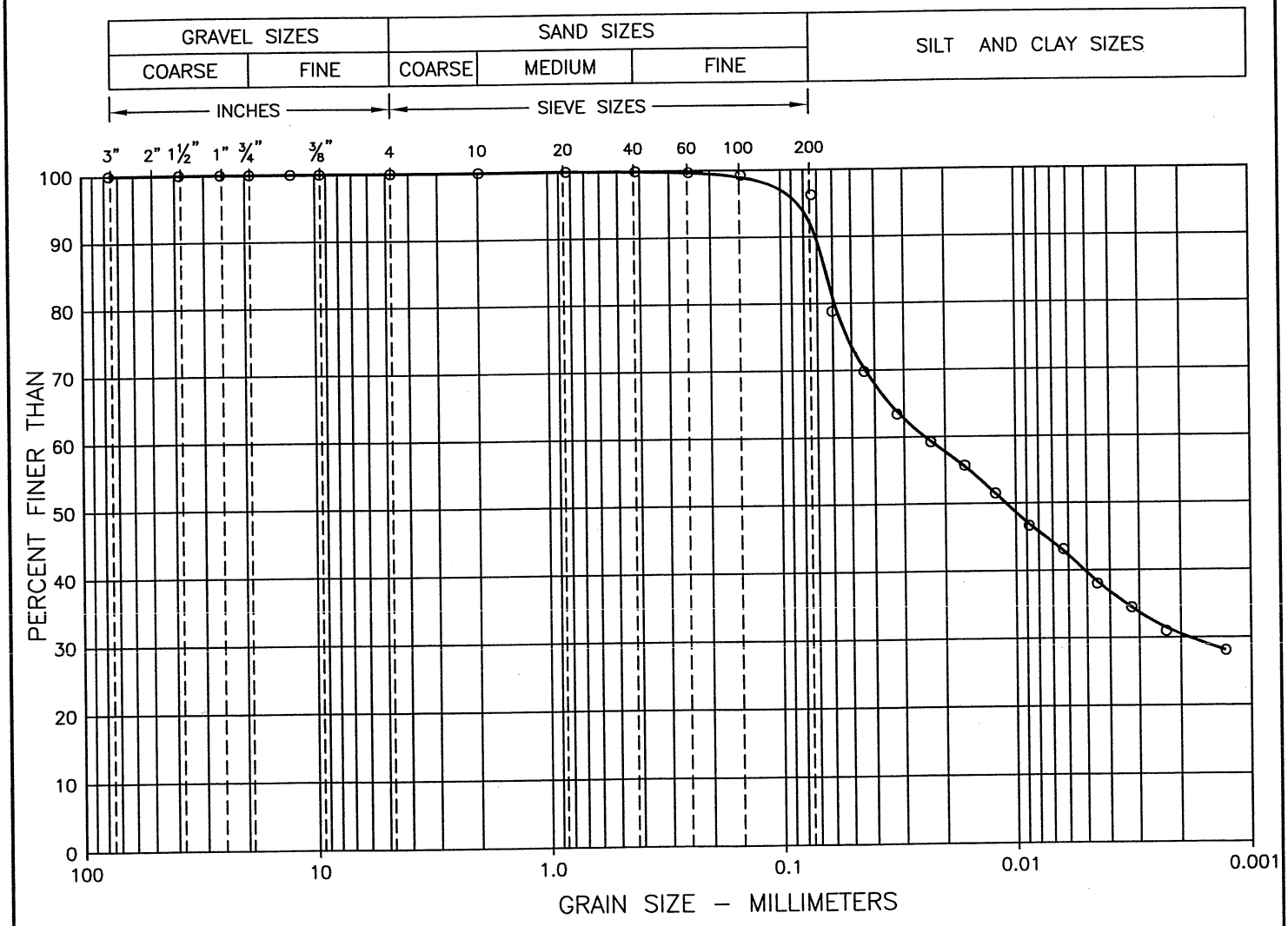
Sample No.: 44

Depth (m): 1.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	4	66	30



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-13

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: SEPTEMBER 28, 2009

Test Hole No.: 09-4

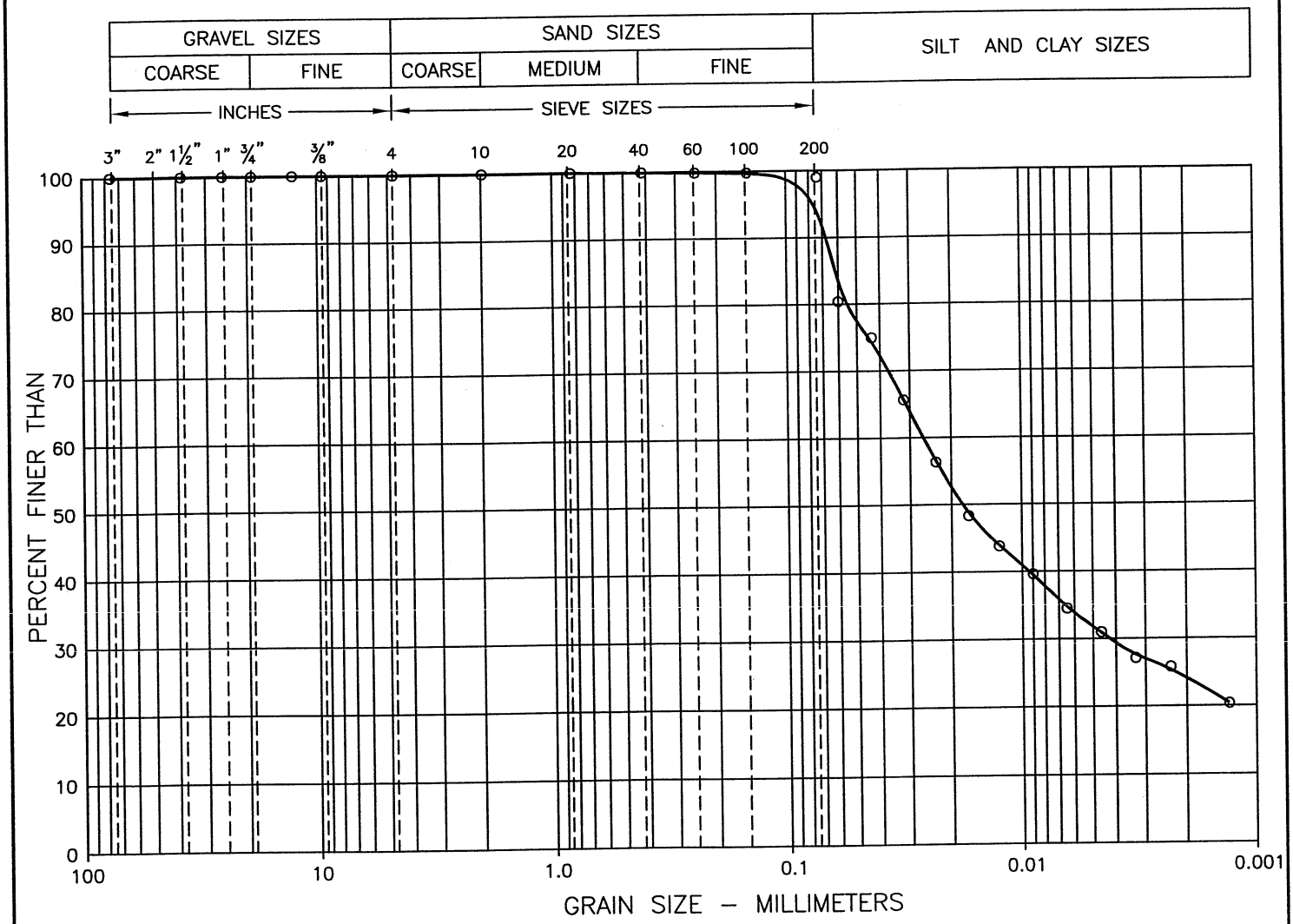
Sample No.: 15

Depth (m): 1.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	1	75	24



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-14

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: SEPTEMBER 28, 2009

Test Hole No.: 09-5

