License a Groundwater Supply

Last Hill RV Golf & Country Club
Eckville Area, 12-21-039-03 W5M

Prepared for
1949561 Alberta Ltd.

Prepared by
hydrogeological consultants ltd. **(HCL)**
1.800.661.7972

June 2016

HCL Project No.: 16-0174.01

PERMIT TO PRACTICE
HYDROGEOLOGICAL CONSULTANTS LTD.
Signature_____
Date_____
PERMIT NUMBER P 385
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

TABLE OF CONTENTS

LIST OF FIGURES

1. Introduction

1.1. Preamble

1949561 Alberta Ltd. requires a water supply of 9.7 cubic metres per day (m³/day) for municipal use at the Last Hill RV Golf & Country Club (RV Park). The water supply is required in 12-21-039-03 W5M, in the Eckville area, which is 102 kilometres southeast of Drayton Valley, Alberta in the South Saskatchewan River Basin, as shown in Figure 1.

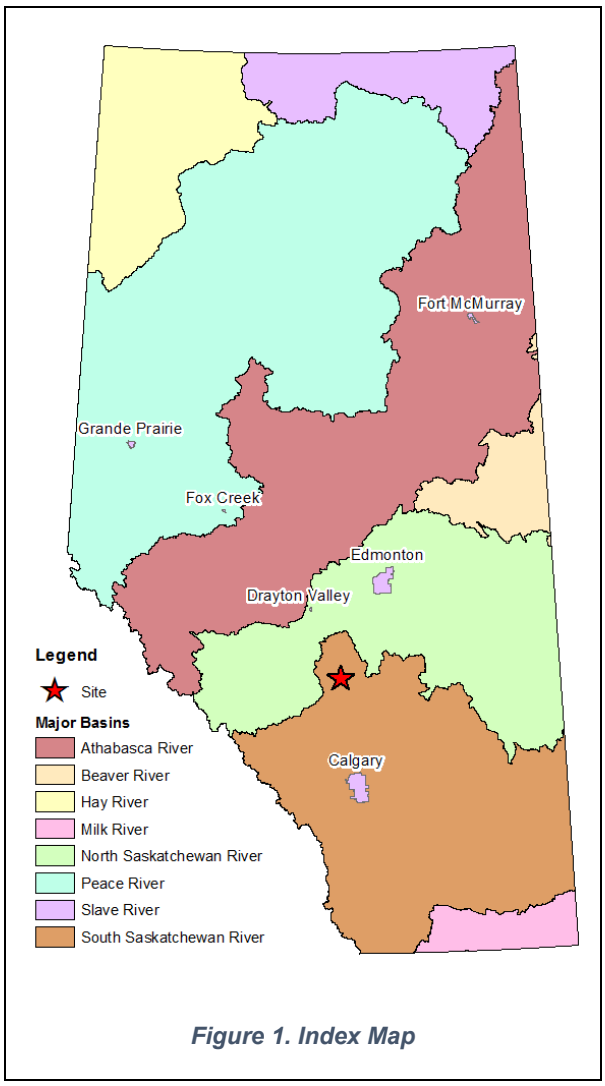


Figure 1. Index Map

1.2. Purpose

Hydrogeological Consultants Ltd. (HCL) was retained to review data from the existing 2016 Water Source Well (2016 WSW) [GIC ID: 9826000] and to prepare a report in support of an application to Alberta Environment and Parks (AEP) for a licence to divert and use up to 3,542 cubic metres per year (m³/year) of groundwater, which is 9.7 m³/day; the groundwater will be for municipal use. The groundwater will be diverted seasonally from May 1 to August (123 days per year) at an average rate of 28.8 m³/day during the season. A copy of the signed application is provided in Appendix A.

1.3. Scope

HCL collected readily available local hydrogeological data, conducted an extended aquifer test with the 2016 WSW, conducted a field-verified water well survey, and used the data to determine the quantity of groundwater available from the proposed water source well on a long-term basis without adversely affecting existing groundwater users, the aquifer or the environment. HCL also conducted a Phase 1 screening assessment to determine if the groundwater from the 2016 WSW is providing groundwater that is under the direct influence of surface water (GWUDI).

1949561 Alberta Ltd. provided details to support the need for the volume of groundwater to be licensed, the proposed use of the groundwater and a chemical analysis of the groundwater from the 2016 WSW.

The area of study (AOS) for this project was a 5x5-section area centred on 21-039-03 W5M. The area of interest (AOI) is the area within 1,600 metres of the water source well to be licensed.

The present groundwater program is in accordance with criteria outlined in the Guide to Groundwater Authorization (Alberta Government, 2011).

2. Background

2.1. General Hydrogeology

The upper bedrock in the AOS is the Paskapoo Formation; the surficial deposits are generally less than 15 metres thick. The hydrogeological map for the area (Tokarsky, 1971) indicates that water well yields are generally in the order of 160 to 650 m³/day from the Paskapoo Formation. The base of groundwater protection is reported to be 539 metres below ground level (BGL). Groundwaters from the Paskapoo Formation are expected to have total dissolved solids (TDS) concentrations of 750 milligrams per litre (mg/L).

2.2. Water Requirements

The required water supply of 3,542 m³/year is based on the following:

- 160 proposed RV sites
- Each RV site will require 0.18 m³/day, as outlined in the Alberta Private Sewage Systems Standard of Practice (Safety Codes Council, 2012)
- Seasonal use, from May 1 to end of August (123 days per year)

2.3. Previous Work

The 2016 WSW was drilled to a depth of 54.9 metres BGL on May 11, 2016, by Alken Basin Drilling Ltd. (Alken); the water well is completed in the depth interval of 45.7 to 51.8 metres BGL in a confined sandstone aquifer.

The 1998 Clubhouse Water Well (1998 Clubhouse WW) was drilled by Alken to a depth of 73.1 metres BGL in 13-21-039-03 W5M on October 6, 1998, and completed in the depth interval of 61.0 to 73.2 metres BGL in an unconfined sandstone aquifer. The 1998 Clubhouse WW was used as an observation water well during an extended aquifer test with the 2016 WSW. The 1998 Clubhouse WW is 260 metres north of the 2016 WSW, as shown on the Site Map (Figure 2 in Section 9 of this report).

3. Methodology

3.1. Existing Data

The local hydrogeological data are from regional hydrogeological information sources and water wells within the AOS. Aquifer parameters are determined from the analysis of aquifer test data using the Jacob Method of analysis. The projected long-term yield of a water source well is based on the AEP Modified Moell Method.

Details related to the water well completion are obtained from The Groundwater Centre (TGWC) database, an enhanced version of the AEP Water Well Information Database; details in the database are provided by water well drilling contractors. Details in TGWC are updated with information collected by HCL.

The chemical quality of the groundwater is based on the results of a chemical analysis by an accredited laboratory qualified to do the analysis.

3.1.1. Groundwater Under the Direct Influence of Surface Water (GWUDI) Guidelines

The level of potable groundwater treatment required is dependent on whether the raw groundwater is under the direct influence of surface water (GWUDI). If the groundwater is not GWUDI, only disinfection is required as an additional health-risk barrier. Groundwater that is a GWUDI source is required to undergo both filtration and disinfection, which is the same treatment that is required for surface water.

The criteria used to determine if a groundwater source is GWUDI are detailed in Appendix E of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems (Alberta Government, January 2006). The criteria include four phases. The first phase (Phase 1) is a GWUDI Screening Assessment. The purpose of the screening is to rapidly identify obvious non-GWUDI groundwater sources that do not require a detailed assessment. The screening includes the following:

- Setting sensitivity
- Proximity to surface water
- Water well construction
- Groundwater quality

Should a groundwater source that provides drinking water fail to meet any of the conditions associated with the above criteria, the source is flagged as potentially GWUDI and further assessment is required as outlined in the January 2006 reference above.

3.2. Collection of New Data

3.2.1. Aquifer Testing

An extended aquifer test is used to obtain the best possible understanding of the aquifer parameters. The aquifer test involves a discharge point and when possible, at least one observation water well. The test is conducted using a submersible pump and appropriate appurtenances for a length of time that is sufficient to at least meet the requirements of 1949561 Alberta Ltd. or the Regulator, depending on which criteria are more stringent; the recovery interval of the aquifer test is at least as long as the pumping interval of the aquifer test.

During the aquifer test, the instantaneous discharge and the cumulative discharge are measured with a turbine meter with an accuracy of ± 1.0%. Water levels are measured with pressure transducers that have an accuracy of ± 0.1% of full range. All data are collected by technically qualified people with experience in collecting hydrogeological data.

3.2.2. Groundwater Sampling

Groundwater samples are collected wearing fresh nitrile gloves for each sampling site. The sample bottle(s) are rinsed with the groundwater to be sampled unless the sample bottle contains preservatives provided by the laboratory doing the analysis. When samples are collected, the sample bottles are filled to capacity with little or no air space remaining. If the analysis is for dissolved metals, samples are field filtered.

Groundwater samples for laboratory analysis are collected for chemical, physical and microbiological analyses, which include: (1) Inorganic Nonmetallic; (2) Dissolved Metals; (3) Total Metals; (4) Microbiological; (5) Routine Water and (6) Physical and Aggregate properties. The groundwater samples are stored in a cooler with ice packs for transport to the laboratory, which is accredited in Alberta to perform the requested analyses.

Field parameters (pH, temperature and EC) are measured after laboratory samples are collected.

The groundwater samples are collected according to the procedures outlined in the HCL field manual.

3.2.2.1. Sampling from Water Well

Ensure that the groundwater discharge sampling point is clean in order to collect an uncontaminated sample. Collect the sample after the groundwater has been discharged for a sufficient length of time to be representative of the groundwater from the aquifer.

3.2.3. Field-Verified Water Well Survey

A field-verified water well survey is completed in an attempt to contact as many of the water well users in the AOI as practical. When contact is made with a water well user, an attempt is made to confirm the data available in TGWC database, to collect any information the water well user is prepared to share, to measure a non-pumping water level (NPWL) in the water well if possible, and to obtain spatial coordinates for the water well. If a water well is located in the field that is not in the database, the water well is added to the database with as much information as possible. If contact cannot be made with the water well user and there is a residence that appears to be related to the water well, a letter is left to allow the water well user to contact HCL to obtain more information about the purpose of the water well survey, and to provide the water well user with an opportunity to participate in the water well survey.

A field survey includes four criteria for identification of a feature:

- Field Action 1: Observed, physically confirmed, and horizontal coordinates obtained after receiving authorization to do so by the owner/user.
- Field Action 2: Confirmed by the owner/user, and horizontal coordinates based on information provided.
- Field Action 3: Expected based on information other than information provided by an owner/user.
- Field Action 4: No evidence could be observed in the field.

3.3. Data Processing

3.3.1. Transmissivity

Transmissivity values for a confined aquifer are calculated from the aquifer test data from the pumped water well(s) using the Cooper-Jacob approximation of the Theis non-equilibrium equation or the Tartakovsky-Neuman Solution for an aquifer test in an unconfined aquifer.

3.3.2. Storativity

The storage coefficient for a confined aquifer represents water derived relative to (1) the expansion of water as the aquifer is depressurized and (2) compression of the aquifer. Storativity is calculated from the analysis of drawdown measured in a suitable observation water well; in the absence of observation water well data, the storativity is estimated based on the lithology of the aquifer.

3.3.3. Theoretical Long-Term Yield

The theoretical long-term yield is calculated from the Modified Moell Method (Alberta Government, March 2011) and is based on the water level in the pumped water well being lowered by 70% of the available drawdown after 20 years of groundwater diversion.

When the aquifer is fully confined, the available drawdown is the linear distance from the NPWL to the top of the aquifer. When the aquifer is not fully confined, the available drawdown is two thirds of the linear distance from the non-pumping water level to the bottom of the aquifer.

For confined aquifers only, the theoretical long-term yield can also be calculated from the Farvolden Method (Alberta Government, March 2011).

3.3.4. Calculation of Drawdown

Drawdowns at various times and distances from the groundwater discharge point are calculated using the Theis non-equilibrium equation based on approximations of W(u). When multiple groundwater discharge points are involved, the principle of superposition is used. The multiple discharge points could be at various locations or at one location.

3.3.5. Predicted Impact

A mathematical model is used to calculate the water levels in the aquifer at various locations within the AOI when pumping from specific water wells within the AOI. The model is called the Infinite Artesian Aquifer Model (IAAM) and is used to calculate water levels at specific locations in the aquifer. The aquifer is considered to be homogeneous and isotropic, and behaves as an aquifer of infinite areal extent; the calculations do not account for direct recharge to the aquifer.

3.4. Spatial Coordinates

All horizontal spatial coordinates are based on a 10-degree Transverse Mercator projection, with the central meridian of 115 degrees west longitude, using the 1983 North American Datum. The vertical spatial coordinates obtained from the digital elevation model are provided by AltaLIS Ltd., the agent for Alberta Data Partnerships Ltd.

3.5. Measurements

Most vertical measurements are provided in the report to one decimal place. The exception is water levels measured by or on behalf of HCL, which are reported to two decimal places. Vertical measurements may be determined to two decimal places, but other than water levels, are presented in the report with only one decimal place. The number of decimals presented in the appendices and in tables may not always reflect the number of decimals presented in the report. In this report, the reference point is the top of casing, and all water-level measurements are reported as metres below top of casing (BTOC) unless otherwise noted.

4. Results

4.1. Site Details

The 2016 WSW is immediately north of the proposed RV Park. Figure 2 shows the location of the 2016 WSW relative to surrounding features.

4.2. Area Water Wells

Appendix D provides a summary of water wells in TGWC database for the AOI. The summary includes the elevations of the completion intervals and the non-pumping water levels, when available.

AEP indicated in an email on April 21, 2016 that there were 22 groundwater authorizations totalling 281,158 m³/year within the AOS, based on data queried from the AEP Environmental Management System. There are also 46 groundwater registrations within the AOS. There are eight groundwater authorizations in the AOI.

4.3. Field-Verified Water Well Survey

The field-verified water well survey within the AOI was completed on April 27 and May 31, 2016 by HCL personnel. The figure in Appendix D shows the spatial distribution of the 58 water wells within the AOI and their field action designations. Of these 58 water wells:

- 12 are Field Action 1: Observed, physically confirmed, and horizontal coordinates obtained after receiving authorization to do so by the owner/user (including the 2016 WSW)
- 6 are Field Action 2: Confirmed by the owner/user, and horizontal coordinates based on information provided.
- 13 are Field Action 3: Expected based on information other than information provided by an owner/user.
- 27 are Field Action 4: No evidence could be observed in the field

In addition to the 58 existing water wells in the AOI, there are records for three reclaimed water wells in the same area. Although the reclaimed water wells are not shown on the map in Appendix D, data from the reclaimed water wells were used where they assist in a better understanding of the local hydrogeology.

