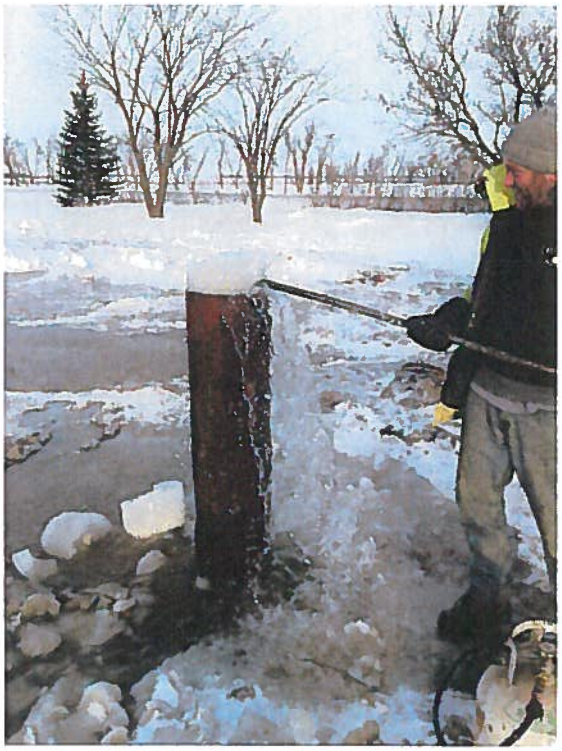
Friesen Drillers Ltd.
since 1892

Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field

Environment Act Proposal

City of Steinbach – Manitoba



Friesen Drillers Ltd.
since 1892

Report to:

City of STEINBACH

Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field

Environment Act Proposal

City of Steinbach – Manitoba

PROVINCE OF MANITOBA
J. J. BELL
Member
22621
Nov. 24/15
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
Friesen Drillers Limited
No. 4016 Date: Nov. 24/2015

November 24, 2015

Prepared by: _____ Date: Nov. 24, 2015
J.J. (Jeff) Bell, B.Sc.(G.E.), P.Eng.

Prepared by: _____ Date: Nov. 24, 2015
J. Paulynn T. Estrella-Legal, B.Sc.(Min.E.), E.I.T.

Authorized by: _____ Date: Nov. 24, 2015
Jason D. Friesen

307 PTH 12 N Steinbach, MB R5G 1T8 Phone 204-326-2485 Fax 204-326-2483 Toll Free 1-888-794-9355

Friesen Drillers Ltd.
307 PTH 12 N Steinbach, MB. R5G 1T8 Phone 204-326-2485 Fax 204-326-2483 Toll Free-1-888-794-9355

Introduction

Friesen Drillers Limited is pleased to submit this environment act proposal for the proposed expansion of the municipal groundwater supply for the City of Steinbach. The City of Steinbach, currently the third largest city in Manitoba, had a recorded population count of 13,524 in 2011 (Statistics Canada, 2011). As the city continues to progressively grow at an approximate rate of 2.4% per year, the city's water supply needs also increases.

The city's existing well field consist of three wells and provides water supply for the City of Steinbach at approximately 1,620 acre/feet per year. Using the current growth rate trend of the city and annual per capita water consumption, Steinbach's current water system supply would be able to support water supply demands of the city until 2020. By 2020, the population of Steinbach is expected to be at approximately 16,742 and additional water supply will be needed in order to service the entire city.

With the purpose of expanding the city's current water supply, the City of Steinbach purchased land, along Park Road, in the northwest area of the city prior to 2011. The City of Steinbach planned the proposed Park Road property for the development of a second well field to supplement the existing well field in supplying the city's water needs from 2020 to 2038.

In 2012, the City of Steinbach retained Friesen Drillers to conduct an extensive hydrogeological assessment of the proposed Park Road municipal groundwater well field in order to determine if it is capable of delivering the additional water supply to allow for the growth of the city up to 2038.

The hydrogeological assessment determined that the proposed Park Road municipal well field, although less transmissive than the expected regional conditions, is capable of providing an additional allocation of 806.50 acre feet per year (994.81 dam^3/year dam per annum. This assumes normal seasonal and climatic conditions, with an annual monitoring program in place. A copy of the hydrogeological report is attached.

Since the attached hydrogeological report is written with a new environmental act proposal for the City of Steinbach in consideration, this report will provide additional details regarding the environmental act proposal and highlight the areas in the existing report where required information may be located.

It should be noted that this environmental act proposal will focus on the hydrogeological aspects of the Park Road municipal well field for the city and will address the aspects of pumping groundwater from the Park Road municipal well field. The provision of a new treatment plant, water lines and pumping stations are beyond the scope of this environment act proposal.

Project Background and Scope of Work

The project background and other details are contained in the hydrogeological assessment pages 2 to 4. The locations of the proposed well field and the current well field are shown in Figure 2.

The land for the proposed well field is owned by the City of Steinbach, a certificate of title is attached as Appendix B the attached hydrogeological report. The city does not hold the mineral rights for the lands, as these have been retained by the Crown. The land on which the well field is located currently zoned as light industrial with the proposed water supply facility designed to comply with the current zoning.

The developmental stages for this proposal are divided into two phases. Phase 1 involves drilling two supply wells in the proposed Park Road well field, testing, licensing and connecting the wells to a treatment plant to service the city. A new raw water pre-treatment reservoir, new iron removal water treatment plant and pumping station will be built for the Park Road well field in order to make a stand alone system. The development schedule for Phase 1 is as follows: obtaining Water Rights Licences and Environment Act Licence in 2015, commencing detailed design in 2016 and tendering the Phase 1 of the project in 2017. Phase 2 involves the drilling and installation of a third well to provide additional water supply and connecting it the raw water lines designated for the Park Road well field. Phase 2 is not expected to commence until 2045 (P. Kalyta, Personal Communications, 2015).

The City of Steinbach is funding this project through municipal tax revenues and water use charges for the existing residents and businesses within the city. There are no other external sources of funding for the project at the present time other than general revenues. However, the City of Steinbach will be open for government funding, if made available. The additional water supply requirement is to support additional residential and business development within the City of Steinbach.

Project Background and Scope of Work (cont'd)

The current water rights licence, environment act licence and permit applications are discussed in pages 4 to 5 of the attached document. Both the current water rights licence (No. 2009-073) and Environment Act License (No. 2885) are attached as Appendix A of the overall groundwater report attached to this document.

Since no other changes other than routine maintenance works are planned for the existing water supply, a new Environment Act License would be required for the new well field. The groundwater exploration permit and authorization are also attached in the hydrogeological repot as Appendix C. The City of Steinbach recently applied for a water rights licence with MCWS – Groundwater Licensing Section. The attached groundwater report was submitted to the department for review.

No public consultation has been conducted for this project at the present time.

Description of the Existing Environment in the Project Area

The existing environment is described in the hydrogeology assessment contained in the attached hydrogeological report. The information is contained in pages 5 through 22.

The nearest body of water to the proposed Park Road well field site is the Manning Canal. The Manning Canal branches out about 4.46 km northwest of the site. The proposed well field is located between two branches of the Manning Canal; one branch is about 0.98 km west of the site while the other branch is about 2.3 km east of the site. The Manning Canal is known to be suitable for aquatic life such as fish species like white sucker, pearl dace, fathead minnow, and brook stickleback (Seine River Watershed Survey, 2003).

Climatic effects are shown on Figure 11 on page 12 of the attached hydrogeological assessment.

There are no First Nations located within the immediate Steinbach area. The nearest First Nation is the Roseau River First Nation, which is located about 50 km to the southwest. There are no major provincial parks in the immediate Steinbach Area. However, the City of Steinbach offers and maintains a few parks and recreation areas for the residents. The city also has a heritage village, Steinbach Mennonite Heritage Village, which is located approximately 1.50 km to the northeast of the proposed well site. This project is not expected to cause any issues for aboriginal treaty rights, or affect traditional hunting/trapping/farming and heritage areas. The project is not expected to have a negative socio-economic impact in the City of Steinbach.

The predominant land use around the Steinbach is primarily agricultural.

Mitigation Measures and Residual Environmental Effects

The predicted impact and long term aquifer response are discussed on pages 34 to 37 of the attached hydrogeology report.

Follow-up Plans, Monitoring, and Reporting

The follow-up plans and long term monitoring are discussed in the attached hydrogeology report. The recommendations are shown on page 38.

It is anticipated that some of the recommendations detailed in the hydrogeology report will be reviewed by the staff of the water rights licensing.

Additional Water Supply Details

Existing System Use

The existing system in the City of Steinbach serves most of the residents and businesses in the city. Parts of the city, however, still operate private water wells for individual businesses and homes.

Existing System Use (cont'd)

The City of Steinbach's Annual Report on drinking water quality indicated 4,114 individual metered service connections. The current water rates are at $1.03/m^3. The water rates have been increasing by $0.05 annually since 2013. Apparently, the water rate increases seem to have shown positive effects in water conservation.

The Steinbach water supply system is relatively simple and straightforward. Majority of the water supply connections are for individual family residences. The rest are divided into commercial, government, municipal, university, school and hospital which form the larger water supply users. The water supply system uses filtration and chlorination, with no further additional treatment undertaken. It is our understanding that the system is operated in accordance with licensing from the Office of Drinking Water – Province of Manitoba.

System Conservation

The City of Steinbach currently has a public awareness education program, which provides articles, tips and information on water conservation at the city's website (www.steinbach.ca) and a community based news and information (www.steinbachonline.com). Quarterly newsletters with information on water conservation are also sent out with the water bills. These coupled with rate increases have shown positive effects in reducing the city's water consumption.

The current daily per capita water consumption for the City of Steinbach is currently at 333 L/day. Figure 1, shown below, shows the average daily per capita water consumption against the total annual water consumption. Figure 2, shown on the following page, illustrates the trend in the actual daily per capita water consumption against the population growth over the last fifteen years. Overall, there has been a reduction of about 20 % in the average daily per capita consumption since the start of the city's water conservation efforts. Details on the long term water supply demands of the City of Steinbach are attached as Appendix D of the attached hydrogeological report.

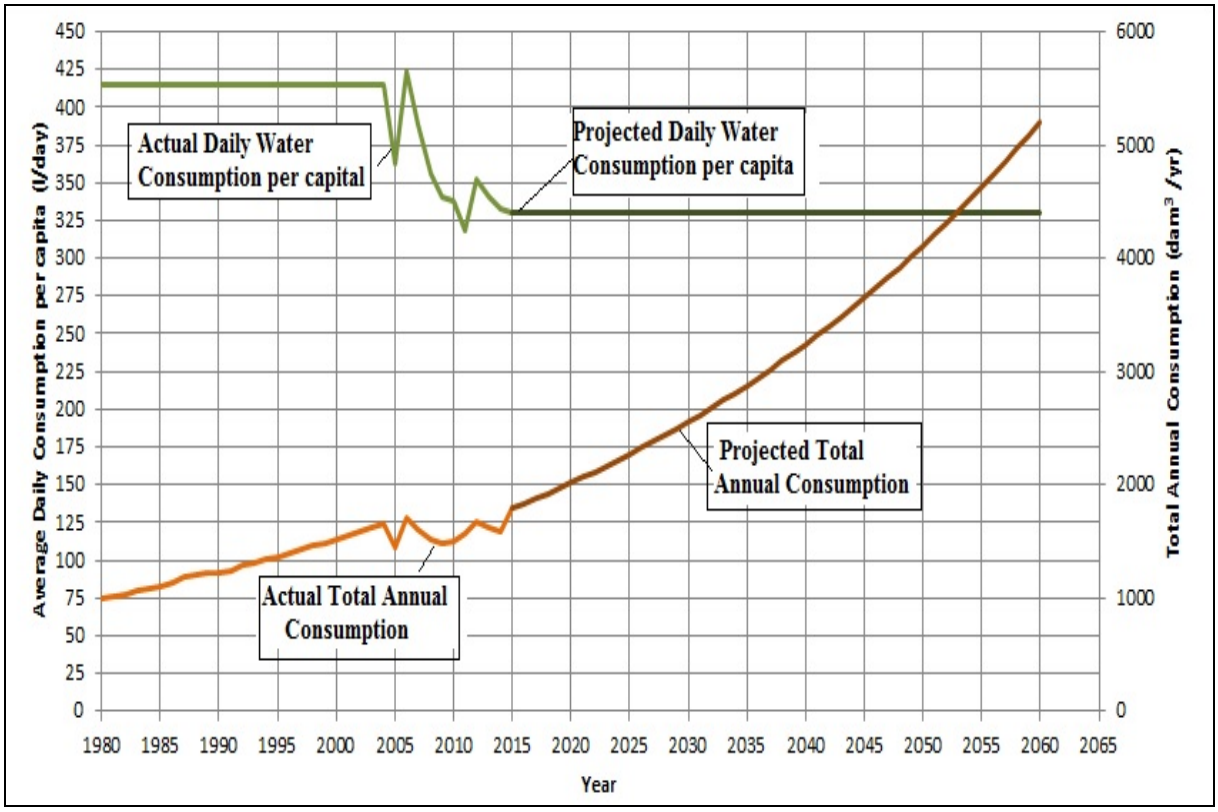


Figure 1 – Daily Water Consumption per Capita (L/day) vs. Total Annual Water Consumption (data source – City of Steinbach, 2015)

System Conservation (cont'd)

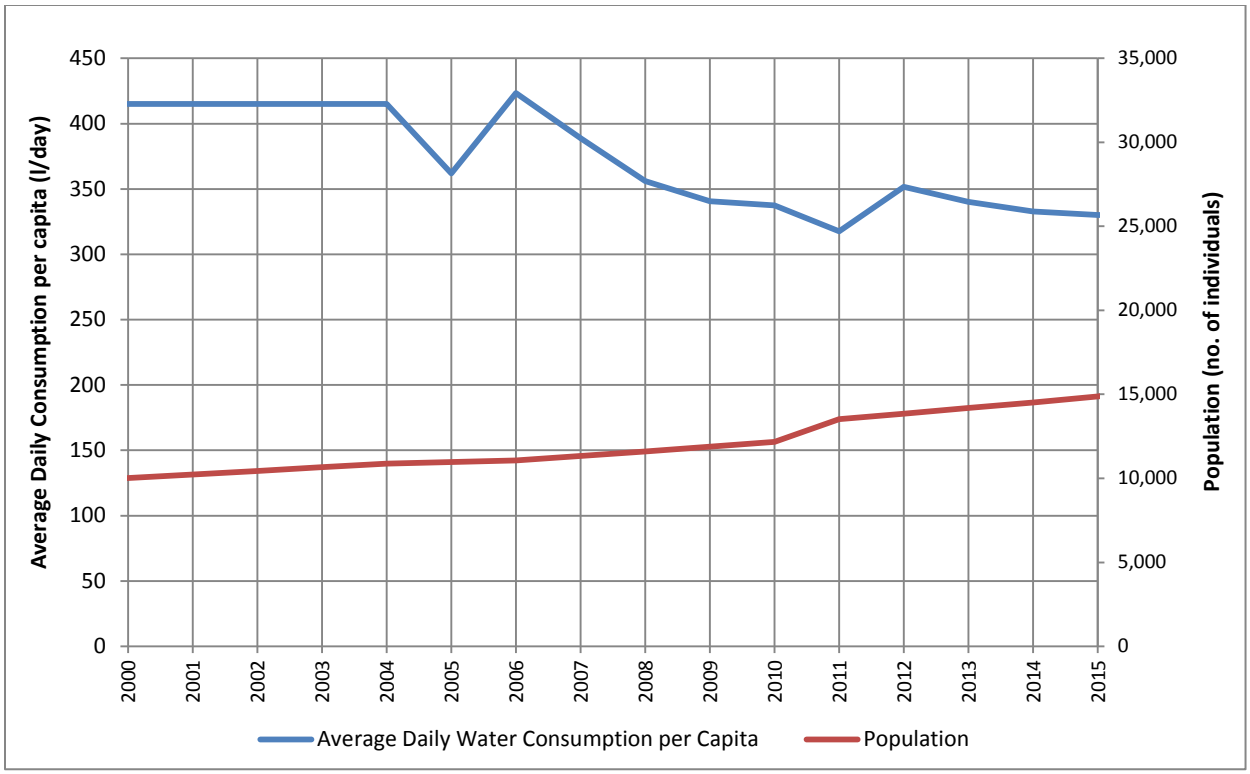


Figure 2 – Actual Daily Water Consumption per Capita (L/day) vs. Population Growth (data source – City of Steinbach, 2015)

Private Water Well Inventory

In order to detail the type of water wells that have been constructed within the City of Steinbach, an inventory of private water wells within 5 km radius of the proposed Park Road well site was completed. The specific details of the well inventory are contained in Appendix E of the attached hydrogeological report. Discussions of predicted impacts are also contained in the attached hydrogeological report pages 34 to 37.