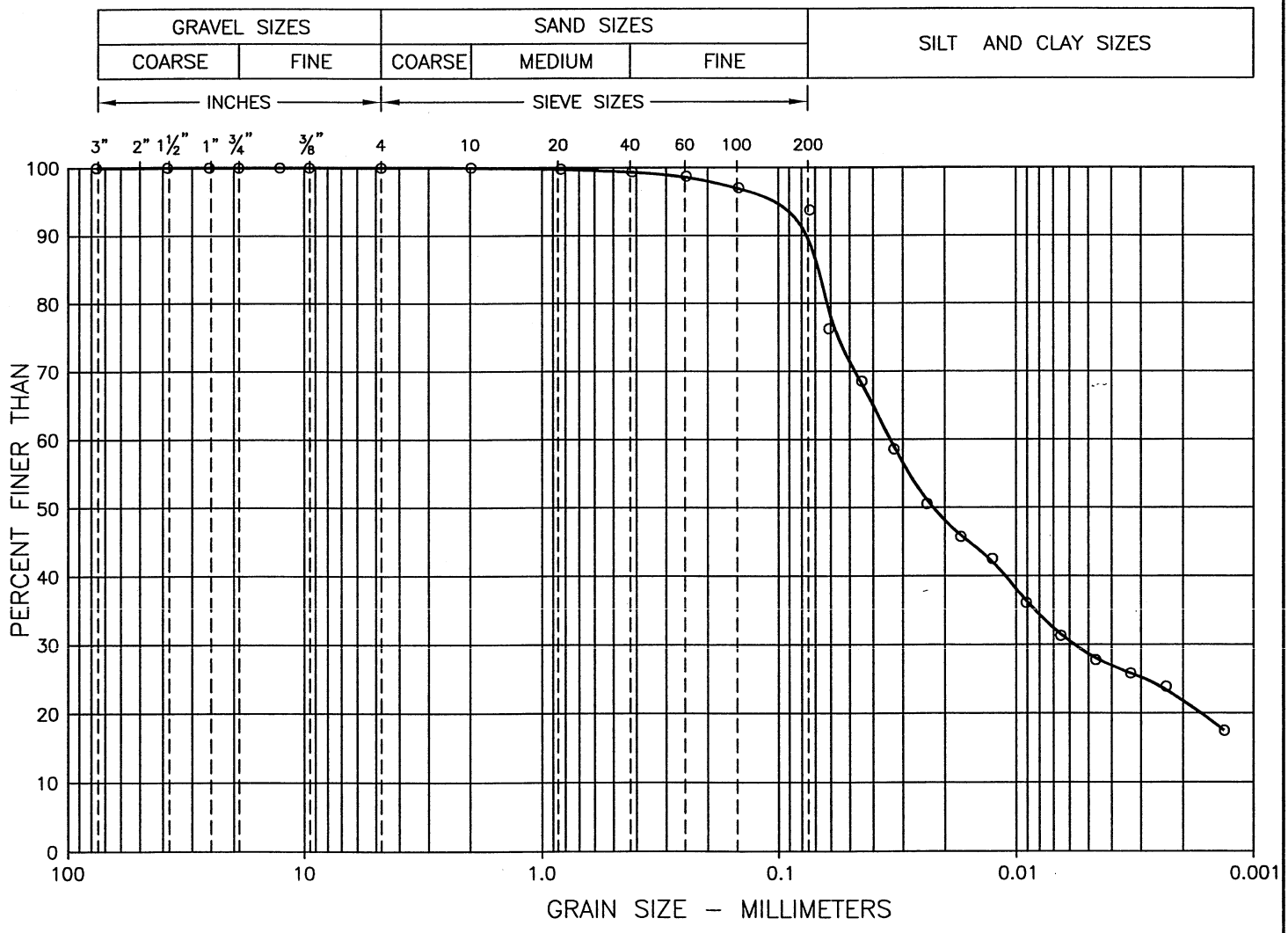
Sample No.: 34

Depth (m): 1.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	6	72	22



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-15

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: SEPTEMBER 28, 2009

Test Hole No.: 09-6

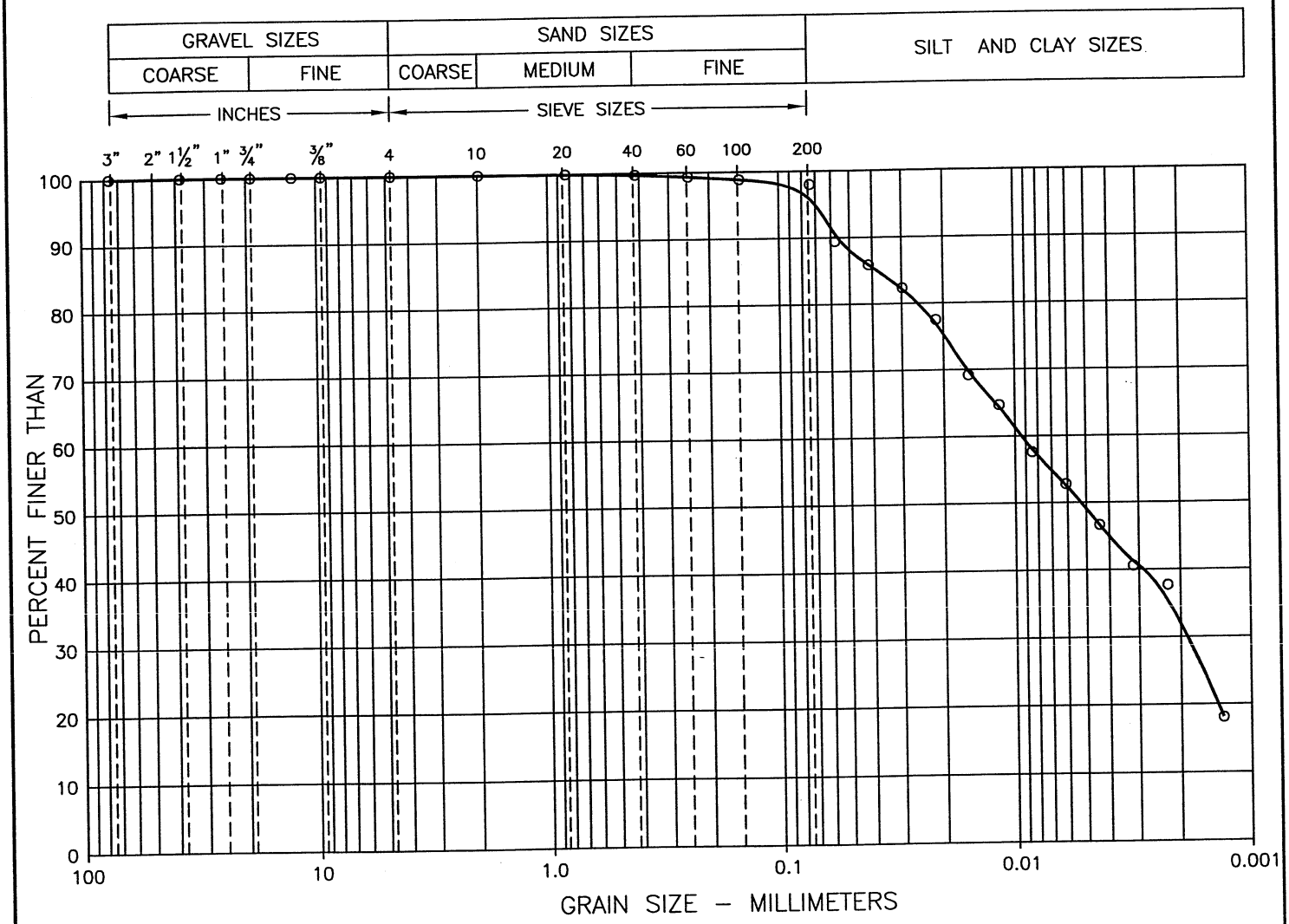
Sample No.: 26

Depth (m): 2.0

Remarks:

Material Description

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	2	66	32



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-16

GRAIN SIZE DISTRIBUTION TEST REPORT