Details for the water wells within the AOI are included in Appendix D and are available on TGWC website.

4.4. Aquifer Parameters

Aquifer Test II (AT II) with the 2016 WSW was completed on May 24, 2016 by HCL. The aquifer test consisted of pumping an average of 282.8 litres per minute (Lpm) (407.2 cubic metres per day) for 1,450 minutes followed by 6,000 minutes of water-level recovery. Analysis of the data indicates that the 2016 WSW is completed in a confined aquifer with an effective transmissivity of 696 metres squared per day (m²/day).

During AT II with the 2016 WSW the water level, in the 1998 Clubhouse WW was measured; a maximum drawdown of 0.07 metres was measured in the 1998 Clubhouse WW. Analysis of the data from the 1998 Clubhouse WW indicates an effective transmissivity of 527 m²/day and a corresponding storativity of 0.006.

The aquifer test details are in Appendix C.

4.5. Chemical Quality

A groundwater sample was collected from the 2016 WSW by HCL personnel and submitted to Exova Canada Inc. for analysis of detailed chemical, physical, and microbiological parameters. The analysis results were reported on May 30, 2016, and are included in Appendix B. The chemical analysis results show that the groundwater is a sodium-bicarbonate-type water with a TDS content of 557 mg/L. There are no analytes in the groundwater from the 2016 WSW that exceeded the maximum acceptable concentrations (MACs) for potable water established for health objectives (Health Canada, 2014). The TDS exceeds the aesthetic objective of 500 mg/L.

5. Interpretation

5.1. The Aquifer

The 2016 WSW has been completed in the depth interval of 45.7 to 51.8 metres BGL through a confined sandstone aquifer that is in the depth interval of 46.0 to 54.9 metres BGL; the sandstone aquifer was identified by Alken. The non-pumping water level in the 2016 WSW prior to the start of AT II was 30.69 metres BTOC; with a casing stick-up of 0.6 metres, the non-pumping water level is 15.9 metres above the top of the sandstone aquifer, indicating a confined aquifer.

The sandstone aquifer in which the 2016 WSW is completed is in the Dalehurst Member of the Paskapoo Formation; the effective (late) transmissivity is 696 m²/day.

5.2. GWUDI

The results of the screening for GWUDI for the 2016 WSW are as follows:

- Sensitivity setting
  The aquifer in which the 2016 WSW is completed is a confined aquifer; the completion interval of the 2016 WSW is at a depth that is greater than 15 metres and therefore passes this test.
- Proximity to surface water
  There are no surface water bodies within 100 metres of the 2016 WSW; the water source well location passes this test.
- Water well construction
  The 2016 WSW was completed by a journeyman water well driller and the annular seal on the surface casing is a bentonite product; the water source well construction passes this test
- Groundwater quality
  - The groundwater from the 2016 WSW does not show any indications of a direct connection to a surface water source. The nitrates, total coliforms and Escherichia Coli are all below detection limits, which suggests that there is no direct input of surface water into the aquifer.

The 2016 WSW passed the GWUDI screening criteria; the groundwater diverted from 2016 WSW should be considered non-GWUDI.

5.3. Yield Calculations

The long-term yield is based on an aquifer that is homogeneous, isotropic and of infinite areal extent. To determine a long-term yield, a safety factor is used that limits the drawdown over 20 years to 70% of the available drawdown. The AEP Modified Moell Method of analysis has been used to determine a long-term yield for the 2016 WSW. Based on the above and the following conditions, the projected theoretical long-term yield (Q_{20}) for the water well is 3,391 m³/day.

Available drawdown (H_a):	15.9 metres
AT II discharge (Q):	282.8 Lpm (407.2 m³/day)
Measured drawdown after 100 minutes ($s_{100\ min}$):	0.80 metres
Calculated drawdown after 100 minutes ($s_{100\ min\ Theor}$):	0.9 metres
Calculated drawdown after 20 years ($s_{20\ years\ Theor}$):	1.4 metres
Effective transmissivity:	696 m²/day

The available drawdown of 15.9 metres is based on a confined aquifer.

5.4. Predicted Impact

The calculated drawdown is 0.01 metres at a distance of 1,600 metres from the 2016 WSW after pumping the water source well at the required 9.7 m³/day for 20 years, using a transmissivity of 527 m²/day and a corresponding storativity of 0.006.

6. Conclusions

The 2016 Water Source Well is completed in a confined aquifer in the depth interval of 46.0 to 54.9 metres BGL. A groundwater diversion from the 2016 WSW of 9.7 m³/day for municipal use for the Last Hill RV Golf & Country Club, is not expected to adversely affect nearby water well users or the aquifer in which the water source well is completed. The chemical quality of the groundwater from the 2016 WSW is suitable for the RV Park use. The local health unit should be contacted prior to consumption of the groundwater from the water source well.

7. Recommendations

It is recommended that Alberta Environment and Parks issue a *Water Act* licence to 1949561 Alberta Ltd. to allow groundwater diversion from the 2016 Water Source Well for municipal use, with the following parameters:

Total annual diversion:	3,542 cubic metres
Maximum daily diversion:	407.2 cubic metres
Maximum pump depth:	46.0 metres below ground level

The technical data provided in this report support the issuance of a licence with these parameters for the Last Hill RV Golf & Country Club in 12-21-039-03 W5M in the Eckville area. A copy of the signed application is in Appendix A.

It is recommended that a groundwater monitoring program be established. Groundwater monitoring requirements should include measuring monthly groundwater diversion from the 2016 WSW, measuring the non-pumping water level on a monthly basis, and collecting a groundwater sample that should be submitted to an accredited laboratory for a routine chemical analysis on a yearly basis.

Prepared by:

Brad Salter, B.Sc., G.I.T.
Junior Hydrogeologist

Reviewed by:

PROFESSIONAL GEOLOGIST ALBERTA
James A. Touw

Jim Touw, P.Geol.
Senior Hydrogeologist

8. Bibliography

Alberta Government. January 2006. Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems. Drinking Water Branch, Environmental Policy Branch, Environmental Assurance Division. http://Alberta.ca

Alberta Government. March 2011. Guide to Groundwater Authorization. http://environment.alberta.ca/03587.html

Health Canada. 2014. Guidelines for Canadian Drinking Water Quality – Summary Table. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Hydrogeological Consultants Ltd. January 2001. Lacombe County. Part of the Red Deer River Basin. Tp 038 to 041, R 21 to 28, W4M and Tp 038 to 041, R 01 to 04, W5M. Regional Groundwater Assessment. Unpublished contract report prepared in conjunction with Agriculture and Agri-Food Canada. HCL 00-174.

Matrix Solutions Inc. August 2006a. Groundwater Supply Well Testing and Evaluation. Office Well – Eckville Facility. 01-29-039-03 W5M.

Matrix Solutions Inc. August 2006b. Groundwater Supply Well Testing and Evacuation. Shop Well – Eckville Facility. 01-29-039-03 W5M.

Matrix Solutions Inc. August 2006c. Groundwater Supply Well Testing and Evaluation. Soil Wash Well – Eckville Facility. 01-29-039-03 W5M

Province of Alberta. Water Act. Water (Ministerial) Regulation. Alberta Regulation 205/1998 (with amendments up to and including Alberta Regulation 185/2015). © Alberta Queen's Printer.

Province of Alberta. Water Act. Revised Statutes of Alberta 2000. Chapter W-3. Current as of December 17, 2014. Office Consolidation. © Alberta Queen's Printer.

Province of Alberta. Environmental Protection and Enhancement Act. Potable Water Regulation. Alberta Regulation 277/2013 (with amendments up to and including Alberta Regulation 63/2015). © Alberta Queen's Printer.

Safety Codes Council. January 2012. Alberta Private Sewage Systems. 2009 Standard of Practice.

Tokarsky, O. 1971. Hydrogeology of the Rocky Mountain House Area, Alberta.

9. Tables and Figures

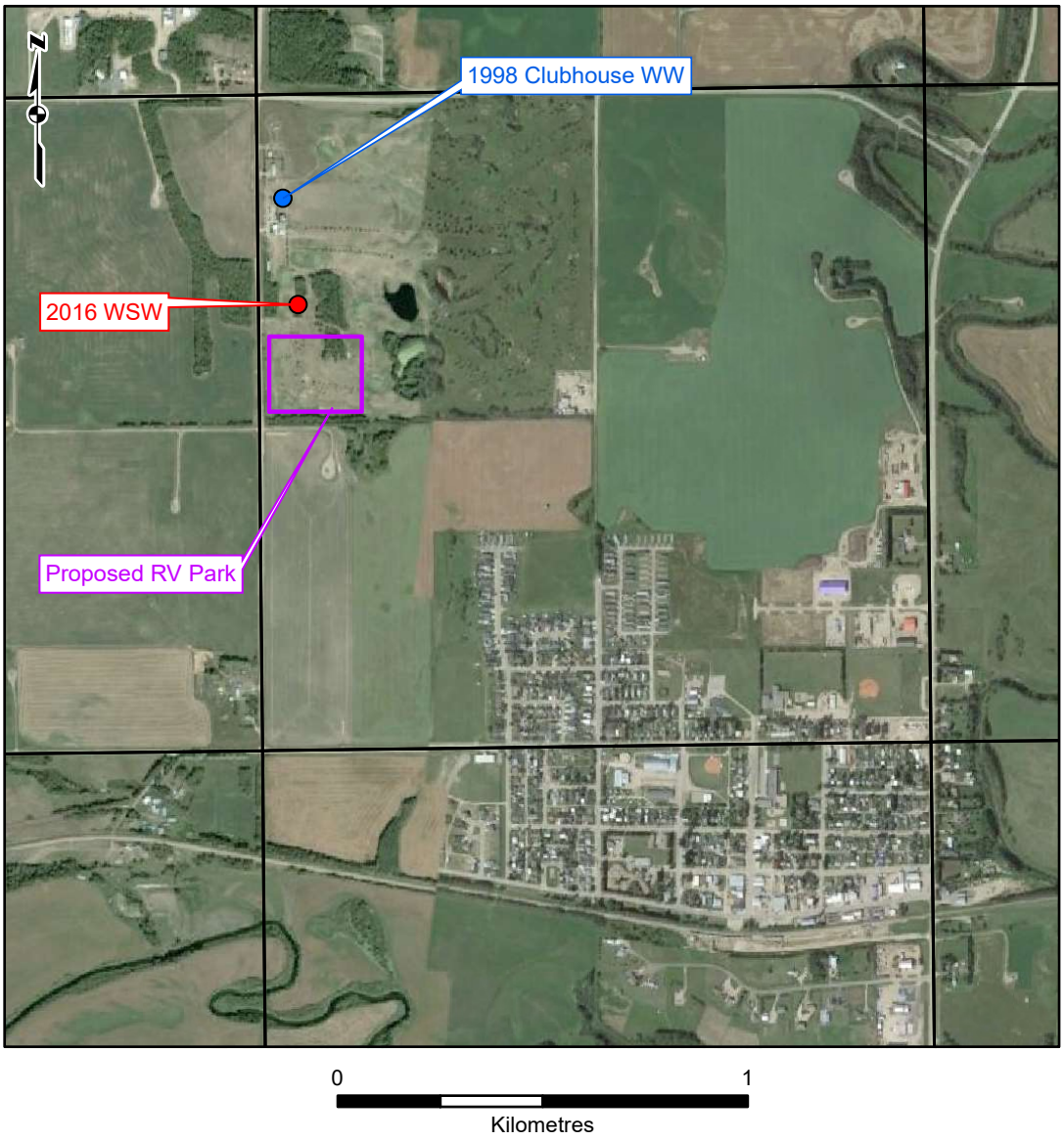


Figure 2. Site Map

10. Supplementary Information

10.1. Glossary of Terms

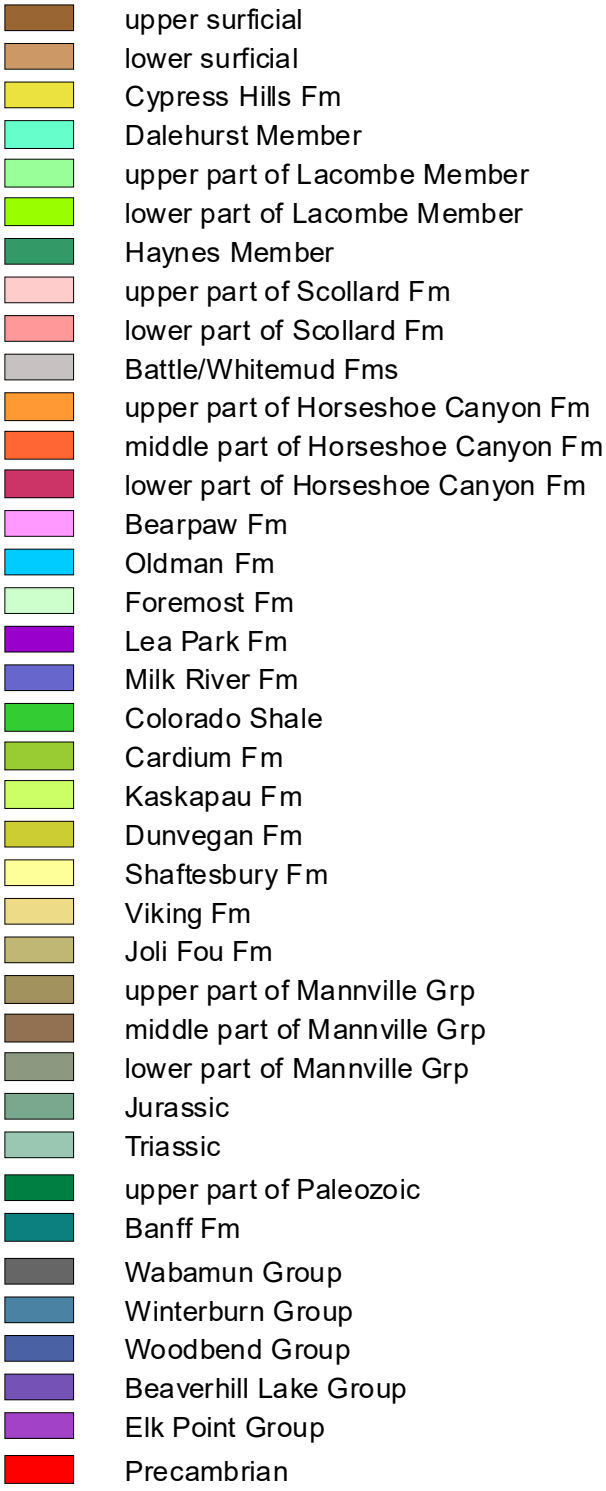
aesthetic objective	Health Canada aesthetic quality guidelines addressing parameters that may affect consumer acceptance of drinking water, such as taste, odour and colour
aquifer	a formation, group of formations or part of a formation that contains saturated permeable rocks capable of transmitting groundwater to water wells or springs in economical quantities
available drawdown	in a confined aquifer, the distance between the non-pumping water level and the top of the aquifer in an unconfined aquifer (water table aquifer), two thirds of the saturated thickness of the aquifer and water level within 5 metres of the top of the aquifer
base of groundwater protection	the depth below which groundwater is expected to have a total dissolved solids concentration of more than 4,000 milligrams per litre
maximum acceptable concentration	the highest level of chemical substances determined by Health Canada to be allowable in drinking water supplies; these substances are generally only a concern if exposure above guideline levels occurs over an extended time
storativity	the volume of water released from storage by a confined aquifer per unit surface area of aquifer per unit decline in hydraulic head (dimensionless)
surficial deposits	all sediments above the bedrock surface
transmissivity	the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient; a measure of the ease with which groundwater can move through the aquifer apparent transmissivity: the value determined from a summary of aquifer test data, usually involving only two water-level readings effective transmissivity: the value determined from late pumping and/or late recovery water-level data from an aquifer test aquifer transmissivity: the value determined by multiplying the hydraulic conductivity of an aquifer by the thickness of the aquifer
yield	a regional analysis term referring to the rate at which a properly completed water well could be pumped, if fully penetrating the aquifer apparent yield: based mainly on apparent transmissivity long-term yield: based on effective transmissivity sustainable yield: based on aquifer parameters determined from long-term water-level and groundwater production monitoring

