BY-LAW NUMBER 2015/39

BY-LAW NO. 2015/39 is a By-law of the County of Wetaskiwin No. 10 in the Province of Alberta, to authorize the adoption of an Area Structure Plan for the purpose of providing a framework for subsequent subdivision and development of the area known as the Fritz and Christina Martin Area Structure Plan within NE 4-47-24-W4M, Plan 3489TR, Lot 6, in accordance with Section 633 of the Municipal Government Act, Chapter M-26.1, Revised Statues of Alberta 2000, and amendments thereto.

WHEREAS: At the requirements of County Council, as per Policy 6606, an Area Structure Plan has been prepared for NE 4-47-24-W4M, Plan 3489TR, Lot 6

AND WHEREAS: The proposed Area Structure Plan has been widely circulated and discussed within the County pursuant to Section 230, 606(1), and 633(1) of the Municipal Government Act, 2000, Chapter M-26.1, and amendments thereto.

NOW THEREFORE: The County of Wetaskiwin No. 10, duly assembled, hereby enacts as follows:

1. The document attached to this By-law as "Appendix A", together with accompanying maps, is hereby adopted as the "Fritz and Christina Martin Area Structure Plan"

   (a) NE 4-47-24-W4M, Plan 3489TR, Lot 6, approximately 5.15 hectares (12.730 acres).

2. This By-law comes into effect on the date of third reading.

READ: A First time this 9 day of Jull A.D., 2015

READ: A Second time this 9 day of July A.D., 2015

READ: A Third time and finally passed this this 9 day of July A.D., 2015

REEVE

CHIEF ADMINISTRATIVE OFFICER

SCHEDULE "A"
By-law 2015/39

Fritz and Christa Martin
P.O. Box 6934
Wetaskiwin, Alberta
T9A 2G5 Tel. 352 2999

2. March 2015

David Blades
Director of Planing & Economic Development
County of Wetaskiwin No 10
P.O. Box 6900
Wetaskiwin, Alberta
T9A 2G5

Dear M. Blades,

Re: Proposal for Subdivision of **LOT 6, PLAN 3489TR, NE 4- 47-24-W4M**

Thank you for your letter of Dec. 29, 2014, in which you requested additional information
which is needed before the plan can be presented to council for approval of proposed subdivision.

The additional information requested is:

1. Proposed lot and their respective size
2. Adjacent Landowner Communication
3. Conclusion of the Thurber Engineering Water Study
4. Waste water Treatment
5. Transportation

1. Proposed Lots.

The two additional lot, A and C, and their respective sizes are:

Lot A is 4.15 Acres (1.66 ha)
Lot C is 3.15 Acres (1.26 ha)

2. Adjacent Landowner Communication

We have contacted our neighbours, asked for their input and provided them with a form and diagram of the proposed subdivision.
Several owners responded by filling out their questionnaire. The completed forms are include in this letter.

3. Conclusion of the Thurber Engineering Water Study.

A copy of the conclusion of this report is attached.

4. Waste Water Treatment.

Waste water treatment is by sub-surface weeping tile effluent disposal field.

5. Transportation.

The two additional lots each have their own entry from Range Road 243

We hope you find this information helpful and we look forward to hearing from you.
In the meantime thank you for your help and the good advice you have given us.

Yours truly,

Fritz and Christa Martin

Table 5.3 indicates that pumping well #236463 at 7.1 L/min would have a calculated potential impact ranging from 3 percent to 8 percent on available drawdown at the nearest wells screened across the same depth. These impacts are conservative and potentially overstated as recharge from the surficial sand dunes is difficult to quantify and not accounted for.

5.4 Groundwater Quality

A groundwater sample was collected from well #236463, on the Site, by Ms. Jackie Maxwell B.Sc. A.I.T. of Thurber on July 29, 2014, and submitted to Maxxam for chemical analyses of (Table 5.4 in Appendix B). The groundwater sample met Health Canada December 2012 CDWQ Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO), except for sodium = 290 mg/L (AO = 200 mg/L), and TDS = 730 mg/L (AO = 500 mg/L). Aesthetic Objectives are recommended for acceptance (through taste, odor, and color criteria) by consumers, but are not health-related guidelines. Regional assessments (HCL, 2008) found median values of 293 mg/L for sodium, and 770 mg/L for TDS in groundwater from the upper bedrock aquifers.

The Total coliform count was 2.0 mpn/100 ml. There are MACs for Total Coliforms in municipal systems, but not for private systems. The groundwater sample from well #236463 did not have sodium thiosulfate preservative. Sodium thiosulfate is a mild dechlorinating agent and arrests the toxic effect of chlorine on Coliforms, therefore the lack of sodium thiosulfate would potentially understate the amount of Coliforms. For non-chlorinated water, there is no effect from sodium thiosulfate preservative. The most likely source of Coliforms in non-chlorinated well water would be an improper seal at the pitless adaptor (subsurface wellhead junction to the house supply line).

The observed Hardness at 87 mg/L is generally characterized as moderately hard (61–120 mg/L).

6. SUMMARY

Based on the information reviewed and two hour pump test performed on well #236463 within the Site development area, the well has an $_{A}Q_{20}$ of 26.7 L/min, which meets the minimum required demand of 3750 m^3/yr (approximately 7.1 L/min). A groundwater sample from #236463, on the Site, met Health Canada December 2012 CDWQ Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO), except for sodium = 290 mg/L (AO = 200 mg/L), and TDS = 730 mg/L (AO = 500 mg/L). Regional assessments (HCL, 2008) found median values of 293 mg/L for sodium, and 770 mg/L for TDS in groundwater from the upper bedrock aquifers.

Pumping the well #236463 at 7.1 L/min would have a calculated potential impact ranging from 3 percent to 8 percent on available drawdown at the nearest wells screened across the same depth. These impacts are conservative and potentially overstated as recharge from the surficial sand dunes is difficult to quantify and not accounted for.

7. REFERENCES

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Andriashek, L.D., 1987, "Drift Thickness of the Edmonton Map Area, NTS 83H", Alberta Energy, map scale 1:250,000.

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Shetsen, I., 1990, "Quaternary Geology, Central Alberta", Alberta Research Council, map scale 1:500,000

Soil Research Institute, 1962, "Soil Survey of the Edmonton Sheet (NTS 83H West Half), Province of Alberta", Canada Department of Agriculture, Ottawa, map scale 1:126,720

Theis, C.V., 1935, "The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage" Transactions American Geophysical Union, Vol.16. pp.519-524

David Blades
Director of Planning & Economic Development
County of Wetaskiwin No. 10
P.O. Box 6960
Wetaskiwin, Alberta

Dear Mr. Blades,

Re: Request for Area Structure Plan to permit subdivision
of the below mentioned lot.

Lot # 6 NE 4 - 47- 24 W4M Plan 3489 TR

We would like to subdivide the above mentioned acreage into three parcels. Permission for subdivision of NE 4-47-24 into eight lots was granted in early 1970. A subsequent Land Use Bylaw adopted by the County of Wetaskiwin allowed for up to 24 lots on this particular quarter section.

A fair number of property owners in this area have opted to embrace the new Land Use Bylaw. For example, in our immediate vicinity there are now nine parcels of about 3-4 acres each. Our acreage, Lot # 6 NE 4 - 47 - 24 W4M Plan 3489 TR, is 12.73 acres in size and is eligible for subdivision into three smaller parcels. This subdivision would be especially welcome to us because keeping the property well maintained and appealing has become a considerable burden.

The proposed plan would be to divide our lot into three acreages of approximately three, four and five acres each. See attached Schedule "A".

Also, please find enclosed an hydrogeological evaluation done by Thurber Engineering.

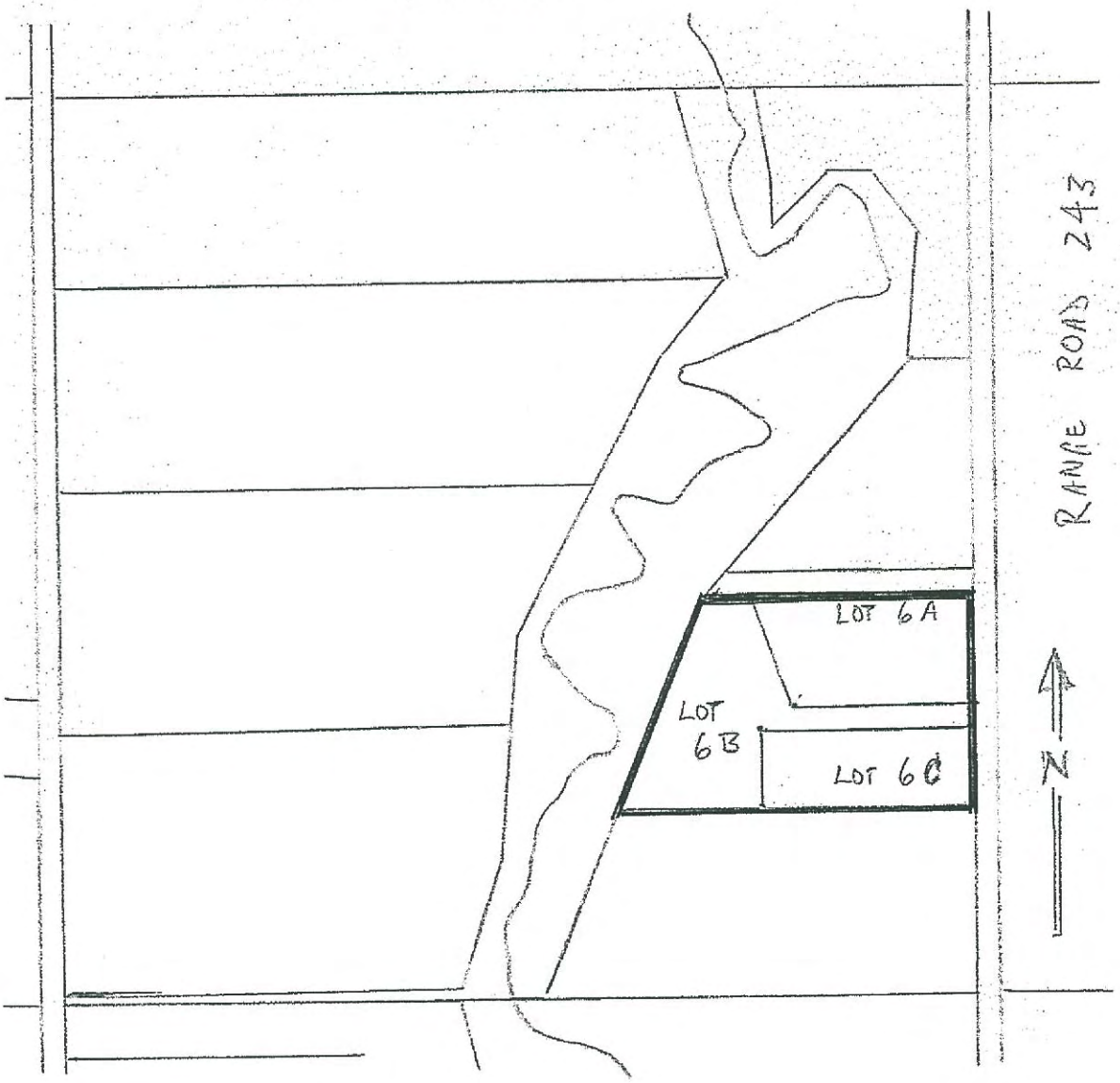
Your truly,

Fritz Martin

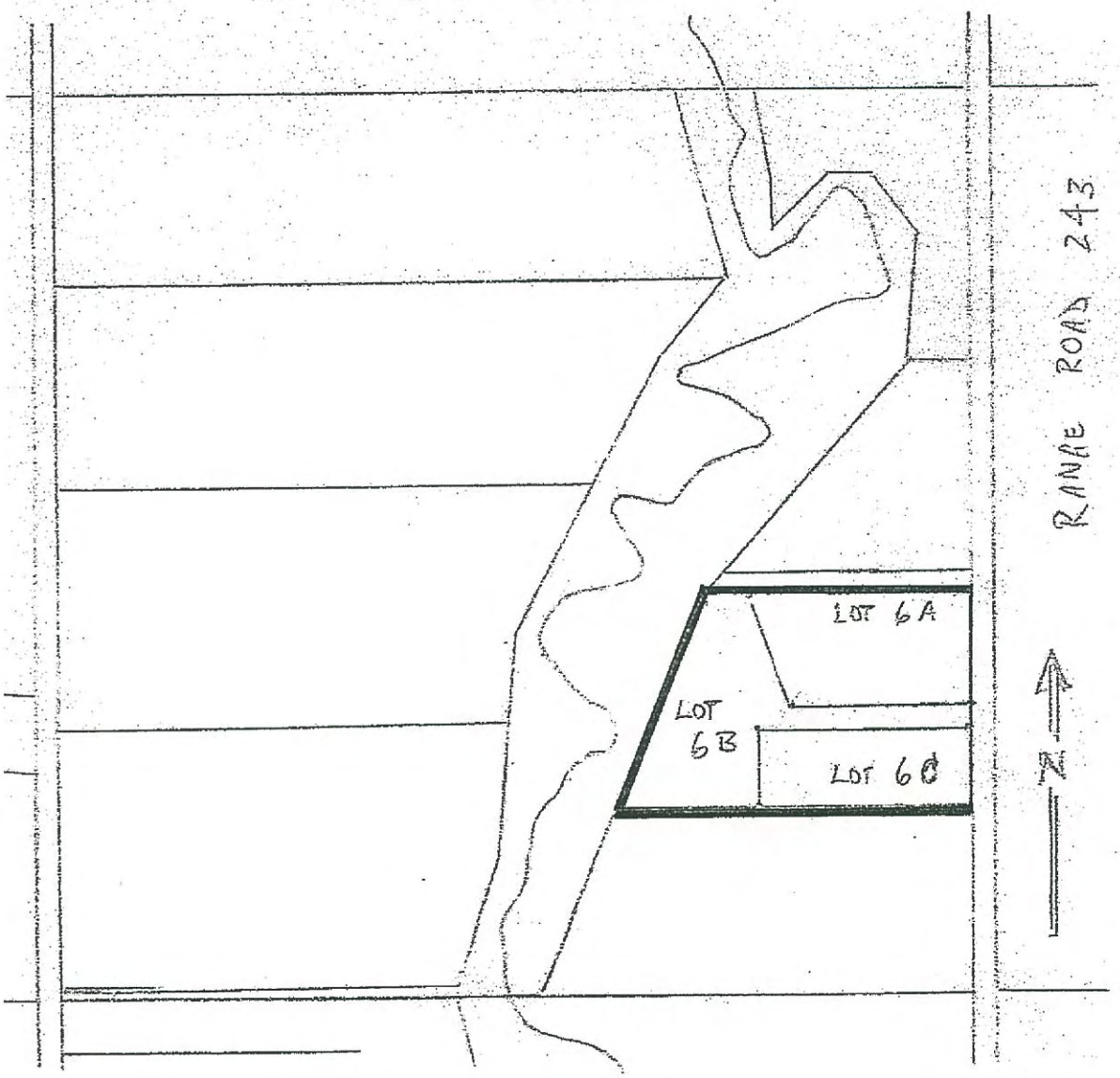
Fritz and Christa Martin
P.O. 6934
Wetaskiwin, Alberta T9A 2G5