Project: SEWAGE LAGOON ADDITION AND LIFT STATION
RADISSON, SK

Project No.: S09-6987

Date Tested: AUGUST 4, 2009

Test Hole No.: 09-7

Sample No.: 7

Depth (m): 1.0

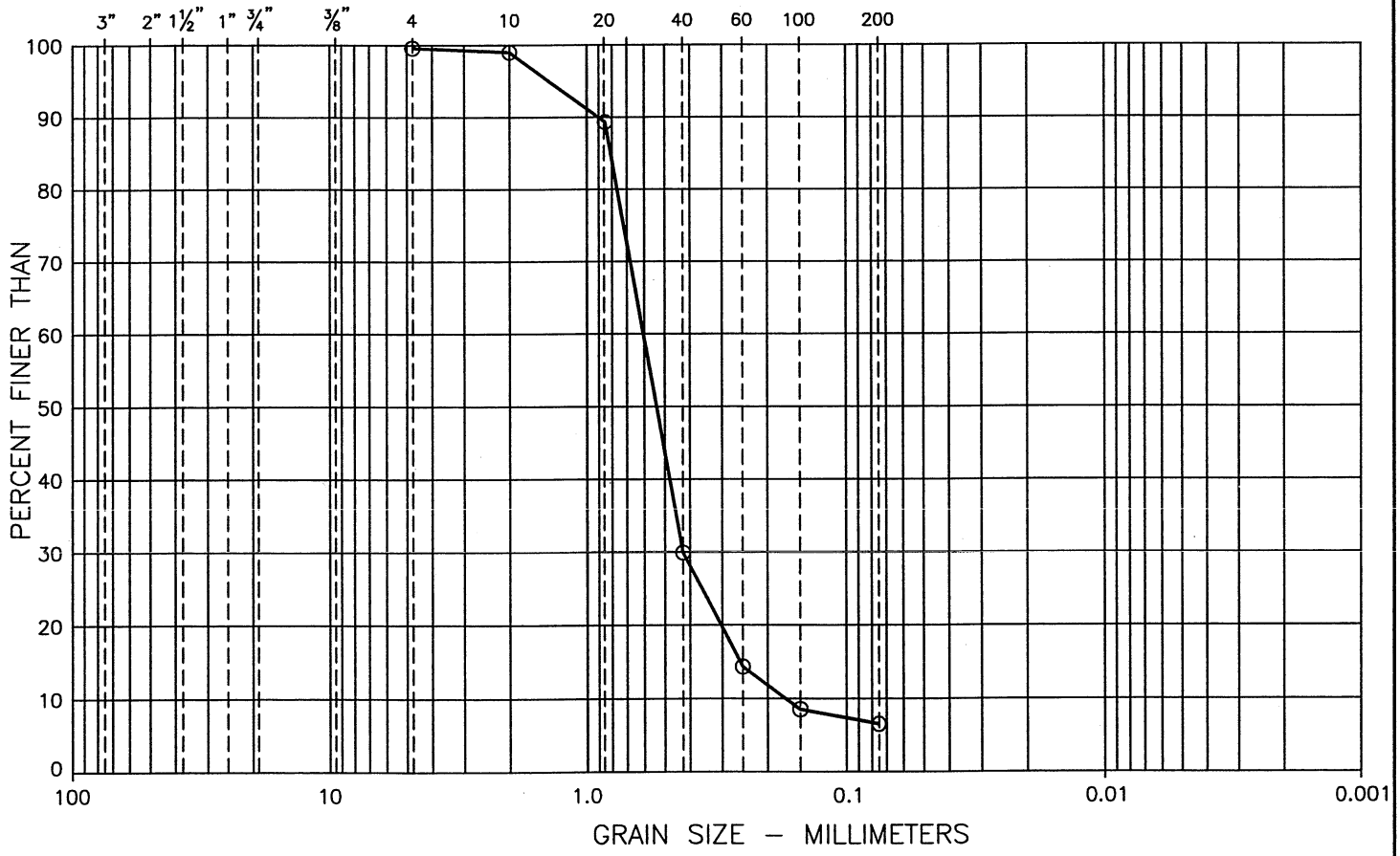
Remarks:

SIEVE SIZE	PERCENT PASSING
No. 4	99.6
No. 10	99.0
No. 20	89.3
No. 40	29.9
No. 60	14.3
No. 100	8.5
No. 200	6.5

Material Description

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
0	93	7

GRAVEL SIZES		SAND SIZES			SILT AND CLAY SIZES
COARSE	FINE	COARSE	MEDIUM	FINE	
← INCHES →		← SIEVE SIZES →			



P. MACHIBRODA ENGINEERING LTD.

DRAWING NO.