10.2. Glossary of Commonly Used Abbreviations, Acronyms and Symbols

AEP	Alberta Environment and Parks
AMSL	above mean sea level
AO	aesthetic objective
AOI	area of interest
AOS	area of study
BGL	below ground level
BTOC	below top of casing
GPS	global positioning system receiver
km	kilometre(s)
Lpm	litre(s) per minute
m	metre(s)
m^2/day	metre(s) squared per day
m^3/day	cubic metre(s) per day
m^3/year	cubic metre(s) per year
MAC	maximum acceptable concentration
mg/L	milligram(s) per litre
NAD83	North American Datum of 1983
NPWL	non-pumping water level
TDS	total dissolved solids
TGWC	The Groundwater Centre www.tgwc.com
WSW	water source well

10.3. Stratigraphy of the "Undisturbed" Geology of Alberta

(as used by Hydrogeological Consultants Ltd.)



10.4. Guidelines for Canadian Drinking Water Quality – Summary Table

Constituent	AO	MAC
pH (pH units)	6.5 - 8.5	---
Conductivity (µS/cm)	---	---
Total Dissolved Solids	500	---
Sodium	200	---
Potassium	---	---
Calcium	---	---
Magnesium	---	---
Total Hardness	---	---
Manganese	0.05	---
Carbonate	---	---
Bicarbonate	---	---
Total Alkalinity	---	---
Sulfate	500	---
Chloride	250	---
Fluoride	---	1.5
Iron	0.3	---
Nitrate (as N)	---	10
Nitrate	---	45
Nitrite (as N)	---	1
Nitrite	---	3
Nitrate + Nitrite (as N)	---	10
Total Coliforms (CFU/100 mL)	---	0
Fecal Coliforms (CFU/100 mL)	---	0
Escherichia coli (CFU/100 mL)	---	0
Ionic Balance (%)	---	---

Concentrations are in milligrams per litre unless otherwise stated.
Note: Constituents marked with –- do not have a recommended maximum concentration associated with them.

CFU/100 mL - Colony Forming Units per 100 millilitres
AO - Aesthetic Objective
MAC - Maximum Acceptable Concentration

GCDWQ–ST - Guidelines for Canadian Drinking Water Quality – Summary Table, Health Canada. 2014

10.5. Conversions

Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inches	25.400 000	millimetres
miles (statute)	1.609 344	kilometres
kilometres	0.621 370	miles (statute)
square feet (ft²)	0.092 903	square metres (m²)
square metres (m²)	10.763 910	square feet (ft²)
square metres (m²)	0.000 001	square kilometres (km²)
Concentration		
grains/gallon (UK)	14.270 050	parts per million (ppm)
parts per million (ppm)	0.998 859	milligrams per litre (mg/L)
milligrams per litre (mg/L)	1.001 142	parts per million (ppm)
Volume (capacity)		
acre feet	1233.481 838	cubic metres
cubic feet	0.028 317	cubic metres
cubic metres	35.314 667	cubic feet
cubic metres	219.969 248	imperial gallons (UK)
cubic metres	264.172 050	gallons (US liquid)
cubic metres	1000.000 000	litres
cubic metres	6.290 000	Barrels of Oil Equivalent (BOE)
imperial gallons (UK)	0.004 546	cubic metres
imperial gallons (UK)	4.546 000	litres
Rate		
litres per minute	0.219 974	imperial gallons per minute (ipgm)
litres per minute	1.440 000	cubic metres/day (m³/day)
imperial gallons per minute (igpm)	6.546 300	cubic metres/day (m³/day)
cubic metres/day (m³/day)	0.152 759	imperial gallons per minute (ipgm)
Pressure		
pound per square inch (psi)	6.894 757	kilopascal (kpa)
kilopascal (kpa)	0.145 038	pound per square inch (psi)
Miscellaneous		
Celsius	F° = 9/5 (C° + 32)	Fahrenheit
Fahrenheit	C° = (F°- 32) * 5/9	Celsius
degrees	0.017 453	radians

Appendix A – Authorization Details

TABLE OF CONTENTS

1. *Water Act* Authorization Application

Alberta Government

Application under the *Water Act* for Approvals and/or Licences

This application form is for activities regulated under the *Water Act*.

The Crown claims ownership of the bed and shore of all permanent and naturally occurring bodies under Section 3(1) of the *Public Lands* Act.

A License of Occupation under the *Public Lands Act* is required for permanent occupation of public land.

Check one or more of the following to indicate type of application

Licence for Diversion of Water ☒	Renewal of Diversion Licence ☐	Approval for Constructing Works ☐
Licence Amendment ☐	Approval Amendment ☐	Preliminary Certificate Amendment ☐
Water Act File No. (for amendments or renewals)		

Applicant

Name or Business Name : 1949561 Alberta Ltd.	Business Contact: Bill MacLean
Address : 20711 - 5 Avenue SW	Phone: 780-405-4354
City / Town : Edmonton	Cell #:
Province : Alberta	Fax No :
Postal Code : T6M 2P4	E-mail :billcar@tbwifi.ca
Are you the owner of the said land or undertaking?	◉ Yes ○ No

Authorized Representative ☐ Same as Applicant

Name or Business Name: Hydrogeological Consultants Ltd.	Business Contact: Jim Touw
Address: 17740 - 118 Avenue NW	Phone: 780.702.2227
City / Town: Edmonton	Cell #: 780.906.1515
Province: Alberta	Fax No.:
Postal Code: T5S 2W3	E-mail:Jim@hcl.ca

Project Description

Tentative Construction Start Date:	N/A	Duration of Construction:	N/A
Tentative Water Diversion Start Date:	Immediately	Duration of Water Diversion/Use:	20 Years

Provide a detailed description, including location of works and activities, relating to the project and attach plans:

1949561 ALberta Ltd. is applying for a groundwater diversion of 3,524 m^3/year (28.8 m^3/day) for the 2016 Last Hill RV Golf & Country Club Water Source Well in 12-21-039-03 W5M for municipal (Recreational Vehicle Park) purposes. Supporting information is provided in the 2016 report prepared by HCL entitled:
License a Groundwater Supply, Last Hill RV Golf & Country Club, Eckville Area, 12-21-039-03 W5M

Water Sources (Location of Works and Activities): ○ Surface Water ◉ Groundwater

Groundwater - Point of Diversion

	Well Id (if known)	Date Well Drilled	Well Location					Purpose	Annual Volume of Water Required (cubic metres)	Maximum Pumping Rate (show units)	Production Intervals		Total Depth (metres)
			1/4	Sec	Twp	Rge	M				Top (metres)	Bottom (metres)	
+													
x		11-May-2016	NW	21	39	3	5	Municipal	3,542	407 m^3/day	45.7	51.8	54.9
If available, provide: Plan/Block/Lot (Legal Sub-division)						UTM Coordinates		Zone 11	Easting (m) 5805726		Northing (m) 678067		

Indicate if a `Drillers Report' is attached? ◉ Yes ○ No

+ - add additional row
x - remove current row

To locate a well id, please search http://www.envinfo.gov.ab.ca/GroundWater/.

Amendment Description (Choose **one** of the following three options)

☐ **Approval Amendment**

Please provide description of amendment required and attach plan if necessary

☐ **Licence Amendment**

☐ **Preliminary Certificate Amendment**

Complete applicable information below: (Choose one or more of the following options)

☐ Increase or decrease rate of diversion.

Please specify

☐ Add a rate of diversion of water if none specified on the licence or preliminary certificate.

Please specify

☐ Add terms or conditions to the licence or preliminary certificate.

Please specify
☐ Add/change the timing of diversion or water specified in the licence or preliminary certificate.
Please specify
☐ Add/change the point of use
Please specify
☐ Move the point of diversion of water or add another point of diversion of water. (Licences only)
Please specify
☐ Notice of disposition of land or undertaking. (Change of ownership)
Please specify
☐ Other amendments requested.
Please specify

Statement of Confirmation:

The information given on this form is true to the best of my knowledge.

If you wish to sign the form with an electronic signature you are bound the same as though you had a fixed signature on paper.

Signature	Date of Signing	Printed Name	Company Name
X	Jun 8/16	Bill MacLeod	1949561 AB Ltd.

Return the completed form to the Alberta Environment Regulatory Approvals Centre:

Regulatory Approvals Centre Main Floor Oxbridge Place 9820 106 Street Edmonton Alberta T5K 2J6 Telephone: 780-427-6311 Fax: 780-422-0154	Submit by E-mail esrd.waapplications@gov.ab.ca

PERSONAL INFORMATION COLLECTION AND USE NOTIFICATION

Personal information on this form is collected under the authority of section 33(c) of the Freedom of Information and Protection of Privacy (FOIP) Act and will be used to administer the Water Act and its associated regulations. ***This form is a public record and is available to anyone****. All information contained on this form (including personal information) is disclosed by Alberta Environment and Parks to anyone requesting a copy in accordance with Section 15(1)(a) of the Water (Ministerial) Regulation. For further information about the collection and use of this information, please contact Alberta Environment and Parks Regulatory Approvals Centre at* ***esrd.waapplications@gov.ab.ca*** *or call (780) 427-6311.*

WATER (MINISTERIAL) REGULATION **- REQUEST FOR CONFIDENTIALITY**

As identified in Section 15(4) of the *Water (Ministerial) Regulation*, If the applicant wishes that a trade secret, process or technical information in the application be kept confidential, the applicant may make a written request to the Director within 30 days after the information is submitted, identifying the information, and requesting that the information be kept confidential and not be disclosed. The written request must identify the specifics of the information to be kept confidential and not to be disclosed. Ultimately, it is the Director who makes the decision regarding the confidentiality of the identified information.

If you are submitting a request to assure confidentiality of certain information such as a trade secret, process or technical information for the Directors consideration, ***submit this information in a separate attachment to the application form.***

2. Excerpts from the Water Act (2013)

Water for household purposes is defined in Section 1(1)(x) of the Water Act as “the use of a maximum of 1250 cubic metres of water per year per household for the purposes of human consumption, sanitation, fire prevention and watering animals, gardens, lawns and trees;”

2.1. Section 23(3)

“(3) If, on or after January 1, 1999, a subdivision of land of a type or class of subdivision specified in the regulations is approved under the Municipal Government Act, a person residing within that subdivision on a parcel of land that adjoins or is above a source of water described in section 21 has the right to commence and continue the diversion of water under section 21 only if

(a) a report certified by a professional engineer or professional geoscientist, as defined in the Engineering and Geoscience Professions Act, was submitted to the subdivision authority as part of the application for the subdivision under the Municipal Government Act, and the report states that the diversion of 1250 cubic metres of water per year for household purposes under section 21 for each of the households within the subdivision will not interfere with any household users, licensees or traditional agriculture users who exist when the subdivision is approved, and
(b) the diversion of water for each of the households within the subdivision under section 21 is not inconsistent with an applicable approved water management plan.”

A licence is required per Section 49(1) of the Water Act “Subject to subsection (2), no person shall

(a) commence or continue a diversion of water for any purpose”

“except pursuant to a licence unless it is otherwise authorized by this Act.”

http://www.qp.alberta.ca/documents/Acts/w03.pdf

3. Excerpts from the Water (Ministerial) Regulation

3.1. Part 7

3.1.1. Water Wells

3.1.1.1. *Water well site specifications*

"44(1) The driller and the owner of a water well must locate the water well site so that

(a) the water well is accessible for cleaning, treatment, repair, testing, maintenance and inspection,
(b) the area immediately surrounding the water well may be kept in a sanitary condition,
(c) surface water does not collect or form a pond in the vicinity of the water well, and
(d) the water well is at least 3.25 metres away from the nearest building.

(2) No person shall locate a water well in a pit."

3.1.1.2. *Distance from sources of contamination*

"46(1) No person shall locate or drill a water well for the diversion of groundwater, other than saline groundwater, closer to a thing described in Column 1 of Table 1 than the distance specified in Column 2 of Table 1.

(2) If the diversion of water from a water well is licensed for municipal purposes, no person shall locate or drill the water well closer than 100 metres from anything listed in Column 1 of Table 1."

Table 1

Column 1 - Source of Substance	Column 2 - Minimum Distance Required
Watertight septic tank or sewage holding tank	10 metres
Sub-surface weeping tile effluent disposal field of an evaporation mound	15 metres
Sewage effluent discharge to the ground surface	50 metres
Sewage lagoon	100 metres
Above ground storage tanks containing petroleum substances	50 metres

3.1.1.3. *Construction Requirements*

"47(a) the water well must be constructed so that surface water or substances can not enter any aquifer;"

(c) "the water well must be constructed so that the casing extends
(i) not less than 20 centimetres above the pumphouse floor or the established ground surface, and
(ii) at least 60 centimetres above the highest flood record in the area, if the water well is not to be equipped with a watertight cap;"

(g) "in the case of a diversion of groundwater from a water well that must be licensed, the water well must be
(i) constructed in a manner that does not result in multiple aquifer completions,
(ii) constructed with an open hole with a slotted or screened section that does not exceed 7.62 metres if distinct water-producing units are not present, and
(iii) sealed the full length of the annulus from the ground surface to the top of the aquifer using suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or using clay slurry, impervious water well cuttings or impervious overburden materials;"

3.1.1.4. *Schedule 3*

Camps do not require a licence under the following condition.