References

Kalyta, Phil. 2015. Personal communication.

Seine River Watershed Survey, 2003. Seine-Rat River Conservation District.
http://srrcd.ca/specialprojects/documents/Fishinsmallwaterwaysorponds.pdf

Limitations

The scope of this report is limited to the matters expressly covered and is intended solely for the client to whom it is addressed. Friesen Drillers Limited makes no warranties, expressed or implied, including without limitation, as to the marketability of the site, or fitness to a particular use. The assessment was conducted using standard engineering and scientific judgment, principles, and practices, within a practical scope and budget. It is based partially on the observations of the assessor during the site visit in conjunction with archival information obtained from a number of sources, which is assumed to be correct; except as provided, Friesen Drillers Limited has made no independent investigations to verify the accuracy or completeness of the information obtained from secondary sources or personal interviews. Generally, the findings, conclusions, and recommendations are based on a limited amount of data (e.g. number of boreholes drilled or water quality samples submitted for laboratory analysis) interpolated between sampling points and the actual conditions on the site may vary from that described above. Any findings regarding the site conditions different from those described above upon which this report was based will consequently change Friesen Drillers Limited's conclusions and recommendations.

Disclaimer

This Friesen Drillers Limited report has been prepared in response to the specific requests for services from the client to whom it is addressed. The content of this document is not intended to be relied upon by any person, firm, or corporation, other than the client of Friesen Drillers Limited, to who it is addressed. Friesen Drillers Limited denies any liability whatsoever to other parties who may obtain access to this document by them, without express prior written authority of Friesen Drillers Limited and the client who has commissioned this document.

Friesen Drillers Ltd.
since 1892

Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM

Proposed Park Road Municipal Supply Well Field

City of Steinbach – Manitoba

Friesen Drillers Ltd.
since 1892

Report to:

City of STEINBACH

Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM

Proposed Park Road Municipal Supply Well Field

City of Steinbach – Manitoba

November 19, 2015

PROVINCE OF MANITOBA
J. J. BELL
Member
22621
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
Friesen Drillers Limited
No. 4016 Date: Nov. 19/2015

Prepared by: _____ Date: Nov. 19, 2015
J.J.(Jeff) Bell, B.Sc.(G.E.), P.Eng.

Prepared by: _____ Date: Nov. 19, 2015
J. Paulynn T. Estrella-Legal, E.I.T.

Authorized by: _____ Date: Nov. 19, 2015
Jason D. Friesen

307 PTH 12 N Steinbach, MB R5G 1T8 Phone 204-326-2485 Fax 204-326-2483 Toll Free 1-888-794-9355

Friesen Drillers Ltd.
307 PTH 12 N Steinbach, MB. R5G 1T8 Phone 204-326-2485 Fax 204-326-2483 Toll Free-1-888-794-9355

Introduction

Friesen Drillers Limited is pleased to present this report detailing the results of our investigation into a proposed expansion of the municipal groundwater supply for the City of Steinbach. Sometime prior to 2011, the City of Steinbach purchased land in the northwest area of the city along Park Road. The site served a number of useful aspects, including the provision of a lift station, piping runs, etc. along the route to the lagoon. City engineering staff developed a conceptual design of a new well field at the site, with the intention of providing approximately 1,000,000 U.S. Gallons of water (1,120 acre feet/year) daily for growth of the city to 2038. This site on Park Road was selected by the city for this purpose.

The City of Steinbach currently relies on three wells contained within the existing well field for water supply. The water supply is approximately 1,620 acre/feet per year, and aims to supply the city to 2020 based on current growth rates.

The following report details the results of the investigation.

Scope of Work and Background

The City of Steinbach developed their first well field near the east side of the city in 1956. Initially two wells were constructed on the site, with both wells completed into the carbonate aquifer and the underlying sandstone aquifer. In the 1970's, the sandstone aquifer in both wells were sealed off with cement, isolating the production from the carbonate aquifer alone. In 1985, a third supply well was added to the well field. One supply well was subsequently replaced in 2008. This well field has been maintained in the current condition since 2008. In 2009, the well field licensing allocation was increased to 1,620 acre feet/year (2,000 dam^3/year). Due to the expansion of the well field, an environment act proposal was provided, and a license was granted for the increase. It should be noted that this increase will effectively maximize the water supply that is available from the existing well field. Calculations show that the existing well field allocation should not be increased due to the effects of drawdown interference. This existing licensed water supply plans are to meet the needs of the City of Steinbach until 2020. Other than routine maintenance and possible future well replacements, there are no plans to modify or change the existing well field at the present time.

Apparently the City of Steinbach purchased land on the southeast corner of Park Road and Keating Road sometime prior to 2011. An existing yard site and house was located on the property. The city purchased the property with the long term plan of developing a water supply, along with other various municipal facilities on the site. The land is located along the pipeline route to the city lagoons, and the site provided a number of other public works conveniences. It should be noted hydrogeological testing was not conducted on the site prior to the purchase by the City of Steinbach.

The City of Steinbach is currently growing at a rate of 2.4% per year, and future water supplies will be needed to allow the city to meet the demand to 2038 (P. Kalyta, personal communication, 2014). The increase in water supplies to meet the city needs is estimated to be an additional 1,120 acre feet/year (1,382 dam^3/year). The population projections for the City of Steinbach are shown below as Figure 1.

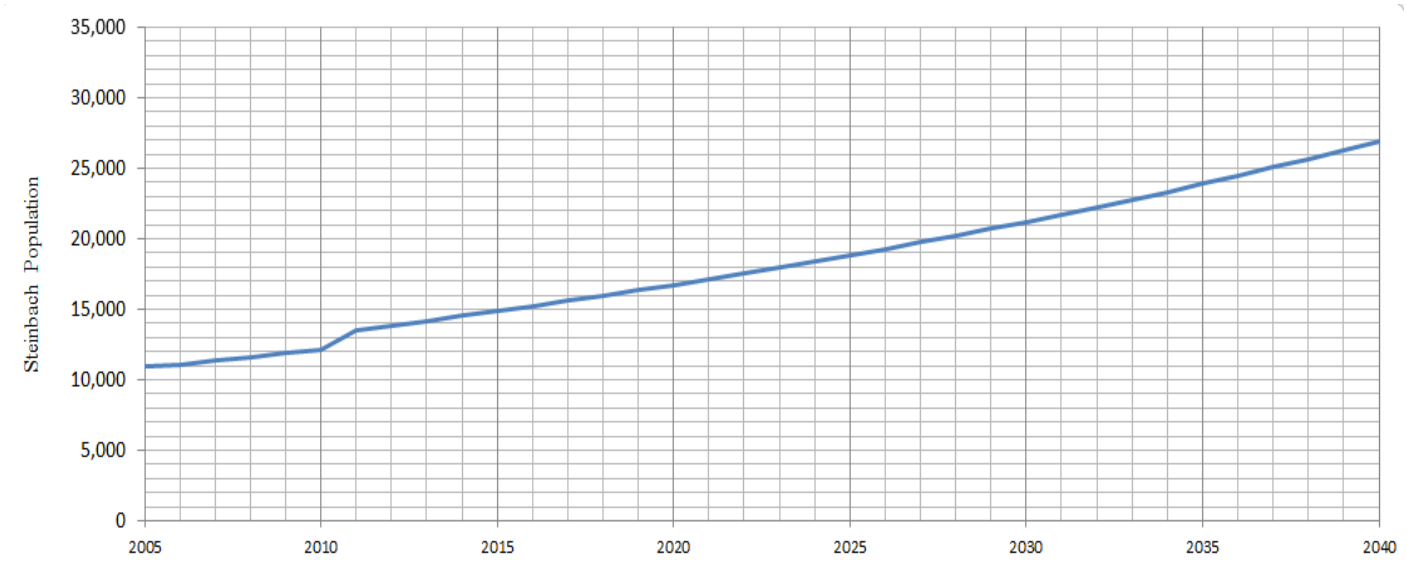


Figure 1 – Population projections for the City of Steinbach (2006 to 2040) (source – City of Steinbach, 2015)

Scope of Work and Background (cont'd)

Once the City of Steinbach purchased the Park Road location, the existing structures were demolished and removed from the site. In order to provide the hydrogeological assessment, Friesen Drillers was retained to undertake the aquifer and well capacity assessment for the Park Road location.

The scope of services for this aquifer and well field capacity assessment include the following:

- Prepare and apply for a groundwater exploration permit for the site from Manitoba Conservation and Water Stewardship (MCWS) – Water Use Licensing Section (WULS).
- Undertake a review of the background site history relating to the water supply.
- Review the background geology and hydrogeology.
- Review all of MCWS hydrograph monitoring stations for long term water levels and groundwater chemistry/isotopic chemistry.
- Undertake a well inventory within a 5 kilometer radius of the production well site
- Complete the drilling and installation of at least three observation wells in both the carbonate and sandstone aquifers surrounding the well field site.
- Design and install two 12 inch diameter production wells, and complete the required developing.
- Undertake a 72 hour pumping test on one of the proposed supply wells, with a pressure transducer monitoring network to monitor water level response over pumping period, including the collection of groundwater quality samples for isotope and geochemical analysis.
- Review the capacity of the well field, and calculate the proposed impact from pumping.
- Complete a detailed report of the investigations that is suitable for submission to MCWS.

The City of Steinbach gave approval to proceed with the work in April of 2012, with the understanding that this project would be a multi-year investigation, with completion of the hydrogeological reporting portion in 2015.

The location of the existing well field and the new proposed Park Road well field site is shown below as Figure 2.

Figure 2 – Location of the existing and proposed well field – City of Steinbach, Manitoba (source – www.googleearth.com, 2015)

Regulatory Requirements for Municipal Groundwater Supplies

Water Rights Act and Existing Licenses

The Province of Manitoba has the responsibility to distribute water under the Water Rights Act. This act requires that anyone using water exceeding 25,000 L/day for commercial, industrial, agricultural, and municipal use must obtain a license under the act. This is also required for industrial and geothermal heating/cooling applications. Water rights licensing is based on a first in time, first in right procedure. For groundwater projects, an exploration permit is required prior to starting the project. In order to provide approval for the exploration permit, MCWS – WULS reviews the available aquifer allocation (if available), to determine if the project is potentially suitable.

Upon completion of the testing of the project, MCWS-WULS reviews the proponent's proposal to determine if there are any third party impacts that may result. If these impacts are present, mitigation factors may be required. These include such things as groundwater interference plans, well repairs, replacements, and pump inspections. These programs are usually undertaken by the proponent of the project. Reports are usually prepared for the project by a consulting hydrogeological engineer or hydrogeologist.

If the application is deemed acceptable and third party impacts are managed or addressed, MCWS-WULS will issue a license for the diversion of groundwater. The proponent then has the right, under some conditions, to the water supply for a specific duration. The right is also protected from other use in the area.

The City of Steinbach has held three licenses in the past. The details are contained below, along with the current license:

- License No. 63 - 37 – 500 acre feet/year – (1963 to 1973) – Two wells completed in carbonate/sandstone aquifers.
- License No. 86-39 – 1,473 acre feet/year – (1986 to 1996) – Two wells initially in the carbonate/sandstone aquifers, followed by three wells completed only in the carbonate aquifer.
- License No. 2009-073 – 1,620 acre feet/year – (2009 to present) – Three wells completed in the carbonate aquifer.

There a number of conditions and clauses on each license. Copies of the current licenses are attached as Appendix A.

The proposed Park Road wells are located on lands that are controlled by the City of Steinbach, although the Crown still controls the mineral rights to the site. A copy of the land title certificate for the site is attached as Appendix B. The nearest First Nation to the site is the Roseau River First Nation I.R.#2, which is located about 50 km to the southwest.

Friesen Drillers submitted a groundwater exploration permit on December 11, 2012. The application provided a requested new groundwater diversion allocation of 1,000 dam^3/year (810.7 acre feet/year). MCWS – WULS issued a groundwater exploration permit on January 16, 2013. There were a number of conditions on the exploration permit, which corresponded well with the defined scope of work for the project. The authorization permit allowed for the testing of the wells under the supervision of a consulting hydrogeologist or hydrogeological engineer.

A copy of the groundwater license application and subsequent authorization is attached as Appendix C.

Environment Act License

In the event that a requested groundwater supply project exceeds 200 dam^3/year, an environment act license is also required. This is required under the Environment Act of the Province.

An Environment Act Proposal is prepared by the proponent for a water supply project. This proposal usually involves the identification of any potential environmental effects from the water supply diversion. The proposal usually identifies potential third party impacts and possible effects. Mitigation measures are usually proposed and evaluated. The proposal is usually advertised for public comment and review. Often times, environmental groups and organizations review these proposals to ensure that environmental effects are taken into consideration. In the event that there is a significant amount of public opposition to a potential project, the Minister of Conservation and Water Stewardship may order the Clean Environment Commission to hold public hearings to review the project and the proposed concerns. Although these public hearings are rare, they have been held for water supply projects in Manitoba in the past.

Environment Act License (cont'd)

Copies of environment act proposals are also submitted to various organizations within governments for comments and review. Often, water supply proposals involving groundwater use are reviewed by the Provincial Groundwater Management Section. If the environmental impacts are deemed to be minor, or the mitigation proposals are acceptable, the director will issue an environment act license for the development or project.

The requirement for environment act assessments for water supplies was put into force in the mid 1990's. As a result of this requirement, several water supply systems that did not originally obtain an environment act license would be requested to undertake this aspect upon a request for additional groundwater use allocation.

The City of Steinbach's existing water supply currently holds Environment Act License No. 2885 for the water supply located on the eastern side of the city. This project involves no modifications to the existing water supply; therefore a new Environment Act License application will be required for the site. This application will be filed at a later date.

Water Supply Requirements

The City of Steinbach engineering staff undertook the preliminary planning for the increased water supply for the long term future of the city in January of 2012 (City of Steinbach, 2012). As part of the investigations, the city staff reviewed the long term population growth projections for the city. The City of Steinbach is currently growing at a rate of 2.4% per year, and future water supplies will be needed to allow the city to meet the demand to 2038 (P. Kalyta, personal communication, 2014). The intention is to develop the long term water supply from a secondary well field along Park Road, combined with the associated treatment/disinfection system. The increase in water supplies to meet the city needs is estimated to be an additional 1,120 acre feet/year (1,382 dam^3/year). Over the last ten years, the city per capita water use has declined from about 415 L/person/day to 333 L/person/day). This reduction has taken place without a formal water conservation program in being place (P. Kalyta, personal communication, 2015).

A summary of the long term water supply demand, along the population projections and associated water use demand is provided in Appendix D.

Site Setting

The Steinbach area is located within the Manitoba lowlands, within the Red River drainage basin. Typically surface drainage is directed towards the Red River, which subsequently flows into the Lake Winnipeg system, which ultimately discharges into Hudson's Bay. The climate in the area is continental, and shows typical variability of seasons and precipitation. According to Environment Canada, precipitation varies across the south eastern part of the province. Near the Steinbach area, average annual precipitation is about 550 mm annually (Environment Canada, 1982). Evapotranspiration is reasonably high and is estimated to be 450 mm annually in southern Manitoba (Environment Canada, 1982). The average temperature in southern Manitoba is about 3.3 degrees Celsius (Environment Canada, 1982).

Surface drainage in the Steinbach area is restricted to the Manning Canal, Seine River, the Seine River Diversion, and the Rat River. Several smaller drainage channels also exist in the area, with one in particular being through Steinbach. Many of the features only flow during the spring melt /recharge season. The majority of precipitation occurs during the spring to fall period.

With the exception of small marshes and springs that are located in the eastern part of the Steinbach area, there are no major natural surface water features. Due to the geological conditions, several exposed gravel pits have been filled with surface run-off. Within the Sandilands area, located about 25 kilometers east of the city, several small lakes, marches, bogs, and swamps are present. Further to the east, several larger surface water lakes are present within the Whiteshell area, which is a part of the Winnipeg River drainage basin.

The area is characterized by flat prairie and agricultural land use. In general, there is very little relief as the land surface is fairly flat and level. Towards the east, the land surface rises and becomes more forested. The local land surface is predominantly used for agricultural activities of mixed grain farming, ranching, and livestock use. The city is a major service center for southeast Manitoba, with a current population nearing 13,524 people, making it the third largest city in Manitoba (Statistics Canada, 2014). The city encompasses 9.87 miles square (P. Kalyta, personal communication, 2015), and has a population density of 528.9 people /km^2.