S09-6987-17

APPENDIX A

EXPLANATION OF TERMS ON
TEST HOLE LOGS

P. MACHIBRODA ENGINEERING LTD.

CLASSIFICATION OF SOILS

Coarse-Grained Soils: Soils containing particles that are visible to the naked eye. They include gravels and sands and are generally referred to as cohesionless or non-cohesive soils. Coarse-grained soils are soils having more than 50 percent of the dry weight larger than particle size 0.080 mm.

Fine-Grained Soils: Soils containing particles that are not visible to the naked eye. They include silts and clays. Fine-grained soils are soils having more than 50 percent of the dry weight smaller than particle size 0.080 mm.

Organic Soils: Soils containing a high natural organic content.

Soil Classification By Particle Size

Clay – particles of size	< 0.002 mm
Silt – particles of size	0.002 – 0.060 mm
Sand – particles of size	0.06 – 2.0 mm
Gravel – particles of size	2.0 – 60 mm
Cobbles – particles of size	60 – 200 mm
Boulders – particles of size	>200 mm

TERMS DESCRIBING CONSISTENCY OR CONDITION

Coarse-grained soils: Described in terms of compactness condition and are often interpreted from the results of a Standard Penetration Test (SPT). The standard penetration test is described as the number of blows, N, required to drive a 51 mm outside diameter (O.D.) split barrel sampler into the soil a distance of 0.3 m (from 0.15 m to 0.45 m) with a 63.5 kg weight having a free fall of 0.76 m.

Compactness Condition	SPT N-Index (blows per 0.3 m)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	Over 50

Fine-Grained Soils: Classified in relation to undrained shear strength.

Consistency	Undrained Shear Strength (kPa)	N Value (Approximate)	Field Identification
Very Soft	<12	0-2	Easily penetrated several centimetres by the fist.
Soft	12-25	2-4	Easily penetrated several centimetres by the thumb.
Firm	25-50	4-8	Can be penetrated several centimetres by the thumb with moderate effort.
Stiff	50-100	8-15	Readily indented by the thumb, but penetrated only with great effort.
Very Stiff	100-200	15-30	Readily indented by the thumb nail.
Hard	>200	>30	Indented with difficulty by the thumbnail.

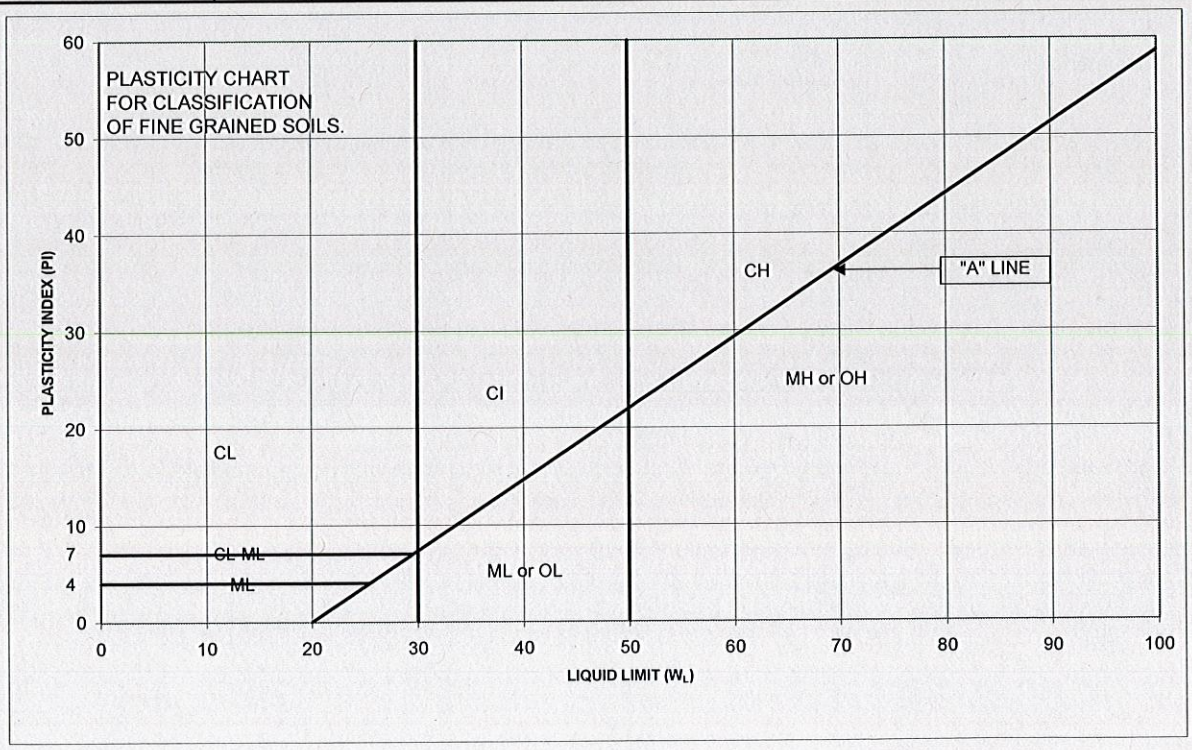
Organic Soils: Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS

Poorly Graded	- predominance of particles of one grain size.
Well Graded	- having no excess of particles in any size range with no intermediate sizes lacking.
Mottled	- marked with different coloured spots.
Nuggety	- structure consisting of small prismatic cubes.
Laminated	- structure consisting of thin layers of varying colour and texture.
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks.
Fractured	- broken by randomly oriented interconnecting cracks in all 3 dimensions.