"(1)(a) a diversion of water of up to 1250 cubic metres per camp per year for the purposes of human consumption, sanitation, fire prevention and other uses related to the camp;"

http://www.qp.alberta.ca/documents/Regs/1998_205.pdf

4. Excerpts from the Alberta Government Guide to Groundwater Authorization

4.1. Parameters for Groundwater Quality Analysis

TABLE 1.0 LIST OF PARAMETERS FOR GROUNDWATER QUALITY ANALYSIS

Routine Analysis		Detailed Analysis		Bacteriological Analysis
Bicarbonate (HCO_3)	Sulphate (SO_4)	Arsenic (As)	Nitrite + Nitrate (NO_2 + NO_3)	E. coli (CFU/100 mL)
Calcium (Ca)	Temperature	Bicarbonate (HCO_3)	Nitrogen-Ammonia (NH_3)	Coliforms–Total (CFU/100 mL)
Carbonate (CO_3) Chloride	Total Dissolved Solids	Calcium (Ca)	Total Kjeldahl Nitrogen (TKN)	
(Cl)	Total Alkalinity	Carbonate (CO_3)	pH	
Electrical Conductivity	Total Hardness	Chloride (Cl)	Phosphorus (P)	
Fluoride (F)		Colour (TCU)	Potassium (K)	
Iron (Fe)		Copper (Cu)	Sodium (Na)	
Magnesium (Mg)		Fluoride (F) Iron	Sulphate (SO_4)	
Manganese (Mn)		(Fe)	Sulphide (H_2S)	
Nitrite + Nitrate (NO_2 + NO_3)		Lead (Pb)	Total Alkalinity	
pH		Magnesium (Mg)	Total Dissolved Solids (TDS)	
Potassium (K)		Manganese (Mn)	Total Hardness	
Sodium (Na)		Mercury (Hg)	Turbidity (NTU)	
		Metals (total)	Zinc (Zn)	

4.2. Recommended Minimum Length of Aquifer Test for Maximum Water Diversion

APPENDIX 4: Minimum Recommended Length of Aquifer Test and Information Required for the Maximum Water Diversion/Drainage

Government of Alberta

Daily Pumping Rate	Number of Days	Maximum Yearly Water Requirement	Length of Pumping and Recovery Period at Anticpated Maximum Pumping Rate	Observation/ Monitoring Site	Information Required under Section 2
up to 10 m^3/day (2200 lgpd) (1.5 lgpm)	365	3650 m^3 (803,000 lg)	2 + 2 hours* (or longer) and at least 90% recovery	0	2.1 2.2.3 2.2.6 (A) to (M) 2.2.10
> 10 to 35 m^3/day (2200 to 7700 lgpd) (1.5 to 5.3 lgpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	0–1	All of Section 2
> 35 to 65 m^3/day (7700 to 14,300 lgpd) (5.3 to 10.0 lgpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	1	All of Section 2
> 65 to 265 m^3/day 14,300 to 60,500 lgpd) (10.0 to 40.0 lgpm)	applicant to enter	applicant to enter	48 + 48 hours (or longer) and at least 90% recovery	1–2	All of Section 2
> 265 m^3/day	applicant to enter	applicant to enter	72 + 72 hours (or longer) and at least 90% recovery	1–2	All of Section 2

*In some cases, more information or longer aquifer tests may be required.

LEGEND:

g = gallons
lgpd = Imperial gallons per day
lgpm = Imperial gallons per minute
m^3 = cubic metre = 220 Imperial gallons
> = greater than

http://environment.gov.ab.ca/info/library/8361.pdf

Appendix B – Water Well Details

TABLE OF CONTENTS

2016 Water Source Well

12-21-039-03 W5M

(M42502.496176)

Well Spatial Location:

Easting: ***41,909***
Northing: ***5,800,363***
(spatial accuracy GPS Supplied by Drilling Contractor — 10TM NAD83)

Ground Elevation AMSL (m): ***959***
(elevation accuracy MT DEM)

Date Completed: ***May 11, 2016***

Depth Drilled (m): ***54.9***

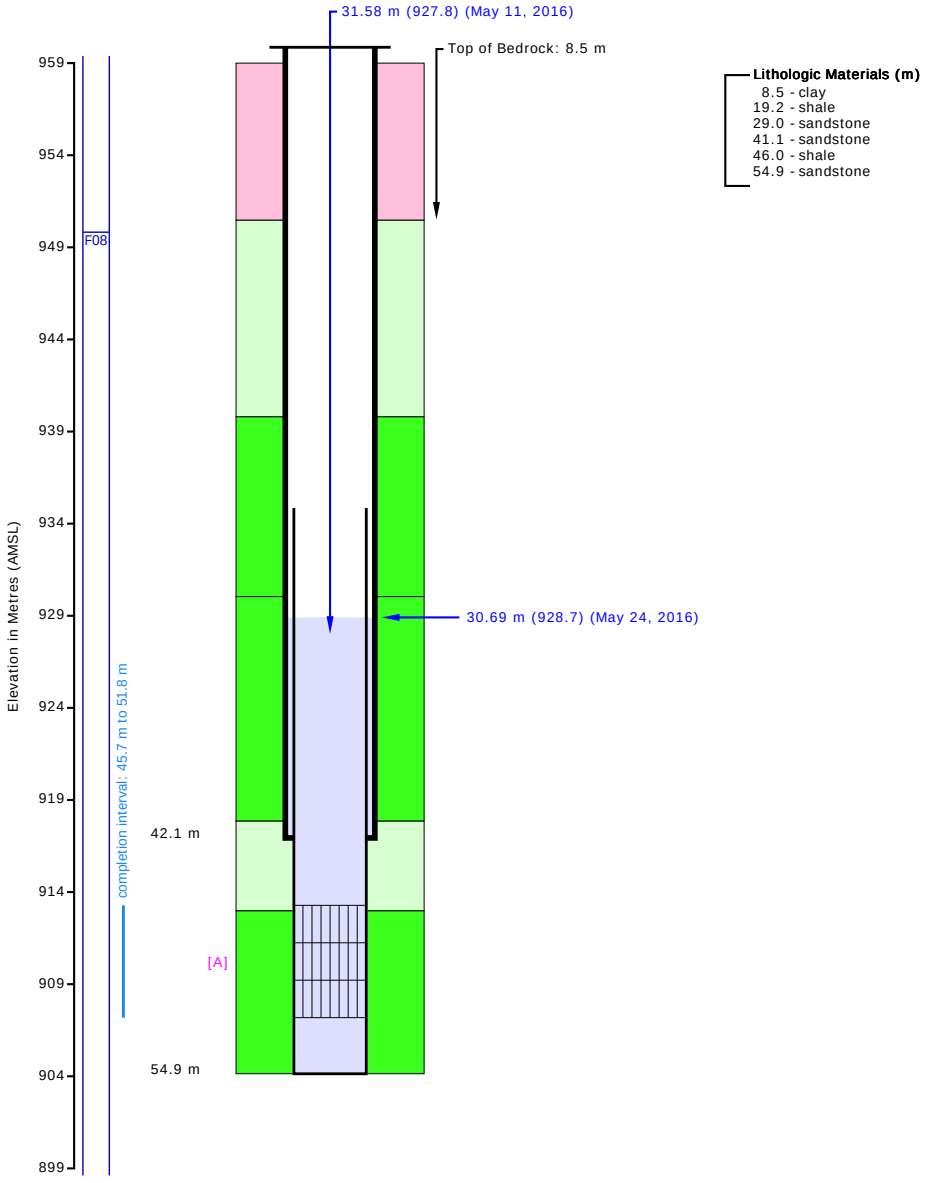
Completion Interval (m): ***45.7*** – ***51.8 ****
(TGWC determined value)*

Earliest Water Level (m): ***31.58*** – ***May 11, 2016***

Most Recent Water Level (m): ***30.69*** – ***May 24, 2016***

GIC ID: ***9826000***

2016 Water Source Well
Water Well Diagram



Lithology Legend

Surficial: Unsorted; Fine Grained; Coarse Grained

Bedrock: Fine Grained; Coarse Grained

Other

Geologic Unit Legend (Top) - Regional Analysis

F08 - Dalehurst Member

Summary

TGWC ID: M42502.496176
Well Name: 2016 Water Source Well
Legal Location: 12-21-039-03 W5M
Casing (OD): 141.3 mm; Steel (5.6")
Liner (OD): 114.3 mm; PVC (4.5")
Casing Stick-Up: 0.6 m (not drawn to scale)
Completion [A]: 45.7 to 51.8 m; Screened
Water Level (recent): 30.69 m (928.7m AMSL) on May 24, 2016 @ 12:00
Water Level (oldest): 31.58 m (927.8m AMSL) on May 11, 2016 @ 14:30

NOTE: Geologic Unit is a guide based on a regional groundwater assessment completed by Hydrogeological Consultants Ltd. (HCL) (http://www.hcl.ca) on behalf of Lacombe County in conjunction with Prairie Farm Rehabilitation Administration (P.F.R.A.).
Drawn: June 07, 2016 14:26 --- http://www.tgwc.ca

TitleComments

Owner: ***Last Hill RV Golf & Country Club***
Eckville, AB
Contractor: ***Alken Basin Drilling Ltd.***
Name: ***2016 Water Source Well***

Field Survey: ***May 24, 2016 - Confirmed - Physically***
Work Type: ***New Well*** | Date Started: ***May 11, 2016***
Drilling Method: ***Rotary & Air*** | Date Completed: ***May 11, 2016***
Proposed Use: ***Municipal*** | Well Status: ***Producing***
Completion Type: ***Casing/Perforated Liner*** | Feature Class: ***Water Well***

METRIC REPORT

12-21-039-03 W5M

M42502.496176

209863 – 2 Google

Easting (m):	***41,909*** **	86/80
Northing (m):	***5,800,363*** **	
Elevation (m):	***959*** ***	
Lot:		
Block:		
Plan:		

Presence of Gas: ***No***

Elog Taken: ***No***
Gamma Taken: ***No***
Flowing: ***No***
Stick Up (m): ***0.6***

General Details

Depth Completed (m)*: ***51.8*** | Top of Bedrock (m): ***8.5 ****
Depth Drilled (m): ***54.9*** | Completion Interval (m): ***45.7 – 51.8 ****

Completion Details

Surface Casing: ***Steel – 141.3 mm (O.D.) x 6.60 mm (thick) x 42.1 m (bottom)***
Liner: ***PVC – 114.3 mm (O.D.) x 6.00 mm (thick)***; *Top:* ***24.4 (m)***; *Bottom:* ***54.9 (m)***

Intervals

Screen: ***45.7*** *to* ***51.8 m***
Bentonite Chips & Slurry: ***0.0*** *to* ***42.1 m***
Drive Shoe: ***42.1*** *to* ***42.7 m***

Lithology Details

Elevation (AMSL)	Depth (BGL)	Lithology Descriptions (rate Lpm)
950.9	8.5	Brown Clay
940.2	19.2	Grey Shale
930.4	29.0	Brown Sandstone
918.2	41.1	Grey Sandstone
913.4	46.0	Grey Shale
904.5	54.9	Grey Sandstone

Chemistry Summary Details (mg/L, except as noted) (most recent first)

Sampling Details: ***May 24, 2016 @ 13:50***
Analysis Details: ***May 30, 2016 - Exova Canada Inc. (1139358-1)***

Constituent	Result	Constituent	Result	Constituent	Result
Conductivity (µS/cm):	***889***	Nitrate as N:	***< 0.01***	Colour (TCU):	***8***
Total Dissolved Solids:	***557***	Nitrite as N:	***< 0.005***	Turbidity (NTU):	***0.9***
Hardness (as CaCO3):	***112***	pH (pH Unit):	***8.28***	Fluoride:	***0.16***
T-Alkalinity (as CaCO3):	***488***	Ion Balance (%):	***95***	Carbonate:	***< 6***
P-Alkalinity (as CaCO3):	***< 5***	Total Coliforms:	***< 1***	Bicarbonate:	***596***
Nitrate + Nitrite as N:	***< 0.01***	Fecal Coliforms:		Hydroxide:	***< 5***
Total Suspended Solids:		Escherichia coli:	***< 1***	Total Iron:	***0.11***
Sulfate Reducing Bacteria*:				Total Mn:	***0.028***
Iron Related Bacteria**:				Temperature (°C):	***19.3***

Constituent	Extractable	Dissolved	Constituent	Extractable	Dissolved
Calcium:		***22.8***	Mercury:		
Chloride:		***1.3***	Molybdenum		
Iron:		***< 0.01***	Magnesium:		***13.4***
Manganese:		***0.023***	Sodium:		***180***
Aluminum:			Potassium:		***1.8***
Arsenic:			Vanadium:		
Barium:			Strontium:		
Beryllium:			Nickel:		
Cadmium:			Zinc:		
Chromium:			Copper:		
Cobalt:			Lead:		
Sulfate:		***44***	Uranium:		

(1 / 1)
Extractable - unfiltered
Dissolved - filtered
*** MAC Exceedence
209863

Comments: ***Sample collected by Hydrogeological Consultants Ltd. (HCL)***

Note: Constituents have been compared to the maximum acceptable concentration, Health Canada. 2014. Guidelines for Canadian Drinking Water Quality – Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safetv Branch. Health Canada. Ottawa. Ontario.