Proposed Subdivision in
County of Wetaskwin

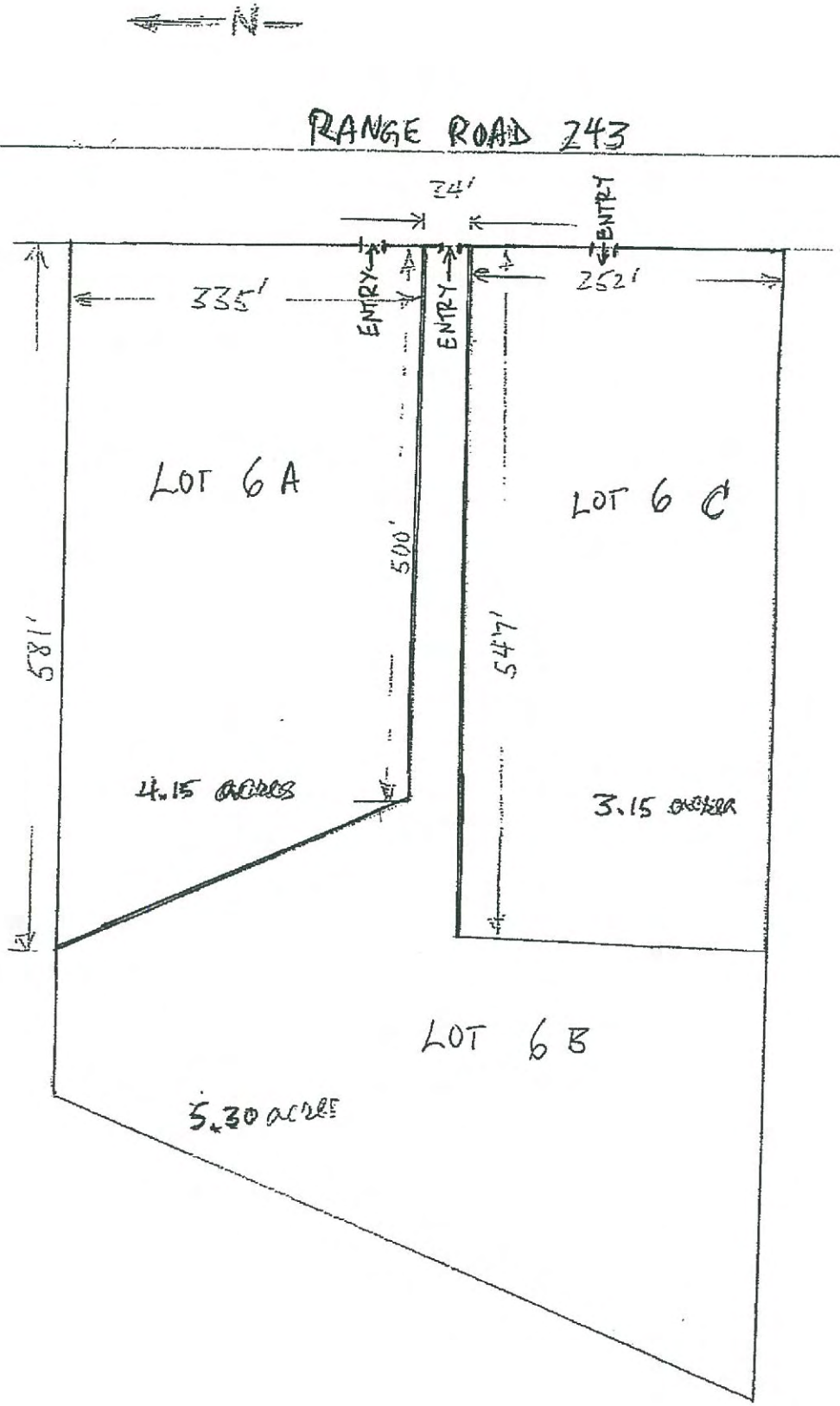
NE4-47-24 W4
Lot 6 Plan 3489 TR

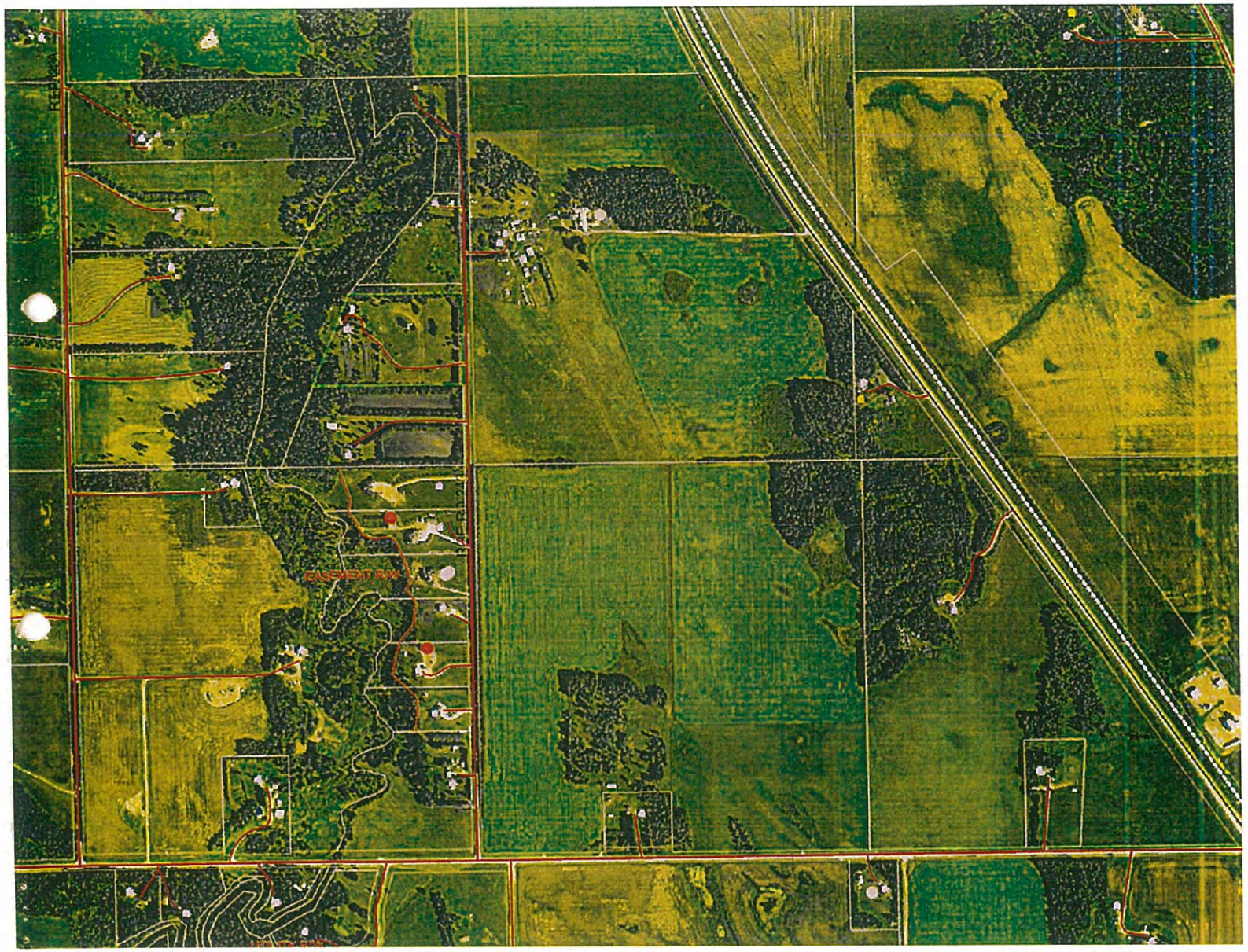


Proposed Subdivision in
County of Wetaskwin
NE4-47-24 W4
Lot 6 Plan 3482 TR



LOT 6, PLAN 3489 TR, NE 4-47-24-W4M

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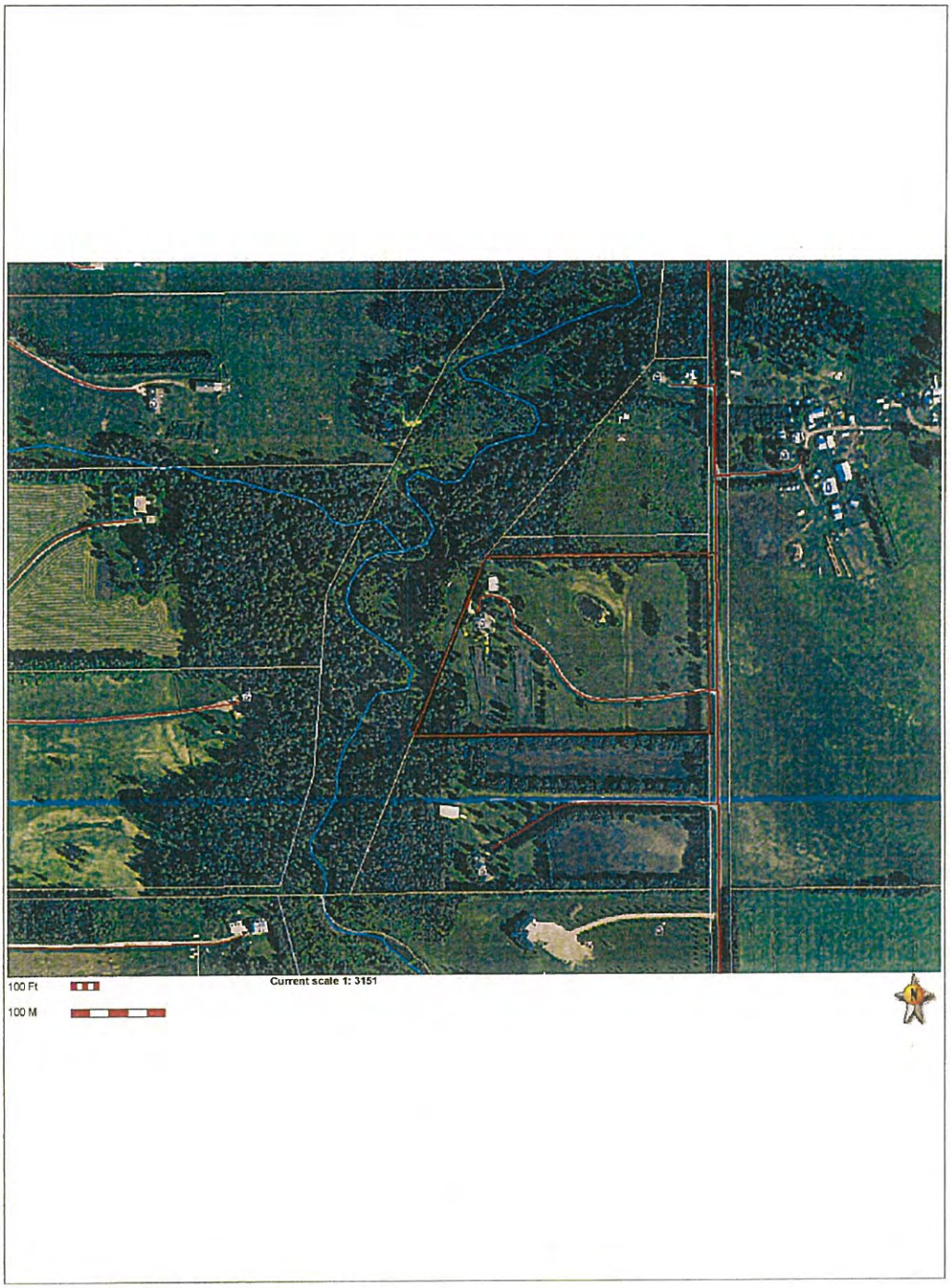
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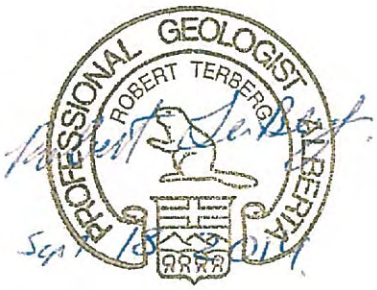
THURBER ENGINEERING LTD.

GROUNDWATER SUPPLY EVALUATION
PROPOSED RESIDENTIAL SUBDIVISION
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Report

for

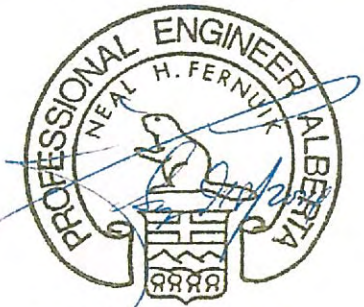
Dr. Fritz Martin



R. TerBerg, M.Sc., P.Geol.
Senior Hydrogeologist

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature
Date
PERMIT NUMBER: P 5186
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Date: September 18, 2014
File: 19-6740-0



N. Fernuik, M.Sc., P.Biol., P.Eng.
Review Principal

200, 9636 - 51 Avenue, Edmonton, AB T6E 6A5 T: 780 438 1460 F: 780 437 7125
www.thurber.ca

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APPENDIX D
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1. INTRODUCTION

This report presents a Groundwater Supply Evaluation by Thurber Engineering Ltd. (Thurber) for a proposed residential subdivision (the "Site") of Lot 6 Plan 3489TR in NE-4-47-24 W4M near the hamlet of Millet, Alberta.

Mr. Fritz Martin authorized the work on July 2, 2014 from Thurber's May 5, 2014, proposal.

Use of this report is subject to the Statement of Limitations and Conditions that is included at the end of the text of this report. The reader's attention is specifically drawn to these conditions as it is considered essential that they be followed for the proper use and interpretation of the report.

2. BACKGROUND

Thurber understands that the existing lot is to be subdivided into three residential lots. The County of Westaskiwin requires a minimum pumping test duration of two hours pumping and up to two hours recovery, along with an impact assessment for the potential addition of wells on the subdivided lots. The current Alberta Environment and Sustainable Resource Development (ESRD) standard stipulates that 1,250 cubic metres (m^3) of water per year are to be available for each individual lot. For the proposed subdivision of three lots, the minimum sustainable yield requirement would then be 3750 m^3/year. The March 2011 Alberta Environment Guide to Groundwater Authorization requires a detailed hydrogeological assessment report, including a yield calculation and impact assessment, once the water requirement exceeds 3650 m^3/year.

Thurber has confirmed that the existing well on Site is identified by Alberta Water Well record #236463.

3. OBJECTIVE AND SCOPE OF WORK

The objective is to assess the potential impact to the producing aquifer and nearby aquifer users of producing 3750 m^3/year (approximately 7.1 L/min) from the existing well.

The proposed scope of work generally includes the following:

Stage 1: Desktop Study

- Compile a hydrogeological review of publicly available literature and well records for the area of the Site.
- Conduct a field well survey within a 1.6 km radius of the existing well.

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Stage 2: Field Investigation

- Conduct a pumping test with the available installed pump over 2 hours drawdown and up to 2 hours recovery.
- Conduct aquifer parameter estimation with the pumping test data.
- Assess the impact of pumping with model simulations of the 3750 m^3/year (approximately 7.1 L/min) pump rate.
- Collect a groundwater sample for groundwater quality assessment.
- Prepare a report summarizing the findings.

The field well survey was modified to identify wells by reconciling available well owners with the latest title documents, and aerial photos. This approach was used as many well owners do not respond to field verification of wells.

4. DESKTOP HYDROGEOLOGICAL ASSESSMENT

4.1 Site Topography

The Site is located in 9-4-47-24 W4M, approximately 1 km west of Highway 2A and 7 km south of Millet in the County of Westaskiwin, Alberta. An aerial photo of the site area with ESRD estimated water well locations within a 1.6 km radius of the site, is shown on Drawing 19-6740-0-1 in Appendix A.

The nearest permanent surface water body is Bigstone Creek, approximately 70 m northwest of the Site. The creek has meandering drainage within a northwards draining valley that is approximately 200 m wide and approximately 4 m lower than the surrounding plains. The Bigstone Creek valley is titled as County Reserve. Other nearby surface water bodies are seasonal including one 20 m by 40 m slough located in the east portion of the Site as shown on Drawing 19-6740-0-1.

4.2 Geological and Hydrogeological Characteristics

4.2.1 Geology

Drawing 19-6740-0-2, in Appendix A, presents a cross-section of the study area based on Alberta Water Well report logs. There are two main geological units present: overlying surficial deposits and bedrock.

The surficial deposits are comprised of a vegetated black sandy loam (Soil Research Institute, 1962) over sand dunes (Shetsen, 1990) with gently rolling topography and low gradient undulations of up to 3 m elevation deviation from 760 m above mean sea level (AMSL). There are northwest-trending dune ridges in the study area. From Alberta water well records, the sand dunes are 6 m to 10 m thick and overlie glaciolustrine clays of 10 m to 14 m thickness. The overall surficial drift thickness is up to 20 m (Andriashek, 1987). The Bigstone Creek valley is lined with recent reworked silt and organics.

Bedrock occurs at approximately 20 m depth in the area and is represented by the Horseshoe Canyon Formation (Ceroici, 1979) of the Edmonton Group, which includes gray carbonaceaous shales, coal seams (up to 1 m thick), and isolated sandstone beds (up to 3 m thick).

4.2.2 Hydrogeology

Within the study area there are two aquifer types present: the sand dunes in the surficial drift and the Horseshoe Canyon Formation sandstone beds.

The uppermost aquifers are in sand dunes in the surficial deposits with expected yields of 8.6 m^3/day to 35 m^3/day (6 L/min to 24 L/min; Ceroici, 1979) and typically used for septic drainage or surface water drainage by dugouts.

The Millet sandstone beds in the Horseshoe Canyon Formation, near Millet, have historically been known as artesian aquifers (water level higher than top of aquifer) with expected yields of 10 m^3/day to 250 m^3/day (6.9 L/min to 174 L/min; HCL, 2008).

4.3 Well Survey

A well survey was compiled using the Abadata database of Alberta Water Well reports and records were reconciled to locations using a title survey of current landowners and a 2012 aerial photo. This method was used to mitigate the often minimal response to field-verification and domestic wells are usually within 20 m of the intended house.

Tables 4.1 and 4.2 in Appendix B summarize the completion specifications and lithologs, respectively, from 69 ESRD well records within a 1.6 km radius of the tested well. The wells with available depth information were completed in the Horseshoe Canyon Formation. The water wells are classed by recorded usage as follows:

- 58 domestic

- 5 domestic & stock
- 3 stock
- 3 unknown

There are 23 reported wells, within a 1.6 km radius of the tested well, that share overlapping screen interval depths with the tested well.

For the potential impact assessment to the 23 wells, available drawdown was assessed from comparison of the screen intervals in Table 4.1 with the formation bases listed in Table 4.2, and static water levels from Table 4.3 in Appendix B. The sandstone beds in the Horseshoe Canyon Formation are confined artesian aquifers, as the static water levels are higher than the tops of the sandstone beds, with an average available drawdown of approximately 25 m.

ESRD water well records of well #236463, on the Site, includes the following:

- The well was installed by Big Iron Drilling Ltd. on April 5, 1983, for Fritz Martin.
- Water production is from a pair of sandstone interbeds, at 24.7 m to 26.2 m and 41.8 m to 45.7 m, within a shale. The depth interval near top of bedrock has been classified as the Millet sandstones (Ceroici, 1979) and the Upper Bedrock Aquifer (HCL, 2008).
- The production casing was installed from 22.6 m to 45.7 m, although no screen/perforation interval was reported. We have assumed a perforation interval of approximately 21.0 m from 24.7 m to 45.7 m, as this is the maximum extent of production casing that could be exposed to the formation and the interval coincides with the top and bottom of the two sandstone beds penetrated by the production casing. This assumption is conservative as a shorter production interval would imply that the formation is more productive. Verification would require a videolog of the well.
- The surface casing is a 141 mm standpipe driven to 24.7 m depth.
- The static water level was 6.1 m below ground surface, for an available drawdown of 18.6 m to the top of confined aquifer.

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5. WELL TESTING RESULTS

5.1 Pumping Test Description and Interpretation

A pumping test of well #236463, on the Site, was completed by Ms. Jackie Maxwell, B.Sc. A.I.T. of Thurber at the Site on July 29, 2014. The observed static water level depth in the well was of 9.9 m below top of pipe (9.4 m bgs). The well was pumped at 26.7 L/min (38.4 m^3/day) through two hours. A Solinst Levellogger was used, but could not get past the transition depth between the driven surface casing and the smaller diameter production casing. The pumping drawdown extended below that casing transition depth so the manual dipmeter measurements were used for testing.

The water level dropped to 20.1 m below top of pipe (19.6 m bgs) for a net drawdown of 10.2 m and a resulting specific capacity of 2.62 L/min/m (pumping effort per unit drawdown).

For the context of a confined aquifer, the Cooper-Jacob (1946) method was chosen for pumping test data analysis; while the recovery data was assessed by the Theis (1935) method for recovery from confined aquifers.

TABLE 5.1
PUMPING TEST RESULTS OF TESTED WELL
(NE-4-47-24 W4M) NEAR MILLET, ALBERTA

Analytic Method	Hydraulic Conductivity (m/s)	Transmissivity (m^2/s)
Constant Rate 26.7 L/min Cooper-Jacob (late time)	3.9E-06	8.2E-05
Theis Recovery	7.2E-06	1.5E-04
Geometric Means	**5.3E-06**	**1.1E-04**

5.2 Theoretical 20-Year Safe Yield

The available drawdown (H_a) of 14.3 m was estimated from top of aquifer depth (24.7 m bgs) minus static water level (9.4 m bgs) observed on July 29, 2014. The transmissivities were based on an assumed 21 m perforation interval. The estimated twenty year safe yield ($_AQ_{20}$) was estimated to be in the order of 45 L/min, using the Farvolden method for confined aquifers and a mean transmissivity of 1.11×10^{-4} m^2/s (per Table 5.2). Regional assessments (HCL, 2008) found a mean transmissivity of 6.4×10^{-4} m^2/s.

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TABLE 5.2
THEORETICAL LONG-TERM YIELD OF TESTED WELL
(NE-4-47-24 W4M) NEAR MILLET, ALBERTA

Q_{20} m^3/s (L/min)	Transmissivity (m^2/s)	H_a (m)	Pumping Test rate m^3/s (L/min)
7.49×10^{-4} (44.9)	1.11×10^{-4}	14.3	4.45×10^{-4} (26.7)

ESRD has a policy of taking the lower of a tested rate and the resulting calculated rate, hence the pumping test rate of 26.7 L/min would likely become the ESRD licensed rate.