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR AND OFTEN FIBROUS TEXTURE
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS More than half coarse fraction larger than No. 4 sieve size	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS FOR GW
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI > 7
	SANDS More than half coarse fraction smaller than No. 4 sieve size	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			SP	POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI >7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSING NO. 200 SIEVE SIZE)	SILTS Below "A" line on plasticity chart; negligible organic content		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$
	CLAYS Above 'A" line on plasticity chart; negligible organic content		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	$W_L > 30 < 50$
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$
			OH	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$



recpt/PMEL/repref/SoilClassChart

P. MACHIBRODA ENGINEERING LTD.

APPENDIX B

GROUNDWATER RECORDS

WWDR # 035691

Client # 835691

Completion	24/10/1961
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	15	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

100 ft from N/S Boundary N N/S Boundary

1300 ft from E/W Boundary W E/W Boundary

Well Information

Driller #	040281	CAPLETTE E	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	20 ft		
Water Level	11 ft		
Bit	30.0 inches		
Struck	11 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
	20		Wood

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1695 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
2	Topsoil	Unknown	Unknown
13	Sandy Clay	Yellow	Unknown
20	Sand	Unknown	Unknown

WWDR # 115159

Client # 886459

Completion	12/10/2001
RM	405
MB	07
SB	29
NTSMAP	73B06

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
14	NW1/4	15	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002122	ELK POINT DRILLING CORP	
Water Use	Domestic	Well Use	Water Test Hole
Hole #	001		
Installation Method	Drilled		
Depth	255 ft		
Water Level	ft		
Bit	4.7 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft) Btm (ft) Dia (in) Description

Screens

Length (ft) Btm (ft) Dia (in) Slot (in) Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1706 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	SCANNED
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
16	Clay	Yellow	Sandy
26	Clay	Grey	Unknown
46	Till	Grey	Sandy
48	Sand	Unknown	Clayey
54	Till	Grey	Sandy
106	Till	Grey	Clayey
112	Till	Brown	Sandy
116	Sand	Brown	Fine-medium
126	Silt	Brown	Unknown
168	Till	Grey	Unknown
176	Sand & Gravel	Unknown	Clayey
212	Till	Grey	Unknown
214	Sand & Gravel	Unknown	Coal Streaks
224	Till	Grey	Gravelly
240	Till	Grey	Firm
255	Clay	Grey	Noncalcareous

WWDR # 035697

Client # 050405

Completion	18/11/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002182 HERON WATER WELL DRILLING LTD (1987)

Water Use Municipal Well Use Water Test Hole

Hole # 002

Installation Method Unknown

Depth 180 ft

Water Level ft

Bit inches

Struck ft

Flowing Head ft

Completion Method

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down ft

Duration hrs

Pumping Rate igpm

Temp deg. F

Elevation 1715 ft

Recommended

Rec Pumping Rate igpm

Intake ft

Aquifer

E-Log No

Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
3	Gravel	Unknown	Unknown
25	Gravelly Clay	Brown	Unknown
180	Clay	Yellow	Unknown

WWDR # 035693

Client # 835693

Completion	01/09/1947
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	000000	UNKNOWN	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Unknown		
Depth	60 ft		
Water Level	25 ft		
Bit	inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
			Wood

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	Glac
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
60	Sand & Gravel	Unknown	Clayey

WWDR # 035694

Client # 835694

Completion	13/06/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	044563	FUNK L	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	20 ft		
Water Level	7 ft		
Bit	36.0 inches		
Struck	7 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
	20	36.0	Wood

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
7	Clay	Black	Unknown
8	Sand	Unknown	Unknown
20	Clay	Yellow	Unknown

WWDR # 035695

Client # 835695

Completion 29/04/1960
RM
MB 07
SB 29
NTSMAP 73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)
0 ft from N/S Boundary N/S Boundary
0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 044563 FUNK L
Water Use Domestic
Hole # 002
Installation Method Bored
Depth 60 ft
Water Level ft
Bit 24.0 inches
Struck ft
Flowing Head ft
Completion Method

Well Use Water Test Hole

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down ft
Duration hrs
Pumping Rate igpm
Temp deg. F
Elevation 1715 ft

Recommended

Rec Pumping Rate igpm
Intake ft
Aquifer
E-Log No
Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
10	Sand	Unknown	Unknown
60	Clay	Unknown	Unknown

WWDR # 035696

Client # 835696

Completion	30/06/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002182 HERON WATER WELL DRILLING LTD (1987)

Water Use Domestic Well Use Withdrawal

Hole #

Installation Method Drilled

Depth 146 ft

Water Level 20 ft

Bit 4.5 inches

Struck 130 ft

Flowing Head ft

Completion Method Open Hole

Well Casings	Length (ft)	Btm (ft)	Dia (in)	Description
		146	4.5	Steel

Screens	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down 15.0 ft

Duration 48 hrs

Pumping Rate 5.0 igpm

Temp 40 deg. F

Elevation 1715 ft

Recommended

Rec Pumping Rate igpm

Intake ft

Aquifer

E-Log No

Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
10	Gravel	Unknown	Unknown
60	Clay	Brown	Unknown
120	Clay	Blue	Unknown
146	Sand & Gravel	Unknown	Unknown

WWDR # 035698

Client # 835698

Completion	23/04/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	044563	FUNK L	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	32 ft		
Water Level	ft		
Bit	30.0 inches		
Struck	22 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings	Length (ft)	Btm (ft)	Dia (in)	Description
	32		30.0	Unknown

Screens	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
10	Sand	Unknown	Unknown
22	Clay	Unknown	Unknown
32	Clay	Blue	Unknown

WWDR # 035699

Client # 835699

Completion	03/11/1961
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

14 ft from N/S Boundary S N/S Boundary

25 ft from E/W Boundary E E/W Boundary

Well Information

Driller #	040281	CAPLETTE E	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	36 ft		
Water Level	16 ft		
Bit	24.0 inches		
Struck	22 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
	34	24.0	Wood

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
2	Topsoil	Unknown	Unknown
17	Clay	Yellow	Unknown
22	Clay	Brown	Unknown
24	Gravel	Unknown	Unknown
34	Clay	Brown	Unknown
36	Gravel	Unknown	Unknown

WWDR # 035700

Client # 050405

Completion 26/11/1962
RM
MB 07
SB 29
NTSMAP 73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NE1/4	20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)
0 ft from N/S Boundary N/S Boundary
0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002265 INTERNATIONAL WATER SUPPLY LTD
Water Use Municipal
Well Use Water Test Hole
Hole #
Installation Method Drilled
Depth 500 ft
Water Level ft
Bit 5.0 inches
Struck ft
Flowing Head ft
Completion Method

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down ft
Duration hrs
Pumping Rate igpm
Temp deg. F
Elevation 1715 ft