General Comments / Observations

Most Recent Water Level (m): *30.69 m – May 24, 2016*
Pump Intake BTOC (m): *45.7 on May 24, 2016*

Aquifer Tests

	Date & Time	Testing Method	Depth of Test Interval	Duration (minutes) Pumping	Recovery	Avg. Rate (Lpm)	NPWL (metres)	Drawdown (metres)	Pump (metres)	Q20 (m³/day)* Apparent	Effective	Transmissivity (m²/day)* Apparent	Aquifer	Effective	
2	2016-05-24 12:00	Pump	45.7 to 51.8	1,450	6,000	282.8	30.7	0.8	45.7	4,938.6	3,390.8		5946.0	696.0	R C
1	2016-05-11 14:30	Pump	45.7 to 51.8	120	120	172.8	31.6	0.1	—						R C

Alias IDs

GIC ID: *9826000*
GIC (WellReportID): *12029626*

** The Groundwater Centre (**TGWC**) calculated or determined value.*
*** 86 - GPS Supplied by Drilling Contractor — 10TM NAD83*
**** 80 - MT DEM — {Ground; AMSL}*

2016 Water Source Well
AEP – Water Well Drilling Report

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 9826000
GoA Well Tag No.
Drilling Company Well ID 1580
Date Report Received 2016/06/06

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LAST HILL GOLF			ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	12	21	39	3	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.372830 Longitude -114.384160
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 947.01 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Drilling Information

Method of Drilling
Rotary - Air

Type of Work
New Well

Proposed Well Use
Other

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
8.53		Brown Clay
19.20		Gray Shale
28.96		Brown Sandstone
41.15	Yes	Gray Sandstone
46.02		Gray Shale
54.86	Yes	Gray Sandstone

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 90.92 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2016/05/11	172.75	31.39

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
54.86 m	54.86 m	2016/05/11	2016/05/11

Borehole

Diameter (cm)	From (m)	To (m)
19.94	0.00	42.06
12.70	42.06	54.86

Surface Casing (if applicable)
Steel
Size OD : 14.13 cm
Wall Thickness : 0.655 cm
Bottom at : 42.06 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.602 cm
Top at : 24.38 m
Bottom at : 54.86 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
45.72	51.82	1.168		30.48

Perforated by Drill

Annular Seal Bentonite Slurry
Placed from 0.00 m to 42.06 m
Amount 150.00 Gallons

Other Seals

Type	At (m)
Drive Shoe	42.06
Shale Trap	42.67

Screen Type
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RILEY PEARSON

Certification No
83061A

Company Name
ALTAIR WATER AND DRILLING SERVICES INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2016/05/11

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 9826000
GoA Well Tag No.
Drilling Company Well ID 1580
Date Report Received 2016/06/06

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LAST HILL GOLF			ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	12	21	39	3	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.372830 Longitude -114.384160
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 947.01 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 60.96 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 90.92 L/min
Recommended Pump Intake Depth (From TOC) 45.72 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well
CAMPGROUND WELL. ADDITIONAL ANNULAR SEAL: 100 POUNDS BENTONITE CHIPS

Yield Test

Taken From Top of Casing
Measurement in Metric

Test Date 2016/05/11
Start Time 2:30 PM
Static Water Level 31.39 m

Method of Water Removal
Type PUMP
Removal Rate 172.75 L/min
Depth Withdrawn From 45.72 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
31.58	0:00	31.64
31.67	1:00	31.58
31.67	2:00	31.58
31.67	3:00	31.58
31.67	4:00	31.58
31.67	5:00	31.58
31.67	6:00	31.58
31.67	7:00	31.58
31.67	8:00	31.58
31.67	9:00	31.58
31.67	10:00	31.58
31.67	12:00	31.58
31.64	14:00	31.58
31.64	16:00	31.58
31.64	18:00	31.58
31.64	20:00	31.58
31.64	25:00	31.58
31.64	30:00	31.58
31.64	35:00	31.58
31.64	40:00	31.58
31.64	50:00	31.58
31.64	60:00	31.58
31.64	75:00	31.58
31.64	90:00	31.58
31.64	105:00	31.58
31.64	120:00	31.58

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
SHOP	5455.31	L	2016/05/11 7:30 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RILEY PEARSON

Certification No
83061A

Company Name
ALTAIR WATER AND DRILLING SERVICES INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2016/05/11

2016 Water Source Well
Chemical Analysis Results (May 30, 2016)

Exova
7217 Roper Road NW
Edmonton, Alberta
T6B 3J4, Canada

T: +1 (780) 438-5522
F: +1 (780) 434-8586
E: Edmonton@exova.com
W: www.exova.com

Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**1139358**
Report To:	Hydrogeological Consultants	ID:	16-0174.01	Control Number:	
	17740 - 118 Avenue	Name:	License a Groundwater Supply	Date Received:	May 24, 2016
	Edmonton, AB, Canada	Location:	Eckville Area	Date Reported:	May 30, 2016
	T5S 2W3	LSD:	NW 21-039-03 W5M	Report Number:	2105593
Attn:	Tara Parker	P.O.:	18129		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	1139358-1
Sample Date	May 24, 2016
Sample Time	13:50
Sample Location	
Sample Description	2016 Last Hill GC WW (M42502.496176) /
Matrix	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	0.314			0.025
Ammonium/Ammonia Preservation			Yes			
Kjeldahl Nitrogen	Total	mg/L	0.41			0.07
Phosphorus	Total	mg/L	<0.05			0.05
Sulfide	Total	mg/L	<0.002			0.002
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Dissolved						
Subsample	Field Filtered		Lab Filtered			
Metals Total						
Aluminum	Total	mg/L	0.03			0.02
Calcium	Total	mg/L	24.2			0.2
Iron	Total	mg/L	0.11			0.05
Magnesium	Total	mg/L	14.2			0.2
Manganese	Total	mg/L	0.028			0.005
Potassium	Total	mg/L	2.0			0.4
Silicon	Total	mg/L	4.56			0.05
Sodium	Total	mg/L	181			0.4
Sulfur	Total	mg/L	15.3			0.3
Mercury	Total	mg/L	<0.000005			0.000005
Antimony	Total	mg/L	<0.0002			0.0002
Arsenic	Total	mg/L	0.0004			0.0002
Barium	Total	mg/L	0.051			0.001
Beryllium	Total	mg/L	<0.0001			0.0001
Bismuth	Total	mg/L	<0.0005			0.0005
Boron	Total	mg/L	0.185			0.002
Cadmium	Total	mg/L	<0.00001			0.00001
Chromium	Total	mg/L	<0.0005			0.0005
Cobalt	Total	mg/L	<0.0001			0.0001
Copper	Total	mg/L	0.001			0.001
Lead	Total	mg/L	0.0004			0.0001
Lithium	Total	mg/L	0.040			0.001
Molybdenum	Total	mg/L	0.002			0.001
Nickel	Total	mg/L	<0.0005			0.0005
Selenium	Total	mg/L	0.0004			0.0002

Exova
7217 Roper Road NW
Edmonton, Alberta
T6B 3J4, Canada

T: +1 (780) 438-5522
F: +1 (780) 434-8586
E: Edmonton@exova.com
W: www.exova.com

Exova

Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**1139358**
Report To:	Hydrogeological Consultants	ID:	16-0174.01	Control Number:	
	17740 - 118 Avenue	Name:	License a Groundwater Supply	Date Received:	May 24, 2016
	Edmonton, AB, Canada	Location:	Eckville Area	Date Reported:	May 30, 2016
	T5S 2W3	LSD:	NW 21-039-03 W5M	Report Number:	2105593
Attn:	Tara Parker	P.O.:	18129		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	1139358-1
Sample Date	May 24, 2016
Sample Time	13:50
Sample Location	
Sample Description	2016 Last Hill GC WW (M42502.496176) /
Matrix	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Total - Continued						
Silver	Total	mg/L	<0.00001			0.00001
Strontium	Total	mg/L	0.680			0.001
Thallium	Total	mg/L	<0.00005			0.00005
Tin	Total	mg/L	<0.001			0.001
Titanium	Total	mg/L	0.0013			0.0005
Uranium	Total	mg/L	<0.0005			0.0005
Vanadium	Total	mg/L	0.0003			0.0001
Zinc	Total	mg/L	0.031			0.001
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1			1
Escherichia coli	Membrane Filtration	CFU/100 mL	<1			1
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	8			5
Turbidity		NTU	0.9			0.1
Routine Water						
pH			8.28			
Temperature of observed pH		°C	19.3			
Electrical Conductivity	at 25 °C	uS/cm	889			1
Calcium	Dissolved	mg/L	22.8			0.2
Magnesium	Dissolved	mg/L	13.4			0.2
Sodium	Dissolved	mg/L	180			0.4
Potassium	Dissolved	mg/L	1.8			0.4
Iron	Dissolved	mg/L	<0.01			0.01
Manganese	Dissolved	mg/L	0.023			0.005
Chloride	Dissolved	mg/L	1.3			0.4
Fluoride		mg/L	0.16			0.05
Nitrate - N		mg/L	<0.01			0.01
Nitrite - N		mg/L	<0.005			0.005
Nitrate and Nitrite - N		mg/L	<0.01			0.01
Sulfate (SO4)	Dissolved	mg/L	44.0			0.9
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	596			
P-Alkalinity	as CaCO3	mg/L	<5			5

Exova
7217 Roper Road NW
Edmonton, Alberta
T6B 3J4, Canada

T: +1 (780) 438-5522
F: +1 (780) 434-8586
E: Edmonton@exova.com
W: www.exova.com

Exova

Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**1139358**
Report To:	Hydrogeological Consultants	ID:	16-0174.01	Control Number:	
	17740 - 118 Avenue	Name:	License a Groundwater Supply	Date Received:	May 24, 2016
	Edmonton, AB, Canada	Location:	Eckville Area	Date Reported:	May 30, 2016
	T5S 2W3	LSD:	NW 21-039-03 W5M	Report Number:	2105593
Attn:	Tara Parker	P.O.:	18129		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	1139358-1
Sample Date	May 24, 2016
Sample Time	13:50
Sample Location	
Sample Description	2016 Last Hill GC WW (M42502.496176) /
Matrix	Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Routine Water - Continued						
T-Alkalinity	as CaCO3	mg/L	488			5
Total Dissolved Solids	Calculated	mg/L	557			1
Hardness	Dissolved as CaCO3	mg/L	112			
Ionic Balance	Dissolved	%	95			

Approved by:

Michael Yohemas, BSc
Laboratory Operations Manager

Data have been validated by Analytical Quality Control and Exova's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

1998 Clubhouse Water Well

13-21-039-03 W5M

(M36727.989175)

Well Spatial Location:

Easting: ***41,872***
Northing: ***5,800,624***
(spatial accuracy MT GPS — 10TM NAD83)

Ground Elevation AMSL (m): ***975***
(elevation accuracy MT DEM)

Date Completed: ***October 06, 1998***

Depth Drilled (m): ***73.1***

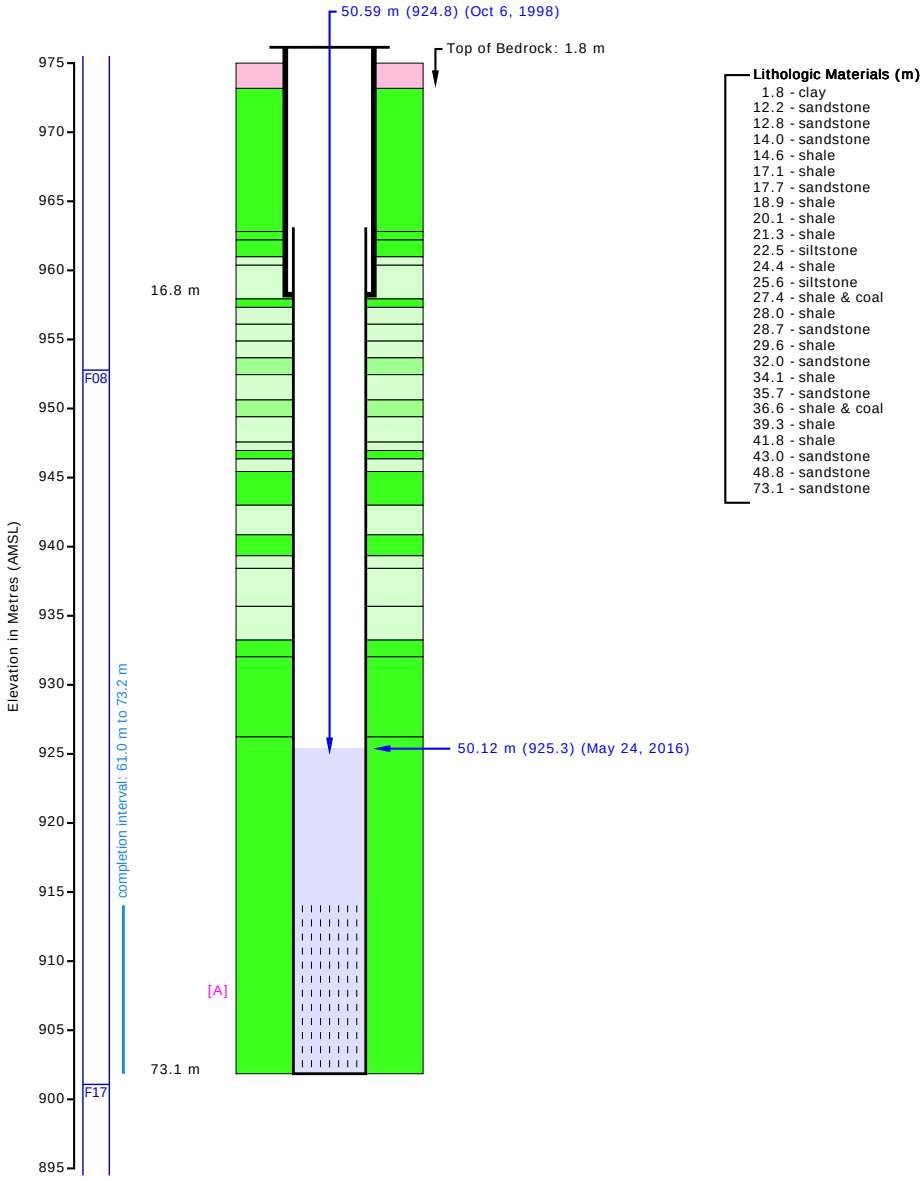
Completion Interval (m): ***61.0 – 73.2 ****
(TGWC determined value)*

Earliest Water Level (m): ***50.59 – October 06, 1998***

Most Recent Water Level (m): ***50.12 – May 24, 2016***

GIC ID: ***491534***

1998 Clubhouse Water Well
Water Well Diagram



Lithology Legend

Surficial: Unsorted; Fine Grained; Coarse Grained

Bedrock: Fine Grained; Coarse Grained

Other

Geologic Unit Legend (Top) - Regional Analysis

F08 - Dalehurst Member
F17 - Upper Lacombe Member

Summary

TGWC ID: M36727.989175
Well Name: 1998 Clubhouse Water Well
Legal Location: 13-21-039-03 W5M
Casing (OD): 139.7 mm; Steel (5.5")
Liner (OD): 114.3 mm; Plastic (4.5")
Casing Stick-Up: 0.5 m (not drawn to scale)
Completion [A]: 61.0 to 73.2 m; Slotted
Water Level (recent): 50.12 m (925.3m AMSL) on May 24, 2016 @ 12:00
Water Level (oldest): 50.59 m (924.8m AMSL) on October 6, 1998 @ 11:00

NOTE: Geologic Unit is a guide based on a regional groundwater assessment completed by Hydrogeological Consultants Ltd. (HCL) (http://www.hcl.ca) on behalf of Lacombe County in conjunction with Prairie Farm Rehabilitation Administration (P.F.R.A.).
Drawn: June 07, 2016 14:26 --- http://www.tgwc.ca

TitleComments

Owner: ***Last Hill RV Golf & Country Club***
Box 406, Eckville, AB T0M 0V0
Contractor: ***Alken Basin Drilling Ltd.***
Name: ***1998 Clubhouse Water Well***