Surrounding the proposed well field at Park Road, the following land use is present:

- North: Agricultural lands and rural residential properties.

Site Setting (cont'd)

- East: Agricultural lands, followed by the light commercial and residential buildings.
- South: Agricultural lands, followed by the light commercial and residential buildings.
- West: Agricultural lands, followed by the City of Steinbach lagoons

The approximate boundaries of the City of Steinbach are shown below as Figure 3.

Figure 3 – Approximate boundaries – City of Steinbach (source – City of Steinbach, 2015)

Geology and Hydrogeology of the Steinbach Area

Bedrock Geology

The Steinbach area is located within the eastern fringes of the Western Canadian Sedimentary Basin (WCSB), or the Williston Basin. The WCSB is a wide spread wedge shaped sedimentary basin with Precambrian bedrock as the basement feature. Figure 4, shown below, details the extent of the WCSB, and shows the location of the study area.

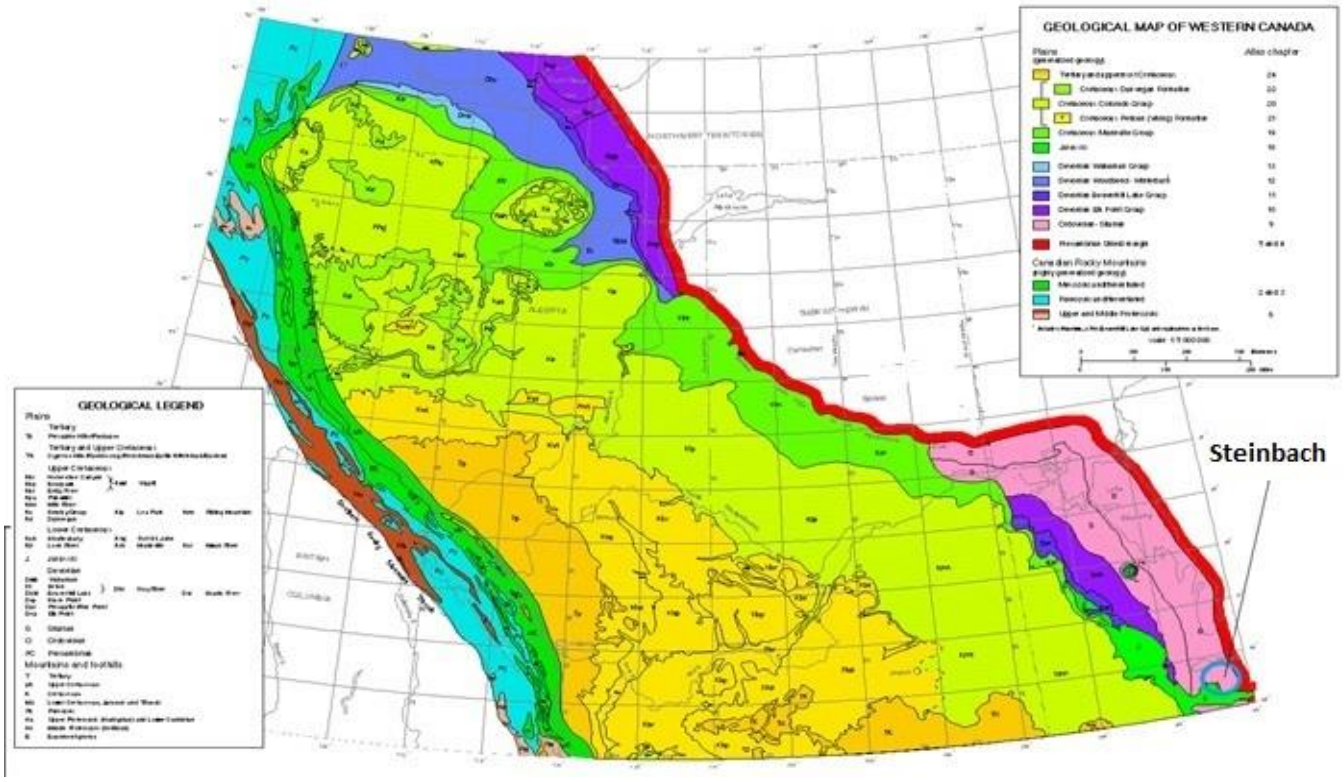


Figure 4 – WCSB showing location of the Steinbach area. (source - Alberta Geological Survey, 2009)

The basin extends throughout the central Canadian plains, and underlies about 1.4 million km². The basin extends north into the Northwest Territories, to the eastern fringes of the Rocky Mountains, and westerly, into central Manitoba. A large portion of the basin extends into the northwest United States. Precambrian igneous and metamorphic rocks form the basal geologic unit across the WCSB.

The Precambrian basement bedrock is expected to lie at a depth of approximately 300 to 320 feet below grade within the Steinbach area. This is expected to change within the area, as the formation typically dips about 5 to 10 feet every mile westward. This follows the dip of the WCSB in the southeastern area of Manitoba. Overlying the Precambrian Surface is the Winnipeg Formation sandstone. The sandstone sequence is thought to be about 60 to 80 feet thick in the area (Betcher, 1986). The Winnipeg Formation consists mainly of layered silica sandstone and marine shales. The sandstone is generally very weakly cemented in the area, which is known locally as the Carmen Sand. A substantial number of wells have been drilled into this formation in the Steinbach area. Overlying the sandstone is a thin (10 to 20 feet in some places) sequence of marine shales. This shale sequence acts as an aquitard overlying the sandstone units (Betcher, 1986).

Overlying the Winnipeg Formation is the carbonate bedrock of the Red River Formation, which typically consists of alternating layers of limestone and dolostone with very thin basal shale layers. There is a conformable transfer between the two geological units. It is reported that the Selkirk Member of the carbonate sequence is approximately 140 feet in total thickness within the Steinbach area (Betcher, 1986). The Red River Formation and the overlying carbonate units are collectively called the carbonate evaporite unit in Manitoba. This unit extends south of the Steinbach area, through the Manitoba Interlake, to The Pas, and beyond. The upper surfaces of the carbonate bedrock have been eroded, worn, and highly damaged by erosional unconformities and Pleistocene glaciations. The surface has also been impacted by some karstic features in the geologic past.

A regional geological cross section approximately includes the City of Steinbach area is shown on the following page as Figure 5.

Bedrock Geology (cont'd)

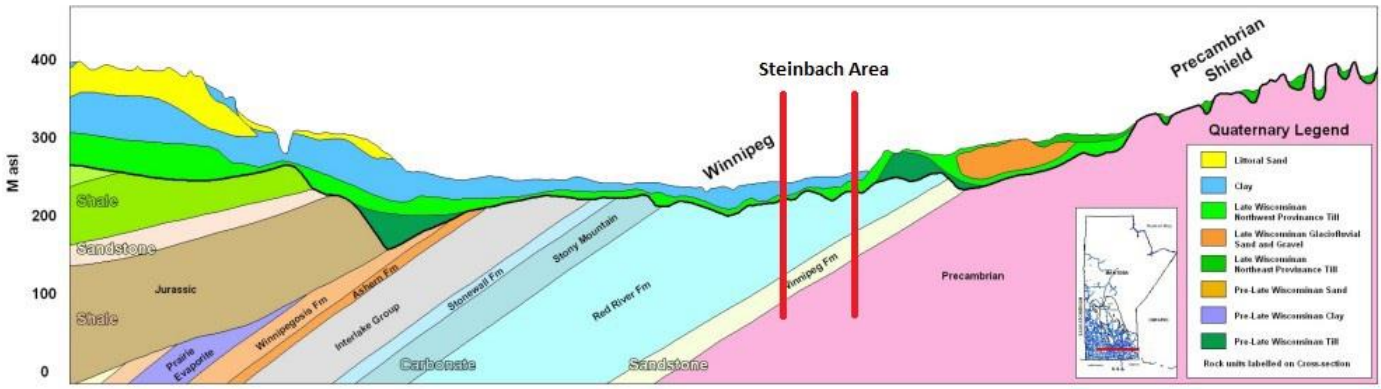


Figure 5 – Geological cross section approximately through the Steinbach area. (source – Matile and Keller, 2007)

Surficial Geology

The carbonate bedrock surface was extensively eroded during the pre-glacial period. This erosion resulted in significant damage to the upper surfaces. Joint sets, fractures, and voids were present, along with an extensive karstic development. Some of these features have been infilled with more recent sediments. A dense basal till unit, with some layers of sand and gravel, was deposited directly on the carbonate bedrock surface during the glaciations. Some of the previous permeable features were infilled during this period.

After the final glacial retreat, a pro-glacial lake developed, which resulted in the deposition of water laid tills, and glacio fluvial silty grey clays. The overburden material acts as a confining layer in the southeast of Manitoba. In the Steinbach area the overburden clay and glacial till is thought to be about 80 to 100 feet in thickness. The glacial till is typically about 80 feet thick.

Hydrogeology

Groundwater flow in the carbonate bedrock of the Red River Formation generally occurs in the fracture and joint sets in the rock. The size, extent, and interconnectivity of the fracture system govern horizontal and vertical groundwater movement through the bedrock. Due to this geologic condition, aquifer transmissivity and storativity can vary significantly over a relatively short distance, resulting in substantial variations in well yield (Render, 1970). The Red River Formation is considered to be a significant water supply resource throughout the central portion of Manitoba, being developed for municipal, commercial, and private water supply systems (Betcher et. al, 1995).

Although the aquifer is known locally as a single aquifer, there are numerous fracture sets, joints, bedding planes, and karstic features, which indicate that the aquifer should technically be known as an aquifer system.

Groundwater flow in the Winnipeg Formation sandstone is through the weakly cemented, poorly consolidated quartzose sandstone. The thin marine shale sequence acts as an aquitard between the two aquifers (Betcher, 1986).

In some areas of the southeast, there are significant sand and gravel aquifers occurring within the overburden sediments. In the Steinbach area, there are some minor sand and gravel sequences within the till, but these appear to be very sporadic, with no major areas forming a regional aquifer.

Groundwater flow is from east to west in both aquifers in the Steinbach area. Recharge to the aquifers occurs from a major sand and gravel moraine series that lies to the east. This moraine is known as the Sandilands area. Within the Sandilands, coarse sands, gravels, silts and clays lie directly on the bedrock sub crop of both Paleozoic sequences. These highland moraines accept snow melt run off and rainfall, and impose a high head on the two Paleozoic bedrock aquifers in the area. The exact amount of groundwater recharge to the formation has not been determined by research. This recharge dynamic is presented in Betcher and Ferguson (2003) and is shown on the following page as Figure 6.

Hydrogeology (cont'd)

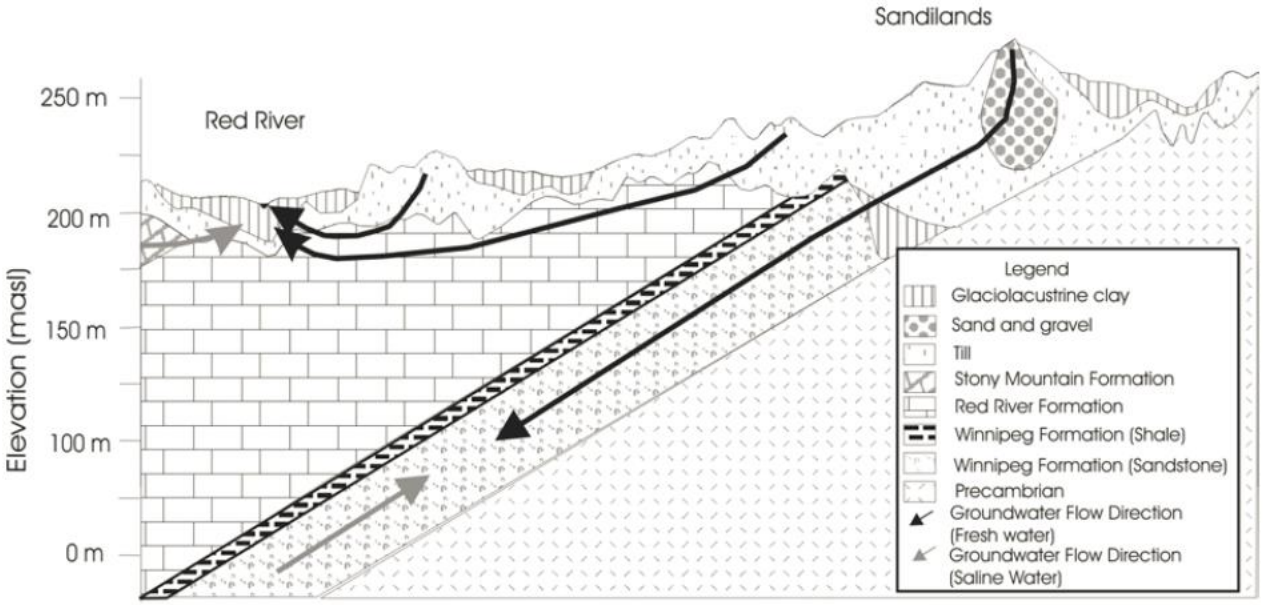


Figure 6 – Simple drawing of the groundwater recharge dynamics in the Southeastern Manitoba. (source – Betcher and Ferguson, 2003)

Groundwater discharge in the area occurs through a variety of means. The carbonate aquifer is known to discharge in the Red River Floodway, and into other creeks, drains and streams in the area. There is thought to be some discharge to the Red River near Winnipeg, and likely discharge into Lake Winnipeg. Further, there is some domestic, farm municipal well consumption on the aquifer, with the largest user in the area being the City of Steinbach. Groundwater discharge in the Winnipeg Formation occurs through domestic, farm and municipal well pumping, and basal discharge into Lake Winnipeg.

The potentiometric surfaces in the carbonate and sandstone aquifers within in the Steinbach area is shown below and on the following page as Figures 7 and 8. It should be noted that the groundwater flow directions and heads are very similar in both formations.

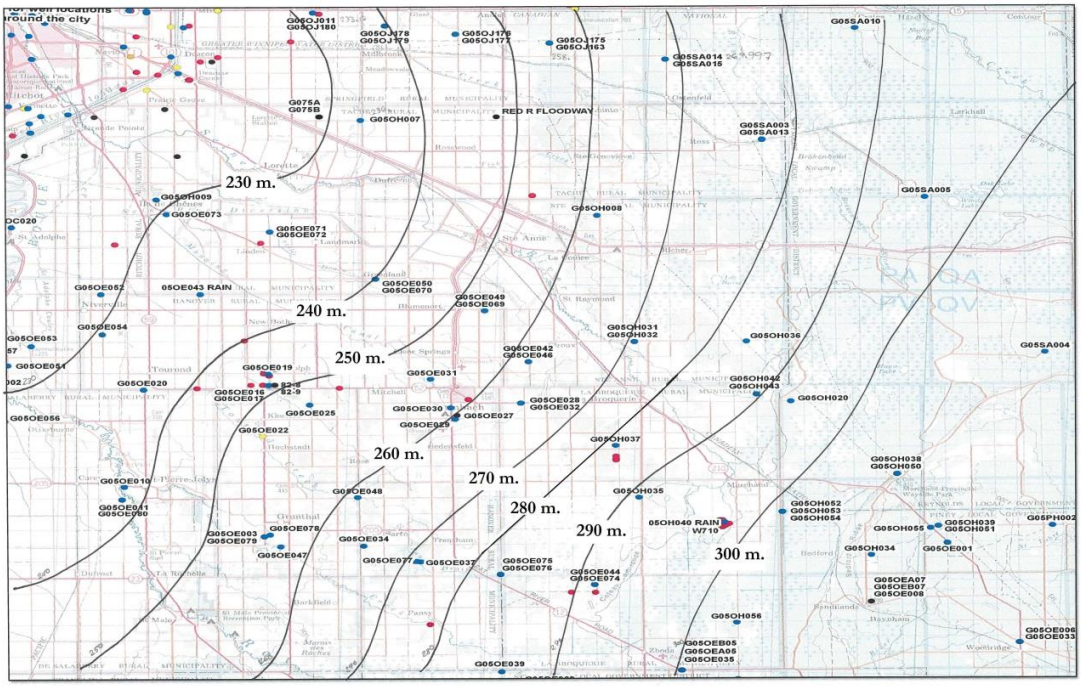


Figure 7 – Groundwater flow in the carbonate aquifer – Southeast Manitoba area (data source – MCWS, 2014)