5.3 Impact Assessment

There are 23 wells within a 1.6 km radius from the Site well that are known to produce from approximately the same depth. Theis (1935) method drawdown predictions for pumping at the projected demand rate of 7.1 L/min after 20 years are provided in Appendix C. This data was then used to assess the 20 year projected drawdown in groundwater wells within the 1.6 km radius. Many of the wells did not have static water levels recorded and therefore did not have available drawdown from which to calculate percentage impact.

TABLE 5.3
PROJECTED 20 YEAR STEADY STATE DRAWDOWN
FOR WELL #236463 PUMPED AT 7.1 L/MIN
(NE-4-47-24 W4M) NEAR MILLET, ALBERTA

Well #	Approx. radius from #236463 (m)	Approx. Projected Drawdown (m)	Available Drawdown (m)	% Impact
1030220	364	1.30	N/A	N/C
1780235	441	1.24	N/A	N/C
236467	496	1.20	36.0	3%
166471	516	1.19	14.4	8%
1030048	717	1.11	N/A	N/C
1130063	833	1.08	N/A	N/C
229704	937	1.04	29.8	3%
236441	937	1.04	22.9	5%
1780303	1167	1.00	N/A	N/C
290375	1369	0.96	25.6	4%
1030022	1442	0.95	N/A	N/C
236239	1455	0.94	20.4	5%
1030209	1526	0.94	N/A	N/C
1780194	1549	0.94	N/A	N/C
1780286	1566	0.93	N/A	N/C
1780180	1590	0.93	N/A	N/C

N/A: not available
N/C: not calculated

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Table 5.3 indicates that pumping well #236463 at 7.1 L/min would have a calculated potential impact ranging from 3 percent to 8 percent on available drawdown at the nearest wells screened across the same depth. These impacts are conservative and potentially overstated as recharge from the surficial sand dunes is difficult to quantify and not accounted for.

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6. SUMMARY

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Hydrogeological Consultants Ltd. (HCL), March 2008, "Regional Groundwater Assessment - Part of the North Saskatchewan River Basin Parts of Tp 044 to 048, R 22 to 28, W4M & Tp 045 to 047, R 01 to 07, W5M", Prepared for the County of Wetaskiwin in conjunction with Agriculture and Agri-Food Canada (Prairie Farm Rehabilitation Administration).

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THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

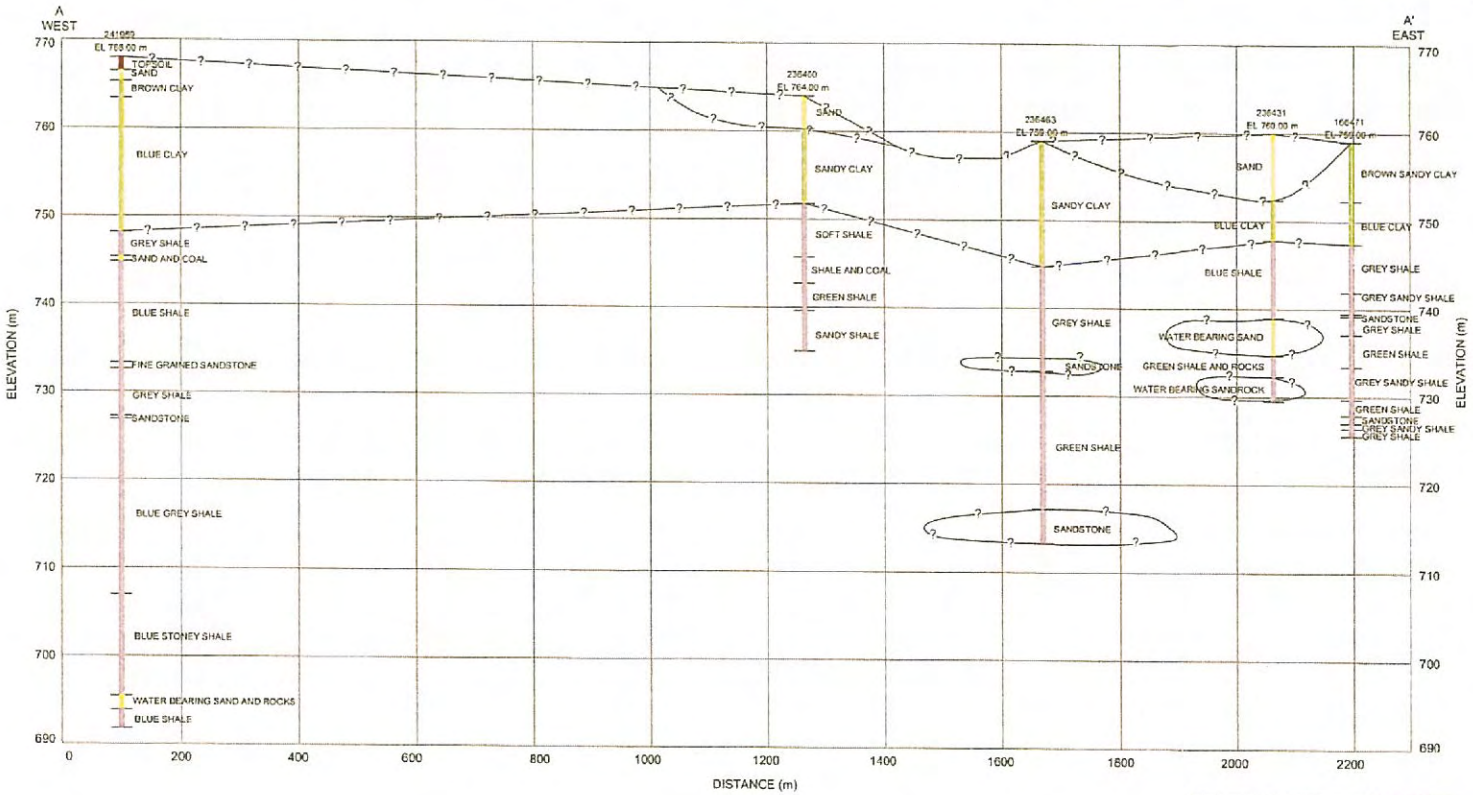
b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over . . . .)

THURBER

APPENDIX A

Drawings



NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

MARTIN, DR. FRITZ

GROUNDWATER EVALUATION STUDY
(NE-4-47-24 W4M) NEAR MILLET, ALBERTA

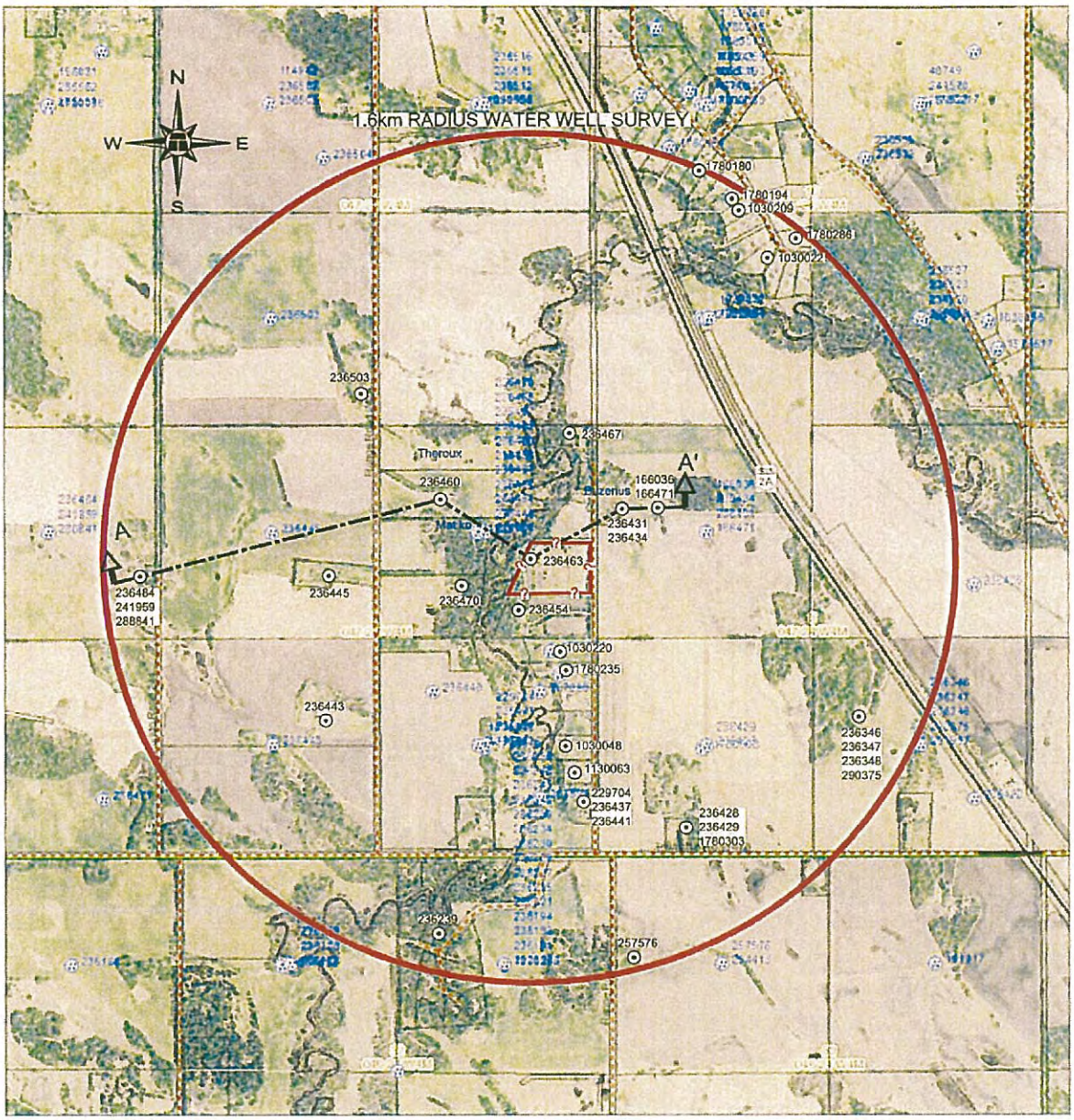
STRATIGRAPHIC CROSS - SECTION A - A'

DWG No. 19-6740-0-2

DRAWN BY	ML
DESIGNED BY	RTB
APPROVED BY	NHF
SCALE	H.1:7500 V.1:500
DATE	SEPTEMBER 2014
FILE No.	19-6740-0

THURBER ENGINEERING LTD.

Z:\19\19-6740-0119-6740-0-1-2.dwg - 1 - Sep. 16, 2014



LEGEND

—?— APPROXIMATE SUBJECT PROPERTY BOUNDARY

⊙ VERIFIED WATER WELL LOCATION

Ⓦ WATER WELL

0 250 500 750 1000 1250 1500m

SCALE APPROX. 1:25000

2014 BASE PLAN PROVIDED BY ABADATA

GROUNDWATER EVALUATION STUDY
(NE-4-47-24 W4M) NEAR MILLET, ALBERTA

SITE MAP

DWG No. 19-6740-0-1

MARTIN, DR. FRITZ

DRAWN BY	ML
DESIGNED BY	RTB
APPROVED BY	NHF
SCALE	APPROX. 1:25000
DATE	SEPTEMBER 2014
FILE No.	19-6740-0

THURBER ENGINEERING LTD.

THURBER

APPENDIX B

Tables

TABLE 4.1
ALBERTA WATER WELL SURVEY
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

		Location Information				Drilling			SURFACE CASING			Screen/Perforations Interval				Pump		Aquifer		
Well #	Well Owner	Location	Latitude	Longitude	Approx. meters from #236463	Date Completed	Depth (m)	Proposed Use	Type	OD (mm)	Bottom (m)	Type	OD (mm)	Top (m)	Bottom (m)	Depth (m)	Rate (L/min)	Top of Aquifer	Available Drawdown	Chemistries on File
40746	WASSERMAN, ISRAEL	SE-04-047-24-W4	53.021702	-113.445535		13-Jun-02	39.6	Domestic	Plastic	152	28.0	Plastic	114	27.7	39.3	21.3	45	36.0	25.9	0
166036	FINNMAN, GERALD	NW-03-047-24-W4	53.029758	-113.435825	516	30-Apr-80	30.5	Stock	Steel	127	21.9							26.9	19.2	0
166471	FINMAN, GERALD	NW-03-047-24-W4	53.029758	-113.435825	516	13-Mar-92	33.5	Domestic	Plastic	152	22.6	Plastic	114	21.3	33.5	21.3	45	31.1	14.4	0
215034		NE-04-047-24-W4	53.028933	-113.445536			24.4	Domestic	Unknown	102										1
229704	BREDLOW, STEVE	07-04-047-24-W4	53.019794	-113.440041	937	4-Oct-93	48.8	Domestic	Plastic	152	31.7	Plastic	114	36.6	48.8	27.4	54	44.2	29.8	0
236191	GAVEL, FRANK	NE-32-045-24-W4	53.014267	-113.444574		2-May-78	57.9	Domestic	Steel	102	25.6							48.8		0
236192	BANSKE, HERB	NE-32-046-24-W4	53.014267	-113.444574		13-May-81	41.1	Domestic	Steel	141	19.8	Steel	114	35.1	41.1	33.5	45	35.1	30.2	0
236194	SHIPPELT, SUSAN	NE-32-046-24-W4	53.014267	-113.444574			95.1	Domestic												1
236221	GANSKE, HERB	NE-32-046-24-W4	53.014267	-113.444574		26-Aug-82	33.5	Domestic	Steel	114	25.6							25.6, 31.1	10.4	1
236225	SPYKSMA, WARREN	NE-32-046-24-W4	53.014267	-113.444574		29-Aug-82	40.2	Domestic	Steel	114	29.0							29.0, 32.6, 38.1	12.2	0
236227	BREITKREUZ, ALFRED	NE-32-046-24-W4	53.014267	-113.444574			76.5	Domestic												2
236228	MUSIOWSKY, BASIL A.	NE-32-046-24-W4	53.014267	-113.444574			56.4	Domestic												1
236230	GANSKE, KEITH	NE-32-046-24-W4	53.014267	-113.444574		22-Apr-83	39.6	Domestic	Steel	114	26.8							28.8, 33.2		0
236234	GENTES, P.	NE-32-046-24-W4	53.014267	-113.444574		18-Aug-83	36.6	Domestic	Steel	141	25.9							29.0		0
236239	BROMLEY, WILLIAM	NE-32-046-24-W4	53.014267	-113.444574	1455	2-Jun-87	45.7	Domestic	Steel	140	15.5	Plastic	114	27.4	42.7			27.1, 42.1	20.4	0
236242	WHITTAKER, MARG	NE-32-046-24-W4	53.014267	-113.444574				Domestic												0
236245	GANSKE, HERB	NE-32-046-24-W4	53.014267	-113.444574		27-Feb-85	54.9	Domestic	Steel		42.7						68	50.3	29.0	0
236248	CHEEVER, JEFF	NE-32-046-24-W4	53.014267	-113.444574		1-Nov-88	64.0	Domestic	Steel	140	44.2					36.6	27	50.3, 57.9	36.6	0
236250	SCHMIDT, JEFF/LINDA	NE-32-046-24-W4	53.014267	-113.444574			42.7	Domestic												0
236346	HOFFMAN, TERRY	SE-03-047-24-W4	53.021677	-113.421205	1369		45.7	Domestic												1
236347	HOFFMAN, TERRY	SE-03-047-24-W4	53.021677	-113.421205	1369	9-May-78	41.1	Unknown	Steel	140	25.6							33.5	26.8	2
236348	HOFFMAN, TERRY	SE-03-047-24-W4	53.021677	-113.421205	1369	1-Jul-80	39.6	Domestic												2
236428	KNUDSEN, R.	SW-03-047-24-W4	53.018918	-113.434318	1167		24.4	Domestic												1
236429	NELSON	SW-03-047-24-W4	53.018918	-113.434318	1167		30.5	Unknown												0
236431	FINMAN, HELMAR	NW-03-047-24-W4	53.029723	-113.437822	393	28-May-70	30.5	Domestic	Unknown	114	20.4							21.0, 27.7	15.2	0
236434	FINNMAN, H.	NW-03-047-24-W4	53.029723	-113.437822	393		61.0	Domestic												1
236435	COOK, ROY	09-03-047-24-W4	53.027101	-113.418206		16-May-77	36.6	Domestic & Stock	Steel	114	29.0					32.9	14	29.0	16.8	0
236437	BREDLOW, HERBERT	07-04-047-24-W4	53.019794	-113.440041	937	18-Feb-74	39.6	Domestic & Stock	Galvanized Steel	105	20.4							18.3	6.9	2
236440	BREDLOW	07-04-047-24-W4	53.019794	-113.440041		1-Jan-33	65.5	Unknown	Unknown	51										0
236441	BREDLOW, HERB	07-04-047-24-W4	53.019794	-113.440041	937	4-Nov-88	54.9	Stock	Steel	140	27.4	Plastic	114	27.4	54.9		23	32.0, 48.2	22.9	0
236443	STANLEY, RON	SW-04-047-24-W4	53.021702	-113.45753	983	1-May-75	24.4	Domestic & Stock	Galvanized Steel	105	19.2							21.3	19.8	0
236445	BECK	NW-04-047-24-W4	53.027461	-113.45427	762		79.2	Domestic												1
236446	PIERCE, FRANK L.	NE-04-047-24-W4	53.028933	-113.445536		1-Jun-74	36.6	Domestic	Galvanized Steel	114	18.6					15.2		23.8, 30.5	18.3	1
236451	MEYER, BEN.	NE-04-047-24-W4	53.020598	-113.440427		1-Jun-74	30.5	Domestic	Galvanized Steel	114	19.2							25.3	21.3	1
236454	GREENE, EARL	NE-04-047-24-W4	53.026277	-113.443667	200	1-Jun-77	30.5	Domestic	Galvanized Steel	114	19.2					18.3	27	20.1	14.3	0
236457	MCCRAKEN, JERRY	NE-04-047-24-W4	53.028933	-113.445536		4-Jul-75	30.5	Domestic & Stock	Galvanized Steel	114	18.9					12.2		23.8	17.6	1
236459	LYNCH, BOB	NE-04-047-24-W4	53.028933	-113.445536		2-Jun-75	30.5	Domestic	Galvanized Steel	114	18.9							20.4	17.0	1
236460	BREITKREUS, ED	NE-04-047-24-W4	53.030049	-113.448011	407	21-Sep-81	29.0	Domestic	Steel	114	22.3					15.2	45	24.4	15.9	0
236463	MARTIN, FRITZ	NE-04-047-24-W4	53.028025	-113.442956	0	5-Apr-83	45.7	Domestic	Steel	141	24.7	Steel	114	22.6	45.7	40.2	0	24.7, 41.8	18.6	0
236467	PLETZ, ERHARD	NE-04-047-24-W4	53.032279	-113.440764	496	25-Feb-84	48.8	Domestic	Steel	141	28.0	Steel	114	42.7	48.8	36.6	0	44.8	36.0	1
236468	MCCRACKEN, CAROL	NE-04-047-24-W4	53.028933	-113.445536			36.6	Domestic												2
236470	WOODS, JACK R.	NE-04-047-24-W4	53.02711	-113.446851	281		30.5	Domestic												0
236484	BAILER, WARREN	NE-05-047-24 W4M	53.027442	-113.464839	1470		54.9	Domestic												0
236503	CLARKE, ROSS	SW-09-047-24-W4	53.03362	-113.452442	890			Domestic												0
236529	STENGEL, ART	SW-10-047-24-W4	53.036143	-113.433202		13-Aug-65	27.4	Domestic & Stock	Unknown	102	15.2							16.8, 24.4	10.7	2
241959	BAILER, ELMER	NE-05-047-24 W4M	53.027442	-113.464839	1470	1-Apr-74	76.2	Stock								24.4		72.5		0
254413	BARRA, DARREN	NW-33-046-24-W4	53.014291	-113.4324		11-Mar-94	54.9	Domestic	Plastic	152	43.3	Plastic	114	48.8	54.9	24.4	45	51.2	37.5	0
257576	GANSKE, BRIAN	NW-33-046-24-W4	53.014291	-113.4324	1550	27-Apr-95	61.0	Domestic	Plastic	152	45.7	Plastic	114	48.8	61.0	18.3	45	56.1	49.2	0
267690	MASSEY, JARVIS/MARILYN	08-04-047-24-W4	53.02351	-113.442536		26-Oct-95	73.2	Domestic	Plastic	152	49.7					27.4	36	53.4	51.2	0
267698	MASSEY, JARVIS/MARILYN	01-04-047-24-W4	53.019894	-113.442536		6-Oct-95	67.1	Domestic	Plastic	152	47.9					24.4	41	53.4	51.2	0
288841	BAILER, LAURIE/WARREN	NE-05-047-24 W4M	53.027442	-113.464839	1470	3-Jul-97	71.6	Domestic			5.5					36.6		39.6, 64.0		0
290375	HOFFMAN, TERRY	SE-03-047-24-W4	53.021677	-113.421205	1369	20-Aug-98	41.1	Domestic	Plastic	152	25.6	Plastic	102	29.0	41.1	22.9	45	33.5	25.6	0
291967	BIGSTONE AGRO CENTRE	SE-03-047-24-W4	53.021677	-113.421205		30-Sep-98	42.7	Domestic	Plastic	152	24.4	Plastic	102	30.5	42.7	21.3	54	36.6	31.7	0
292690	NEELIN, BILL	NE-32-046-24-W4	53.014267	-113.444574		13-Jul-99	44.2	Domestic	Plastic	152	30.8					29.0	41	41.8	37.5	0
1030003	CUNNINGHAM, AL	SE-04-047-24-W4	53.0217	-113.446		21-Jan-05	61.0	Domestic	Plastic	152	43.3	Plastic	114	45.7	61.0	21.3	54	50.6, 55.5, 58.5		0
1030022	JENSEN, JACK & CONNIE	SW-10-047-24-W4	53.0362	-113.433	1442	21-Apr-05	48.8	Domestic	Plastic	152	38.4	Plastic	114	36.6	48.8	15.2	54	46.3		0