Field Survey: ***April 28, 2016 - Confirmed - Physically***
Work Type: ***New Well*** | Date Started: ***October 6, 1998***
Drilling Method: ***Rotary*** | Date Completed: ***October 6, 1998***
Proposed Use: ***Domestic*** | Well Status: ***Producing***
Completion Type: ***Casing/Perforated Liner*** | Feature Class: ***Water Well***

METRIC REPORT

Easting (m): ***41,872.07*** ** 75/80
Northing (m): ***5,800,623.81*** **
Elevation (m): ***975*** ***
Lot:
Block:
Plan:
Rural Address: ***39325 RR 34***
Presence of Gas: ***No***

13-21-039-03 W5M

M36727.989175

000000 — 1 Google

Elog Taken: ***No***
Gamma Taken: ***No***
Flowing: ***No***
Stick Up (m): ***0.5***

General Details

Depth Completed (m)*: ***73.2***
Depth Drilled (m): ***73.1***
Top of Bedrock (m): ***1.8 ****
Completion Interval (m): ***61.0 – 73.2 ****

Completion Details

Surface Casing: ***Steel – 139.7 mm (O.D.) x 6.20 mm (thick) x 16.8 m (bottom)***
Liner: ***Plastic – 114.3 mm (O.D.) x 6.00 mm (thick)***; Top: ***12.2 (m)***; Bottom: ***73.2 (m)***

Intervals

Slotted: ***61.0*** to ***73.2 m*** - ***0.375 x 0.375*** - *Method*: ***Hand Drill***

Drive Shoe: ***0.0*** to ***16.8 m***

Chemistry Summary Details (mg/L, except as noted) (most recent first)

Lithology Details

Elevation (AMSL)	Depth (BGL)	Lithology Descriptions (rate Lpm)
973.6	1.8	Brown Clay
963.2	12.2	Brown Sandstone
962.6	12.8	Grey Sandstone
961.4	14.0	Brown Sandstone
960.8	14.6	Brown Shale
958.3	17.1	Green Shale
957.7	17.7	Brown Sandstone
956.5	18.9	Green Shale
955.3	20.1	Grey Shale
954.1	21.3	Brown Shale
952.9	22.5	Brown Siltstone
951.0	24.4	Grey Shale
949.8	25.6	Grey Siltstone
948.0	27.4	Grey Shale & Coal
947.4	28.0	Green Shale
946.8	28.7	Green Sandstone
945.8	29.6	Green Shale
943.4	32.0	Grey Sandstone
941.3	34.1	Grey Shale
939.7	35.7	Grey Sandstone
938.8	36.6	Grey Shale & Coal
936.1	39.3	Green Shale
933.6	41.8	Brownish Grey Shale
932.4	43.0	Brown Sandstone
926.6	48.8	Brownish Grey Sandstone
902.3	73.1	Grey Sandstone

General Comments / Observations

Field Survey Comments (HCL), Apr 28, 2016: Original owner: Al Halgren. Water well is located 30 metres north of the clubhouse.

Most Recent Water Level (m): *50.12 m – May 24, 2016*
Pump Intake BTOC (m): *73.2 on October 6, 1998*

Aquifer Tests

	Date & Time	Testing Method	Depth of Test Interval	Duration (minutes) Pumping	Recovery	Avg. Rate (Lpm)	NPWL (metres)	Drawdown (metres)	Pump (metres)	Q20 (m³/day)* Apparent	Effective	Transmissivity (m²/day)* Apparent	Aquifer	Effective	
	2016-05-24 12:00	--- Used as Observation Water Well During Aquifer Test No. 2 with M42502.496176 ---												527.0	R C
2	2015-04-14	Pump	[unknown]	60	60	38.6	50.1	0.0	—						R C
1	1998-10-06 11:00	Air	[unknown]	120	120	181.8	50.6	—	73.2						R C

Alias IDs

GIC ID: *491534*
GIC (WellReportID): *491534*

** The Groundwater Centre (**TGWC**) calculated or determined value.*
*** 75 - MT GPS — 10TM NAD83*
**** 80 - MT DEM — {Ground; AMSL}*

1998 Clubhouse Water Well
AEP – Water Well Drilling Report

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 491534
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1998/10/19

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
HALGREN, AL(LAST HILL GOLF COU	P.O. BOX 406 ECKVILLE				T0M 0V0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	21	039	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.373934 Longitude -114.379349
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Rotary
Type of Work: New Well
Proposed Well Use: Domestic

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
1.83		Brown Clay
12.19		Brown Sandstone
12.80		Gray Sandstone
14.02		Brown Sandstone
14.63		Brown Shale
17.07		Green Shale
17.68		Brown Sandstone
18.90		Green Shale
20.12		Gray Shale
21.34		Brown Shale
22.56		Brown Siltstone
24.38		Gray Shale
25.60		Gray Siltstone
27.43		Gray Shale & Coal
28.04		Green Shale
28.65		Green Sandstone
29.57		Green Shale
32.00		Gray Sandstone
34.14		Gray Shale
35.66		Gray Sandstone
36.58		Gray Shale & Coal
39.32		Green Shale
41.76		Brownish Gray Shale
42.98		Brown Sandstone
48.77		Brownish Gray Sandstone
73.15		Gray Sandstone

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 181.84 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1998/10/06	181.84	50.60

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
73.15 m		1998/10/06	1998/10/06

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	73.15

Surface Casing (if applicable)
Steel
Size OD : 13.97 cm
Wall Thickness : 0.620 cm
Bottom at : 16.76 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.602 cm
Top at : 12.19 m
Bottom at : 73.15 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
60.96	73.15	0.953		0.95

Perforated by Hand Drill

Annular Seal Drive Shoe
Placed from 0.00 m to 16.76 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: ALKEN BASIN DRILLING LTD.
Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 491534
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1998/10/19

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
HALGREN, AL(LAST HILL GOLF COU	P.O. BOX 406 ECKVILLE				T0M 0V0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	21	039	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.373934 Longitude -114.379349
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 181.84 L/min
Recommended Pump Intake Depth (From TOC) 64.01 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 2'.

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1998/10/06	12:00 AM	50.60 m

Method of Water Removal
Type Air
Removal Rate 181.84 L/min
Depth Withdrawn From 73.15 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
	1:00	50.60
	5:00	50.60
	10:00	50.60
	20:00	50.60
	120:00	50.60

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
ALKEN BASIN DRILLING LTD.

Copy of Well report provided to owner
Date approval holder signed

Appendix C – Extended Aquifer Test Details

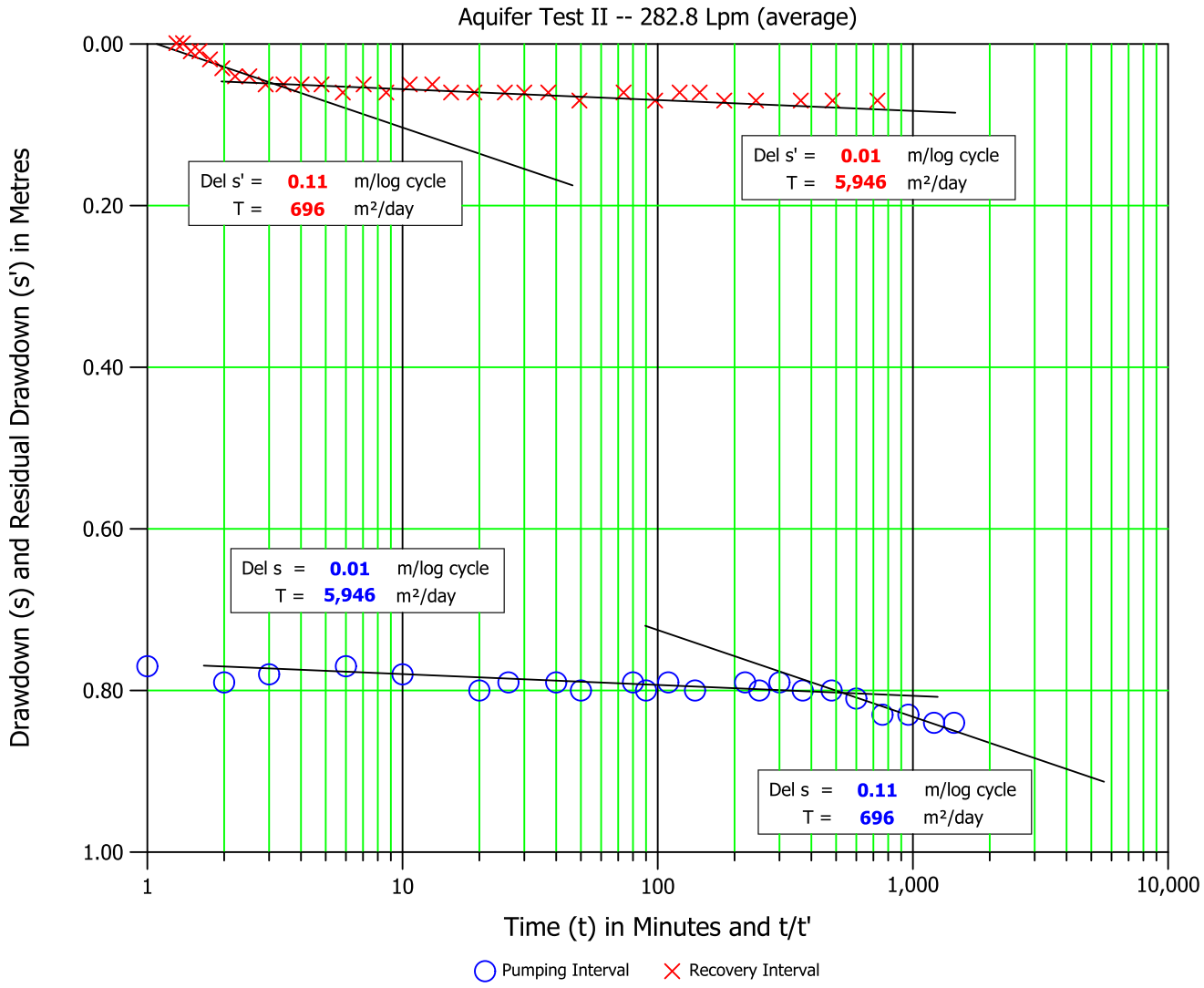
TABLE OF CONTENTS

Aquifer Test II with the 2016 Water Source Well

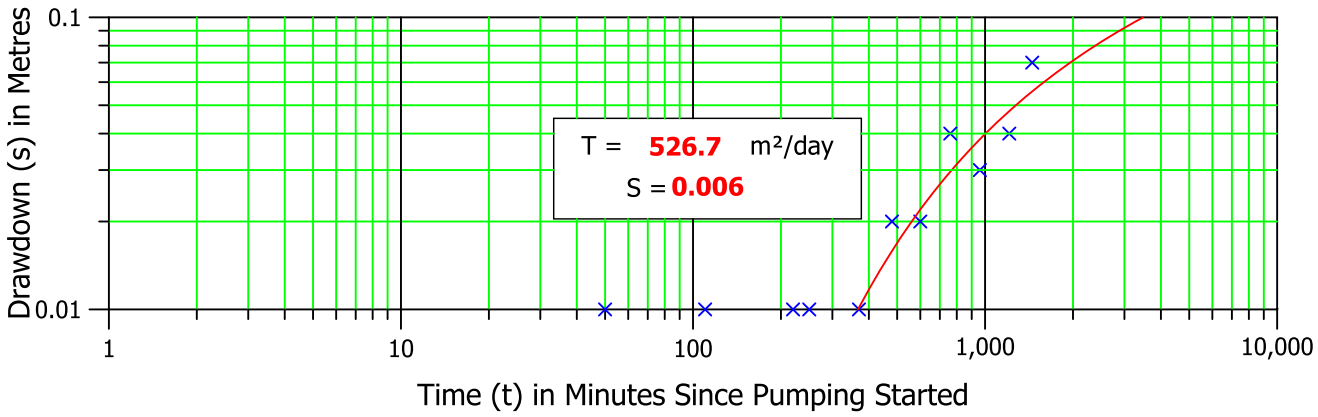
Test Started: May 24, 2016 @ 12:00 Hrs
Discharge (Lpm): 282.8

	NPWL (m BTOC)	Distance from Pumped Water Well (m)
Pumped Water Well:		
2016 Water Source Well	30.69	[redacted]
Observation Water Well:		
1998 Clubhouse Water Well	50.12	263

Aquifer Test II
Pumped Water Well (2016 Water Source Well)



1998 Clubhouse Water Well
Used as Observation Water Well
during Aquifer Test II with 2016 Water Source Well – Graph



Average Discharge Rate (Lpm): 282.8
Distance from pumped water well (M42502.496176) (m): 263

Aquifer Test II Data

Pumped Water Well:

2016 Water Source Well

Observation Water Well:

1998 Clubhouse Water Well

2016 Water Source Well

Aquifer Test II

12-21-039-03 W5M

Average Discharge (Lpm):	**282.8**	Pre-Test Water Level - NPWL (m):	**30.69**
Date Test Started:	**May 24, 2016**	Depth to Pump Intake (m):	**45.7**
Time Test Started (hours):	**12:00**	Test Interval — Top (m):	**45.7**
Pumping Interval (minutes):	**1,450**	Test Interval — Bottom (m):	**51.8**
Recovery Interval (minutes):	**6,000**	Top of Main Aquifer (m):*	**46.0**

***N/A** - Information Not Available*

Reference: M42502.496176 (AT 2)

** **TGWC** calculated or determined value.*

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (metres)	Discharge (Lpm)
1	0.77	282.0
2	0.79	282.0
3	0.78	282.0
6	0.77	282.0
10	0.78	282.0
20	0.80	282.7
26	0.79	282.0
40	0.79	282.8
50	0.80	283.0
80	0.79	282.7
90	0.80	282.5
110	0.79	282.9
140	0.80	281.9
220	0.79	281.3
250	0.80	281.6
300	0.79	281.4
370	0.80	282.0
480	0.80	281.0
600	0.81	282.0
760	0.83	283.0
960	0.83	284.0
1,210	0.84	285.0
1,450	0.84	282.0

Recovery Interval

Measurement Point: Top of Casing

Time (t') Since Pumping Stopped (minutes)	(t/t')	Residual Drawdown (s') (metres)
2	726	0.07
3	484	0.07
4	364	0.07
6	243	0.07
8	182	0.07
10	146	0.06
12	122	0.06
15	98	0.07
20	74	0.06
30	49	0.07
40	37	0.06
50	30	0.06
60	25	0.06
80	19.1	0.06
100	15.5	0.06
120	13.1	0.05
150	10.7	0.05
190	8.6	0.06
240	7.0	0.05
300	5.8	0.06
380	4.8	0.05
480	4.0	0.05
600	3.4	0.05
760	2.9	0.05
960	2.5	0.04
1,200	2.2	0.04
1,500	2.0	0.03
1,900	1.76	0.02
2,400	1.60	0.01
3,000	1.48	0.01
3,800	1.38	0.00
4,800	1.30	0.00
6,000	1.24	0.00

Test Comments:

Aquifer test conducted by Hydrogeological Consultants Ltd.