Hydrogeology (cont'd)

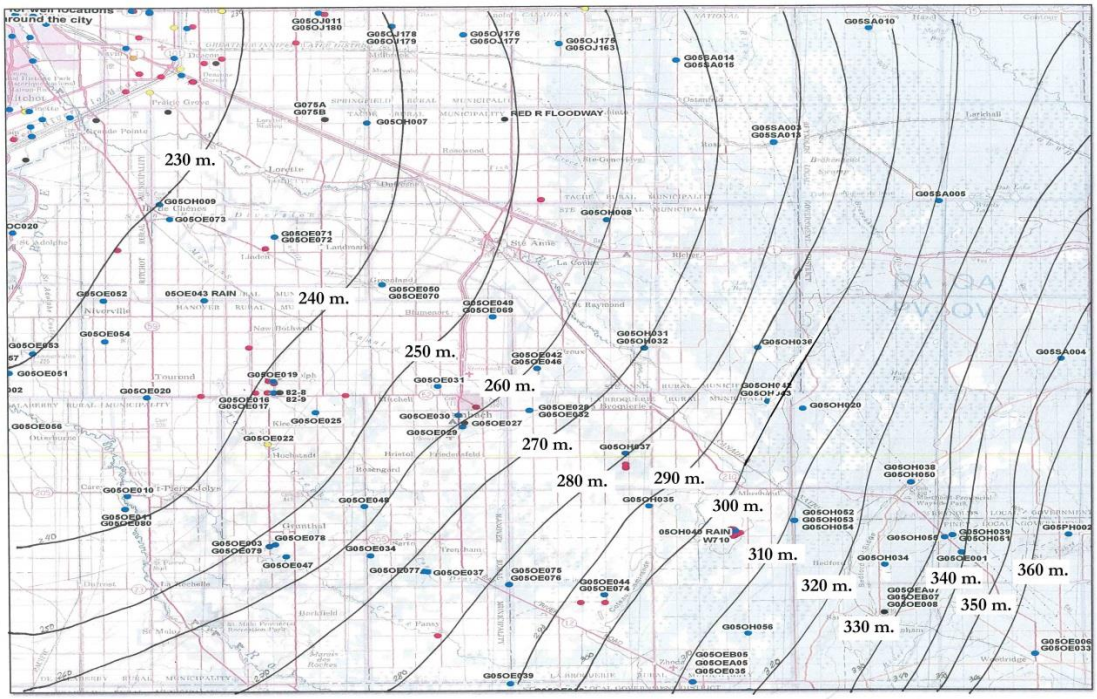


Figure 8 – Groundwater flow in the sandstone aquifer – Southeast Manitoba area (data source – MCWS, 2014)

The carbonate aquifer gradient in the Steinbach area was determined to be about 8.49 x 10^{-4}, and a resultant vector of about 312 degrees. The sandstone flow direction was determined to be almost the same, with a similar gradient.

The southeastern area of Manitoba generally has high permeability in the carbonate bedrock, with transmissivity values ranging from 5,000 to 150,000 U.S.G.P.D./ft. (Render, 1970). Due to the fractured rock nature of the aquifer, the permeability varies substantially with distance. In the Winnipeg Formation Sandstone, Wang et. al. (2008) determined the hydraulic conductivity of the Winnipeg Formation Sandstone to be about 2.38 x 10^{-5} m/s. Assuming about 100 feet on average for a formation thickness, the transmissivity was determined to be about 5,000 to 10,000 U.S.G.P.D./ft. on average.

Interformational flow between the overlying carbonate aquifer system and the underlying Winnipeg Formation is of considerable interest in the area (Betcher, 1986). As stated previously, the thin marine shale sequence overlying the sandstone is thought to be a highly effective aquitard, thereby isolating the two units. Betcher (1986) provided evidence of the significant geochemical differences between the two formations as reason for the effectiveness of the aquitard. In the Winnipeg area, the Winnipeg Formation shale separates the saline/brackish glaciogenic groundwater of the formation with the overlying freshwater of the carbonate aquifer. It is highly likely that some fluid movement occurs through the Winnipeg Formation shale, although it is expected that with the similar heads, and the Ghyben-Herzberg relationship, there is little fluid transfer between the two formations. In reviewing the theory of saline/fresh water boundaries in porous media aquifers, we note the Ghyben-Herzberg relation, which states that in the event of a 1.0 foot drop in the static water level of an unconfined coastal aquifer, the saline water interface will rise approximately 40 feet (Freeze and Cherry, 1979). The extent of the fluid movement between the two formations across the Winnipeg Formation shale is not completely known at the time.

In the Steinbach area, the situation is significantly different, as the two water qualities in the carbonate and Winnipeg Formation are isotopically very similar. Further, there has been an estimate of over 5,000 wells drilled in the freshwater area of the Paleozoic in southeastern Manitoba. Betcher and Ferguson (2003) reported that these interconnecting boreholes have resulted in localized losses in the naturally softened groundwater from the Winnipeg Formation, and local water quality changes in the carbonate aquifer. Betcher and Ferguson (2003) further estimated the volumetric discharge in head between the carbonate aquifer and sandstone aquifer as shown on the following page as Figure 9.

Hydrogeology (cont'd)

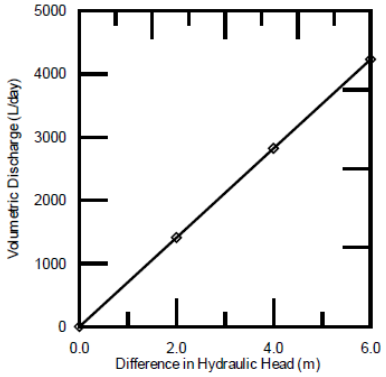


Figure 9 – Relationship between head difference between the carbonate aquifer and the sandstone aquifer as plotted for the southeastern Manitoba aquifers.(Betcher and Ferguson, 2003)

This relationship between the sandstone and carbonate aquifers will be discussed in further detail in the following sections. In addition to the hydraulic relationship between the two aquifers, there is also a geochemical relationship. The testing conducted during this investigation is extremely interesting from a hydrogeological point of view, as it explores the relationship between the carbonate and sandstone aquifers in greater detail.

Local Hydrograph Review

In order to review the regional groundwater flow directions and the long term response in the carbonate and sandstone aquifers over the last 50 years across the Steinbach area, the following MCWS chart hydrograph stations were accessed for potentiometric elevations:

- G05OH031 – Carbonate Aquifer
- G05OE049 – Carbonate Aquifer
- G05OE050 – Carbonate Aquifer
- G05OE042 – Carbonate Aquifer
- G05OE031 – Carbonate Aquifer
- G05OH037 – Carbonate Aquifer
- G05OE029 – Carbonate Aquifer
- G05OE030 – Carbonate Aquifer
- G05OE027 – Carbonate Aquifer
- G05OE032 – Carbonate Aquifer
- G05OH032 – Sandstone Aquifer
- G05OE069 – Sandstone Aquifer
- G05OE070 – Sandstone Aquifer
- G05OE046 – Sandstone Aquifer
- G05OE028 – Sand and Gravel Aquifer

Hydrograph data source – MCWS, 2012/2013

The observation (hydrograph) well locations are shown below as Figure 10.

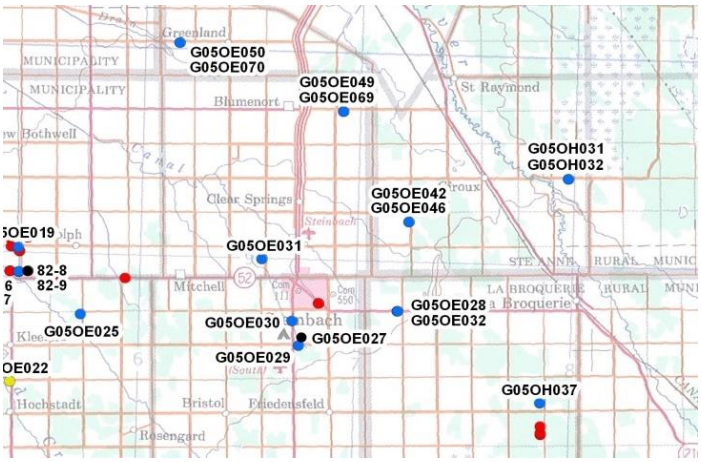


Figure 10 – MCWS Observation Well locations in the Steinbach area (source – MCWS, 2012)

Local Hydrograph Review (cont'd)

Through a review of the precipitation data and hydrographs, the following comments can be noted. The average annual precipitation in the area is typically around 575 mm/year (1981 to 2010), with typical seasonal and climatic variations. Some years, for example, the precipitation has been higher than 800 mm, with some drier years showing less than 400 mm.

In order to determine the seasonal and climatic effects on the hydrograph network, three long term hydrograph stations were plotted against the total annual precipitation, which is shown below in Figure 11. The locations of these long term stations are shown on the following page as Figure 12. The majority of the stations in the Steinbach area were installed in the early 1990's, and these three long term hydrograph stations date back to the early 1960's. Although there are fairly major seasonal and climate changes, the long term hydrograph record appears to be stable, with only minor fluctuations and changes. Two fairly pronounced drier periods occurred during the mid-1970's and in the late 1980's, and both of these are clearly reflected in the hydrograph of OH008.

The record generally shows a fairly stable hydrograph response, with some minor depressions and rises with seasonal and climatic variations. There does not appear to be any long term progressive drawdown in the area that is not explainable. There will be more details on this topic discussed below.

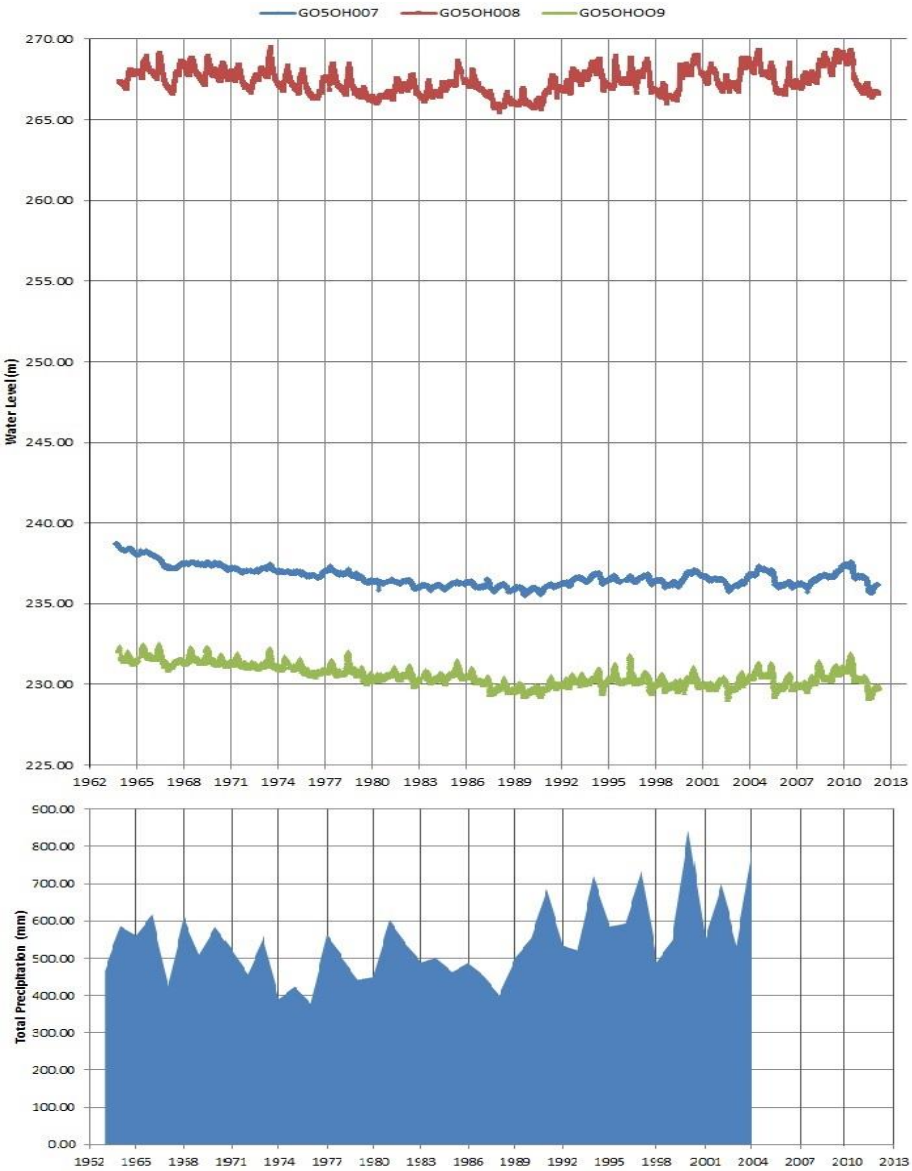


Figure 11- Long term total annual precipitation versus G05OH007/OH008/OH009 (data source –Environment Canada, 2005/MCWS, 2014)

Local Hydrograph Review (cont'd)

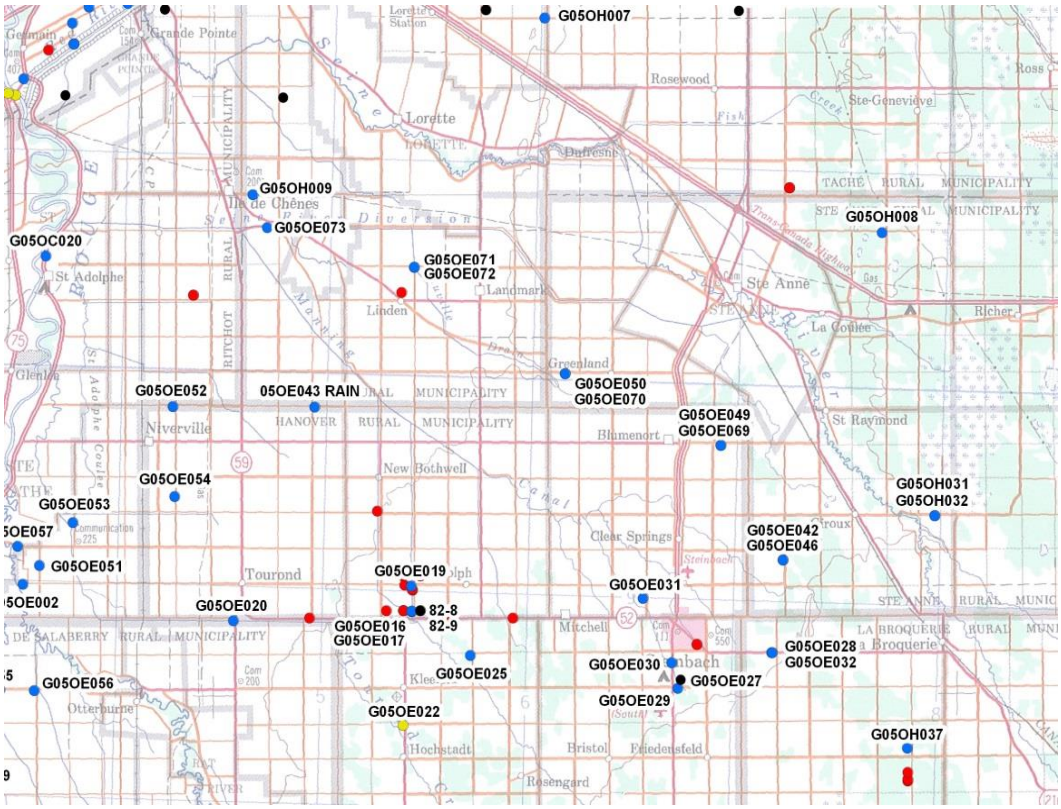


Figure 12 – Location of G05OH007/OH008/OH009 (source – MCWS, 2012)

In 2006/2007, MCWS began a project to investigate groundwater resources in the southeast. A number of long term hydrograph stations in the carbonate aquifer were twinned with observation well stations completed into the Winnipeg Formation. Although the record is relatively short and a slight head difference is present, the hydrographs appear to be an exact image of each other, with each equally displaying similar change in static water levels. An example station is shown below as Figure 13.