TABLE 4.1
ALBERTA WATER WELL SURVEY
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

		Location Information			Approx. meters from #236463	Drilling			SURFACE CASING			Screen/Perforations Interval				Pump		Aquifer		
Well #	Well Owner	Location	Latitude	Longitude		Date Completed	Depth (m)	Proposed Use	Type	OD (mm)	Bottom (m)	Type	OD (mm)	Top (m)	Bottom (m)	Depth (m)	Rate (L/min)	Top of Aquifer	Available Drawdown	Chemistries on File
1030048	SONNENBERG, SCOTT	SE-04-047-24-W4	53.021684	-113.441018	717	28-Apr-04	51.8	Domestic	Plastic	152	34.1	Plastic	114	36.6	51.8	18.3	45	48.2		0
1030154	WILLIS, ANDY	SW-10-047-24-W4	53.0362	-113.433		22-Feb-07	51.2	Domestic	Plastic	152	34.1	Plastic	114	17.1	51.2	30.5	45	18.9, 24.4, 43.3		0
1030209	MOISAN, DANNY & JAININE	11-10-047-24-W4	53.039819	-113.431356	1526	11-Oct-08	54.9	Domestic	Plastic	152	34.7	Plastic	114	33.5	54.9	36.6	45	46.9, 51.2		0
1030220	SWITZER, BLAINE & JOY	08-4-47-24-W4	53.024874	-113.441494	354	13-May-09	61.0	Domestic	Plastic	152	40.5	Plastic	114	39.6	61.0	27.4	54	56.7		0
1030246	VENTER, CHRIS	NE-32-46-24-W4	53.014236	-113.444568		19-May-10	47.9	Domestic	Plastic	152	22.9	Plastic	114	20.4	47.9	30.5	45	39.0, 45.1		0
1130063	WOMBOLD, JASON & RACHEL	01-04-047-24-W4	53.020698	-113.440427	833	4-Feb-04	61.0	Domestic	Plastic	152	29.9	Plastic	114	48.8	61.0	36.6	45	53.6		0
1780161	DICK, TED	NE-04-047-24-W4	53.0269	-113.446		4-Apr-07	48.8	Domestic	Plastic	152	31.4	Plastic	102	42.7	48.8	18.3	45	41.1		0
1780180	FILLION, KELLY & CARRIE	12-10-47-24-W4	53.041147	-113.433556	1590	2-Oct-07	36.6	Domestic	Plastic	152	24.7	Plastic	102	30.5	36.6	18.3	45	30.5		0
1780194	FLEWELLING, JOHN & ANNAMARIE	11-10-47-24-W4	53.040195	-113.431734	1549	21-May-07	36.6	Domestic	Plastic	152	25.9	Plastic	102	30.5	36.6	18.3	36	29.0		0
1780235	CRAWFORD, RUSS	8-4-47-24-W4	53.024244	-113.440995	441	20-Sep-07	39.6	Domestic	Plastic	152	30.5	Plastic	102	36.6	39.6	27.4	36			0
1780286	HENDRICKS, OTIS	SW-10-47-24-W4	53.036155	-113.433426	1566	27-Oct-09	36.6	Domestic	Plastic	152	26.5	Plastic	102	30.5	36.6		40	24.4		0
1780303	HORSLEY, ALISON	SW-3-47-24-W4	53.018918	-113.434318	1167	3-May-10	36.6	Domestic	Plastic	152	34.4	Plastic	114	33.5	36.6	18.3	36	34.7		0
1780319	QUINTON, DEXTER & SUE	SE-4-47-24-W4	53.021585	-113.445595		9-Sep-10	42.7	Domestic	Plastic	152	25.3	Plastic	114	36.6	42.7	30.5	18	39.0		0

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
40746	SE-04-047-24 W4M	6.7	Brown Sandy Clay
40746	SE-04-047-24 W4M	15.8	Blue Clay & Rocks
40746	SE-04-047-24 W4M	18.9	Gray Shale
40746	SE-04-047-24 W4M	20.1	Gray Sandy Shale
40746	SE-04-047-24 W4M	20.7	Sandstone
40746	SE-04-047-24 W4M	22.3	Gray Sandy Shale
40746	SE-04-047-24 W4M	23.5	Green Shale
40746	SE-04-047-24 W4M	25.0	Gray Shale
40746	SE-04-047-24 W4M	26.8	Gray Sandy Shale
40746	SE-04-047-24 W4M	29.9	Green Shale
40746	SE-04-047-24 W4M	32.3	Gray Shale
40746	SE-04-047-24 W4M	36.0	Gray Sandy Shale
40746	SE-04-047-24 W4M	37.5	Sandstone
40746	SE-04-047-24 W4M	39.0	Gray Sandy Shale
40746	SE-04-047-24 W4M	39.6	Green Shale
166036	NW-03-047-24 W4M	7.6	Sand
166036	NW-03-047-24 W4M	13.7	Blue Clay
166036	NW-03-047-24 W4M	21.3	Gray Shale
166036	NW-03-047-24 W4M	25.9	Green Shale
166036	NW-03-047-24 W4M	29.0	Sand & Shale
166036	NW-03-047-24 W4M	30.5	Gray Shale
166471	NW-03-047-24 W4M	6.7	Brown Sandy Clay
166471	NW-03-047-24 W4M	11.6	Blue Clay
166471	NW-03-047-24 W4M	17.1	Gray Shale
166471	NW-03-047-24 W4M	19.5	Gray Sandy Shale
166471	NW-03-047-24 W4M	19.8	Sandstone
166471	NW-03-047-24 W4M	21.9	Gray Shale
166471	NW-03-047-24 W4M	25.6	Green Shale
166471	NW-03-047-24 W4M	29.3	Gray Sandy Shale
166471	NW-03-047-24 W4M	31.1	Green Shale
166471	NW-03-047-24 W4M	32.0	Sandstone
166471	NW-03-047-24 W4M	32.6	Gray Sandy Shale
166471	NW-03-047-24 W4M	33.5	Gray Shale
229704	SE-04-047-24 W4M	8.5	Sand
229704	SE-04-047-24 W4M	13.4	Blue Clay
229704	SE-04-047-24 W4M	15.2	Coal
229704	SE-04-047-24 W4M	27.1	Blue Clay
229704	SE-04-047-24 W4M	28.7	Coal
229704	SE-04-047-24 W4M	32.9	Green Shale
229704	SE-04-047-24 W4M	33.5	Sandstone
229704	SE-04-047-24 W4M	35.4	Gray Sandy Shale
229704	SE-04-047-24 W4M	37.8	Green Shale
229704	SE-04-047-24 W4M	39.6	Gray Shale
229704	SE-04-047-24 W4M	41.5	Gray Sandy Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
229704	SE-04-047-24 W4M	44.2	Green Shale
229704	SE-04-047-24 W4M	44.8	Sandstone
229704	SE-04-047-24 W4M	47.5	Gray Sandy Shale
229704	SE-04-047-24 W4M	48.8	Green Shale
236191	NE-32-046-24 W4M	3.0	Sand
236191	NE-32-046-24 W4M	12.2	Blue Clay
236191	NE-32-046-24 W4M	15.2	Blue Shale
236191	NE-32-046-24 W4M	27.4	Green Shale
236191	NE-32-046-24 W4M	48.8	Blue Shale
236191	NE-32-046-24 W4M	56.4	Sand & Shale
236191	NE-32-046-24 W4M	57.9	Green Shale
236192	NE-32-046-24 W4M	4.0	Brown Sandy Clay
236192	NE-32-046-24 W4M	9.8	Gray Sandy Clay
236192	NE-32-046-24 W4M	10.7	White Sandstone
236192	NE-32-046-24 W4M	12.2	Green Shale
236192	NE-32-046-24 W4M	14.0	Gray Sandstone
236192	NE-32-046-24 W4M	21.3	Shale & Coal
236192	NE-32-046-24 W4M	24.7	Gray Sandstone
236192	NE-32-046-24 W4M	26.5	Gray Shale
236192	NE-32-046-24 W4M	27.1	Sandstone
236192	NE-32-046-24 W4M	35.1	Gray Shale
236192	NE-32-046-24 W4M	41.1	Gray Hard Sandstone
236221	NE-32-046-24 W4M	3.7	Clay
236221	NE-32-046-24 W4M	4.6	Clay & Rocks
236221	NE-32-046-24 W4M	13.7	Blue Clay
236221	NE-32-046-24 W4M	14.0	Coal
236221	NE-32-046-24 W4M	19.8	Soft Shale
236221	NE-32-046-24 W4M	22.9	Brown Shale
236221	NE-32-046-24 W4M	25.6	Hard Shale
236221	NE-32-046-24 W4M	26.2	Hard Sandstone
236221	NE-32-046-24 W4M	31.1	Hard Shale
236221	NE-32-046-24 W4M	31.7	Hard Sandstone
236221	NE-32-046-24 W4M	33.5	Hard Shale
236225	NE-32-046-24 W4M	4.6	Sand
236225	NE-32-046-24 W4M	8.5	Sandy Clay
236225	NE-32-046-24 W4M	15.2	Blue Clay
236225	NE-32-046-24 W4M	19.2	Soft Shale
236225	NE-32-046-24 W4M	21.3	Brown Shale
236225	NE-32-046-24 W4M	21.9	Coal
236225	NE-32-046-24 W4M	29.0	Hard Shale
236225	NE-32-046-24 W4M	29.6	Hard Sandstone
236225	NE-32-046-24 W4M	32.6	Hard Shale
236225	NE-32-046-24 W4M	32.9	Hard Sandstone

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
236225	NE-32-046-24 W4M	38.1	Hard Shale
236225	NE-32-046-24 W4M	38.7	Hard Sandstone
236225	NE-32-046-24 W4M	40.2	Hard Shale
236230	NE-32-046-24 W4M	2.4	Clay & Rocks
236230	NE-32-046-24 W4M	6.7	Brown Clay
236230	NE-32-046-24 W4M	7.3	Coal
236230	NE-32-046-24 W4M	9.1	Black Clay
236230	NE-32-046-24 W4M	13.7	Black Shale
236230	NE-32-046-24 W4M	15.8	Brown Shale
236230	NE-32-046-24 W4M	21.0	Brown Shale
236230	NE-32-046-24 W4M	26.8	Brown Shale
236230	NE-32-046-24 W4M	28.0	Hard Sandstone
236230	NE-32-046-24 W4M	29.3	Soft Sandstone
236230	NE-32-046-24 W4M	33.2	Shale
236230	NE-32-046-24 W4M	34.1	Hard Sandstone
236230	NE-32-046-24 W4M	36.6	Soft Sandstone
236230	NE-32-046-24 W4M	39.6	Shale
236234	NE-32-046-24 W4M	7.6	Clay
236234	NE-32-046-24 W4M	18.3	Blue Shale
236234	NE-32-046-24 W4M	20.7	Coal
236234	NE-32-046-24 W4M	27.4	Green Shale
236234	NE-32-046-24 W4M	29.0	Gray Shale
236234	NE-32-046-24 W4M	34.7	Sand & Shale
236234	NE-32-046-24 W4M	36.6	Green Shale
236239	NE-32-046-24 W4M	0.6	Topsoil
236239	NE-32-046-24 W4M	2.1	Sand
236239	NE-32-046-24 W4M	10.7	Sandy Clay
236239	NE-32-046-24 W4M	12.2	Sandstone
236239	NE-32-046-24 W4M	16.8	Shale
236239	NE-32-046-24 W4M	17.4	Coal
236239	NE-32-046-24 W4M	27.1	Shale
236239	NE-32-046-24 W4M	28.0	Water Bearing Sandstone
236239	NE-32-046-24 W4M	33.5	Shale
236239	NE-32-046-24 W4M	35.1	Sandstone
236239	NE-32-046-24 W4M	37.2	Shale
236239	NE-32-046-24 W4M	41.1	Sandstone
236239	NE-32-046-24 W4M	42.1	Shale
236239	NE-32-046-24 W4M	44.2	Water Bearing Sandstone
236239	NE-32-046-24 W4M	45.7	Shale
236245	NE-32-046-24 W4M	4.6	Sand
236245	NE-32-046-24 W4M	18.3	Clay & Rocks
236245	NE-32-046-24 W4M	25.9	Soft Shale
236245	NE-32-046-24 W4M	29.9	Hard Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
236245	NE-32-046-24 W4M	30.5	Hard Sandstone
236245	NE-32-046-24 W4M	50.3	Hard Shale
236245	NE-32-046-24 W4M	52.4	Hard Sandstone
236245	NE-32-046-24 W4M	54.3	Soft Sandstone
236245	NE-32-046-24 W4M	54.9	Hard Shale
236248	NE-32-046-24 W4M	7.6	Sand
236248	NE-32-046-24 W4M	18.3	Clay & Rocks
236248	NE-32-046-24 W4M	25.9	Soft Shale
236248	NE-32-046-24 W4M	29.9	Hard Shale
236248	NE-32-046-24 W4M	30.5	Hard Sandstone
236248	NE-32-046-24 W4M	50.3	Hard Shale
236248	NE-32-046-24 W4M	52.4	Hard Sandstone
236248	NE-32-046-24 W4M	54.3	Soft Sandstone
236248	NE-32-046-24 W4M	57.9	Hard Shale
236248	NE-32-046-24 W4M	61.0	Soft Sandstone
236248	NE-32-046-24 W4M	64.0	Hard Shale
236347	SE-03-047-24 W4M	6.1	Sand
236347	SE-03-047-24 W4M	9.1	Brown Clay
236347	SE-03-047-24 W4M	12.2	Blue Clay
236347	SE-03-047-24 W4M	21.3	Brown Shale
236347	SE-03-047-24 W4M	33.5	Green Shale
236347	SE-03-047-24 W4M	38.1	Brown Sandy Shale
236347	SE-03-047-24 W4M	41.1	Green Shale
236431	NW-03-047-24 W4M	7.6	Sand
236431	NW-03-047-24 W4M	12.2	Blue Clay
236431	NW-03-047-24 W4M	21.0	Blue Shale
236431	NW-03-047-24 W4M	25.3	Water Bearing Sand
236431	NW-03-047-24 W4M	27.7	Green Shale & Rocks
236431	NW-03-047-24 W4M	30.5	Water Bearing Sandrock
236435	09-03-047-24 W4M	4.3	Brown Clay
236435	09-03-047-24 W4M	29.0	Soft Clay & Sand
236435	09-03-047-24 W4M	29.6	Gray Hard Sandstone
236435	09-03-047-24 W4M	30.2	Brown Shale
236435	09-03-047-24 W4M	36.6	Siltstone
236437	SE-04-047-24 W4M	18.3	Clay & Sand
236437	SE-04-047-24 W4M	20.4	Coal
236437	SE-04-047-24 W4M	39.6	Shale
236441	SE-04-047-24 W4M	9.1	Sand
236441	SE-04-047-24 W4M	24.7	Clay & Rocks
236441	SE-04-047-24 W4M	27.4	Soft Shale
236441	SE-04-047-24 W4M	32.0	Hard Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
236441	SE-04-047-24 W4M	32.9	Hard Sandstone
236441	SE-04-047-24 W4M	34.1	Soft Sandstone
236441	SE-04-047-24 W4M	48.2	Hard Shale
236441	SE-04-047-24 W4M	48.5	Hard Sandstone
236441	SE-04-047-24 W4M	51.8	Soft Sandstone
236441	SE-04-047-24 W4M	54.9	Black Shale
236443	SW-04-047-24 W4M	6.1	Brown Clay
236443	SW-04-047-24 W4M	16.8	Blue Shale
236443	SW-04-047-24 W4M	21.3	Gray Shale
236443	SW-04-047-24 W4M	22.3	Sandrock
236443	SW-04-047-24 W4M	24.4	Blue Shale & Rocks
236448	NE-04-047-24 W4M	3.0	Sand
236448	NE-04-047-24 W4M	7.6	Brown Clay
236448	NE-04-047-24 W4M	14.0	Blue Clay
236448	NE-04-047-24 W4M	23.8	Gray Shale
236448	NE-04-047-24 W4M	24.7	Fine Grained Sandrock
236448	NE-04-047-24 W4M	30.5	Blue Shale & Rocks
236448	NE-04-047-24 W4M	33.2	Sandrock
236448	NE-04-047-24 W4M	36.6	Blue Shale & Rocks
236451	NE-04-047-24 W4M	1.8	Sand
236451	NE-04-047-24 W4M	4.6	Brown Clay
236451	NE-04-047-24 W4M	12.8	Blue Clay
236451	NE-04-047-24 W4M	19.8	Blue Clay
236451	NE-04-047-24 W4M	25.3	Gray Shale
236451	NE-04-047-24 W4M	26.5	Sandrock
236451	NE-04-047-24 W4M	30.5	Blue Shale
236454	NE-04-047-24 W4M	7.3	Brown Sandy Clay
236454	NE-04-047-24 W4M	10.7	Blue Sandy Clay
236454	NE-04-047-24 W4M	13.1	Gray Sandy Clay
236454	NE-04-047-24 W4M	15.5	Clay & Rocks
236454	NE-04-047-24 W4M	18.6	Green Sandy Shale
236454	NE-04-047-24 W4M	19.5	Gray Shale
236454	NE-04-047-24 W4M	20.1	Gray Sandy Shale
236454	NE-04-047-24 W4M	22.3	Soft Sandstone
236454	NE-04-047-24 W4M	22.9	Sandstone
236454	NE-04-047-24 W4M	26.8	Soft Sandstone
236454	NE-04-047-24 W4M	27.7	Sandstone
236454	NE-04-047-24 W4M	30.5	Soft Sandstone
236457	NE-04-047-24 W4M	6.7	Gravelly Sand & Coal
236457	NE-04-047-24 W4M	13.1	Blue Clay
236457	NE-04-047-24 W4M	23.8	Gray Shale
236457	NE-04-047-24 W4M	24.7	Sandrock