1998 Clubhouse Water Well

Used as Observation Water Well During
Aquifer Test II with 2016 Water Source Well

13-21-039-03 W5M

Pumped Well: Average Discharge (Lpm):	**282.8**	Pre-Test Water Level - NPWL (m):	**50.12**
Pumped Well: Date Test Started:	**May 24, 2016**	Distance From Pumped Well (m):	**263**
Pumped Well: Time Test Started (hours):	**12:00**	Test Interval — Top (m):	**61.0**
Pumped Well: Pumping Interval (minutes):	**1,450**	Test Interval — Bottom (m):	**73.2**
Pumped Well: Recovery Interval (minutes):	**6,000**	Top of Main Aquifer (m):*	**48.8**

***N/A** - Information Not Available*

Obs: M36727.989175; 1.1 — Pumped: M42502.496176; 2

** **TGWC** calculated or determined value.*

This report was generated on: June 06, 2016 — Data "AS IS"; no warranty either expressed or implied. © TGWC — Page 1 of 1

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (metres)
1	0.00
2	-0.01
3	-0.01
6	-0.01
10	-0.01
20	0.00
26	0.00
40	-0.01
50	0.01
80	0.00
90	-0.01
110	0.01
140	0.00
220	0.01
250	0.01
300	0.00
370	0.01
480	0.02
600	0.02
760	0.04
960	0.03
1,210	0.04
1,450	0.07

Recovery Interval

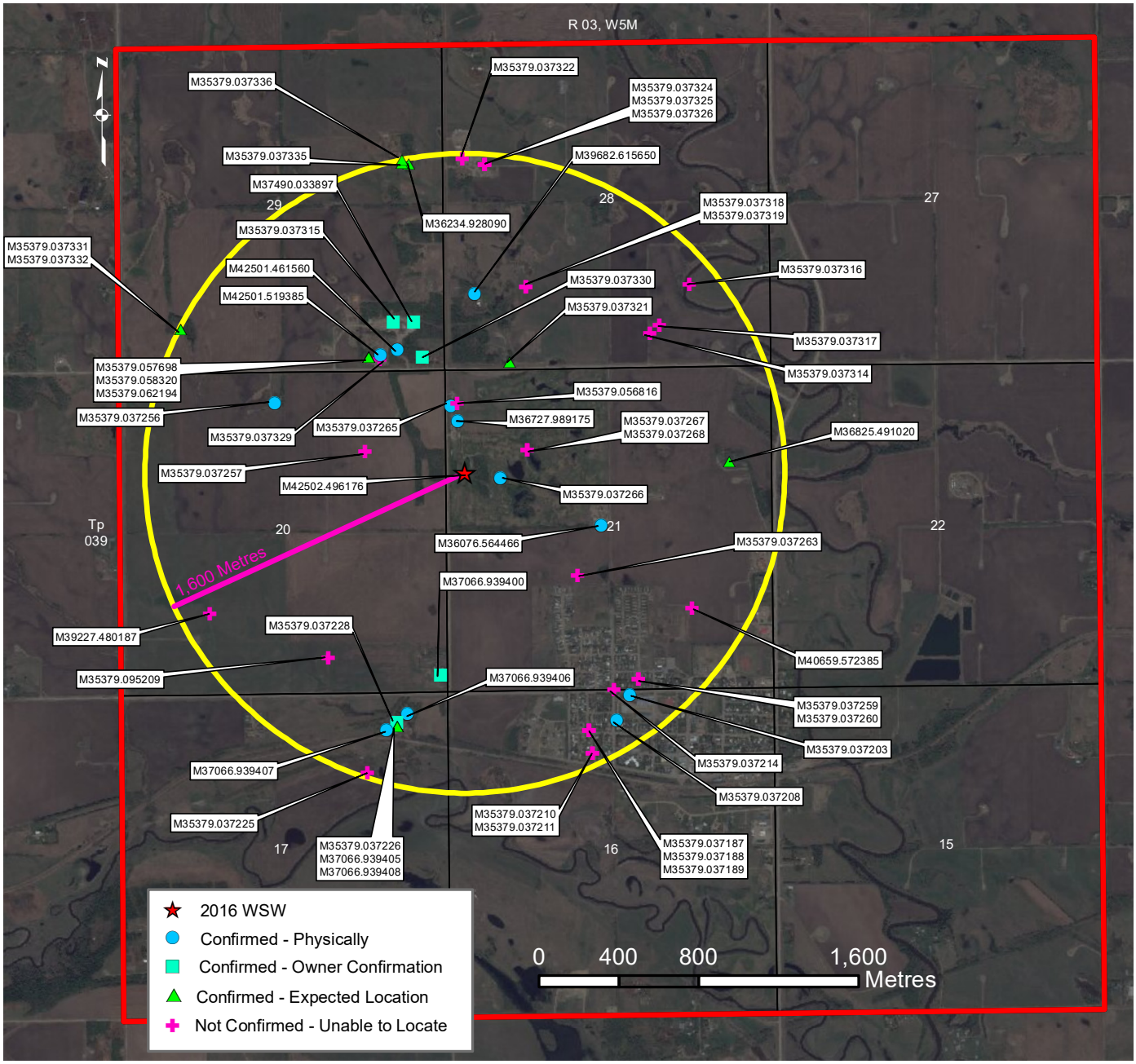
Measurement Point: Top of Casing

Time (t') Since Pumping Stopped (minutes)	(t/t')	Residual Drawdown (s') (metres)
2	726	0.06
3	484	0.06
4	364	0.07
6	243	0.06
8	182	0.06
10	146	0.06
12	122	0.06
15	98	0.07
20	74	0.06
30	49	0.07
40	37	0.06
50	30	0.06
60	25	0.06
80	19.1	0.04
100	15.5	0.05
120	13.1	0.05
150	10.7	0.04
190	8.6	0.04
240	7.0	0.05
300	5.8	0.05
380	4.8	0.04
480	4.0	0.04
600	3.4	0.04
760	2.9	0.04
960	2.5	0.03
1,200	2.2	0.04
1,500	2.0	0.02
1,900	1.76	0.02
2,400	1.60	0.01
3,000	1.48	0.01
3,800	1.38	0.00
4,800	1.30	0.00
6,000	1.24	-0.01

Test Comments:

Aquifer test conducted by Hydrogeological Consultants Ltd.

Appendix D – Water Well Survey



Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 1 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Last Hill RV Golf & Country Club	Last Hill RV Golf & Country Club	Last Hill RV Golf & Country Club	Weeks, F.	Kingsep, L.	Bender, Doug & Dianna
Legal Location	**12-21-039-03 W5M**	**11-21-039-03 W5M**	**13-21-039-03 W5M**	**NW 21-039-03 W5M**	**NW 21-039-03 W5M**	**13-21-039-03 W5M**
Ground Elevation	959.4 m	946.9 m	975.4 m	944.1 m	944.1 m	978.4 m
Well Type	New Well	New Well	New Well	Federal Well Survey	Federal Well Survey	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	54.9 m	103.6 m	73.1 m	42.7 m	18.3 m	67.1 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	15.0 m	18.5 m	10.8 m	-	-	-
Max. Pumping Rate	282.8 Lpm	386.4 Lpm	282.8 Lpm	-	-	27.3 Lpm
Completion Details	45.7 - 51.8 m	36.6 - 70.7 m	61.0 - 73.2 m			35.0 - 67.1 m
Distance	0 m	180 m	263 m	337 m	337 m	343 m
Earliest Water Level	May 11, 2016	Sep 01, 1981	Oct 06, 1998	Jul 06, 1950	-	Apr 19, 1972
	31.6 m	18.3 m	50.6 m	27.4 m	-	47.9 m
Latest Water Level	2016-05-24	2016-05-30	2016-05-24	1950-07-06	-	2005-11-25
	30.7 m	18.1 m	50.1 m	27.4 m	-	39.1 m
Daily Use	-	-	~2,046 L	-	-	-
Number of Chemistries (latest analysis)	1 May 30, 2016	-	-	-	-	-
Comments		Original owner: Halgren, Al. Water well is located on fairway 11 east of the dugout.	Original owner: Al Halgren. Water well is located 30 metres north of the clubhouse.			Seal type listed as 'Driven' but no interval defined.
AENV Well ID(s)		429555	491534	429556	429557	429554
Licensed/Registered Diversion	-	3.4 m³/day	1.2 m³/day	-	-	-

Consultant Details						
TGWC ID	M42502.496176	M35379.037266	M36727.989175	M35379.037267	M35379.037268	M35379.037265
Date Verified	May 24, 2016	May 30, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(01) Confirmed - Physically	(01) Confirmed - Physically	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically
Well Name	2016 Water Source Well	1981 Water Well	1998 Clubhouse Water Well	[unknown]	[unknown]	1972 Bender Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 2 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Hallgren, Al	Forhan, A.G.	Kasper, N.	Matthews, Cliff	Medicine River Oil Recyclers Ltd.	Marshall, A.J.
Legal Location	**NW 21-039-03 W5M**	**NE 20-039-03 W5M**	**SW 28-039-03 W5M**	**01-29-039-03 W5M**	**SE 29-039-03 W5M**	**01-29-039-03 W5M**
Ground Elevation	975.5 m	953.1 m	944.7 m	975.6 m	971.6 m	969.1 m
Well Type	New Well	Federal Well Survey	Federal Well Survey	Well Inventory	Well Inventory	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	36.6 m	32.0 m	30.5 m	56.4 m	-	27.4 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	16.5 m	-	-	-		-
Max. Pumping Rate	54.6 Lpm	-	-	-	-	45.5 Lpm
Completion Details	22.6 - 30.5 m					14.0 - 27.4 m
Distance	353 m	512 m	601 m	617 m	704 m	711 m
Earliest Water Level	Oct 20, 1988	-	Jun 11, 1969	Jan 01, 1962	Jan 04, 2003	Aug 17, 1961
	6.1 m	-	21.3 m	47.2 m	47.3 m	7.6 m
Latest Water Level	1988-10-20	-	1969-06-11	1962-01-01	2016-03-29	1961-08-17
	6.1 m	-	21.3 m	47.2 m	46.8 m	7.6 m
Daily Use	-	-	-	-	-	-
Number of Chemistries	-	-	1	-	1	-
(latest analysis)			Dec 15, 1969		Jan 31, 2006	
Comments	Originally listed as NW 11-39-2 W5M.			Water well is located in water well pit 20 metres southwest of the house beside a power pole.	[Hydrogeological Consultants Ltd. (HCL) field survey (April 2016), water well is located 1 metre west of the main office.	Seal type listed as 'Driven' but no interval defined.
AENV Well ID(s)	355204	429546	429610	429619		429618
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.056816	M35379.037257	M35379.037321	M35379.037330	M42501.461560	M35379.037329
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location	(02) Confirmed - Owner Confirmation	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate
Well Name	[unknown]	[unknown]	[unknown]	1962 Matthews Water Well	Main Office Water Well	[unknown]

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Parameter						
Owner / Lessee	Medicine River Oil Recyclers Ltd.	Newalta Corporation Ltd.	Elgert, Fred	Elgert, Fred	Elgert, Fred	Jennings Drilling Company Ltd.
Legal Location	**SE 29-039-03 W5M**	**11-21-039-03 W5M**	**SE 29-039-03 W5M**	**SE 29-039-03 W5M**	**SE 29-039-03 W5M**	**06-21-039-03 W5M**
Ground Elevation	969.1 m	943.9 m	967.4 m	967.4 m	967.4 m	942.1 m
Well Type	Well Inventory	New Well	Well Inventory	Chemistry	Chemistry	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	-	36.0 m	54.9 m	42.7 m	51.8 m	29.0 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	11.5 m	-	-	-	-
Max. Pumping Rate	-	454.6 Lpm	90.9 Lpm	-	-	113.7 Lpm
Completion Details		29.9 - 36.0 m	48.8 - 54.9 m			6.7 - 29.0 m
Distance	725 m	732 m	751 m	751 m	751 m	762 m
Earliest Water Level	-	Oct 26, 1985	Jan 01, 1965	-	-	Mar 23, 1961
	-	19.2 m	6.1 m	-	-	18.3 m
Latest Water Level	-	2016-04-28	1965-01-01	-	-	1961-03-23
	-	18.4 m	6.1 m	-	-	18.3 m
Daily Use	-	-	-	-	-	-
Number of Chemistries (latest analysis)	-	2 Aug 03, 1994	-	-	-	-
Comments	[Hydrogeological Consultants Ltd. (HCL) field survey (April 2016), water well located 25 metres west of the west office building on-site that is rented by Terra Firma.]	Water well is located west of the office and is used to supply water to the office and also washing.				Seal type listed as 'Driven' but no interval defined.
AENV Well ID(s)			356100	356729	360670	429552
Licensed/Registered Diversion	-	6.8 m^3/day	-	-	-	-

Consultant Details						
TGWC ID	M42501.519385	M36076.564466	M35379.057698	M35379.058320	M35379.062194	M35379.037263
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(01) Confirmed - Physically	(01) Confirmed - Physically	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(04) Not Confirmed - Unable to Locate
Well Name	West Shop Water Well	1985 Water Source Well	[unknown]	Well No. 1	Well No. 2	[unknown]