Recommended

Rec Pumping Rate igpm
Intake ft
Aquifer
E-Log No
Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
2	Topsoil	Unknown	Unknown
17	Silty Clay	Brown	Unknown
22	Clay	Unknown	Stoney
37	Clay	Brown	Stoney
74	Clay	Grey	Sand-gravel Streaks
112	Clay	Grey	Boulders
114	Sand	Grey	Silty
156	Clay	Grey	Hard
225	Clay	Grey	Hard
302	Clay	Unknown	Shale Streaks
365	Shale	Unknown	Clayey
375	Shale	Unknown	Stoney
397	Shale	Unknown	Sandy
500	Shale	Unknown	Hard

WWDR # 035701

Client # 835701

Completion	12/04/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NE1/4	20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	044563	FUNK L	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	18 ft		
Water Level	14 ft		
Bit	30.0 inches		
Struck	14 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
	18	30.0	Wood

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
8	Sand	Unknown	Unknown
18	Clay	Unknown	Unknown

WWDR # 035702

Client # 835702

Completion	24/06/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	20	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

1000 ft from N/S Boundary N N/S Boundary

350 ft from E/W Boundary W E/W Boundary

Well Information

Driller #	002182	HERON WATER WELL DRILLING LTD (1987)	
Water Use	Domestic	Well Use	Water Test Hole
Hole #			
Installation Method	Drilled		
Depth	175 ft		
Water Level	ft		
Bit	4.5 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1720 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
50	Clay	Brown	Unknown
175	Clay	Blue	Unknown

WWDR # 057372

Client # 857217

Completion	07/10/1978
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NE1/4	21	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002122	ELK POINT DRILLING CORP	
Water Use	Domestic	Well Use	Water Test Hole
Hole #			
Installation Method	Drilled		
Depth	202 ft		
Water Level	ft		
Bit	4.7 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Length (ft) Btm (ft) Dia (in) Description

Well Casings

Length (ft) Btm (ft) Dia (in) Slot (in) Description

Screens

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1700 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	Yes
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
18	Clay	Brown	Soft
22	Clay	Brown	Soft
47	Till	Brown	Clayey
70	Till	Grey	Unknown
74	Till	Unknown	Unknown
93	Till	Grey	Unknown
95	Sand	Unknown	Unknown
186	Till	Grey	Unknown
202	Clay	Grey	Noncalcareous

WWDR # 057217

Client # 857217

Completion	15/03/1979
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NE1/4	21	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	54 ft		
Water Level	ft		
Bit	42.0 inches		
Struck	13 ft		
Flowing Head	ft		
Completion Method	Curbed		

	Length (ft)	Btm (ft)	Dia (in)	Description
Well Casings	56	54	30.0	Galvanized Iron

	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
Screens					

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	1.0 igpm
Temp	deg. F
Elevation	1700 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
5	Clay	Yellow	Unknown
13	Sandy Clay	Unknown	Dry
20	Sandy Clay	Unknown	Wet
42	Till	Unknown	Unknown
48	Clay	Unknown	Fractured
54	Clay	Blue	Stoney

WWDR # 035703

Client # 050405

Completion	17/11/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	21	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

400 ft from N/S Boundary S N/S Boundary

40 ft from E/W Boundary E E/W Boundary

Well Information

Driller #	002182	HERON WATER WELL DRILLING LTD (1987)	
Water Use	Municipal	Well Use	Water Test Hole
Hole #	001		
Installation Method	Unknown		
Depth	250 ft		
Water Level	ft		
Bit	inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
3	Topsoil	Unknown	Unknown
40	Clay	Brown	Unknown
110	Clay	Blue	Unknown
250	Sandy Clay	Blue	Unknown

WWDR # 035704

Client # 835704

Completion / /
RM
MB 07
SB 29
NTSMAP 73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
		22	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)
0 ft from N/S Boundary N/S Boundary
0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 000000 UNKNOWN
Water Use Domestic Well Use Withdrawal
Hole # Length (ft) Btm (ft) Dia (in) Description
Installation Method Unknown Well Casings Wood
Depth 90 ft
Water Level 55 ft
Bit 24.0 inches Length (ft) Btm (ft) Dia (in) Slot (in) Description
Struck ft Screens
Flowing Head ft
Completion Method Curbed

Pump Test

Draw Down ft
Duration hrs
Pumping Rate igpm
Temp deg. F
Elevation ft

Recommended

Rec Pumping Rate 1.0 igpm
Intake ft
Aquifer Glac
E-Log No
Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description

WWDR # 115160

Client # 886459

Completion	15/10/2001
RM	405
MB	07
SB	29
NTSMAP	73B06

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
09	NE1/4	22	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002122	ELK POINT DRILLING CORP	
Water Use	Domestic	Well Use	Water Test Hole
Hole #	001		
Installation Method	Drilled		
Depth	264 ft		
Water Level	ft		
Bit	4.7 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1706 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	SCANNED
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
15	Sand	Brown	Unknown
30	Clay	Grey	Unknown
58	Till	Grey	Sandy
97	Till	Grey	Clayey
200	Till	Grey	Sandy
214	Till	Unknown	Clayey
224	Till	Grey	Sandy
252	Till	Grey	Clayey
264	Clay	Grey	Noncalcareous

WWDR # 092523

Client # 892523

Completion	07/11/1988
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	22	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

300 ft from N/S Boundary N N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002259	HI-TECH DRILLING LTD	
Water Use	Domestic	Well Use	Water Test Hole
Hole #	1		
Installation Method	Drilled		
Depth	259 ft		
Water Level	ft		
Bit	4.8 inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Open Hole		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1700 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	Yes
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
25	Clay	Red	Unknown
67	Clay	Unknown	Silty
74	Clay	Unknown	Gravelly
93	Till	Grey	Unknown
97	Sand	Unknown	Silty
100	Till	Grey	Silty
180	Till	Grey	Unknown
200	Sand	Unknown	Silty
204	Sand	Unknown	Fine
259	Till	Grey	Unknown

WWDR # 092524

Client # 892524

Completion	08/11/1988
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	22	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

40 ft from N/S Boundary N N/S Boundary

1100 ft from E/W Boundary W E/W Boundary

Well Information

Driller #	002259	HI-TECH DRILLING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #	2		
Installation Method			
Depth	110 ft		
Water Level	16 ft		
Bit	4.8 inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Well Screen And Gravel Pack		

	Length (ft)	Btm (ft)	Dia (in)	Description
Well Casings	92	90	4.5	P.V.C.