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
236457	NE-04-047-24 W4M	25.9	Gray Shale
236457	NE-04-047-24 W4M	28.3	Sandrock
236457	NE-04-047-24 W4M	29.6	Blue Shale & Rocks
236457	NE-04-047-24 W4M	30.5	Sandrock
236459	NE-04-047-24 W4M	3.0	Brown Clay
236459	NE-04-047-24 W4M	7.3	Brown Clay & Sand
236459	NE-04-047-24 W4M	13.1	Blue Clay
236459	NE-04-047-24 W4M	20.4	Gray Shale
236459	NE-04-047-24 W4M	21.6	Sandrock
236459	NE-04-047-24 W4M	25.6	Blue Shale
236459	NE-04-047-24 W4M	28.0	Sandrock
236459	NE-04-047-24 W4M	30.5	Blue Shale & Rocks
236460	NE-04-047-24 W4M	3.7	Sand
236460	NE-04-047-24 W4M	12.2	Sandy Clay
236460	NE-04-047-24 W4M	18.3	Soft Shale
236460	NE-04-047-24 W4M	21.3	Shale & Coal
236460	NE-04-047-24 W4M	24.4	Green Shale
236460	NE-04-047-24 W4M	29.0	Sandy Shale
236463	NE-04-047-24 W4M	14.3	Sandy Clay
236463	NE-04-047-24 W4M	24.7	Gray Shale
236463	NE-04-047-24 W4M	26.2	Sandstone
236463	NE-04-047-24 W4M	41.8	Green Shale
236463	NE-04-047-24 W4M	45.7	Sandstone
236467	NE-04-047-24 W4M	13.7	Sandy Clay
236467	NE-04-047-24 W4M	17.7	Green Shale
236467	NE-04-047-24 W4M	23.8	Soft Sandstone
236467	NE-04-047-24 W4M	24.4	Hard Sandstone
236467	NE-04-047-24 W4M	32.0	Gray Shale
236467	NE-04-047-24 W4M	32.3	Hard Sandstone
236467	NE-04-047-24 W4M	44.8	Gray Shale
236467	NE-04-047-24 W4M	46.6	Water Bearing Sandstone
236467	NE-04-047-24 W4M	48.8	Gray Shale & Coal
236529	SW-10-047-24 W4M	4.6	Sand
236529	SW-10-047-24 W4M	11.0	Clay
236529	SW-10-047-24 W4M	16.8	Blue Shale
236529	SW-10-047-24 W4M	18.3	Sandy Shale
236529	SW-10-047-24 W4M	24.4	Blue Shale
236529	SW-10-047-24 W4M	25.9	Sandy Shale
236529	SW-10-047-24 W4M	27.4	Blue Shale
241959	NE-05-047-24 W4M	1.5	Topsoil
241959	NE-05-047-24 W4M	2.7	Sand

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
241959	NE-05-047-24 W4M	4.6	Brown Clay
241959	NE-05-047-24 W4M	19.8	Blue Clay
241959	NE-05-047-24 W4M	22.6	Gray Shale
241959	NE-05-047-24 W4M	23.2	Sand & Coal
241959	NE-05-047-24 W4M	34.7	Blue Shale
241959	NE-05-047-24 W4M	35.4	Fine Grained Sandstone
241959	NE-05-047-24 W4M	40.8	Gray Shale
241959	NE-05-047-24 W4M	41.1	Sandstone
241959	NE-05-047-24 W4M	61.0	Blue Gray Shale
241959	NE-05-047-24 W4M	72.5	Blue Stoney Shale
241959	NE-05-047-24 W4M	74.1	Water Bearing Sand & Rocks
241959	NE-05-047-24 W4M	76.2	Blue Shale
254413	NW-33-046-24 W4M	6.1	Brown Sand
254413	NW-33-046-24 W4M	19.2	Blue Clay
254413	NW-33-046-24 W4M	28.7	Gray Shale
254413	NW-33-046-24 W4M	30.2	Gray Sandy Shale & Sandstone
254413	NW-33-046-24 W4M	32.0	Gray Shale
254413	NW-33-046-24 W4M	33.5	Green Shale
254413	NW-33-046-24 W4M	39.0	Gray Shale
254413	NW-33-046-24 W4M	42.1	Sandstone
254413	NW-33-046-24 W4M	49.7	Green Shale
254413	NW-33-046-24 W4M	51.2	Gray Sandy Shale
254413	NW-33-046-24 W4M	52.1	Sandstone
254413	NW-33-046-24 W4M	54.9	Green Shale
257576	NW-33-046-24 W4M	4.3	Brown Clay & Rocks
257576	NW-33-046-24 W4M	7.9	Blue Clay & Rocks
257576	NW-33-046-24 W4M	9.8	Green Shale
257576	NW-33-046-24 W4M	17.1	Gray Shale
257576	NW-33-046-24 W4M	17.7	Sandstone
257576	NW-33-046-24 W4M	19.5	Gray Sandy Shale
257576	NW-33-046-24 W4M	21.3	Brown Shale
257576	NW-33-046-24 W4M	25.6	Green Shale
257576	NW-33-046-24 W4M	29.0	Gray Shale
257576	NW-33-046-24 W4M	29.6	Sandstone
257576	NW-33-046-24 W4M	31.7	Gray Sandy Shale
257576	NW-33-046-24 W4M	38.4	Green Shale
257576	NW-33-046-24 W4M	40.2	Gray Sandy Shale
257576	NW-33-046-24 W4M	40.5	Sandstone
257576	NW-33-046-24 W4M	42.1	Gray Sandy Shale
257576	NW-33-046-24 W4M	43.9	Gray Shale
257576	NW-33-046-24 W4M	46.9	Green Shale
257576	NW-33-046-24 W4M	47.5	Gray Sandy Shale
257576	NW-33-046-24 W4M	48.2	Sandstone
257576	NW-33-046-24 W4M	50.0	Gray Sandy Shale
257576	NW-33-046-24 W4M	52.4	Gray Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
257576	NW-33-046-24 W4M	53.6	Green Shale
257576	NW-33-046-24 W4M	56.1	Gray Sandy Shale
257576	NW-33-046-24 W4M	56.7	Sandstone
257576	NW-33-046-24 W4M	58.5	Gray Sandy Shale
257576	NW-33-046-24 W4M	61.0	Green Shale
267890	08-04-047-24 W4M	2.7	Brown Clay
267890	08-04-047-24 W4M	4.3	Sand
267890	08-04-047-24 W4M	21.3	Blue Clay & Rocks
267890	08-04-047-24 W4M	22.6	Green Shale
267890	08-04-047-24 W4M	23.5	Brown Shale
267890	08-04-047-24 W4M	24.1	Coal
267890	08-04-047-24 W4M	25.3	Gray Shale
267890	08-04-047-24 W4M	26.2	Gray Sandy Shale
267890	08-04-047-24 W4M	26.5	Sandstone
267890	08-04-047-24 W4M	27.7	Gray Sandy Shale
267890	08-04-047-24 W4M	29.3	Brown Shale
267890	08-04-047-24 W4M	32.3	Gray Shale
267890	08-04-047-24 W4M	34.7	Gray Sandy Shale
267890	08-04-047-24 W4M	35.4	Sandstone
267890	08-04-047-24 W4M	37.2	Gray Sandy Shale
267890	08-04-047-24 W4M	40.2	Green Shale
267890	08-04-047-24 W4M	42.1	Gray Sandy Shale
267890	08-04-047-24 W4M	42.7	Sandstone
267890	08-04-047-24 W4M	43.9	Gray Sandy Shale
267890	08-04-047-24 W4M	45.1	Green Shale
267890	08-04-047-24 W4M	47.5	Gray Sandy Shale
267890	08-04-047-24 W4M	50.3	Green Shale
267890	08-04-047-24 W4M	51.8	Gray Sandy Shale
267890	08-04-047-24 W4M	58.5	Green Shale
267890	08-04-047-24 W4M	59.7	Gray Sandy Shale
267890	08-04-047-24 W4M	63.4	Green Shale
267890	08-04-047-24 W4M	64.0	Sandstone
267890	08-04-047-24 W4M	65.2	Gray Sandy Shale
267890	08-04-047-24 W4M	68.9	Green Sandstone
267890	08-04-047-24 W4M	72.5	Gray Sandy Shale
267890	08-04-047-24 W4M	73.2	Gray Shale
267898	01-04-047-24 W4M	0.6	Black Topsoil
267898	01-04-047-24 W4M	5.5	Sand
267898	01-04-047-24 W4M	17.7	Blue Clay & Rocks
267898	01-04-047-24 W4M	20.4	Gray Shale
267898	01-04-047-24 W4M	20.7	Sandstone
267898	01-04-047-24 W4M	21.3	Brown Shale
267898	01-04-047-24 W4M	22.9	Coal
267898	01-04-047-24 W4M	26.2	Gray Shale
267898	01-04-047-24 W4M	27.4	Green Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
267898	01-04-047-24 W4M	28.0	Sandstone
267898	01-04-047-24 W4M	30.2	Gray Sandy Shale
267898	01-04-047-24 W4M	32.3	Green Shale
267898	01-04-047-24 W4M	33.5	Gray Sandy Shale
267898	01-04-047-24 W4M	34.1	Sandstone
267898	01-04-047-24 W4M	34.7	Gray Sandy Shale
267898	01-04-047-24 W4M	35.7	Sandstone
267898	01-04-047-24 W4M	37.5	Green Shale
267898	01-04-047-24 W4M	38.7	Gray Sandy Shale
267898	01-04-047-24 W4M	39.0	Sandstone
267898	01-04-047-24 W4M	40.2	Gray Sandy Shale
267898	01-04-047-24 W4M	41.5	Green Shale
267898	01-04-047-24 W4M	43.9	Gray Sandy Shale
267898	01-04-047-24 W4M	44.5	Green Shale
267898	01-04-047-24 W4M	46.3	Gray Sandy Shale
267898	01-04-047-24 W4M	51.8	Green Shale
267898	01-04-047-24 W4M	55.5	Gray Sandy Shale
267898	01-04-047-24 W4M	59.1	Green Shale
267898	01-04-047-24 W4M	63.4	Gray Sandy Shale
267898	01-04-047-24 W4M	64.3	Sandstone
267898	01-04-047-24 W4M	66.1	Gray Sandy Shale
267898	01-04-047-24 W4M	67.1	Green Shale
288841	NE-05-047-24 W4M	3.0	Brown Clay
288841	NE-05-047-24 W4M	3.7	Sand
288841	NE-05-047-24 W4M	18.3	Blue Clay
288841	NE-05-047-24 W4M	39.6	Gray Shale
288841	NE-05-047-24 W4M	40.5	Sandstone
288841	NE-05-047-24 W4M	48.8	Green Shale
288841	NE-05-047-24 W4M	64.0	Gray Shale
288841	NE-05-047-24 W4M	70.1	Sandy Shale & Sandstone
288841	NE-05-047-24 W4M	71.6	Green Shale
290375	SE-03-047-24 W4M	6.1	Sand
290375	SE-03-047-24 W4M	9.4	Brown Clay
290375	SE-03-047-24 W4M	11.9	Blue Clay
290375	SE-03-047-24 W4M	21.3	Brown Shale
290375	SE-03-047-24 W4M	33.5	Green Shale
290375	SE-03-047-24 W4M	38.1	Brown Sandy Shale
290375	SE-03-047-24 W4M	41.1	Green Shale
291967	SE-03-047-24 W4M	3.0	Brown Sandy Clay
291967	SE-03-047-24 W4M	10.7	Blue Clay
291967	SE-03-047-24 W4M	24.4	Gray Clay
291967	SE-03-047-24 W4M	30.5	Green Shale
291967	SE-03-047-24 W4M	36.6	Gray Shale
291967	SE-03-047-24 W4M	41.1	Sandy Shale & Sandstone