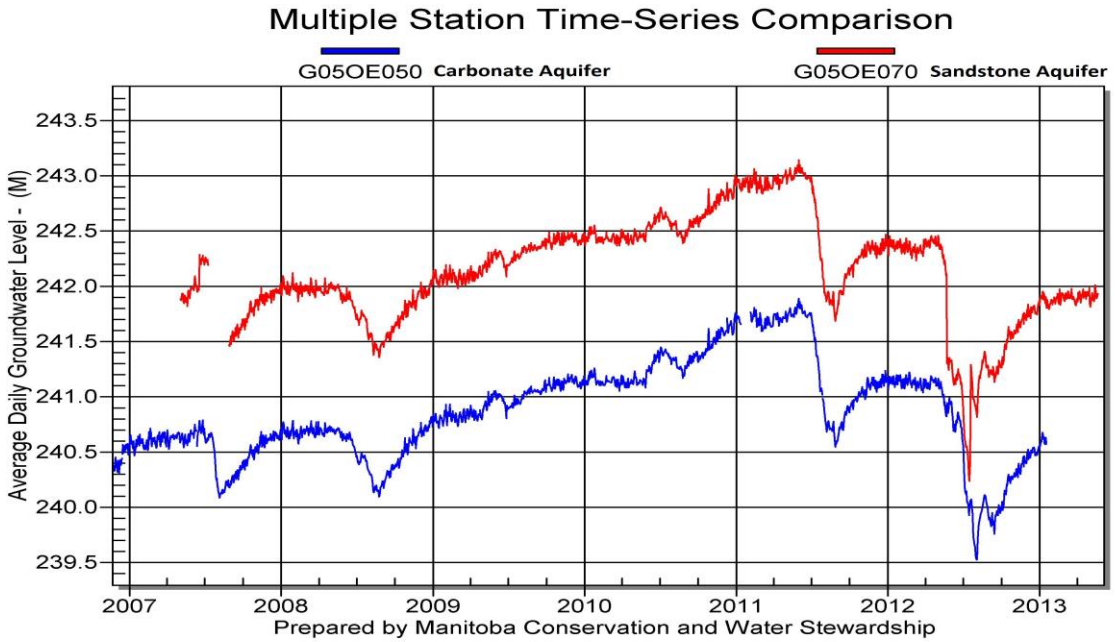


Figure 13 – Multi-station hydrograph comparison. G05OE050 is completed into the carbonate aquifer, while G05OE070 is completed into the sandstone aquifer. (source – MCWS, 2013)

Local Hydrograph Review (cont'd)

As part of this project, an opportunity was presented to conduct some monitoring of the relationship between the carbonate aquifer and the Winnipeg Formation sandstone aquifer. This project allowed for the instrumentation and monitoring of several wells completed into both aquifer units.

In the Steinbach area, static water levels in the Winnipeg Formation are generally higher than in the overlying carbonate aquifer. This condition apparently has been present for long periods of time, as in the early 1900's, it was known that drilling into the Winnipeg Formation sandstone would result in flowing conditions (J. Friesen, personal communication, 2007). This condition is thought to be intuitive, since there is much more opportunities for natural groundwater to discharge from the overlying carbonate aquifer system. The hydrograph record at G05OE050/G05OE070 reflects a fairly "undeveloped" area of both aquifers, which would not be overly affected by the pumping of either aquifer. At this site, the water level of the Winnipeg Formation is about 1.3 m (4.3 feet) higher than that of the overlying carbonate aquifer.

In the Steinbach area, the existing City of Steinbach wells develop the carbonate aquifer; while in the Blumenort area, Granny's Poultry Co-operative has developed the Winnipeg Formation sandstone. It is also well known in the area that there are a vast number of interconnecting boreholes between both formations. For many years, up until the mid-1980's, the City of Steinbach wells were completed open hole through both formations. The Granny's poultry wells up until 2012, pumped from both zones. Since 2012, the sandstone only has been developed, although the open hole interconnecting wells are still present on the site (Bell, 2014).

Despite almost 60 years of pumping, the static water levels in the Winnipeg Formation sandstone are still very similar in elevation to the static water levels in the carbonate aquifer. The levels, as shown below in Figure 14 are extremely similar, although during shutdown, the sandstone static water level is noted to be higher. Generally speaking, they respond in a very similar manner to each other, although there are indications from Figure 14, which show slightly different recovery rate, meaning that it is likely that the Winnipeg Formation sandstone would likely recover slightly higher than the carbonate aquifer, which is being developed at this location.

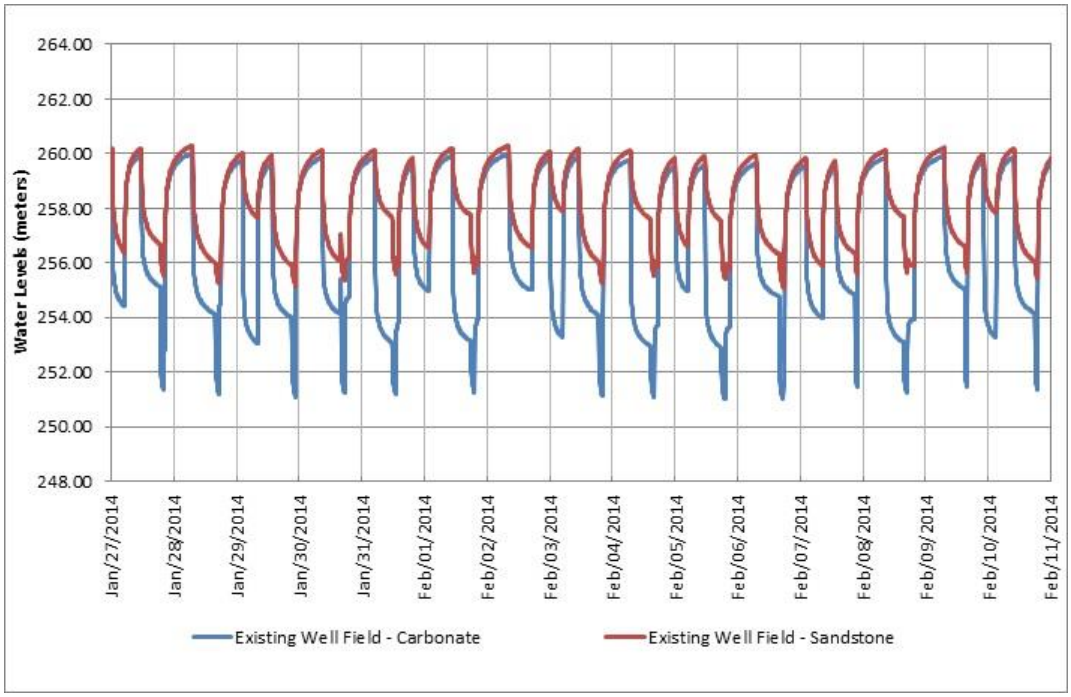


Figure 14 – Existing well field hydrograph station showing the Winnipeg Formation and the Carbonate Aquifer

It is extremely interesting that after 30 to 40 years of pumping from the combined wells, and an additional 30 years of pumping from only the carbonate aquifer, the static water levels in the Winnipeg Formation sandstone are still above the carbonate aquifer level at the wells field. Although it was always speculated that the sandstone aquifer had an effect on the carbonate aquifer, this hydrograph represents the strength of this effect. Further, this hydrograph response demonstrates the level of interconnectivity between the two formations in the area. The sandstone aquifer appears to be almost perfectly connected in this location, with slightly different boundary conditions.

Local Hydrograph Review (cont'd)

The hydrograph shown in Figure 14 also draws attention to the fact that through pumping of the carbonate aquifer, there is an immediate response in the underlying Winnipeg Formation unit, although the effect is dampened somewhat. This effect is also shown in the recovery of both units. Although the pumping is only in the carbonate aquifer, both levels recover at similar rates to their pre pumping static water levels. This hydrograph leads weight to the supposition that considering the carbonate aquifer alone in the Steinbach/Blumenort area may lead to erroneous interpretations.

At the Granny's Poultry site, the situation is somewhat different, as the carbonate bedrock is not being developed at this location. The hydrograph from the Granny's Poultry site is shown below as Figure 15.

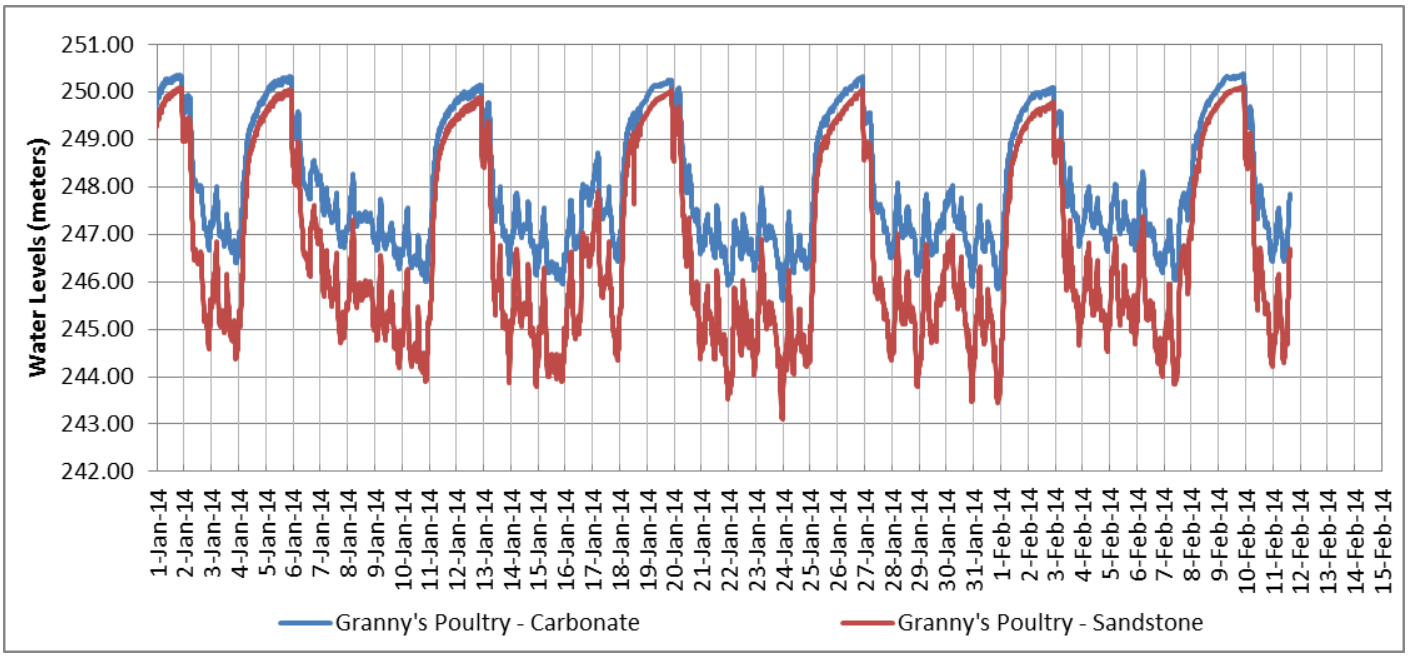


Figure 15 – Granny's Poultry nested observation well

The situation at Granny's Poultry reflects very similar conditions, as the sandstone aquifer and carbonate aquifer reflect very similar pumping conditions, with almost an equal response to the pumping. In the case of the Granny's site, the carbonate aquifer level is consistently higher than the sandstone level. The more irregular, cyclical pumping nature of the Granny's site is quite evident, along with their 5 days per week working schedule, with weekends off. The water use throughout the plant is also clearly not regular or consistent in any way, with some weeks using more water than others. Overall, the recovery data on the weekends is very consistent and regular.

Around the Steinbach area, the Sandstone aquifer is thought to have approximately 1.5 m of head above the carbonate aquifer level, under a no pumping state of nature. This level rises somewhat towards the west, as in Ile des Chenes, the Sandstone hydrograph is about 3.5 m higher than the overlying carbonate aquifer. This is logical, as there are more opportunities for discharge on the carbonate aquifer than there would be for the Winnipeg Formation Sandstone aquifer. It is known that pumping either of the formations separately will cause a similar pressure decline in the non-pumping formation.

As part of the MCWS investigations into the aquifers in the southeast in 2008, Wang et. al. (2008), noted that most hydrograph records recovered after the 1991 dry period, with the exception of an area located west of Steinbach. Wang et. al. (2008) concluded that this was the result of development pressure, as it was in a negative drawdown condition. The area is shown on the following page as Figure 16.

Local Hydrograph Review (cont'd)

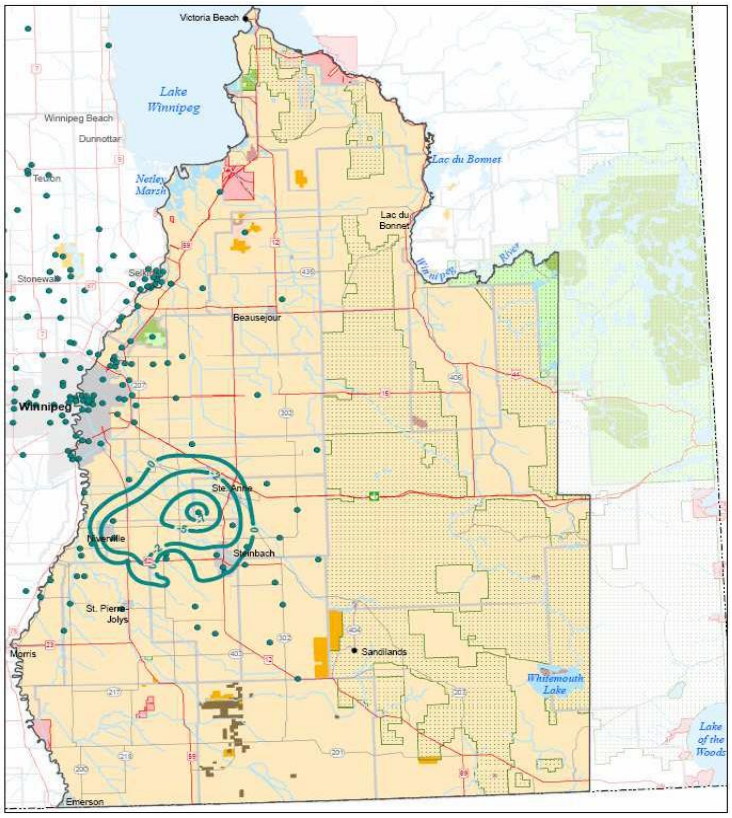


Figure 16 – Negative drawdown in the carbonate aquifer (units are unknown) (source – Wang, et. al., 2008)

Figure 16 shows a negative drawdown of about -7 in an area centered near the City of Steinbach. The units are not depicted on the map**;** although the rest of the paper uses meters (Wang, 2008).

This concept is somewhat difficult to accept, as there are no major production wells or consumptive groundwater users in the area, other than the LUD of Landmark, which was put into service, at about 60 U.S.G.P.M., in 1991. It is also speculated by Wang et. al, (2008) that this section of the carbonate aquifer may take longer to come to equilibrium from climatic changes and pumping stress. It was noted in the paper that the remainder of the southeast did not show any development stress, even around the well-established drawdown cone around the City of Steinbach supply wells. In effect, what they were discussing was a potentiometric area in the aquifer that did not respond to increased groundwater recharge; in effect a constant head discharge area. There are zones like this along the mid part of the Red River Floodway Channel.

It is speculated that the situation Wang refers to is drawdown and an area of constant head that has resulted from a project conducted by MCWS in the 1970's, when the Seine River diversion channel was dug through the area. In an area west of Steinbach, the drain base, of what is called the Manning Canal continued to blow out from the high artesian Carbonate Aquifer conditions that were present. In order to lower the heads in the area, four large diameter relief wells were constructed, and were allowed to drain through a pipeline to the Red River. Eventually this water was collected at the Towns of Ste. Agathe and Ile des Chenes, and is still currently used for water supply in the area. The four wells apparently discharges over 500 U.S.G.P.M. per well when originally constructed. Since the installation, the static water levels have declined somewhat to the point that the flow rate is considerably less. According to some residents in the area, the drawdown in the aquifer has been noted several miles to the north near Landmark and New Bothwell.

It is speculated that the "negative drawdown" discussed by Wang et. al. (2008) is a result of the MCWS artificial head lowering and constant Carbonate Aquifer conditions caused by the south lateral drain head lowering project. Thus, the current water levels in the area are the new "state of equilibrium" for the area. It was noted by Wang (personal communication, 2014) that the discharge wells have been operating since the 1980's, and that the effects would already be complete by 1991. It is felt that long term drawdown conditions over 20 years or more may be required to see the effects of the discharge. An example of this is the Red River Floodway, which took more than 20 years for the effects to begin to stabilize.