	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
Screens	10	100	4.5	12	Stainless Steel

Pump Test

Draw Down	ft
Duration	1 hrs
Pumping Rate	30.0 igpm
Temp	deg. F
Elevation	1700 ft

Recommended

Rec Pumping Rate	10.0 igpm
Intake	ft
Aquifer	
E-Log	Yes
Phys	E02

Lithology List

Depth to Base of (ft)	Material	Colour	Description
16	Sand & Gravel	Red	Unknown
31	Clay	Yellow	Silty
54	Till	Grey	Unknown
100	Sand & Gravel	Unknown	Unknown
108	Till	Grey	Unknown
110	Sand	Unknown	Unknown

WWDR # 098061

Client # 886459

Completion 25/01/1990
RM
MB 07
SB 29
NTSMAP 73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	22	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)
0 ft from N/S Boundary N/S Boundary
0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002122 ELK POINT DRILLING CORP
Water Use Domestic
Well Use Water Test Hole
Hole # 1
Installation Method Drilled
Depth 274 ft
Water Level ft
Bit 4.7 inches
Struck ft
Flowing Head ft
Completion Method

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down ft
Duration hrs
Pumping Rate igpm
Temp deg. F
Elevation 1700 ft

Recommended

Rec Pumping Rate igpm
Intake ft
Aquifer
E-Log No
Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
6	Clay	Brown	Silty
16	Silt	Brown	Sandy
20	Clay	Brown	Soft
33	Clay	Grey	Calcareous
242	Till	Grey	Unknown
252	Till	Grey	Hard
274	Shale	Grey	Noncalcareous

WWDR # 065297

Client # 865285

Completion	04/11/1980
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	30 ft		
Water Level	4 ft		
Bit	48.0 inches		
Struck	4 ft		
Flowing Head	ft		
Completion Method	Curbed		

	Length (ft)	Btm (ft)	Dia (in)	Description
Well Casings	32	30	30.0	Galvanized Iron

	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
Screens					

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	4.0 igpm
Temp	deg. F
Elevation	1710 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
4	Gravel	Unknown	Coarse
7	Gravel	Unknown	Water
30	Clay	Blue	Unknown

WWDR # 065285

Client # 865285

Completion	04/11/1980
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	30 ft		
Water Level	4 ft		
Bit	48.0 inches		
Struck	4 ft		
Flowing Head	ft		
Completion Method	Curbed		

	Length (ft)	Btm (ft)	Dia (in)	Description
Well Casings	32	30	30.0	Galvanized Iron

	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
Screens					

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	4.0 igpm
Temp	deg. F
Elevation	1710 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
4	Gravel	Unknown	Coarse
7	Gravel	Unknown	Water
30	Clay	Blue	Unknown

WWDR # 112083

Client # 814523

Completion	16/08/2000
RM	405
MB	07
SB	29
NTSMAP	73B06

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002115	WELLEN BORING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #	001		
Installation Method	Bored		
Depth	96 ft		
Water Level	7 ft		
Bit	42.0 inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Perforated Casing		

Well Casings	Length (ft)	Btm (ft)	Dia (in)	Description
	98	96	30.0	Fiberglass

Screens	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
	35	92	30.0	70	Fiberglass

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	35.0 igpm
Temp	deg. F
Elevation	1706 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
4	Gravel	Brown	Stoney
16	Clay	Brown	Soft
55	Till	Grey	Clayey
59	Sand	Grey	Medium
62	Gravel	Grey	Fine
82	Till	Unknown	Clayey
90	Gravel	Grey	Fine
96	Till	Grey	Clayey

WWDR # 065296

Client # 814523

Completion	07/11/1980
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	89 ft		
Water Level	55 ft		
Bit	48.0 inches		
Struck	17 ft		
Flowing Head	ft		
Completion Method	Curbed		

	Length (ft)	Btm (ft)	Dia (in)	Description
Well Casings	87	85	30.0	Galvanized Iron

	Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description
Screens					

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	40.0 igpm
Temp	deg. F
Elevation	1710 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
2	Clay	Yellow	Unknown
5	Gravel	Unknown	Dry
17	Clay	Yellow	Unknown
18	Sandy Clay	Unknown	Seepage
55	Clay	Yellow	Unknown
62	Sand	Unknown	Water
73	Clay	Blue	Sand Streaks
80	Gravel	Unknown	Water
89	Sand	Unknown	Water

WWDR # 035706

Client # 050405

Completion 01/11/1962
RM
MB 07
SB 29
NTSMAP 73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)
0 ft from N/S Boundary N/S Boundary
0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002265 INTERNATIONAL WATER SUPPLY LTD
Water Use Municipal
Well Use Water Test Hole
Hole # 006
Installation Method Drilled
Depth 130 ft
Water Level 7 ft
Bit 5.0 inches
Struck ft
Flowing Head ft
Completion Method

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down 28.0 ft
Duration 1 hrs
Pumping Rate 10.0 igpm
Temp deg. F
Elevation 1710 ft

Recommended

Rec Pumping Rate igpm
Intake ft
Aquifer
E-Log No
Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Gravel Streaks
8	Clay	Brown	Gravel Streaks
24	Clay	Brown	Stoney
46	Clay	Grey	Stoney
52	Gravelly Clay	Unknown	Boulders
64	Sand & Gravel	Unknown	Clayey
74	Gravelly Clay	Unknown	Soft
81	Clay	Grey	Sand Streaks
83	Sand	Unknown	Fine-medium
87	Sandy Clay	Unknown	Hard
94	Sand	Unknown	Fine-medium
95	Clay	Grey	Stoney
97	Sand & Gravel	Grey	Clayey
120	Clay	Unknown	Sand-gravel Streaks
130	Clay	Grey	Stoney

WWDR # 035705

Client # 050405

Completion	28/11/1962
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	27	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	002265	INTERNATIONAL WATER SUPPLY LTD	
Water Use	Municipal	Well Use	Water Test Hole
Hole #	005		
Installation Method	Drilled		
Depth	151 ft		
Water Level	ft		
Bit	5.0 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Length (ft) Btm (ft) Dia (in) Description

Well Casings

Length (ft) Btm (ft) Dia (in) Slot (in) Description

Screens

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1710 ft

Recommended

Rec Pumping Rate	1.0 igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Gravelly
6	Sand & Gravel	Unknown	Boulders
8	Clay	Brown	Boulders
25	Clay	Grey	Soft
54	Clay	Unknown	Boulders
57	Sand & Gravel	Unknown	Fine
92	Sand & Gravel	Grey	Clayey
98	Sand & Gravel	Unknown	Fine
117	Clay	Grey	Stoney
121	Gravelly Clay	Unknown	Unknown
131	Clay	Grey	Boulders
151	Clay	Grey	Hard