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
291967	SE-03-047-24 W4M	42.7	Gray Shale
292690	NE-32-046-24 W4M	14.3	Blue Clay & Sand
292690	NE-32-046-24 W4M	22.9	Gray Shale
292690	NE-32-046-24 W4M	24.4	Sandstone
292690	NE-32-046-24 W4M	29.9	Gray Shale
292690	NE-32-046-24 W4M	35.1	Green Shale
292690	NE-32-046-24 W4M	41.8	Gray Shale
292690	NE-32-046-24 W4M	42.7	Sandy Shale & Sandstone
292690	NE-32-046-24 W4M	44.2	Green Shale
1030003	SE-04-047-24 W4M	6.7	Brown Clay & Rocks
1030003	SE-04-047-24 W4M	16.5	Black Clay & Rocks
1030003	SE-04-047-24 W4M	18.9	Green Shale
1030003	SE-04-047-24 W4M	19.8	Sandy Shale
1030003	SE-04-047-24 W4M	20.7	Sandstone
1030003	SE-04-047-24 W4M	22.9	Gray Sandy Shale
1030003	SE-04-047-24 W4M	26.2	Green Shale
1030003	SE-04-047-24 W4M	26.8	Gray Shale
1030003	SE-04-047-24 W4M	28.7	Gray Sandy Shale
1030003	SE-04-047-24 W4M	29.3	Sandstone
1030003	SE-04-047-24 W4M	29.9	Gray Shale
1030003	SE-04-047-24 W4M	34.1	Green Shale
1030003	SE-04-047-24 W4M	36.0	Gray Sandy Shale
1030003	SE-04-047-24 W4M	39.0	Green Shale
1030003	SE-04-047-24 W4M	39.9	Gray Shale
1030003	SE-04-047-24 W4M	40.8	Gray Sandy Shale
1030003	SE-04-047-24 W4M	41.5	Sandstone
1030003	SE-04-047-24 W4M	42.1	Gray Sandy Shale
1030003	SE-04-047-24 W4M	46.3	Green Shale
1030003	SE-04-047-24 W4M	47.2	Gray Shale
1030003	SE-04-047-24 W4M	50.6	Gray Sandy Shale
1030003	SE-04-047-24 W4M	51.2	Sandstone
1030003	SE-04-047-24 W4M	55.5	Gray Sandy Shale
1030003	SE-04-047-24 W4M	56.4	Sandstone
1030003	SE-04-047-24 W4M	58.5	Gray Sandy Shale
1030003	SE-04-047-24 W4M	59.4	Sandstone
1030003	SE-04-047-24 W4M	60.4	Gray Sandy Shale
1030003	SE-04-047-24 W4M	61.0	Green Shale
1030022	SW-10-047-24 W4M	4.9	Gray Fine Grained Sand & Gravel
1030022	SW-10-047-24 W4M	9.8	Blue Clay
1030022	SW-10-047-24 W4M	14.0	Green Shale
1030022	SW-10-047-24 W4M	15.2	Gray Sandy Shale
1030022	SW-10-047-24 W4M	16.2	Sandstone
1030022	SW-10-047-24 W4M	17.1	Gray Sandy Shale
1030022	SW-10-047-24 W4M	23.2	Gray Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
1030022	SW-10-047-24 W4M	24.4	Gray Sandy Shale
1030022	SW-10-047-24 W4M	25.0	Sandstone
1030022	SW-10-047-24 W4M	26.2	Gray Sandy Shale
1030022	SW-10-047-24 W4M	28.0	Green Shale
1030022	SW-10-047-24 W4M	32.3	Gray Shale
1030022	SW-10-047-24 W4M	34.1	Gray Sandy Shale
1030022	SW-10-047-24 W4M	34.7	Sandstone
1030022	SW-10-047-24 W4M	36.6	Gray Sandy Shale
1030022	SW-10-047-24 W4M	39.6	Green Shale
1030022	SW-10-047-24 W4M	42.1	Gray Sandy Shale
1030022	SW-10-047-24 W4M	43.9	Gray Shale
1030022	SW-10-047-24 W4M	46.3	Gray Sandy Shale
1030022	SW-10-047-24 W4M	47.2	Sandstone
1030022	SW-10-047-24 W4M	48.2	Gray Sandy Shale
1030022	SW-10-047-24 W4M	48.8	Green Shale
1030048	SE-04-047-24 W4M	7.9	Brown Sandy Clay & Rocks
1030048	SE-04-047-24 W4M	9.8	Sand
1030048	SE-04-047-24 W4M	20.1	Blue Clay & Rocks
1030048	SE-04-047-24 W4M	21.9	Gray Shale
1030048	SE-04-047-24 W4M	23.8	Gray Sandy Shale
1030048	SE-04-047-24 W4M	24.4	Sandstone
1030048	SE-04-047-24 W4M	25.0	Gray Sandy Shale
1030048	SE-04-047-24 W4M	27.4	Green Shale
1030048	SE-04-047-24 W4M	29.3	Gray Shale
1030048	SE-04-047-24 W4M	31.4	Gray Sandy Shale
1030048	SE-04-047-24 W4M	32.9	Gray Shale
1030048	SE-04-047-24 W4M	38.4	Green Shale
1030048	SE-04-047-24 W4M	40.2	Gray Shale
1030048	SE-04-047-24 W4M	42.1	Gray See Comments Shale
1030048	SE-04-047-24 W4M	44.5	Gray Shale
1030048	SE-04-047-24 W4M	48.2	Gray Sandy Shale
1030048	SE-04-047-24 W4M	49.1	Sandstone
1030048	SE-04-047-24 W4M	50.6	Gray Sandy Shale
1030048	SE-04-047-24 W4M	51.8	Green Shale
1030154	SW-10-047-24 W4M	5.5	Sand
1030154	SW-10-047-24 W4M	10.4	Blue Clay & Rocks
1030154	SW-10-047-24 W4M	16.5	Green Shale
1030154	SW-10-047-24 W4M	18.9	Gray Sandy Shale
1030154	SW-10-047-24 W4M	19.8	Sandstone
1030154	SW-10-047-24 W4M	20.7	Gray Sandy Shale
1030154	SW-10-047-24 W4M	22.9	Gray Shale
1030154	SW-10-047-24 W4M	24.4	Gray Sandy Shale
1030154	SW-10-047-24 W4M	25.3	Sandstone
1030154	SW-10-047-24 W4M	26.8	Gray Sandy Shale
1030154	SW-10-047-24 W4M	31.7	Green Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
1030154	SW-10-047-24 W4M	33.2	Gray Sandy Shale
1030154	SW-10-047-24 W4M	39.0	Green Shale
1030154	SW-10-047-24 W4M	40.5	Gray Shale
1030154	SW-10-047-24 W4M	43.3	Gray Sandy Shale
1030154	SW-10-047-24 W4M	44.2	Sandstone
1030154	SW-10-047-24 W4M	50.3	Gray Sandy Shale
1030154	SW-10-047-24 W4M	51.2	Green Shale
1030209	11-10-047-24 W4M	5.5	Sand & Rocks
1030209	11-10-047-24 W4M	11.0	Blue Clay & Rocks
1030209	11-10-047-24 W4M	13.4	Green Shale
1030209	11-10-047-24 W4M	15.8	Gray Shale
1030209	11-10-047-24 W4M	20.1	Gray Sandy Shale
1030209	11-10-047-24 W4M	22.3	Gray Shale
1030209	11-10-047-24 W4M	23.5	Gray Sandy Shale
1030209	11-10-047-24 W4M	24.1	Sandstone
1030209	11-10-047-24 W4M	25.6	Gray Sandy Shale
1030209	11-10-047-24 W4M	28.3	Green Shale
1030209	11-10-047-24 W4M	29.3	Gray Shale
1030209	11-10-047-24 W4M	31.1	Gray Sandy Shale
1030209	11-10-047-24 W4M	32.3	Sandstone
1030209	11-10-047-24 W4M	33.5	Gray Sandy Shale
1030209	11-10-047-24 W4M	39.0	Green Shale
1030209	11-10-047-24 W4M	44.2	Gray Shale
1030209	11-10-047-24 W4M	46.9	Gray Sandy Shale
1030209	11-10-047-24 W4M	47.9	Sandstone
1030209	11-10-047-24 W4M	51.2	Gray Fine Grained Sand & Shale
1030209	11-10-047-24 W4M	52.1	Sandstone
1030209	11-10-047-24 W4M	54.3	Gray Sandy Shale
1030209	11-10-047-24 W4M	54.9	Green Shale
1030220	08-4-47-24 W4M	6.4	Sand
1030220	08-4-47-24 W4M	7.3	Brown Sandy Clay
1030220	08-4-47-24 W4M	16.2	Blue Sandy Clay & Rocks
1030220	08-4-47-24 W4M	17.4	Brown Shale
1030220	08-4-47-24 W4M	20.7	Green Shale
1030220	08-4-47-24 W4M	22.9	Gray Sandy Shale
1030220	08-4-47-24 W4M	26.2	Gray Shale
1030220	08-4-47-24 W4M	28.0	Gray Sandy Shale
1030220	08-4-47-24 W4M	28.7	Sandstone
1030220	08-4-47-24 W4M	29.6	Gray Sandy Shale
1030220	08-4-47-24 W4M	34.7	Brown Shale
1030220	08-4-47-24 W4M	38.4	Gray Sandy Shale
1030220	08-4-47-24 W4M	39.0	Sandstone
1030220	08-4-47-24 W4M	39.6	Gray Sandy Shale
1030220	08-4-47-24 W4M	47.5	Brown Shale
1030220	08-4-47-24 W4M	54.3	Gray Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
1030220	08-4-47-24 W4M	56.7	Gray Sandy Shale
1030220	08-4-47-24 W4M	57.9	Water Bearing Sandstone
1030220	08-4-47-24 W4M	59.7	Gray Sandy Shale
1030220	08-4-47-24 W4M	61.0	Brown Shale
1030246	NE-32-46-24 W4M	6.7	Brown Sandy Clay & Rocks
1030246	NE-32-46-24 W4M	13.1	Blue Clay & Rocks
1030246	NE-32-46-24 W4M	14.0	Gray Shale
1030246	NE-32-46-24 W4M	16.5	Brown Shale
1030246	NE-32-46-24 W4M	17.4	Coal
1030246	NE-32-46-24 W4M	20.1	Brown Shale
1030246	NE-32-46-24 W4M	20.7	Gray Sandy Shale
1030246	NE-32-46-24 W4M	21.9	Gray Shale
1030246	NE-32-46-24 W4M	34.1	Green Shale
1030246	NE-32-46-24 W4M	36.9	Gray Shale
1030246	NE-32-46-24 W4M	39.0	Gray Fine Grained Shale
1030246	NE-32-46-24 W4M	39.6	Sandstone
1030246	NE-32-46-24 W4M	41.5	Gray Sandy Shale
1030246	NE-32-46-24 W4M	45.1	Gray Fine Grained Shale
1030246	NE-32-46-24 W4M	46.0	Sandstone
1030246	NE-32-46-24 W4M	47.2	Gray Sandy Shale
1030246	NE-32-46-24 W4M	47.9	Green Shale
1130063	01-04-047-24 W4M	10.4	Brown Sandy Clay
1130063	01-04-047-24 W4M	21.6	Gray Sandy Clay
1130063	01-04-047-24 W4M	22.6	Brown Shale & Coal
1130063	01-04-047-24 W4M	23.2	Coal
1130063	01-04-047-24 W4M	23.8	Brown Shale & Coal
1130063	01-04-047-24 W4M	28.0	Gray Shale
1130063	01-04-047-24 W4M	28.3	Brown Shale & Coal
1130063	01-04-047-24 W4M	35.7	Gray Shale
1130063	01-04-047-24 W4M	36.6	Gray Sandstone
1130063	01-04-047-24 W4M	41.5	Gray Shale
1130063	01-04-047-24 W4M	44.2	Sandstone
1130063	01-04-047-24 W4M	53.6	Gray Shale
1130063	01-04-047-24 W4M	61.0	Sandstone
1780161	NE-04-047-24 W4M	7.6	Sand
1780161	NE-04-047-24 W4M	18.3	Blue Clay
1780161	NE-04-047-24 W4M	30.5	Gray Shale & Sandstone
1780161	NE-04-047-24 W4M	41.1	Green Shale
1780161	NE-04-047-24 W4M	45.7	Sandy Shale & Sandstone
1780161	NE-04-047-24 W4M	48.8	Green Shale
1780180	12-10-47-24 W4M	6.1	Sand
1780180	12-10-47-24 W4M	12.2	Blue Clay
1780180	12-10-47-24 W4M	18.3	Gray Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
1780180	12-10-47-24 W4M	27.4	Green Shale
1780180	12-10-47-24 W4M	30.5	Gray Shale
1780180	12-10-47-24 W4M	35.1	Sandy Shale & Sandstone
1780180	12-10-47-24 W4M	36.6	Green Shale
1780194	11-10-47-24 W4M	6.1	Sand
1780194	11-10-47-24 W4M	13.7	Blue Clay
1780194	11-10-47-24 W4M	18.3	Gray Shale
1780194	11-10-47-24 W4M	20.7	Sandy Shale & Sandstone
1780194	11-10-47-24 W4M	26.8	Green Shale
1780194	11-10-47-24 W4M	29.0	Gray Shale
1780194	11-10-47-24 W4M	33.5	Sandstone
1780194	11-10-47-24 W4M	36.6	Green Shale
1780235	8-4-47-24 W4M	10.7	Sand
1780235	8-4-47-24 W4M	30.5	Blue Clay
1780235	8-4-47-24 W4M	36.6	Green Shale
1780235	8-4-47-24 W4M	39.6	Sandy Shale & Sandstone
1780286	SW-10-47-24 W4M	4.6	Sand
1780286	SW-10-47-24 W4M	7.6	Blue Clay
1780286	SW-10-47-24 W4M	13.7	Green Shale
1780286	SW-10-47-24 W4M	15.2	Sandstone
1780286	SW-10-47-24 W4M	20.7	Green Shale
1780286	SW-10-47-24 W4M	21.3	Sandstone
1780286	SW-10-47-24 W4M	22.9	Gray Shale
1780286	SW-10-47-24 W4M	24.4	Green Shale
1780286	SW-10-47-24 W4M	33.5	Light Brown Sandy Shale & Sandstone
1780286	SW-10-47-24 W4M	36.6	Green Shale
1780303	SW-3-47-24 W4M	4.6	Sand
1780303	SW-3-47-24 W4M	7.6	Brown Clay
1780303	SW-3-47-24 W4M	15.2	Blue Clay
1780303	SW-3-47-24 W4M	22.9	Gray Shale
1780303	SW-3-47-24 W4M	27.4	Sandstone
1780303	SW-3-47-24 W4M	30.5	Gray Shale
1780303	SW-3-47-24 W4M	34.7	Green Shale
1780303	SW-3-47-24 W4M	36.6	Sandstone
1780319	SE-4-47-24 W4M	4.6	Brown Sandy Clay
1780319	SE-4-47-24 W4M	7.6	Sand & Rocks
1780319	SE-4-47-24 W4M	10.7	Sandy Clay
1780319	SE-4-47-24 W4M	16.8	Blue Clay
1780319	SE-4-47-24 W4M	17.4	Gray Shale
1780319	SE-4-47-24 W4M	18.6	Coal
1780319	SE-4-47-24 W4M	23.8	Gray Shale
1780319	SE-4-47-24 W4M	26.2	Green Shale

TABLE 4.2
WATER WELL LITHOLOGS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Location	Depth (m)	Formation
1780319	SE-4-47-24 W4M	27.4	Gray Shale
1780319	SE-4-47-24 W4M	28.3	Sandstone
1780319	SE-4-47-24 W4M	29.3	Gray Shale
1780319	SE-4-47-24 W4M	29.6	Sandstone
1780319	SE-4-47-24 W4M	32.3	Green Shale
1780319	SE-4-47-24 W4M	34.4	Gray Shale
1780319	SE-4-47-24 W4M	39.0	Green Shale
1780319	SE-4-47-24 W4M	41.1	Sandstone
1780319	SE-4-47-24 W4M	42.7	Green Shale

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
166036	30-Apr-80	N/A	6.7	14.3	Pump	18.3	45
166471	13-Mar-92	N/A	6.7	15.8	Pump	21.3	45
236192	13-May-81	N/A	4.9	33.5	Air	33.5	45
236221	28-Aug-82	N/A	15.2	21.3	Pump	21.3	45
236225	29-Aug-82	N/A	16.8	27.4	Pump	27.4	27
236230	22-Apr-83	N/A	9.1	18.3	Pump	18.3	68
236234	18-Aug-83	N/A	6.1	16.8	Pump	16.8	32
236239	2-Jun-87	N/A	6.7	45.7	Bailer	45.7	18
236245	27-Feb-88	N/A	21.3	39.6	Air	39.6	68
236248	1-Nov-88	N/A	13.7	27.4	Pump	27.4	27
236347	9-May-78	N/A	6.7	0.0	Pump	10.7	45
236348	20-Jan-81	N/A	22.9				
236428	8-May-80	N/A	6.1				
236431	28-May-70	N/A	5.8	12.2	Unknown		36
236435	16-May-77	N/A	12.2		Pump	32.0	14
236437	18-Feb-74	N/A	11.4		Pump		91
236441	4-Nov-88	N/A	9.1	21.3	Pump	21.3	23
236443	1-May-75	N/A	1.5		Pump		36
236448	1-Jun-74	N/A	5.5		Pump		36
236451	1-Jun-74	N/A	4.0		Pump		41
236454	1-Jun-77	N/A	5.8		Air	18.3	50
236457	4-Jul-75	N/A	6.3		Pump	11.3	32
236459	2-Jun-75	N/A	3.4		Pump		27
236460	21-Sep-81	N/A	8.5		Bailer	8.5	45
236463	5-Apr-83	N/A	6.1	33.8	Bailer	33.8	45
236467	28-Feb-84	N/A	8.8	48.8	Unknown		73
236529	13-Aug-65	N/A	6.1		Unknown		45
12002478		11:00 AM	9.4			12.2	1

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
40746	13-Jun-02	N/A	13.1	14.6	Pump	21.3	45

Pumping Depth (m)	Elapsed Time	Recovery (m)
13.7	1	13.9
14.0	2	13.7
14.2	3	13.6
14.2	4	13.5
14.3	5	13.4
14.3	6	13.4
14.3	7	13.3
14.4	8	
14.4	9	
14.4	10	13.1
14.5	12	
14.5	14	
14.5	16	
14.6	20	
14.6	25	
14.6	30	
14.6	35	
14.6	120	

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
229704	4-Oct-93	N/A	14.4	24.4	Pump	27.4	54

Pumping Depth (m)	Elapsed Time	Recovery (m)
14.4	0	
18.1	1	20.1
20.6	2	17.7
21.4	3	16.8
22.0	4	16.2
22.7	5	15.7
22.9	6	15.6
23.1	7	15.5
23.2	8	15.5
23.4	9	15.5
23.5	10	15.4
23.6	12	15.4
23.7	14	15.3
23.8	16	15.3
23.9	20	15.2
24.1	25	15.1
24.3	30	
24.4	35	
24.4	40	
24.4	50	
24.4	60	
24.4	75	
24.4	90	
24.4	105	
24.4	120	

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
254413	11-Mar-94	N/A	13.7	21.0	Pump	27.4	45

Pumping Depth (m)	Elapsed Time	Recovery (m)
16.8	1	15.2
17.7	2	
19.2	3	
19.8	4	
20.7	5	
20.7	6	
20.7	7	
20.9	8	
20.9	9	
21.0	10	
21.0	12	
21.0	14	
21.0	16	
21.0	120	

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
257576	27-Apr-95	7:12 AM	6.9	13.4	Pump	18.3	45

Pumping Depth (m)	Elapsed Time	Recovery (m)
7.6	1	11.6
8.5	2	10.4
9.4	3	9.3
10.1	4	8.2
10.7	5	7.6
11.1	6	7.3
11.6	7	7.0
11.9	8	6.9
12.2	9	6.9
12.4	10	6.9
12.6	12	6.9
12.8	14	6.9
13.0	16	6.9
13.1	20	6.9
13.2	25	
13.2	30	
13.3	35	
13.4	40	
13.4	50	
13.4	60	
13.4	75	
13.4	90	
13.4	105	
13.4	120	

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
267890	26-Oct-95	N/A	12.2	42.7	Air	42.7	36

Pumping Depth (m)	Elapsed Time	Recovery (m)
	1	40.5
	2	39.0
	3	37.8
	4	36.6
	5	35.4
	6	34.1
	7	32.9
	8	31.7
	9	30.5
	10	29.3
	12	27.1
	14	25.0
	16	23.2
	20	20.1
	25	18.3
	30	16.8
	35	15.2
	40	14.0
	50	13.4

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
267898	6-Oct-95	N/A	12.2	16.9	Pump	24.4	41

Pumping Depth (m)	Elapsed Time	Recovery (m)
14.0	1	14.9
14.9	2	13.7
15.4	3	13.6
15.7	4	13.3
15.8	5	13.0
16.0	6	12.8
16.2	7	12.6
16.3	8	12.5
16.4	9	12.4
16.5	10	12.3
16.5	12	12.3
16.6	14	12.2
16.7	16	
16.9	20	12.2
16.9	25	12.2
16.9	30	
16.9	120	

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
290375	20-Aug-98	N/A	7.9	14.9	Pump	22.9	45

Pumping Depth (m)	Elapsed Time	Recovery (m)
8.0	0	15.1
9.3	1	12.1
10.1	2	10.9
10.7	3	10.0
11.0	4	9.4
11.3	5	9.2
11.5	6	8.9
11.7	8	8.6
11.8	10	8.4
11.8	12	8.3
12.7	14	8.2
13.6	16	8.2
14.3	20	8.1
14.6	25	8.0
14.7	30	
15.0	50	
15.0	60	
15.1	75	

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
291967	30-Sep-98	N/A	4.9	11.6	Pump	22.9	54

Pumping Depth (m)	Elapsed Time	Recovery (m)
5.0	0	11.8
7.9	1	8.6
9.4	2	7.1
10.2	3	6.5
10.9	4	6.1
11.1	5	5.8
11.3	6	5.7
11.6	8	5.6
11.8	10	5.5
11.9	14	5.2
11.8	20	5.0
11.8	30	
11.8	40	
11.8	60	

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
292690	13-Jul-99	N/A	4.3	24.4	Pump	29.0	41

Pumping Depth (m)	Elapsed Time	Recovery (m)
4.5	0	24.4
7.6	1	20.7
10.3	2	18.8
12.9	3	17.4
15.4	4	16.2
17.5	5	15.3
19.0	6	14.6
19.7	7	14.2
20.2	8	13.9
21.8	9	13.7
22.3	10	13.6
23.1	14	13.4
23.8	20	13.3
24.6	30	13.2
24.6	35	13.1
24.7	40	
24.4	60	

TABLE 4.3
WATER WELL PUMPING TESTS
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
12001957	25-Aug-09	13:0 PM	8.8		Pump	46.0	6

Pumping Depth (m)	Elapsed Time	Recovery (m)
29	0	46.0
	1	45.0
	2	45.0
	3	44.6
	4	44.2
	5	43.8
	6	43.4
	7	43.0
	8	42.7
	9	42.3
	10	42.1
	12	41.5
	14	40.6
	16	39.8
	20	38.6
	25	37.0
	30	35.6
	35	34.5
	40	33.4
	50	31.3
	60	29.3
	75	27.0
	90	25.0
	105	23.2
151.08	120	21.6

Well #	Test Date	Start Time	Static Water Level (m)	End Water Level (m)	Test Type:	Withdrawal Depth (m)	Removal Rate:
12004363	5-Oct-10	16:20 PM	23.0		Air	41.1	18

Pumping Depth (m)	Elapsed Time	Recovery (m)
75.62	0	41.1
	1	37.6
	2	36.2
	3	34.5
	4	32.7
	5	31.0
	6	29.5
	7	28.3
	8	27.3
	10	25.5
	12	24.5
	14	23.8
	16	23.6
	18	23.3
	20	23.2
	25	23.1
135	120	