Regional Groundwater Geochemistry

The geochemistry of the two aquifers in the southeast of Manitoba is complex. In the geologic past, prior to the start of the Pleistocene glaciations, it is highly likely that both aquifers were saline or brackish. Due to the subcrop recharge dynamics of the moraines present to the east, the aquifers receive a large amount of freshwater recharge annually. This has resulted in a large freshwater presence in both the carbonate and Winnipeg Formation Aquifers. This freshwater has formed a distinctive "wedge" in the southeast of the province. Figures 17 and 18, shown below; depict the freshwater portions of the carbonate and Winnipeg Formation aquifers, respectively.

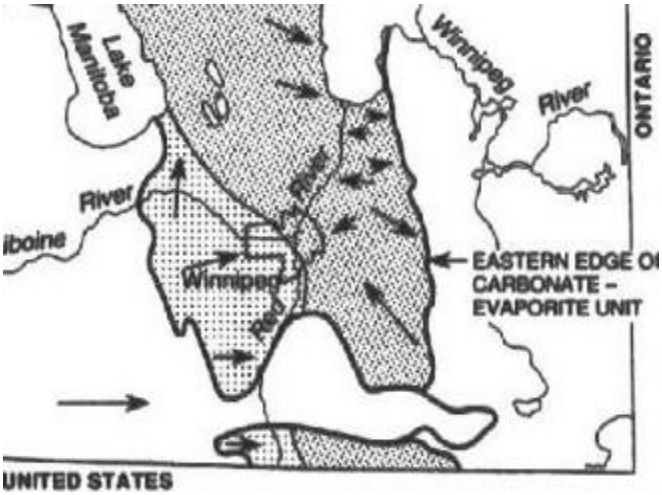


Figure 17– Carbonate Aquifer freshwater areas (saline areas are shown as to the west of the River) (source – Betcher et. al, 1995.)

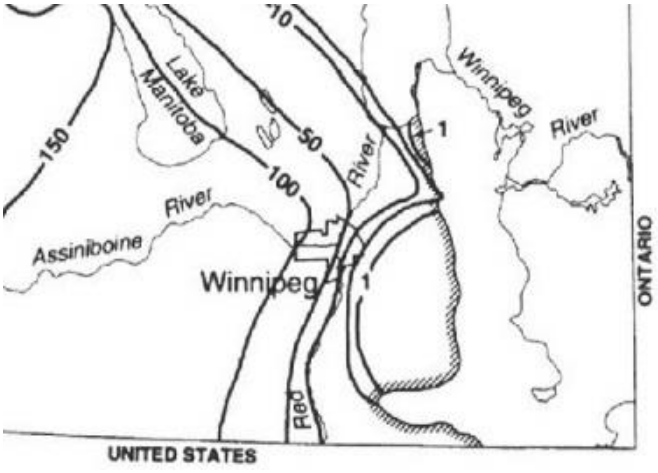


Figure 18– Winnipeg Formation chemistry (> 1 g/L is fresh) (source – Betcher, et. al., 1995.)

In order to determine the background groundwater geochemistry across the Steinbach area, the following MCWS hydrograph station groundwater sampling results were reviewed.

- G05OH031 – Carbonate Aquifer
- G05OE049 – Carbonate Aquifer
- G05OE050 – Carbonate Aquifer
- G05OE042 – Carbonate Aquifer
- G05OE031 – Carbonate Aquifer
- G05OH037 – Carbonate Aquifer
- G05OE029 – Carbonate Aquifer
- G05OE030 – Carbonate Aquifer
- G05OE027 – Carbonate Aquifer
- G05OE032 – Carbonate Aquifer
- G05OH032 – Sandstone Aquifer
- G05OE069 – Sandstone Aquifer
- G05OE070 – Sandstone Aquifer
- G05OE046 – Sandstone Aquifer
- G05OE028 – Sand and Gravel Aquifer

Observation well chemistry data (source – MCWS, 2012/2013)

The results from the MCWS observation wells were plotted on a trilinear plot for comparison purposes. The results are shown on the following page as Figure 19.

Generally, the groundwater quality declines towards the west. Moving further west from the recharge area results in rising concentrations of major ions and total dissolved solids. In both aquifers, the groundwater quality is mostly Calcium/Magnesium/ Bicarbonate type. However particularly in the Carbonate Aquifer there are zones of Calcium/Magnesium/Chloride waters.

This flushing action of recent recharge through the area acts as a natural softening of the groundwater from the Winnipeg Formation. The freshwater is not moving uniformly through the aquifer, as shown by Phipps et. al, (2008). In addition, the change in chemistry between the sandstone and overlying carbonate aquifer is shown on the following page as Table 1.

Regional Geochemistry (cont'd)

In the Steinbach/Blumenort area, the water quality in the carbonate is expected to be very similar to the underlying sandstone aquifers. It is noted that the calcium and bicarbonate concentrations in the sandstone are elevated above the carbonate aquifer, while the sodium, chlorides, and sulphates of the sandstone are lower. It is speculated that this is largely due to the intermixing of both aquifers in the area. It is thought to be normal for the carbonate aquifer to have much poorer quality water.

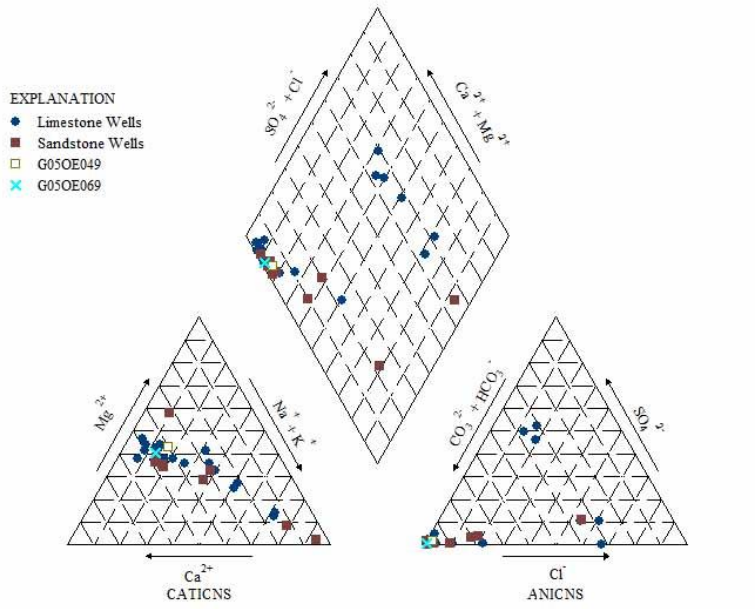


Figure 19 – Piper plot (data source – MCWS, 2013)

Table 1 MCWS Observation Wells Comparison of Carbonate and Sandstone Aquifers in the Steinbach/Blumenort area		
Parameter	**G05OE049 – Carbonate Aquifer**	**G05OE069 – Sandstone Aquifer**
Calcium	54.9 mg/L	67.3 mg/L
Magnesium	35.7 mg/L	35.4 mg/L
Sodium	24.7 mg/L	17.6 mg/L
Potassium	4.6 mg/L	6.98 mg/L
Carbonate	< 0.5 mg/L	< 0.5 mg/L
Bicarbonate	372 mg/L	416 mg/L
Chloride	5.53 mg/L	1.67 mg/L
Sulphate	4.49 mg/L	< 1.00 mg/L
Conductivity	560 umhos/cm	600 umhos/cm
Total Dissolved Solids	301 mg/L	331 mg/L
Barium	0.48 mg/L	1.55 mg/L

Table 1 – Comparison of sandstone and carbonate aquifer basic routine geochemistry. (data source – MCWS, 2012)

Regional Geochemistry (cont'd)

It should be noted through a review of the concentrations in Table 1, that the concentration of Barium was reported. This level apparently exceeds the Guidelines for Canadian Drinking Water Quality (GCDWQ, 2008). This has been somewhat of an issue in the Blumenort area, where both aquifers have been interconnected. The reason for the increase in barium concentration is not known, but is speculated to be a result of the interconnection of the two aquifers.

The regional distribution of groundwater quality types in the carbonate aquifer is reasonably complex. It is no doubt influenced by the interconnections of the Winnipeg Formation Sandstone, and the recharge dynamics. Phipps et. al. (2008) mapped the distribution of groundwater quality types in the carbonate aquifer, which is shown below as Figure 20.

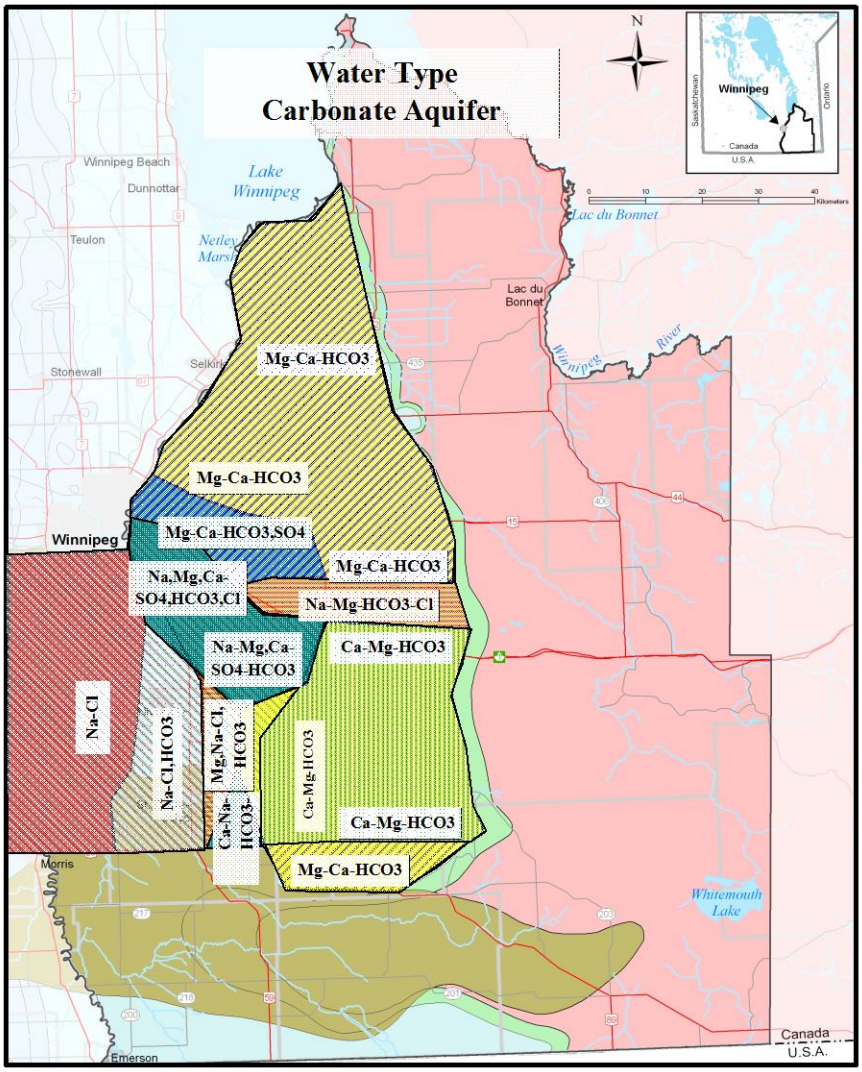


Figure 20 – Groundwater quality type variations in the carbonate aquifer in southeastern Manitoba. (source – Phipps, et. al., 2008)

Due to the interconnectivity of the aquifers in the Steinbach area, it has long been speculated that that has been some water quality changes in both aquifers. This has been a difficult case to prove with the lack of long term data from both aquifers with a continuous point source well. During this project, the long term routine raw water quality data for the City of Steinbach was collected and plotted to determine if there was any long term effect of groundwater quality changes. The City of Steinbach has been collecting raw groundwater quality data annually since 1993 from their three supply wells in the carbonate aquifer.

An example result of the groundwater quality plotting for well No. 2 is shown on the following page as Figure 21.

Regional Geochemistry (cont'd)

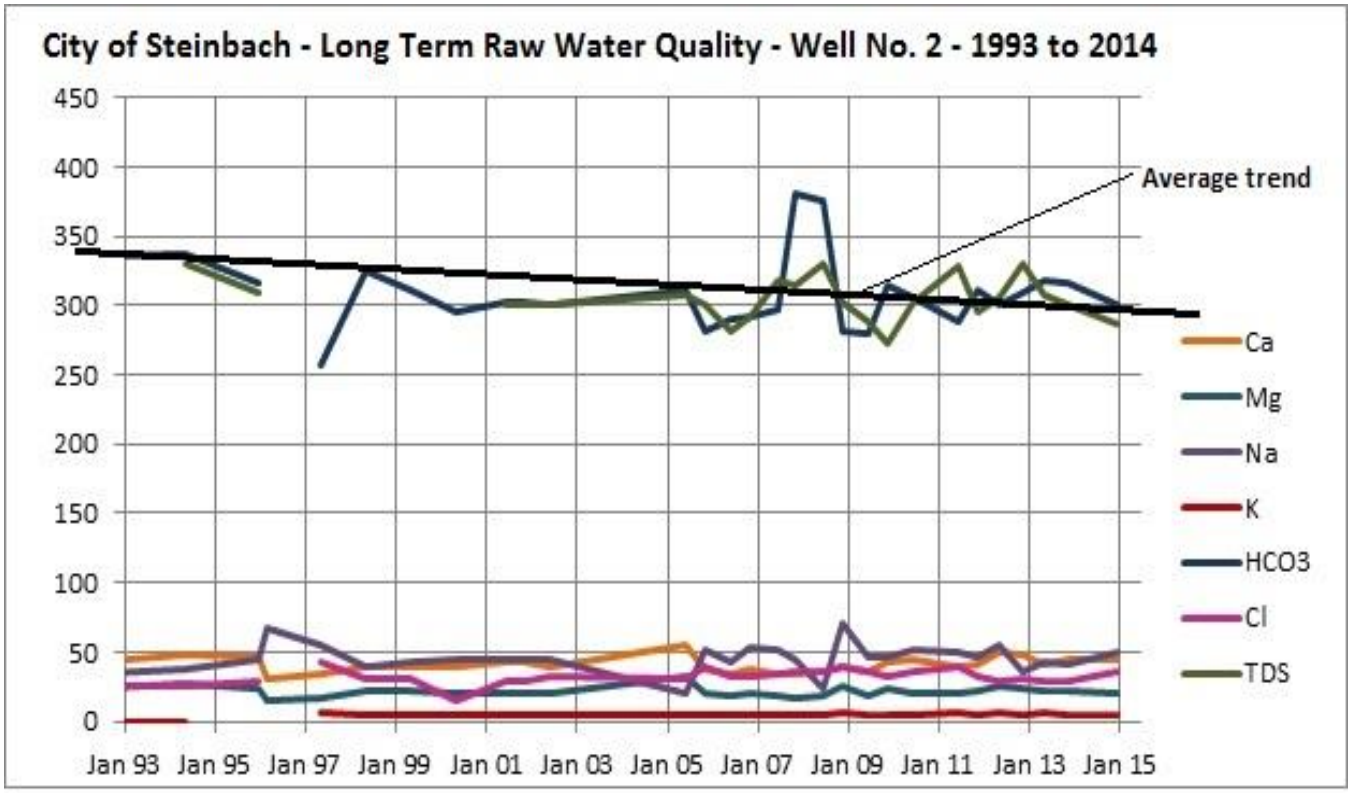


Figure 21 – Long term raw water quality trends – City of Steinbach Well No. 2 (1993 to 2014) (data source – City of Steinbach, 2015)

The groundwater quality of the carbonate aquifer in the majority of parameters is generally stable, although the total dissolved solids and magnesium appear to be on a slightly decreasing trend. This effect is generally shown across all three wells, and is thought to be a result of sandstone water leakage from the underlying sandstone aquifer. The recharge dynamics of the carbonate aquifer have not changed throughout the recent geological time, therefore the only logical explanation is the increasing effect of the aquifer interconnectivity. There is no specific long term data for comparison from the Winnipeg Formation.

During field investigations by the MCWS in the Southeast, samples were collected for the analysis of isotopes of oxygen. The ratios of the main isotopes that comprise the water molecule ($^{18}O/^{16}O$) and $^{2}H/^{1}H$ are important for hydrogeological investigations (Freeze and Cherry, 1979). The units are presented in delta (δ) units as parts per thousand or ‰ (Freeze and Cherry, 1979) relative to standard mean oceanic water (SMOW). The two isotopes of water have different freezing and vapour points, which leads to different concentrations as a result of freezing, condensation, melting, and evaporation (Freeze and Cherry, 1979). As water is evaporated from the ocean, there is a decline in the ^{18}O concentration by a specific amount. As the vapor condenses, the precipitation has a higher ^{18}O concentration. This process continues as the vapor moves inland, and undergoes many cycles of condensation and evaporation. This fact makes deuterium and ^{18}O very useful for hydrogeological investigations, as the origin and mixing of different waters can be determined. In order to determine the changes from local precipitation, deuterium and ^{18}O results are plotted to determine the local meteoric water line, which would be expected to be the typical concentrations in recent precipitation events in the southeast.