WWDR # 035710

Client # 835709

Completion	01/01/1958
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	000000	UNKNOWN	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Unknown		
Depth	36 ft		
Water Level	20 ft		
Bit	6.0 inches		
Struck	20 ft		
Flowing Head	ft		
Completion Method	Open Hole		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
			Steel

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	Glac
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
32	Clay	Unknown	Unknown
36	Sand	Unknown	Unknown

WWDR # 035709

Client # 835709

Completion	20/12/1957
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	000000	UNKNOWN	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Unknown		
Depth	36 ft		
Water Level	15 ft		
Bit	6.0 inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Open Hole		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
		6.0	Steel

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	Glac
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description

WWDR # 035708

Client # 835708

Completion	01/07/1957
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SW1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	000000	UNKNOWN	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Unknown		
Depth	100 ft		
Water Level	ft		
Bit	4.5 inches		
Struck	ft		
Flowing Head	ft		
Completion Method	Open Hole		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
			Steel

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	Glac
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
45	Clay	Unknown	Unknown
70	Gravelly Clay	Unknown	Unknown
100	Sand	Unknown	Unknown

WWDR # 065271

Client # 865271

Completion	25/10/1980
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SE1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Water Test Hole
Hole #			
Installation Method	Augered	Well Casings	
Depth	106 ft		
Water Level	ft		
Bit	6.0 inches		
Struck	10 ft	Screens	
Flowing Head	ft		
Completion Method			

Hole #: Length (ft) Btm (ft) Dia (in) Description

Bit: Length (ft) Btm (ft) Dia (in) Slot (in) Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1875 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
10	Sandy Clay	Brown	Unknown
30	Sand	Brown	Water
106	Clay	Unknown	Unknown

WWDR # 035707

Client # 835707

Completion	30/06/1965
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SE1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	044158	FFIB	
Water Use	Domestic	Well Use	Water Test Hole
Hole #			
Installation Method	Jetted		
Depth	12 ft		
Water Level	ft		
Bit	inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Length (ft) Btm (ft) Dia (in) Description

Well Casings

Length (ft) Btm (ft) Dia (in) Slot (in) Description

Screens

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1715 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
8	Clay	Unknown	Unknown
10	Sand	Unknown	Coarse
12	Clay	Unknown	Unknown

WWDR # 014523

Client # 814523

Completion	01/07/1974
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SE1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

1000 ft from N/S Boundary S N/S Boundary

500 ft from E/W Boundary W E/W Boundary

Well Information

Driller #	002197	ANDERSON DRILLING	
Water Use	Domestic	Well Use	Withdrawal
Hole #			
Installation Method	Bored		
Depth	38 ft		
Water Level	8 ft		
Bit	30.0 inches		
Struck	8 ft		
Flowing Head	ft		
Completion Method	Curbed		

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description
			Corrugated Metal

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	30.0 ft
Duration	1 hrs
Pumping Rate	40.0 igpm
Temp	deg. F
Elevation	1700 ft

Recommended

Rec Pumping Rate	2.0 igpm
Intake	35 ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
2	Topsoil	Unknown	Unknown
12	Sand	Unknown	Unknown
38	Clay	Unknown	Unknown

WWDR # 065276

Client # 814523

Completion	11/10/1980
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	SE1/4	28	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller #	043125	TWEIDT WELLBORING SERVICING LTD	
Water Use	Domestic	Well Use	Water Test Hole
Hole #			
Installation Method	Augered		
Depth	40 ft		
Water Level	ft		
Bit	6.0 inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1710 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
1	Topsoil	Unknown	Unknown
4	Clay	Yellow	Unknown
11	Clay	Yellow	Wet
40	Clay	Blue	Stoney

WWDR # 111097

Client # 022619

Completion	28/07/1999
RM	405
MB	07
SB	29
NTSMAP	73B06

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	29	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

0 ft from N/S Boundary N/S Boundary

0 ft from E/W Boundary E/W Boundary

Well Information

Driller # 002122 ELK POINT DRILLING CORP

Water Use Domestic Well Use Water Test Hole

Hole # 001

Installation Method Drilled

Depth 238 ft

Water Level ft

Bit 4.7 inches

Struck ft

Flowing Head ft

Completion Method

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down ft

Duration hrs

Pumping Rate igpm

Temp deg. F

Elevation 1738 ft

Recommended

Rec Pumping Rate igpm

Intake ft

Aquifer

E-Log SCANNED

Phys E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
8	Sand	Brown	Oxidized
24	Silt	Brown	Clayey
37	Till	Grey	Unknown
40	Sand	Unknown	Fine-medium
153	Till	Grey	Sandy
180	Till	Grey	Soft
192	Till	Grey	Sandy
238	Till	Grey	Soft

WWDR # 035711

Client # 050405

Completion	19/11/1960
RM	
MB	07
SB	29
NTSMAP	73B00

Well Location

LSD	Qtr	Sec	Twp	Rge	M	Reserve	RL
	NW1/4	29	40	10	3		

Zone Easting Northing Source Accuracy

Location of Well (in Quarter)

200 ft from N/S Boundary N N/S Boundary

100 ft from E/W Boundary W E/W Boundary

Well Information

Driller #	002182	HERON WATER WELL DRILLING LTD (1987)	
Water Use	Municipal	Well Use	Water Test Hole
Hole #	003		
Installation Method	Unknown		
Depth	250 ft		
Water Level	ft		
Bit	inches		
Struck	ft		
Flowing Head	ft		
Completion Method			

Well Casings

Length (ft)	Btm (ft)	Dia (in)	Description

Screens

Length (ft)	Btm (ft)	Dia (in)	Slot (in)	Description

Pump Test

Draw Down	ft
Duration	hrs
Pumping Rate	igpm
Temp	deg. F
Elevation	1725 ft

Recommended

Rec Pumping Rate	igpm
Intake	ft
Aquifer	
E-Log	No
Phys	E03

Lithology List

Depth to Base of (ft)	Material	Colour	Description
11	Gravel	Unknown	Unknown
60	Clay	Brown	Unknown
250	Gravelly Clay	Unknown	Unknown

Appendix C

Volume Calculations

Storage Cell	Existing Cell 2	New Cell 2
internal edge Length (m)	144.5	144.5
internal edge Width (m)	88.4	106.0
Area (m2)	12770.4	15314.4
Slope (X:1)	4	4
Free Board (m)	1	1
Water Surface Area(m2)	10971.50	13374.55
Water Surface Area(ha)	1.10	1.34
Water Depth	1.44	2.1
Base area (m2)	8605.90	9717.61
Fill Volume (m3)	15031	24145
Total Storage		**39176**