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 4 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Medicine River Oil Recycle	Fred's Trucking & Oilfield Service Ltd	Hallgren, Allan	Hoskey, E.A.	Flater, Ronald	McDonnell, D.
Legal Location	**SE 29-039-03 W5M**	**01-29-039-03 W5M**	**SW 28-039-03 W5M**	**SW 28-039-03 W5M**	**SW 28-039-03 W5M**	**NW 20-039-03 W5M**
Ground Elevation	963.4 m	965.3 m	943.1 m	940.9 m	940.9 m	946.6 m
Well Type	New Well	New Well	New Well	Federal Well Survey	Chemistry	Federal Well Survey
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	61.0 m	61.0 m	36.6 m	24.4 m	-	33.5 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	14.4 m	18.0 m	-	-	-
Max. Pumping Rate	143.6 Lpm	113.7 Lpm	136.4 Lpm	-	-	-
Completion Details	48.8 - 61.0 m	42.7 - 54.9 m	0.0 - 36.6 m			9.8 - 33.5 m
Distance	798 m	836 m	899 m	983 m	983 m	1,011 m
Earliest Water Level	May 28, 2001	Nov 05, 1982	Aug 20, 2001	Jul 05, 1950	-	Jul 17, 1950
	47.2 m	48.8 m	18.1 m	7.6 m	-	27.4 m
Latest Water Level	2006-01-05	2016-03-29	2016-04-28	1950-07-05	-	1950-07-17
	41.7 m	40.4 m	18.6 m	7.6 m	-	27.4 m
Daily Use	~3,549 L	-	~1 L	-	-	-
Number of Chemistries (latest analysis)	1 Jan 11, 2006	1 Jan 11, 2006	-	-	-	-
Comments	Hydrogeological Consultants Ltd. (HCL) field survey, the 2001 Soil Wash Water Well is located west of the boiler and nothwest side of the facility. The water is used for processing purposes as well as retaining water to upstream oil and gas industries.	[Original owner: Elgert, Fred] [The shop water well is located inside the shop building within the facility. Original listed with legal: 02-28-039-03 W5M, legal updated to SE 29-039-03 W5M. The water well is used for industrial process, tank washing purposes and retailing.] [Hydrogeological Consultants Ltd. (HCL) field survey (April 2016).]	Original listed as legal location: NW 21-039-03 W5M, legal updated to SW 28-039-03 W5M. Water well is located 5			
AENV Well ID(s)	498590	429604	1045197	429607	429608	429545
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M37490.033897	M35379.037315	M39682.615650	M35379.037318	M35379.037319	M35379.037256
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	May 30, 2016
Verification Status	(02) Confirmed - Owner Confirmation	(02) Confirmed - Owner Confirmation	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically
Well Name	2001 Soil Wash Water Well	1982 Shop Water Well	2001 Halgren Water Well	[unknown]	[unknown]	1936 McDonnell Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 5 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Smith, Cameraon	Lohman & Johnson Drilling Company	Armeneau, George	Maki, Bill	Carritt, Jamie & Stacey	Carritt, Laurie
Legal Location	**01-20-039-03 W5M**	**02-20-039-03 W5M**	**SE 28-039-03 W5M**	**02-28-039-03 W5M**	**16-17-039-03 W5M**	**NE 17-039-03 W5M**
Ground Elevation	937.7 m	928.5 m	932.6 m	931.3 m	927.1 m	926.4 m
Well Type	Well Inventory	New Well	New Well	New Well	New Well	Well Inventory
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	21.3 m	15.2 m	22.9 m	27.4 m	19.8 m	21.3 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	13.7 m	-	-
Max. Pumping Rate	-	181.8 Lpm	-	45.5 Lpm	113.7 Lpm	-
Completion Details		4.9 - 15.2 m	17.1 - 22.9 m	15.2 - 27.4 m	15.5 - 19.8 m	
Distance	1,020 m	1,147 m	1,164 m	1,224 m	1,238 m	1,295 m
Earliest Water Level	Sep 09, 1969	Aug 28, 1962	-	May 15, 1963	Oct 10, 1963	Jan 01, 1960
	12.2 m	2.1 m	-	13.7 m	3.1 m	3.1 m
Latest Water Level	1969-09-09	1962-08-28	-	1963-05-15	2016-04-28	1960-01-01
	12.2 m	2.1 m	-	13.7 m	2.6 m	3.1 m
Daily Use	-	-	-	-	-	-
Number of Chemistries (latest analysis)	-	-	-	-	-	-
Comments		Originally listed as 16-039-03w5 Seal type listed as 'Driven' but no interval defined.		Seal type listed as 'Cement/Grout' but no interval defined.	Water well is located in the northwest corner in the basement. No water well cap, jet pump. Bottom of basement floor to ground level: 1.65 metres. Casing stick-up from basement floor: 0.27 metres.	water well located in the old milk barn building.
AENV Well ID(s)	485439; 485440	393883	429603	429606	485434	429517
Licensed/Registered Diversion	-	-	-	-	-	0.3 m³/day

Consultant Details						
TGWC ID	M37066.939400	M35379.095209	M35379.037314	M35379.037317	M37066.939406	M35379.037228
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(02) Confirmed - Owner Confirmation	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(02) Confirmed - Owner Confirmation
Well Name	Smith Water Well	[unknown]	[unknown]	[unknown]	1963 Carritt Water Well	1960 Milk Barn Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 6 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	McDonald, D.	Mcdonald, E.	Mcdonald, D.	Village of Eckville	Medicine Valley Transport	Eliuk, M. & D.
Legal Location	**NE 17-039-03 W5M**	**NE 17-039-03 W5M**	**NE 17-039-03 W5M**	**·· 16-039-03 W5M**	**SE 21-039-03 W5M**	**NE 21-039-03 W5M**
Ground Elevation	926.4 m	926.4 m	926.4 m	940.2 m	939.7 m	934.3 m
Well Type	Federal Well Survey	Well Inventory	Federal Well Survey	New Well	New Well	Well Inventory
Water Status	Producing	Producing	Producing	Producing	[unknown]	Producing
Well Depth Drilled	9.8 m	21.3 m	24.4 m	33.5 m	34.4 m	18.3 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	14.9 m	-	-
Max. Pumping Rate	-	-	-	213.7 Lpm	136.4 Lpm	-
Completion Details				9.1 - 33.5 m	21.3 - 32.0 m	
Distance	1,311 m	1,311 m	1,311 m	1,313 m	1,323 m	1,325 m
Earliest Water Level	Jul 17, 1950	Jan 01, 1964	Jul 17, 1950	Jul 24, 1964	Aug 26, 2010	-
	2.4 m	3.1 m	9.2 m	18.6 m	16.5 m	-
Latest Water Level	1950-07-17	1964-01-01	1950-07-17	1964-07-24	2010-08-26	-
	2.4 m	3.1 m	9.2 m	18.6 m	16.5 m	-
Daily Use	-	-	-	-	-	-
Number of Chemistries (latest analysis)	-	-	-	1 Jul 30, 1964	-	-
Comments				Seal type listed as 'Driven' but no interval defined.		
AENV Well ID(s)	429515	485435	485432	429503	1066249	
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.037226	M37066.939405	M37066.939408	M35379.037214	M40659.572385	M36825.491020
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location
Well Name	[unknown]	[unknown]	[unknown]	1964 Observation Water Well	[unknown]	Eliuk Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 7 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Carritt, Laurie	Korhonen, E.	Medicine Valley Transport	Town of Eckville	Neufeld, J. L.	Alberta Wheat Pool Ltd.
Legal Location	**NE 17-039-03 W5M**	**SE 21-039-03 W5M**	**SE 21-039-03 W5M**	**15-16-039-03 W5M**	**NW 16-039-03 W5M**	**NW 16-039-03 W5M**
Ground Elevation	926.0 m	939.9 m	939.9 m	939.3 m	936.8 m	936.8 m
Well Type	Well Inventory	New Well	New Well	New Well	Well Inventory	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	21.3 m	30.5 m	28.0 m	48.5 m	27.4 m	36.3 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	14.3 m	24.6 m	-	-
Max. Pumping Rate	-	45.5 Lpm	136.4 Lpm	681.9 Lpm	159.1 Lpm	68.2 Lpm
Completion Details		9.1 - 30.5 m	11.6 - 28.0 m	19.8 - 46.9 m	12.2 - 27.4 m	25.3 - 36.3 m
Distance	1,344 m	1,347 m	1,347 m	1,384 m	1,427 m	1,427 m
Earliest Water Level	Jan 01, 1949	Nov 06, 1961	Oct 31, 1987	May 27, 1987	Mar 18, 1964	Apr 13, 1981
	3.1 m	18.3 m	13.7 m	21.0 m	15.2 m	15.9 m
Latest Water Level	2016-04-28	1961-11-06	1987-10-31	2016-04-28	1964-03-18	1981-04-13
	6.3 m	18.3 m	13.7 m	22.4 m	15.2 m	15.9 m
Daily Use	-	-	-	-	-	-
Number of Chemistries (latest analysis)	-	-	-	-	1 Apr 22, 1964	-
Comments	Water well located in basement of the house (east side). Casing stick-up is 0.09 metres above basement floor. Basement floor to ground level is 2.22 metres.	Seal type listed as 'Driven' but no interval defined.		Hydrogeological Consultants Ltd. (HCL) field survey, WSW No. 3 is located on northeast corner of the reservoir inside cribbing.	Seal type listed as 'Driven' but no interval defined.	Water at 20'.
AENV Well ID(s)	485433	429548	429549	429492	429476	429477
Licensed/Registered Diversion	-	-	-	159 m^3/day	-	-

Consultant Details						
TGWC ID	M37066.939407	M35379.037259	M35379.037260	M35379.037203	M35379.037187	M35379.037188
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	1949 Carritt Water Well	[unknown]	[unknown]	Water Source Well No. 3	[unknown]	[unknown]

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 8 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	NMR Propane	Town of Eckville	Smith, Murry	Liliedahl, Dwight	Lazzer, Walter	Davenport, Carl
Legal Location	**NW 16-039-03 W5M**	**15-16-039-03 W5M**	**SW 20-039-03 W5M**	**SE 28-039-03 W5M**	**·· 16-039-03 W5M**	**·· 16-039-03 W5M**
Ground Elevation	936.8 m	937.1 m	930.0 m	923.7 m	933.5 m	933.5 m
Well Type	New Well	New Well	New Well	Chemistry	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	80.8 m	45.7 m	24.4 m	-	25.0 m	24.7 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	37.5 m	-	9.4 m	-	-	-
Max. Pumping Rate	27.3 Lpm	-	272.8 Lpm	-	136.4 Lpm	136.4 Lpm
Completion Details	53.3 - 77.7 m	18.3 - 45.7 m	12.2 - 18.3 m		15.2 - 25.0 m	10.7 - 24.7 m
Distance	1,427 m	1,450 m	1,457 m	1,467 m	1,537 m	1,537 m
Earliest Water Level	Oct 17, 1988	Nov 01, 1971	Nov 09, 2005	-	Sep 04, 1962	Sep 03, 1962
	15.9 m	17.7 m	8.8 m	-	13.7 m	12.2 m
Latest Water Level	1988-10-17	2016-04-28	2005-11-09	-	1962-09-04	1962-09-03
	15.9 m	19.9 m	8.8 m	-	13.7 m	12.2 m
Daily Use	-	-	-	-	-	-
Number of Chemistries (latest analysis)	-	-	-	-	-	-
Comments		[Seal type listed as 'Driven' but no interval defined.] [Hydrogeological Consultants Ltd. (HCL) field survey (April 2016), water well is located inside building on the southwest corner of the Lions campground.]			Seal type listed as 'Loose' but no interval defined.	Seal type listed as 'Loose' but no interval defined.
AENV Well ID(s)	429478	429497	1060910	429605	429499	429500
Licensed/Registered Diversion	-	328 m³/day	8.2 m³/day	-	-	-

Consultant Details						
TGWC ID	M35379.037189	M35379.037208	M39227.480187	M35379.037316	M35379.037210	M35379.037211
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	[unknown]	Water Source Well No. 2	[unknown]	[unknown]	[unknown]	[unknown]

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Page: 9 of 10: Printed on June 06, 2016

Parameter						
Owner / Lessee	Hudson's Bay Oil & Gas Company Ltd.	Hudson's Bay Oil & Gas Company Ltd.	Dome Petroleum Ltd.	Bromling, Clint	Elson, Verner	[unknown]
Legal Location	**12-28-039-03 W5M**	**12-28-039-03 W5M**	**12-28-039-03 W5M**	**NE 29-039-03 W5M**	**NW 28-039-03 W5M**	**NE 17-039-03 W5M**
Ground Elevation	943.2 m	943.2 m	943.2 m	949.4 m	944.0 m	923.8 m
Well Type	New Well	New Well	Chemistry	New Well	New Well	Chemistry
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth Drilled	113.7 m	111.9 m	-	48.8 m	39.0 m	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	-	-	-
Max. Pumping Rate	-	-	-	181.8 Lpm	-	-
Completion Details	68.6 - 96.6 m	64.3 - 95.4 m		30.5 - 48.8 m	37.2 - 39.0 m	
Distance	1,547 m	1,547 m	1,547 m	1,570 m	1,572 m	1,577 m
Earliest Water Level	-	-	-	Jul 28, 1997	-	-
	-	-	-	24.1 m	-	-
Latest Water Level	-	-	-	2005-11-25	-	-
	-	-	-	25.8 m	-	-
Daily Use	-	-	-	~1,818 L	-	-
Number of Chemistries (latest analysis)	-	-	-	-	-	-
Comments				Data from Matrix Solutions August 2006 report, water well is located north of the trailer.]	Seal type listed as 'Driven' but no interval defined.	
AENV Well ID(s)	429613	429614	429615	467435	429611	429514
Licensed/Registered Diversion	254 m³/day	254 m³/day	-	-	1.2 m³/day	-

Consultant Details						
TGWC ID	M35379.037324	M35379.037325	M35379.037326	M36234.928090	M35379.037322	M35379.037225
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	[unknown]	[unknown]	[unknown]	1997 Bromling Water Well	[unknown]	[unknown]

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: 2016 Water Source Well

Parameter				
Owner / Lessee	Bromling, Clint	Gustafson, C.	Gustavson, G.	Bromling, Clint
Legal Location	**NE 29-039-03 W5M**	**SW 29-039-03 W5M**	**03-29-039-03 W5M**	**09-29-039-03 W5M**
Ground Elevation	950.1 m	955.8 m	955.8 m	950.2 m
Well Type	New Well	Federal Well Survey	New Well	Chemistry
Water Status	Producing	Producing	Producing	Not In Use
Well Depth Drilled	32.0 m	30.5 m	31.1 m	-
Top of Aquifer	-	-	-	-
Total Available Head	7.5 m	-	-	-
Max. Pumping Rate	81.8 Lpm	-	45.5 Lpm	-
Completion Details	21.0 - 32.0 m		24.4 - 31.1 m	
Distance	1,581 m	1,594 m	1,594 m	1,597 m
Earliest Water Level	Jun 07, 1983	Jul 07, 1950	Jun 30, 1967	-
	23.8 m	6.1 m	13.4 m	-
Latest Water Level	2005-11-25	1950-07-07	1967-06-30	-
	24.5 m	6.1 m	13.4 m	-
Daily Use	-	-	-	-
Number of Chemistries (latest analysis)	-	-	1 Jun 27, 1974	-
Comments	[Data from Matrix Solutions August 2006 report, water well is located southwest of old house.]			Data from Matrix Solutions August 2006 report, water well is located in house and is not in use.]
AENV Well ID(s)	429624	429620	429621	429625
Licensed/Registered Diversion	-	-	-	-

Consultant Details				
TGWC ID	M35379.037335	M35379.037331	M35379.037332	M35379.037336
Date Verified	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016	Apr 28, 2016
Verification Status	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location
Well Name	1983 Bromling Water Well	[unknown]	[unknown]	Old House Water Well