TABLE 5.4
WATER WELL #236463 CHEMISTRY
NEAR MILLET (NE-4-47-24 W4M), ALBERTA

Parameter	Units	CDWQ [1]		Pump Test #1
Misc. Inorganics				
Conductivity	uS/cm	--- [2]		1200
pH	pH	6.5-8.5	AO [3]	8.73
Anions				
Alkalinity (PP as CaCO3)	mg/L	---		23
Alkalinity (Total as CaCO3)	mg/L	---		580
Bicarbonate (HCO3)	mg/L	---		660
Carbonate (CO3)	mg/L	---		27
Hydroxide (OH)	mg/L	---		<0.50
Dissolved Sulphate (SO4)	mg/L	500	AO	<1.0
Dissolved Chloride (Cl)	mg/L	250	AO	48
Nutrients				
Dissolved Nitrite (N)	mg/L	10	MAC [4]	<0.010
Dissolved Nitrate (N)	mg/L	1	AO	<0.010
Lab Filtered Elements				
Dissolved Calcium (Ca)	mg/L	---		28
Dissolved Iron (Fe)	mg/L	0.3	AO	0.10
Dissolved Magnesium (Mg)	mg/L	---		4.2
Dissolved Manganese (Mn)	mg/L	0.05	AO	0.030
Dissolved Potassium (K)	mg/L	---		1.0
Dissolved Sodium (Na)	mg/L	200	AO	**290**
Calculated Parameters				
Anion Sum	meq/L	---		13
Cation Sum	meq/L	---		15
Hardness (CaCO3)	mg/L	---		87
Ion Balance	N/A	---		1.1
Dissolved Nitrate (NO3)	mg/L	45	MAC	<0.044
Nitrate plus Nitrite (N)	mg/L	11	MAC	<0.010
Dissolved Nitrite (NO2)	mg/L	3.2	AO	<0.033
Total Dissolved Solids	mg/L	500	AO	**730**
Microbiological Param.				
E.Coli DST	mpn/100mL	0	MAC	<1.0
Total Coliforms DST	mpn/100mL	N/A [5]		2.0

[1] Health Canada, August 2012, "Guidelines for Canadian Drinking Water Quality—Summary Table"

[2] No applicable guideline

[3] Aesthetic Objective

[4] Maximum Allowable Concentration

BOLD Does not meet applicable guideline

[5] No guideline for non-municipal groundwater

THURBER

APPENDIX C

Pumping Test Analyses

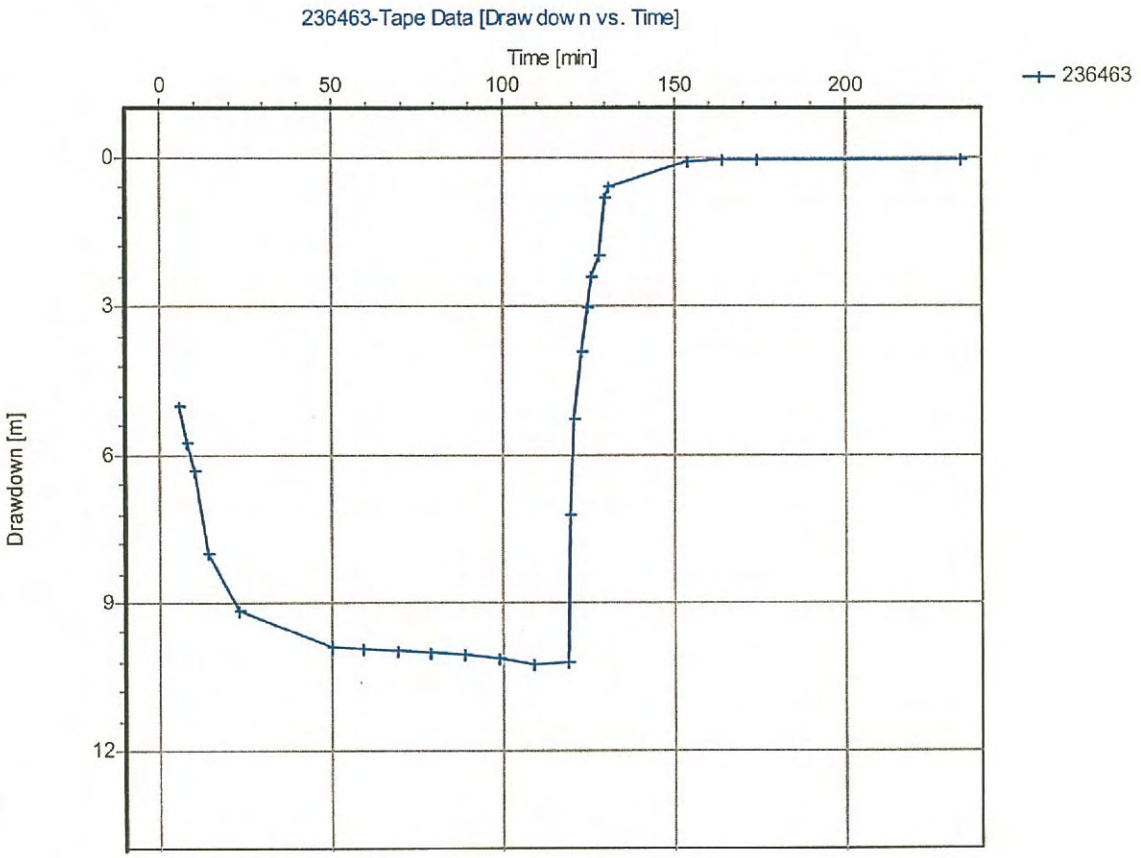
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463-Tape Data**

Analysis Method: **Drawdown vs. Time**

Analysis Results:

Test parameters:				
	Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
	Casing radius:	0.057 [m]		
	Screen length:	21.03 [m]		
	Boring radius:	0.076 [m]		
	Discharge Rate:	0.445 [l/s]		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 8/18/2014

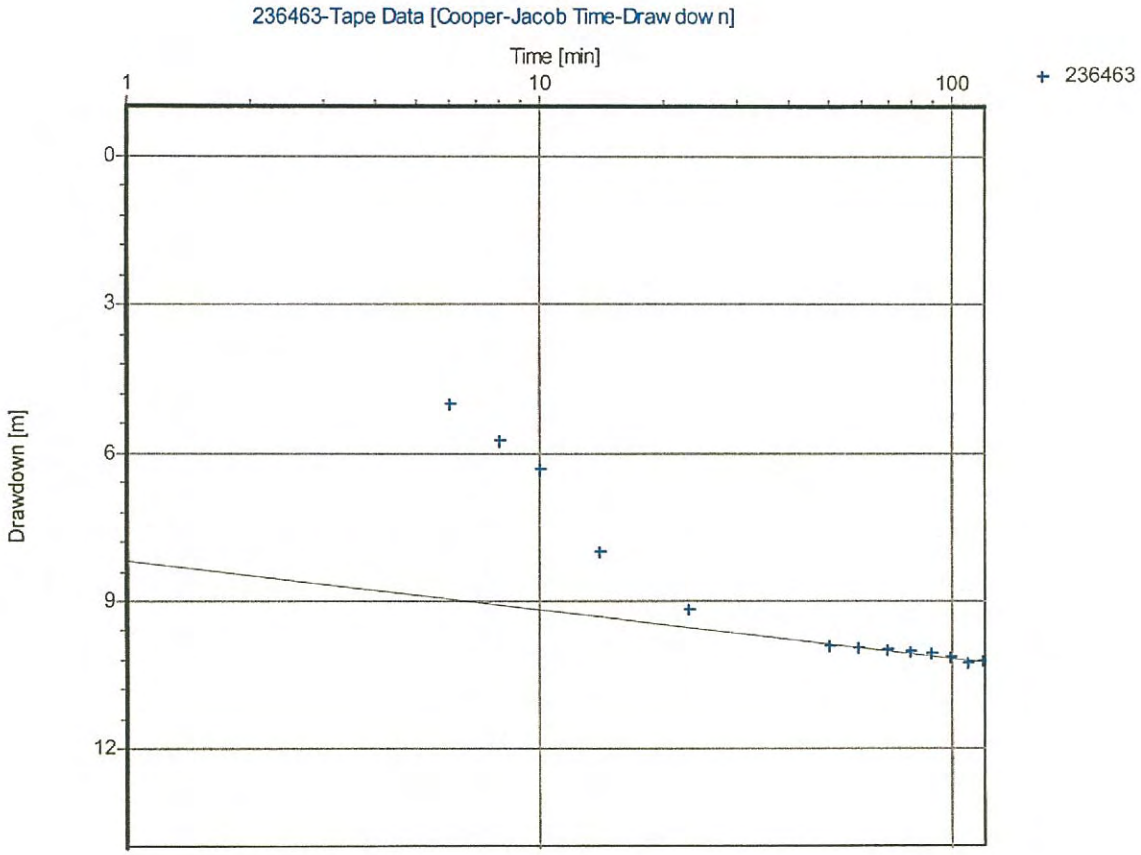
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463-Tape Data**

Analysis Method: **Cooper-Jacob Time-Drawdown**

Analysis Results:	Transmissivity:	8.24E-5 [m²/s]	Conductivity:	3.92E-6 [m/s]

Test parameters:	Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
	Casing radius:	0.057 [m]	Confined Aquifer	
	Screen length:	21.03 [m]		
	Boring radius:	0.076 [m]		
	Discharge Rate:	0.445 [l/s]		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 8/18/2014

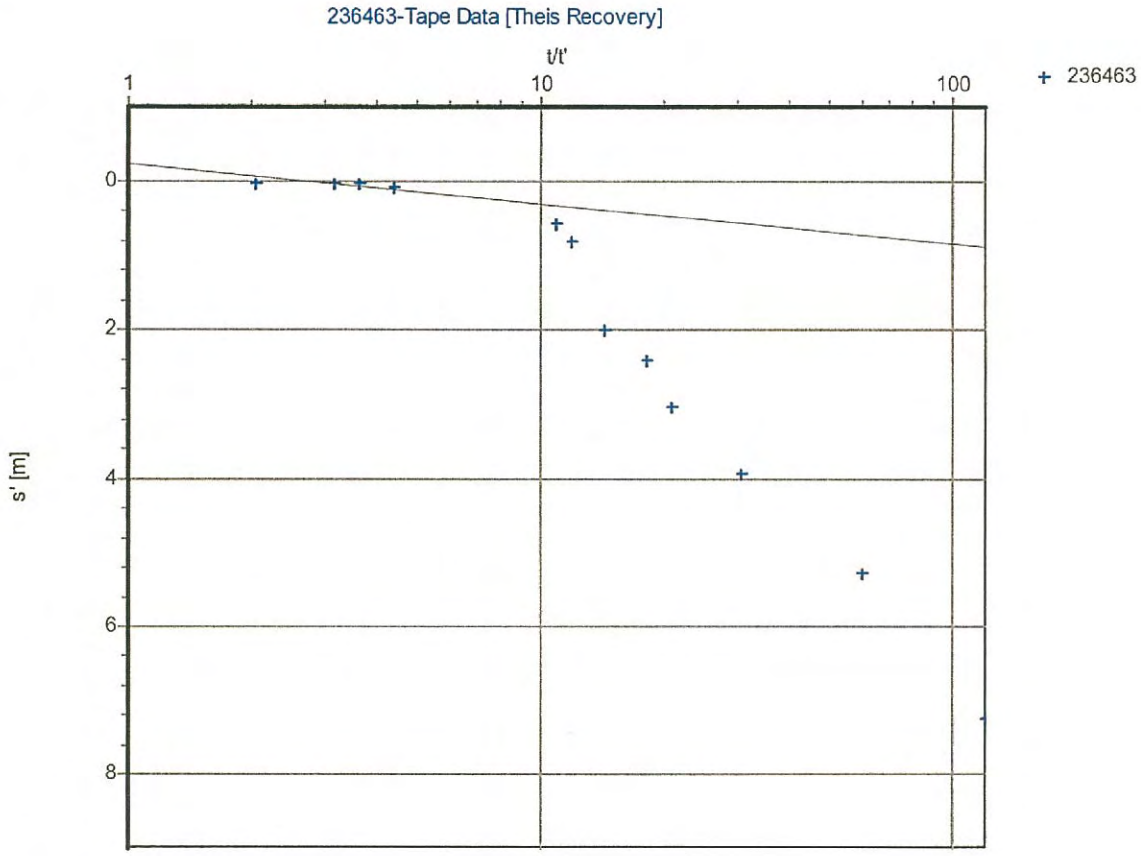
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463-Tape Data**

Analysis Method: **Theis Recovery**

Analysis Results:	Transmissivity:	1.51E-4 [m²/s]	Conductivity:	7.19E-6 [m/s]

Test parameters:	Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
	Casing radius:	0.057 [m]	Confined Aquifer	
	Screen length:	21.03 [m]		
	Boring radius:	0.076 [m]		
	Discharge Rate:	0.445 [l/s]		
	Pumping Time	119 [min]		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 8/18/2014

Thurber Engineering Ltd. Suite 200, 9636-51 Avenue Edmonton, Alberta, T6E 6A5 Phone: 780 438-1460	Pumping Test Data Report Project: Well 236463 Groundwater Evaluation Number: 19-6740-0 Client: Dr. Fritz Martin	Page 1

Data observed at:	**236463**	**Pumping Test:**	**236463-Tape Data**
Distance from PW:	0 [m]	Pumping Well:	236463
Depth to Static WL:	9.92 [m]	Casing radius:	0.057 [m]
Location:	NE 04-047-24 W4	Boring radius:	0.076 [m]
Recorded by:	Jackie Maxwell	Screen length:	21.03 [m]
Date:	7/29/2014	Aquifer Thickness:	21.03 [m]

	Time [min]	Depth to WL [m]	Drawdown [m]
1	0	9.92	0.00
2	6	14.93	5.01
3	8	15.67	5.75
4	10	16.26	6.34
5	14	17.92	8.00
6	23	19.07	9.15
7	50	19.80	9.88
8	59	19.85	9.93
9	69	19.90	9.98
10	79	19.93	10.01
11	89	19.97	10.05
12	99	20.03	10.11
13	109	20.17	10.25
14	119	20.14	10.22
15	120	17.15	7.23
16	121	15.19	5.27
17	123	13.86	3.94
18	125	12.95	3.03
19	126	12.33	2.41
20	128	11.91	1.98
21	130	10.73	0.81
22	131	10.50	0.58
23	154	10.01	0.09
24	164	9.95	0.03
25	174	9.95	0.03
26	234	9.95	0.03

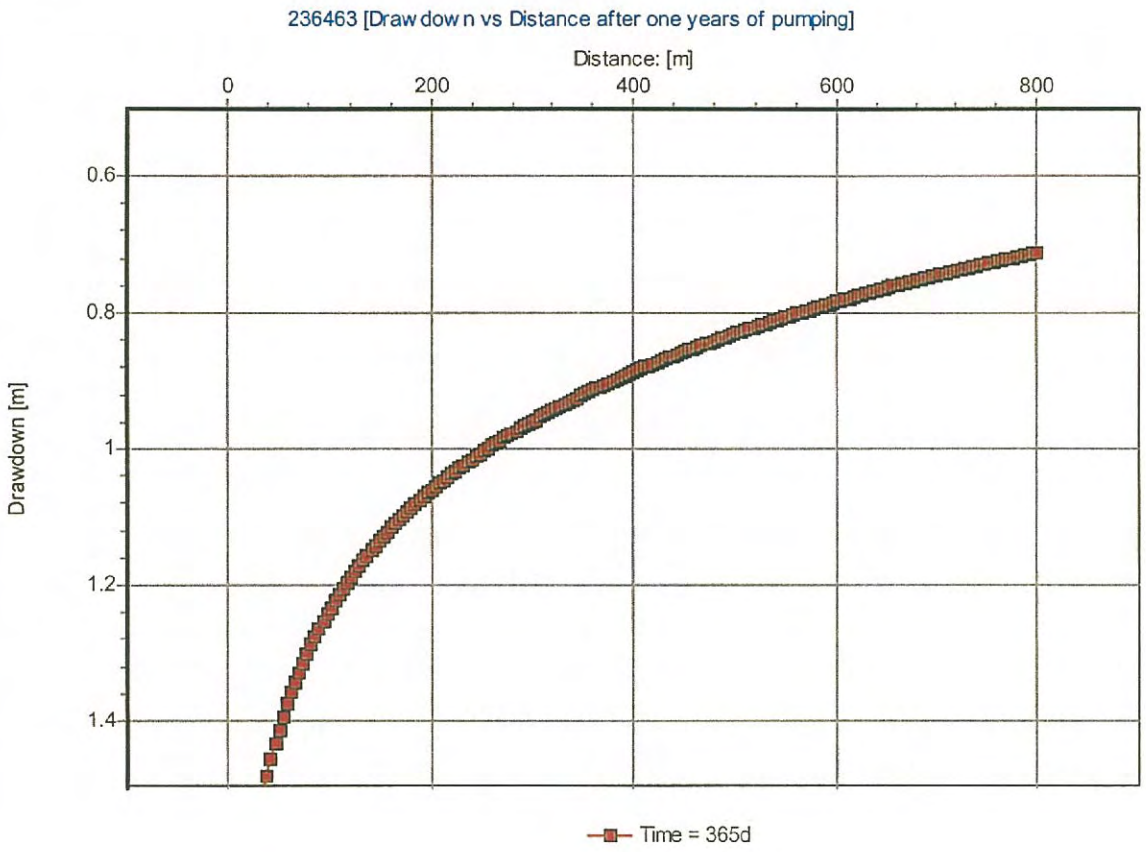
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463**

Analysis Method: **Theis Prediction**

Analysis Results:	Transmissivity:	7.50E-5 [m²/s]
	Storativity:	3.00E-5

Test parameters:	Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
	Casing radius:	0.057 [m]	Drawdown vs. Distance	
	Screen length:	21.03 [m]	Min. Distance:	10 [m]
	Boring radius:	0.076 [m]	Max. Distance:	800 [m]
	Discharge Rate:	10.3 [m³/d]	Time:	365 [d]
	Number of Data Points:	200		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 7/30/2014