Phipps et. al.(2008), conducted sampling of approximately 50 MCWS observation and monitoring wells in 2008, as part of the southeast groundwater study. These results were plotted against a local meteoric water line, which was determined to be $\delta^{2}H = 7.6 \cdot \delta^{18}O + 2.2$, which is the virtually the same as the local meteoric water line for the Gimli area (IAEA, 2012). This plot is shown on the following page as Figure 22. The various aquifers in the southeast are also shown.

Regional Geochemistry (cont'd)

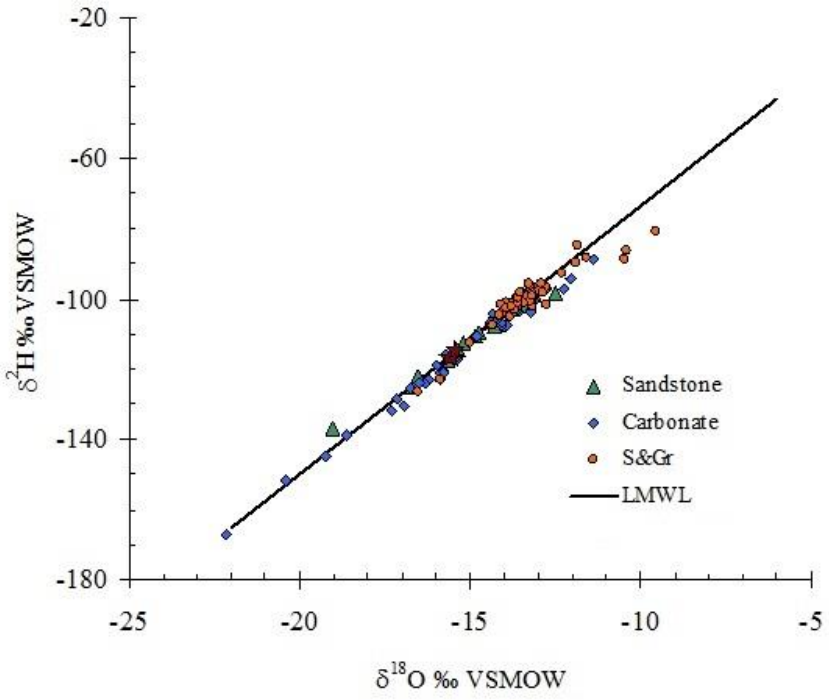


Figure 22 – Local isotopes in the southeast (source – Phipps et. al., 2008)

The values indicate that the groundwater is modern precipitation. The results are typical for fairly recent movement of young recharge water. There is a slight indication of a slope change resulting from snow melt infiltration (Fritz &Clark, 1997). Groundwater from the supply wells is slightly older than the overlying sand and gravel aquifer isotope samples obtained from the recharge moraine area. It should be noted that highly depleted samples are shown to the left on the local meteoric water line, which indicate recharge under very different climatic conditions. This is likely hold over water from the Pleistocene glaciations (Clark, 2014).

The groundwater from the two aquifers in the Steinbach area is fairly recent, and indicates a fairly recent movement through the aquifer towards the area. There is also not a marked change in the values in the sandstone aquifer from the overlying carbonate aquifer in the Steinbach area.

Well Inventory

As part of the requirements from MCWS – Water Rights Licensing Section, a well inventory of risk for private and commercial wells located within a 5.0 km radius of the Park Road well location, was requested in the permit. The inventory would seek to determine the number of private wells in the area that may be located within the potential drawdown cone of the proposed supply well location. The inventory was conducted using MCWS – Groundwater Management Section's GWDRILL (2014) database. The completed inventory is attached as Appendix E.

The well inventory produced a record of nearly 1,100 private, domestic, and municipal water wells within a 5.0 km radius. Due to the magnitude of the number of wells, it was not possible to check them individually for specifics relating to hook up and pump types. Therefore, the wells immediately close to the well site were the only ones checked thoroughly.

The vast majority of the wells in the area are completed either solely within the limestone, or with a multi-aquifer completion through both the carbonate aquifer and the underlying sandstone aquifer. Few wells are completed solely in the sandstone aquifer, with screens and aquifer isolation. It was estimated that about 21% of the water wells in the area are either fully completed in both aquifers, or are bottomed extremely close to the sandstone aquifer. The extent of limestone/sandstone wells in this area is significant, and they seem to be increasing in numbers in the last years.

Well Inventory (cont'd)

Generally speaking, static water levels in the area are either very high, or within 10 feet of surface. The Park Road location is within a flowing well area. The well inventory data also provided a unique opportunity to map the flowing well area around the City of Steinbach.

This flowing well area is shown below as Figure 23. The area was mapped with water well data that generally showed static water levels within 10 feet of surface.

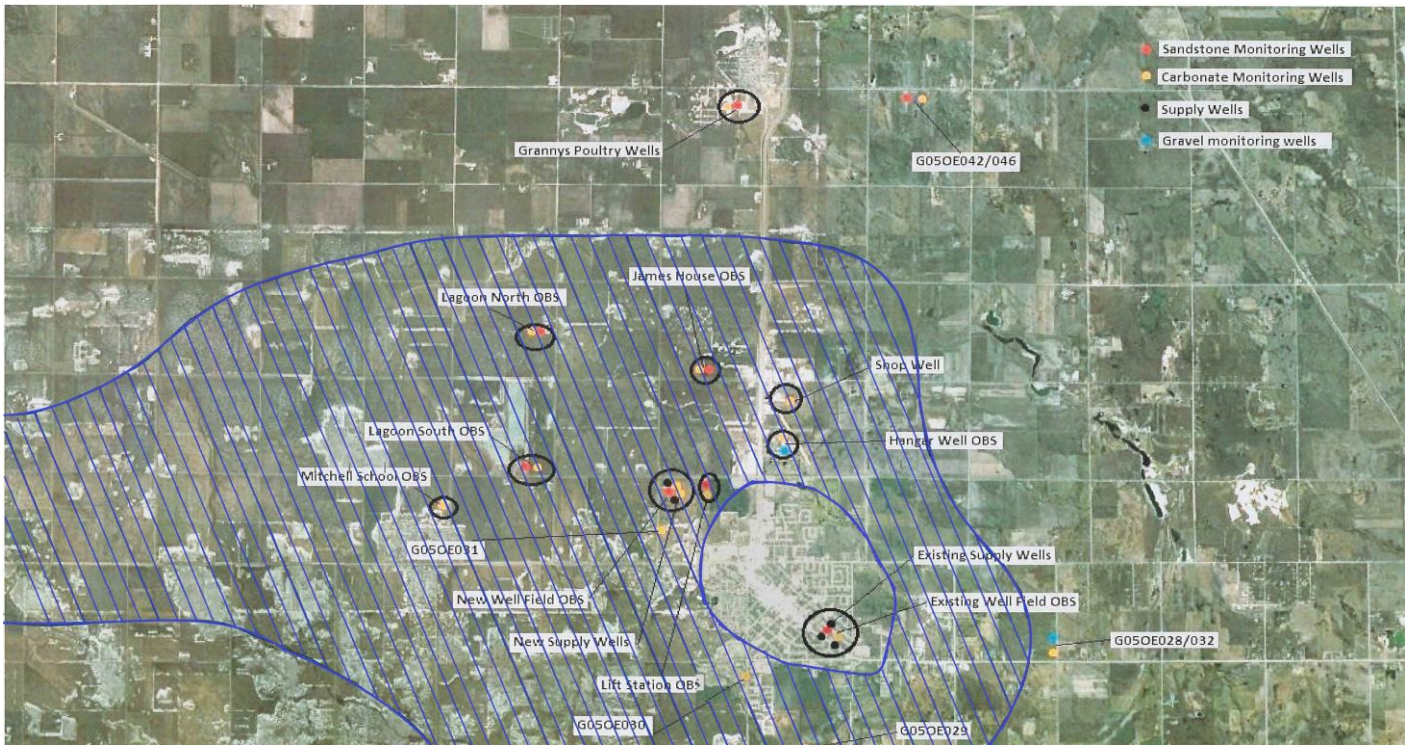


Figure 23 – Flowing well area – City of Steinbach (data source – GWDRILL, 2014)

An interesting aspect of the area that was noted in the well inventory was the grouting conditions of the private wells in the area. Many of the older well records do not indicate a grout type; however the modern wells are predominantly grouted in place with cement. This is likely due to the high static water level that is present in the area. Therefore it is speculated that the majority of wells in the area are grouted with cement, as the high static water level/flowing conditions have been present in this area for many years.

Due to the static water levels that are present, most wells appear to be mechanized with submersible type pumps, single line suction pumps, or two line jetmatic pumps. The hydrographs in the area show several meters of fluctuation from season to season, due mainly to seasonal and climatic effects. It appears that many of the wells in the area flow certain years, and not in other years. The pumping systems in this area would have to deal with these water level fluctuations on a regular basis.

Field Investigations and Testing

Well Installation and Development

Friesen Drillers Limited mobilized to the area in the spring/summer of 2013. The location of the production well field at Park Road was selected by the City of Steinbach; the land was purchased many years previous. The location was selected due to the proximity of electrical power, and the presence of existing water system related infrastructures in the area.

In order to confirm the aquifer conditions at the site, two 5 inch diameter, PVC cased test wells were drilled prior to the construction of the final production wells. The two test wells were named the north and south production well sites respectively. After the drilling of both test wells, short term confirmatory pumping tests were completed. Both well locations showed substantial drawdown pumping 100 U.S.G.P.M., but provided confirmation that production wells would be functional on the site. Both well locations did show some sediment production, although this is fairly typical for open hole fractures in the Steinbach area.

Well Installation and Development (cont'd)

In November 2013, the pre-production test wells were re-constructed into 12 inch diameter steel cased production wells. The 5 inch PVC casing in both wells was removed, and the well locations were over drilled with 12 inch diameter steel casing. The overburden stratigraphy at the site typically consisted of about 20 feet of clay, underlain by glacial till to a depth of approximately 40 feet below grade. Additional layers of clay and till were present to a depth of approximately 90 feet below grade, where the carbonate bedrock was encountered. Casing was seated in the north well at 92 feet below grade, and in the south well at 96 feet below grade. During the installation of the welded steel casing, the upper 40 feet of casing was equipped with carbide cutters on the casing outside, which created an annulus of about 3 to 4 inches in diameter outside the 12 inch casing. When the casing was seated, cementaceous grout was then placed via tremie line at the base of the cutters on the outside of the casing. This created an effective seal against the flowing conditions that are present in the area.

Once the casing was seated in both wells, the bedrock was drilled open hole using an 11 inch diameter bit, to a depth of 222 feet below grade. Large fracturing was noted at a depth of approximately 170 feet below grade. After a significant developing effort in both wells, relatively sand free water was produced. The fractures in both boreholes appeared to be infilled with shale material, which is extremely uncommon for the area. Further microscopic analysis revealed that the material was predominantly shale, and was likely formed during ponding in the area that was subsequently buried by further deposition (Vanjecek, 2014). Additional developing appeared to remove the majority of the sediment from the boreholes, although sediment traps and collection should still be included in the final design and mechanization.

Both wells were sealed with temporary well seals, as the static water level was noted to be approximately 5 feet above surface.

Complete geologic and borehole construction logs for the production wells are attached as Appendix F. The specific well details are presented below in Table 2.

Table 2
Production Well Specific Details
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Well	Latitude	Longitude	Casing Diameter	Casing Depth	Total Depth	Grout Type	Grout
North	N 49.54501º	W 96.70939º	12 inch Steel	92 feet	222 feet	Cement	0-35 feet
South	N 49.54380º	W 96.70776º	12 inch Steel	96 feet	223 feet	Cement	0-35 feet

Table 2 – Well specific details - Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Aquifer Monitoring, Climatic Monitoring and Geodetic Surveying

In order to determine how the aquifer will respond to pumping, an extensive network of observation wells was planned for testing during this investigation.

Three observation wells were drilled during this investigation to add to the monitoring network. The first monitoring well was located within the Park Road well field site, with the remaining two wells located to the west, near the City of Steinbach lagoon site (approximately ½ mile from each well site). These wells will be maintained for long term observation of the carbonate aquifer fluctuations during the proposed operations of the well field.

Due to the suspected influences of the Winnipeg Formation sandstone aquifer, the observation wells were planned as nested monitoring wells, which would allow independent monitoring of both the carbonate aquifer and sandstone aquifer within the same well. The wells were constructed by drilling and installing a 5 inch diameter PVC casing into a three tier step down socket constructed into the carbonate bedrock. The 5 inch casing was then cemented in place. The complete section of carbonate bedrock was then drilled open hole, with an additional 20 to 40 feet of drilling into the Winnipeg Formation sandstone aquifer. A 2 inch diameter PVC liner was then installed into the well, with three shale traps at the base installed through the shale. Slotted pipe was placed below the shale traps. Sand and bentonite were also placed on top of the shale traps to act as an additional seal.

Following the well construction, each section of the borehole was developed with compressed air for several hours. After the completion of the developing, static water levels in both sections of the well showed a head difference between the two formations.

Logs for the constructed observation wells are contained in Appendix G, attached.

Aquifer Monitoring, Climatic Monitoring, and Geodetic Surveying (cont'd)

The monitoring plan for this project was consisted of 25 observation wells (plus the pumping well) completed into the carbonate, sandstone, and overburden sand and gravel wells surrounding the Park Road site. The locations are shown below as Figure 24. The near well observation wells are shown below as Figure 25.

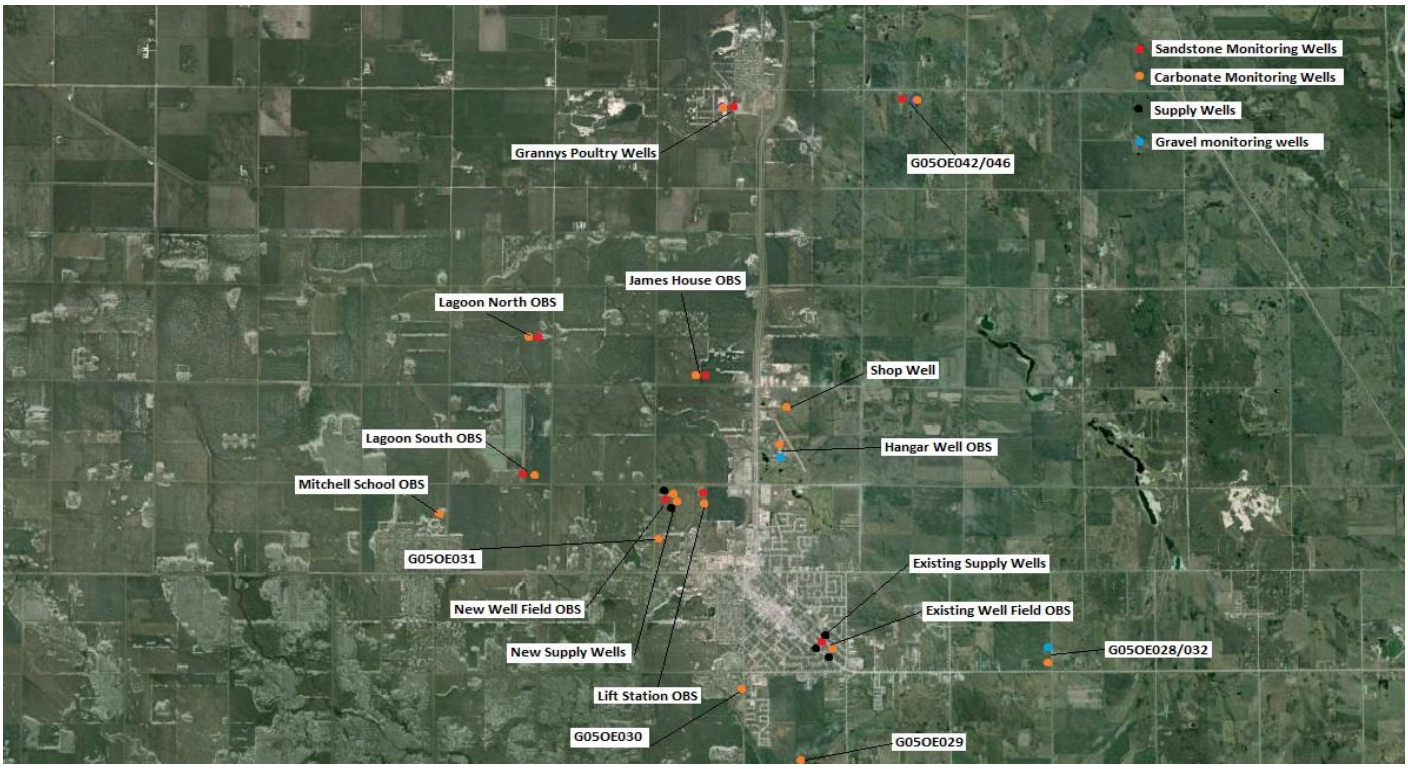


Figure 24 – Monitoring well locations - Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba
(source – GoogleEarth, 2015)