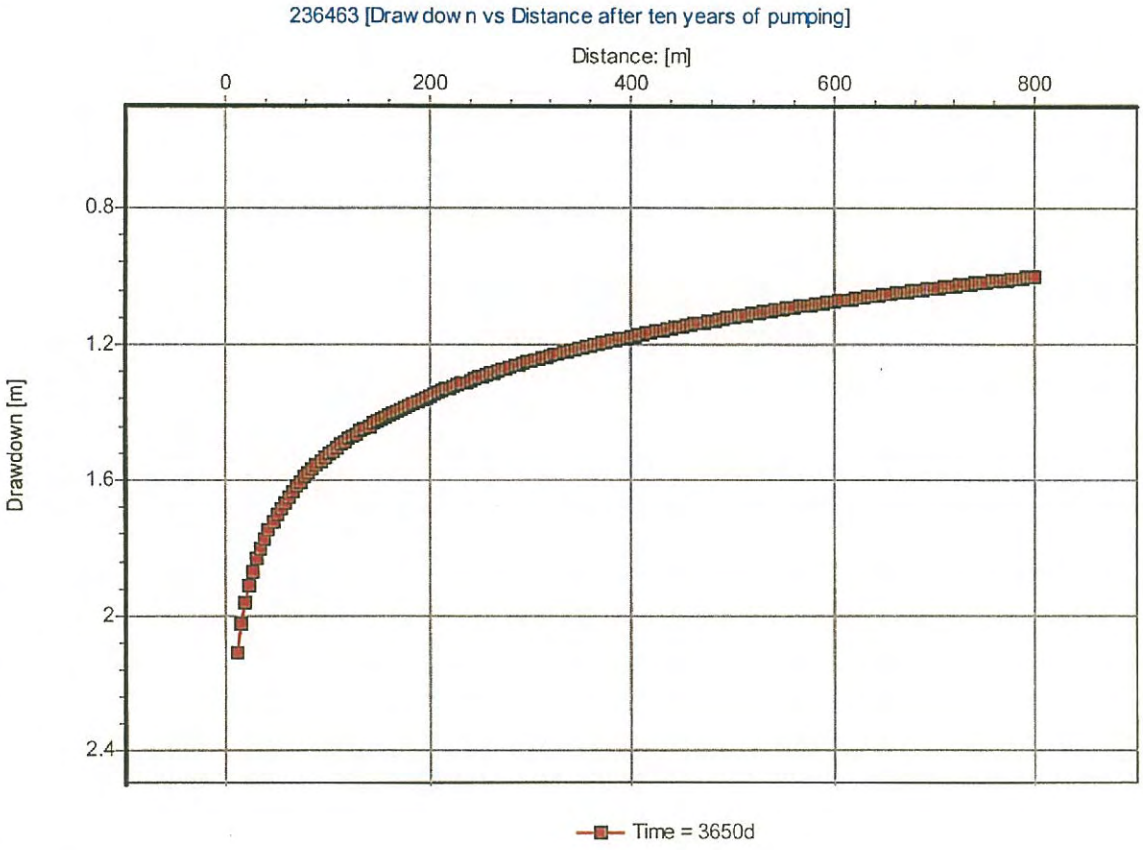
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463**

Analysis Method: **Theis Prediction**

Analysis Results:

Transmissivity:	7.50E-5 [m²/s]
Storativity:	3.00E-5

Test parameters:

Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
Casing radius:	0.057 [m]	Drawdown vs. Distance	
Screen length:	21.03 [m]	Min. Distance:	10 [m]
Boring radius:	0.076 [m]	Max. Distance:	800 [m]
Discharge Rate:	10.3 [m³/d]	Time:	3650 [d]
Number of Data Points:	200		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 7/30/2014

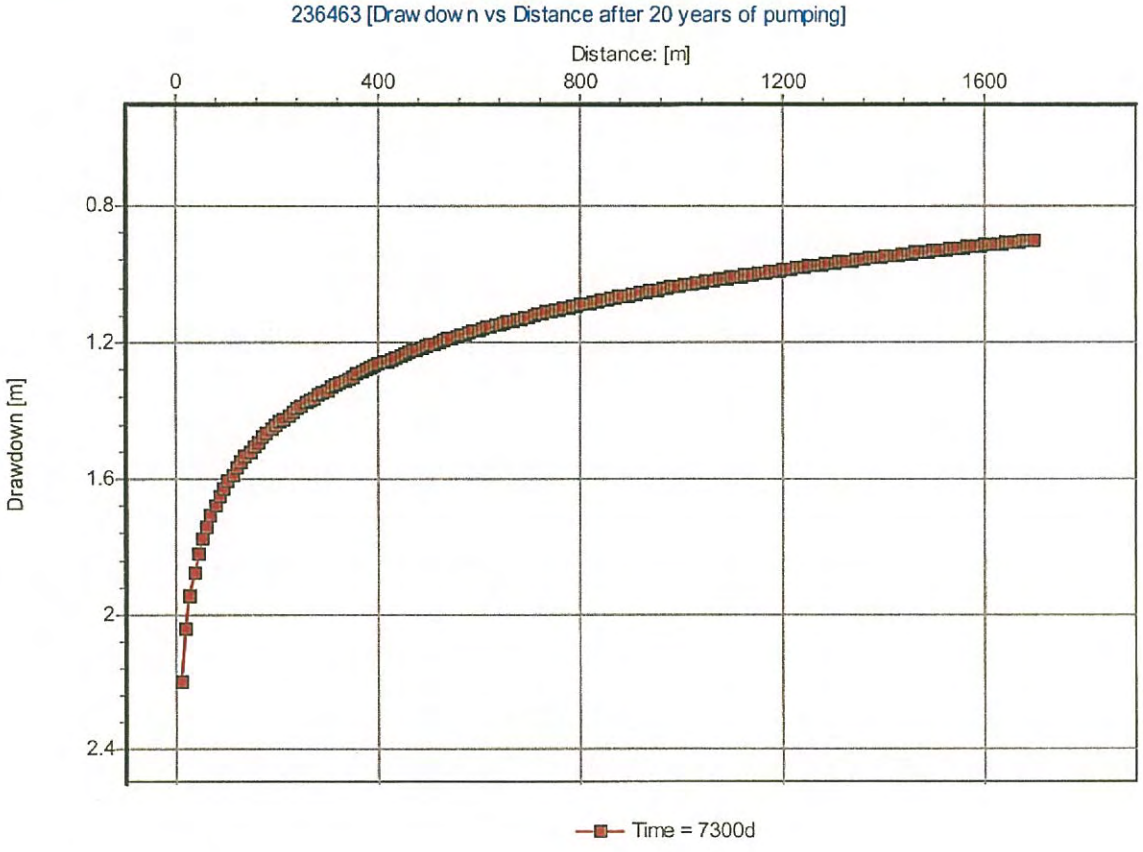
Thurber Engineering Ltd.
Suite 200, 9636-51 Avenue
Edmonton, Alberta, T6E 6A5
Phone: 780 438-1460

Pumping Test Analysis Report

Project: Well 236463 Groundwater Evaluation

Number: 19-6740-0

Client: Dr. Fritz Martin



Pumping Test: **236463**

Analysis Method: **Theis Prediction**

Analysis Results:

Transmissivity:	7.50E-5 [m²/s]
Storativity:	3.00E-5

Test parameters:

Pumping Well:	236463	Aquifer Thickness:	21.03 [m]
Casing radius:	0.057 [m]	Drawdown vs. Distance	
Screen length:	21.03 [m]	Min. Distance:	10 [m]
Boring radius:	0.076 [m]	Max. Distance:	1700 [m]
Discharge Rate:	10.3 [m³/d]	Time:	7300 [d]
Number of Data Points:	200		

Comments:

Evaluated by: Milan Butorac

Evaluation Date: 7/30/2014

THURBER

APPENDIX D

Maxxam Analytics Inc. Laboratory Analysis Report of Groundwater Chemistry

Maxxam

Success Through Science

Your P.O. #: 19-6740-0
Your Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your C.O.C. #: A131736

Attention:ROBERT TERBERG

THURBER ENGINEERING LTD.
200, 9639 - 51 AVENUE
EDMONTON, AB
CANADA T6E 6A5

Report Date: 2014/08/07
Report #: R1616835
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B464892
Received: 2014/07/29, 19:18

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	N/A	2014/07/31	AB SOP-00005	SM 22 2320 B m
Chloride by Automated Colourimetry	1	N/A	2014/08/06	AB SOP-00020	SM 22 4500-Cl G m
Total Coliforms and E.Coli	1	2014/07/30	2014/07/31	EENVSOP-00162	SM 22 9223 A,B m
Conductivity @25C	1	N/A	2014/07/31	AB SOP-00005	SM 22 2510 B m
Hardness	1	N/A	2014/08/05	AB WI-00065	SM 2340B
Elements by ICP-Dissolved-Lab Filtered	1	N/A	2014/08/04	AB SOP-00042	EPA 200.7
Ion Balance	1	N/A	2014/08/06	AB WI-00065	SM 1030E
Sum of cations, anions	1	N/A	2014/08/05	AB WI-00065	SM 1030E
Nitrate and Nitrite	1	N/A	2014/08/01	AB SOP-00023	SM4110B
Nitrate + Nitrite-N (calculated)	1	N/A	2014/08/01	AB SOP-00023	SM 4110-B
Nitrogen, (Nitrite, Nitrate) by IC	1	N/A	2014/07/30	AB SOP-00023	SM 4110-B
pH @25°C (Alkalinity titrator)	1	N/A	2014/07/31	AB SOP-00005	SM 4500-H+B
Sulphate by Automated Colourimetry	1	N/A	2014/08/06	AB SOP-00018	SM 4500 SO4-E
Total Dissolved Solids (Calculated)	1	N/A	2014/08/06	AB WI-00065	SM 1030E

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tanya Eugine, M.Sc., Project Manager
Email: TEugine@maxxam.ca
Phone# (780)577-7144

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B464892
Report Date: 2014/08/07

THURBER ENGINEERING LTD.
Client Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your P.O. #: 19-6740-0
Sampler Initials: JM

ROUTINE WATER - FILTERED (WATER)

Maxxam ID		KF4019		
Sampling Date		2014/07/29		
COC Number		A131736		
	Units	PUMP TEST #1	RDL	QC Batch
Calculated Parameters				
Anion Sum	meq/L	13	N/A	7582581
Cation Sum	meq/L	15	N/A	7582581
Hardness (CaCO3)	mg/L	87	0.50	7582320
Ion Balance	N/A	1.1	0.010	7582321
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	7582632
Nitrate plus Nitrite (N)	mg/L	<0.010	0.010	7582633
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	7582632
Total Dissolved Solids	mg/L	730	10	7581978
Misc. Inorganics				
Conductivity	uS/cm	1200	1.0	7583379
pH	pH	8.73	N/A	7583331
Anions				
Alkalinity (PP as CaCO3)	mg/L	23	0.50	7583378
Alkalinity (Total as CaCO3)	mg/L	580	0.50	7583378
Bicarbonate (HCO3)	mg/L	660	0.50	7583378
Carbonate (CO3)	mg/L	27	0.50	7583378
Hydroxide (OH)	mg/L	<0.50	0.50	7583378
Dissolved Sulphate (SO4)	mg/L	<1.0	1.0	7590240
Dissolved Chloride (Cl)	mg/L	48	1.0	7590144
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	7583613
Dissolved Nitrate (N)	mg/L	<0.010	0.010	7583613
Lab Filtered Elements				
Dissolved Calcium (Ca)	mg/L	28	0.30	7588030
Dissolved Iron (Fe)	mg/L	0.10	0.060	7588030
Dissolved Magnesium (Mg)	mg/L	4.2	0.20	7588030
Dissolved Manganese (Mn)	mg/L	0.030	0.0040	7588030
Dissolved Potassium (K)	mg/L	1.0	0.30	7588030
Dissolved Sodium (Na)	mg/L	290	0.50	7588030

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Maxxam Job #: B464892
Report Date: 2014/08/07

THURBER ENGINEERING LTD.
Client Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your P.O. #: 19-6740-0
Sampler Initials: JM

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		KF4019		
Sampling Date		2014/07/29		
COC Number		A131736		
	Units	PUMP TEST #1	RDL	QC Batch
Microbiological Param.				
E.Coli DST	mpn/100mL	<1.0 (1)	1.0	7583875
Total Coliforms DST	mpn/100mL	2.0 (1)	1.0	7583875

RDL = Reportable Detection Limit
(1) Sample was received unpreserved.

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Maxxam Job #: B464892
Report Date: 2014/08/07

THURBER ENGINEERING LTD.
Client Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your P.O. #: 19-6740-0
Sampler Initials: JM

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	0.7°C

Results relate only to the items tested.

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Success Through Science

Maxxam Job #: B464892
Report Date: 2014/08/07

THURBER ENGINEERING LTD.
Client Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your P.O. #: 19-6740-0
Sampler Initials: JM

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
7583331	MA4	Spiked Blank	pH	2014/07/30		100	%	97 - 103
7583331	MA4	RPD [KF4019-01]	pH	2014/07/31	0.002		%	N/A
7583378	MA4	Spiked Blank	Alkalinity (Total as CaCO3)	2014/07/30		100	%	80 - 120
7583378	MA4	Method Blank	Alkalinity (PP as CaCO3)	2014/07/30	<0.50		mg/L	
			Alkalinity (Total as CaCO3)	2014/07/30	<0.50		mg/L	
			Bicarbonate (HCO3)	2014/07/30	<0.50		mg/L	
			Carbonate (CO3)	2014/07/30	<0.50		mg/L	
			Hydroxide (OH)	2014/07/30	<0.50		mg/L	
7583378	MA4	RPD [KF4019-01]	Alkalinity (PP as CaCO3)	2014/07/31	3.4		%	20
			Alkalinity (Total as CaCO3)	2014/07/31	0.1		%	20
			Bicarbonate (HCO3)	2014/07/31	0.2		%	20
			Carbonate (CO3)	2014/07/31	3.4		%	20
			Hydroxide (OH)	2014/07/31	NC		%	20
7583379	MA4	Spiked Blank	Conductivity	2014/07/30		102	%	90 - 110
7583379	MA4	Method Blank	Conductivity	2014/07/30	<1.0		uS/cm	
7583379	MA4	RPD [KF4019-01]	Conductivity	2014/07/31	0.5		%	20
7583613	SB8	Matrix Spike	Dissolved Nitrite (N)	2014/07/30		102	%	80 - 120
			Dissolved Nitrate (N)	2014/07/30		102	%	80 - 120
7583613	SB8	Spiked Blank	Dissolved Nitrite (N)	2014/07/30		103	%	80 - 120
			Dissolved Nitrate (N)	2014/07/30		103	%	80 - 120
7583613	SB8	Method Blank	Dissolved Nitrite (N)	2014/07/30	<0.010		mg/L	
			Dissolved Nitrate (N)	2014/07/30	<0.010		mg/L	
7583875	CT9	Method Blank	E.Coli DST	2014/07/31	<1.0		mpn/100	
			Total Coliforms DST	2014/07/31	<1.0		mpn/100	
7588030	JHC	Matrix Spike	Dissolved Calcium (Ca)	2014/08/04		NC	%	80 - 120
			Dissolved Iron (Fe)	2014/08/04		98	%	80 - 120
			Dissolved Magnesium (Mg)	2014/08/04		NC	%	80 - 120
			Dissolved Manganese (Mn)	2014/08/04		NC	%	80 - 120
			Dissolved Potassium (K)	2014/08/04		104	%	80 - 120
			Dissolved Sodium (Na)	2014/08/04		93	%	80 - 120
7588030	JHC	Spiked Blank	Dissolved Calcium (Ca)	2014/08/04		104	%	80 - 120
			Dissolved Iron (Fe)	2014/08/04		102	%	80 - 120
			Dissolved Magnesium (Mg)	2014/08/04		102	%	80 - 120
			Dissolved Manganese (Mn)	2014/08/04		102	%	80 - 120
			Dissolved Potassium (K)	2014/08/04		102	%	80 - 120
			Dissolved Sodium (Na)	2014/08/04		97	%	80 - 120
7588030	JHC	Method Blank	Dissolved Calcium (Ca)	2014/08/04	<0.30		mg/L	
			Dissolved Iron (Fe)	2014/08/04	<0.060		mg/L	
			Dissolved Magnesium (Mg)	2014/08/04	<0.20		mg/L	
			Dissolved Manganese (Mn)	2014/08/04	<0.0040		mg/L	
			Dissolved Potassium (K)	2014/08/04	<0.30		mg/L	
			Dissolved Sodium (Na)	2014/08/04	<0.50		mg/L	
7590144	ARD	Matrix Spike	Dissolved Chloride (Cl)	2014/08/06		NC	%	80 - 120
7590144	ARD	Spiked Blank	Dissolved Chloride (Cl)	2014/08/06		100	%	80 - 120
7590144	ARD	Method Blank	Dissolved Chloride (Cl)	2014/08/06	<1.0		mg/L	
7590240	ARD	Matrix Spike	Dissolved Sulphate (SO4)	2014/08/06		119	%	80 - 120
7590240	ARD	Spiked Blank	Dissolved Sulphate (SO4)	2014/08/06		106	%	80 - 120

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Maxxam Job #: B464892
Report Date: 2014/08/07

THURBER ENGINEERING LTD.
Client Project #: DOMESTIC WATER TEST
Site Location: MILLET
Your P.O. #: 19-6740-0
Sampler Initials: JM

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
7590240	ARD	Method Blank	Dissolved Sulphate (SO4)	2014/08/06	<1.0		mg/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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07/12830

Chain of Custody

A131736

Page: ____ of ____

	Invoice To: C/O Report Address ☐	Report To: Same as Invoice ☒	Report Distribution (E-Mail):	REGULATORY GUIDELINES:
Company:	Thurber Engineering Ltd		rterberg@thurber.ca nternuik@thurber.ca jmaxwell@thurber.ca	☐ AT1 ☐ CCME ☐ Regulated Drinking Water ☐ Other:
Contact:	Robert Terberg			
Address:	9636-51 Ave Edm			
	Prov: AB PC: T6E 6W5	Prov: PC:		
Contact #s:	Ph: 780-436-1460 Cell: N/A	Ph: Cell:		

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

PO #:	14-16140-0
Project # / Name:	Domestic Water Test
Site Location:	Millet
Quote #:	
Sampled By:	JLM

SERVICE REQUESTED: ☐ RUSH (Contact lab to reserve) Date Required: ____ ☒ REGULAR (5 to 7 Days)

See reverse for package specifics

	Sample ID	Depth (unit)	Matrix GW / SW Soil	Date/Time Sampled YY/MM/DD 24:00	SOIL: BTEX F1-F4	Sieve (75 micron)	Regulated Metals (CCME / AT1)	Salinity 4	Assessment ICP Metals	Basic Class II Landfill	WATER: ☐BTEX F1 ☐VOCs	☐BTEX F1-F2 ☐BTEX F1-F4	☒ Routine Water ☐ Turb ☐ F	☐ TOC ☐ DOC	Regulated Metals (CCME / AT1): Total	Regulated Metals (CCME / AT1): Dissolved	Mercury ☐ Total ☐ Dissolved	Other Analysis: Total Coliforms	Other Analysis: E.Coli	HOLD - Do not Analyze	# of Containers Submitted
1	PUMP TEST #1	—	GW	14/07/29									X					X	X		2
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Please indicate Filtered, Preserved or Both (F, P, F/P) →

BSS/CHF F/P

Relinquished By (Signature/Print):	Date (YY/MM/DD):	Time (24:00):	
JACKIE MAXWELL	14/07/29	19h12	
Relinquished By (Signature/Print):	Date (YY/MM/DD):	Time (24:00):	
Special Instructions:		# of Jars Used & Not Submitted	

LAB USE ONLY

Received By:	Date:	Time:	Maxxam Job #: B464892		
FIONA CHANHIRUN	2014/07/29	19:18	Custody Seal	Temperature	Ice
Lab Comments:			absent	2,0,0	present