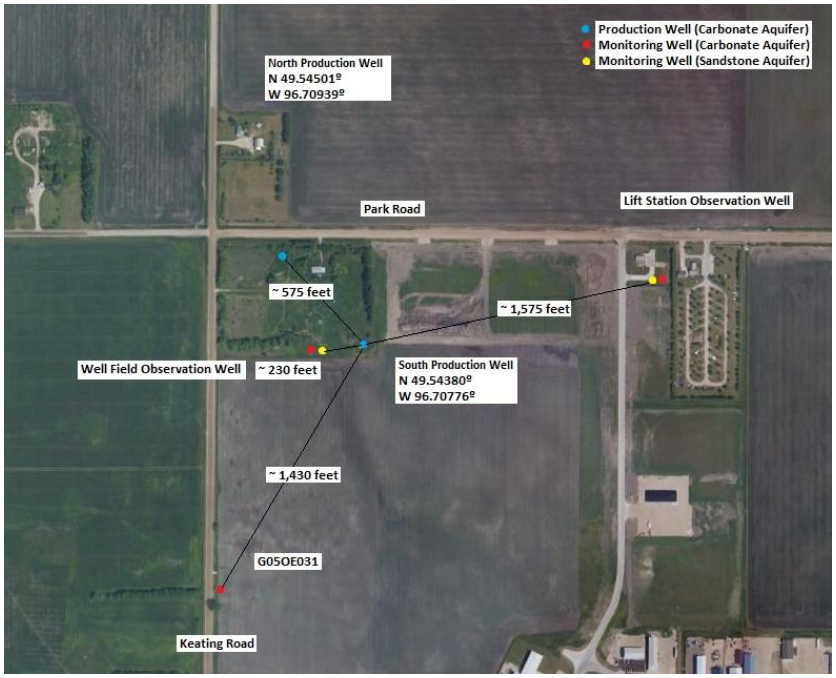


Figure 25 – Near monitoring well locations - Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba
(source – GoogleEarth, 2015)

Aquifer Monitoring, Climatic Monitoring, and Geodetic Surveying (cont'd)

Solinst M30/F100 automatic, data recording pressure transducers were installed in many of the selected observation wells. Other stations employed both manual and Stevens™ Type F paper hydrograph recorders and Telelog™ data recording transducers. The transducers used were the non-vented type, which require barometric pressure correction. A barometric pressure logger was deployed to the site for use in data correction. The transducers were set to record data on ten minute intervals, and were installed about three weeks before the pumping/recovery test. The majority of the instruments were removed about three weeks after the test, with several longer term stations being left in place for an additional month.

The following stations were utilized, as shown below in Table 3.

Table 3
Monitoring Well Specific Details
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Monitoring Well Name	Aquifer/Radial Distance	Monitoring Well Name	Aquifer/Radial Distance
South Production Well	Carbonate/0 feet	James House OBS	Carbonate/~6,575 feet
New Well Field OBS	Carbonate/~230 feet	James House OBS	Sandstone/~6,575 feet
New Well Field OBS	Sandstone/~230 feet	Lagoon North OBS	Carbonate/~10,675 feet
North Production Well	Carbonate/~575 feet	Lagoon North OBS	Sandstone/~10,675 feet
G05OE031	Carbonate/~1,430 feet	Granny's OBS	Carbonate/~21,575 feet
Lift Station OBS	Carbonate/~1,575 feet	Granny's OBS	Sandstone/~21,575 feet
Lift Station OBS	Sandstone/~1,575 feet	G05OE042	Carbonate/~23,535 feet
Hangar OBS	Carbonate/~6,600 feet	G05OE046	Sandstone/~23,535 feet
Hangar OBS	Sand and Gravel/~6,600 feet	Old Well Field OBS	Carbonate/~10,785 feet
Shop Well OBS	Carbonate/~7,785 feet	Old Well Field OBS	Sandstone/~10,785 feet
Mitchell School OBS	Carbonate/~11,990 feet	G05OE030	Carbonate/~11,650 feet
Lagoon South OBS	Carbonate/~7,530 feet	G05OE029	Carbonate/~15,675 feet
Lagoon South OBS	Sandstone/~7,530 feet	G05OE032	Carbonate/~21,955 feet

Table 3 – Monitoring well specific details - Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

The corrected transducer plots and water levels measured in each observation well are attached as Appendix H.

In order to determine the exact location and elevation of the observation well network, the City of Steinbach arranged for a geodetic surveying crew to attend the site. Each observation well location was surveyed with a geodetic GPS total station.

The survey data is also contained in Appendix I.

Pumping/Recovery Test, Geochemical, and Environmental Isotope Sampling

In order to obtain aquifer parameters and to determine how the proposed Park Road well field responds to pumping, a 72 hour pumping test was planned for the site. The testing duration was stated in the scope of work and approved by MCWS – Groundwater Licensing Section. Recovery was to be monitored to at least 90% of the static water level.

A 25 hp Berkeley submersible pump and motor was installed in the South Well at a depth of 100 feet below grade. Power was supplied by an on-site portable generator. During the installation and set up, the pump and motor were tested briefly for one hour to determine the well yield. This allowed the discharge valve to be set. This was undertaken approximately one week before the testing. The pumping test commenced on February 3, 2014. The actual pumping test was conducted until hour 60, when the electrical generator shut down due to an engine fault. The recovery started immediately, and continued as shown in the pumping test data plots contained in Appendix J. It should be noted that at the time of the pumping test, ground frost was present, along with ample snow coverage. The cold conditions made well monitoring challenging due to the flow conditions.

The flow rate was maintained by using a 4 inch by 6 inch orifice meter. The flow meter was checked every half hour. Water levels were monitored using a Powers M-scope well sounder in the pumping well. The flow from the meter was pumped and piped over land and deposited on the site.

Pumping/Recovery Test, Geochemical, and Environmental Isotope Sampling (cont'd)

The pumping test set up for the site is shown below as Figure 26.

Figure 26 – The South Production well and discharge hose heading southwards off the site.

During the 60 hour pumping test on the south well, field measurements of basic water quality parameters were collected. The field instruments were calibrated prior to the test. Field measurements were taken to show the water quality results prior to the release of CO_2 from the sample, which can affect the results over short periods of time. The summary of water quality testing results is shown on Table 4. In addition, groundwater samples were collected from the pumping discharge in laboratory supplied analytical sample bottles every 24 hours. The samples were submitted to ALS Laboratories for routine water quality parameters and metals scan analysis. The results will be discussed in the data analysis section. In addition to the routine geochemical analysis, two environmental isotope samples were collected for the analysis of Oxygen[18] and Deuterium isotopes.

Table 4
Field Water Quality Measurements – South Production Well - 60 Hour Pumping Test
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Pumping Time	Electrical Conductivity	Field Turbidity	pH
12 hours	389 umhos/cm	3.62 NTU	8.2
24 hours	373 umhos/cm	3.10 NTU	8.0
36 hours	419 umhos/cm	4.17 NTU	8.3
48 hours	391 umhos/cm	3.15 NTU	7.9
60 hours	356 umhos/cm	3.52 NTU	8.2

Table 4 – Field parameters – South Production Well pumping test – Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

The following water levels and pumping rates, shown in Table 5, were recorded during the pumping test from the South Production supply well.

Table 5
Pumping Test Specific Details
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Well	Pumping Time	Latitude	Longitude	Casing Depth	Total Depth	Static Water Level	Pumping Water Level	Pumping Rate
South Well	60 hour	N 49.54380º	W 96.70776º	96 ft.	223 ft.	-1.05 ft. above	80.00 ft.	440 U.S.G.P.M.

Table 5 – Pumping test details – South Production Well pumping test – Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Data Analysis

Aquifer Testing Analysis

Through a review of the geological/hydrogeological conditions with the multiple aquifers and interconnection for the Steinbach area, it can easily be surmised that the aquifer analysis will be complex. The Theis (1935) method is the most common approach for analyzing the results from aquifer pumping tests. Critical assumptions integral to the method are detailed as follows:

- Darcy's law is valid
- The aquifer is horizontal and constant thickness
- The aquifer is infinite in areal extent
- The aquifer is bounded by impermeable strata above and below
- Uniform hydraulic conductivity
- Isotropic hydraulic conductivity
- Head always remains above the top of the pumped aquifer
- There are no water level changes that are not due to the pumping.
- Infinitesimal diameter of well
- Fully penetrating the aquifer formation
- Perfectly efficient well
- Single pumping well
- Constant pumping rate
- Constant storage properties through time
- The head is known everywhere prior to pumping.

Through a review of the assumptions, it can be seen that some of the conditions for the analysis of the pumping tests conducted at the on the Park Road well field site are invalid for the Theis (1935) approach. The most significant departure is the notion that the aquifer is bounded by impermeable strata above and below. We know this is not the case. Further, there is significant pumping in the area from both the City of Steinbach and Granny's Poultry which is having a major effect. To complicate matters further, the city wells are drawing from the carbonate aquifer, while the poultry plant is drawing from the sandstone. There is also a high degree of heterogeneity and interconnections between the aquifer systems in the Steinbach area.

The Theis (1935) approach is highly idealized to the assessment of the aquifer, and represents the state of the art for the determination of aquifer parameters. The method has been found to be reasonably workable for aquifer engineering evaluation, all over the world, for nearly 80 years. The conditions for the Steinbach analysis are complex, challenging and are clearly violating some of the conditions of the Theis (1935) approach. In this case, however, the Theis (1935) approach is not being violated severely, and the methodology provides for good comparisons for the other regional work conducted in the area.

The data was entered into Waterloo Hydrogeologic's AquiferTest Professional v4.20, for analysis of aquifer parameters. The data was analyzed using the Cooper-Jacob (1946), and Theis (1935) methods, although the exact same result should be expected, as the Cooper - Jacob (1946) method is simply a straight line approximation of the Theis (1935) method. In order to determine the acceptability of the results, a derivative analysis was used, which is also shown on the attached plot (Bourdet, et. al., 1989). The hydraulic parameters that were determined are shown on the following page as Table 6. The pumping data are attached as Appendix J.

Table 6
Aquifer Parameters – Park Road Well - 60 Hour Pumping Test
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

	South Supply Well	
Drawdown	80.00 ft @ 440 U.S.GPM – 60 hours	
Static Water Level	+ 1.05 ft. from top of casing (above top of casing)	
Available Drawdown	96 ft. (at the time of testing)	
Specific Capacity	5.50 U.S.GPM/ft.	
Method	**Transmissivity**	**Storativity**
Theis Method[1]	12,000 U.S.G./day/ft.	1.00×10^{-5}
Cooper - Jacob Method[2]	12,000 U.S.G./day/ft.	1.00×10^{-5}
Theis Recovery Method[3]	12,000 U.S.G./day/ft.	1.00×10^{-5}

Notes [1] Theis (1935) method using Waterloo Hydrogeologic Limited – Aquifer Test Professional v4.20
[2] Cooper - Jacob (1946) method using Waterloo Hydrogeologic Limited – Aquifer Test Professional v4.20
[3] Theis Recovery (1935) method using Waterloo Hydrogeologic Limited – Aquifer Test Professional v4.20

Table 6 – Aquifer Parameters – South Production Well pumping test – Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Aquifer Testing Analysis (cont'd)

In general, the aquifer was determined to have an approximate transmissivity of about 12,000 U.S.G./ft., based on the results of the 60 hour single pumping well test, and the data from the nearest of the five observation wells, as the response is not detectable in the remaining observation wells due to external pumping influences. The transmissivity is quite low for the carbonate aquifer in this area, which will be discussed in the following sections. The Storage Coefficient was determined to be 1.0 x 10^{-5}, which is very typical for the carbonate aquifer in Manitoba.

The observation well that responded to the pumping were noted to be at distances from the pumping well as follows:

- South Production Well – manual readings ~ 0 ft.(carbonate)
- New Well Field OBS – transducer ~ 230 ft.(carbonate)
- New Well Field OBS – transducer ~ 230 ft.(sandstone)
- North Production Well – manual ~ 575 ft.(carbonate)
- G05OE031 – transducer ~ 1,430 ft.(carbonate)
- Lift Station OBS – manual ~ 1,575 ft.(carbonate)
- Lift Station OBS – manual ~ 1,575 ft.(sandstone)

The response from the pumping wells was extremely interesting and complex. The drawdown versus time for the pumping test is shown below as Figure 27.

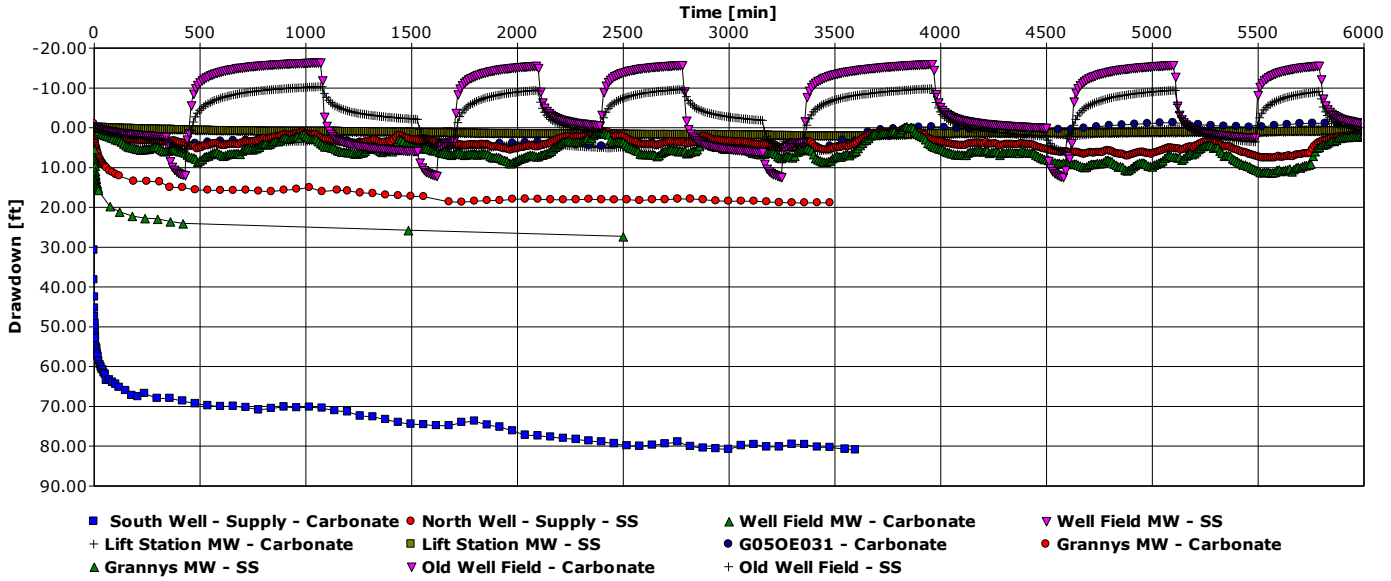


Figure 27 – Drawdown vs. Time for the South Production Well. The constant pumping rate is 440 U.S.G.P.M.

Through a review of Figure 27, the following can be noted:

- The most powerful effects on the water levels in the area are the City of Steinbach existing carbonate production wells, and the Granny's Poultry completed into the Winnipeg Formation sandstone.
- The carbonate aquifer responded in the following four wells:
    - South Production well
    - North Production well
    - Well Field OBS Well
    - G05OE031
    - Lift Station OBS Well
- An interesting aspect is that the sandstone observation also showed a slight response at both observation wells closest to the site. The response was significant, and showed a major contribution to the aquifer during the testing.

Aquifer Testing Analysis (cont'd)

A more detailed view of the responding observation wells in the drawdown versus time is shown below as Figure 28.

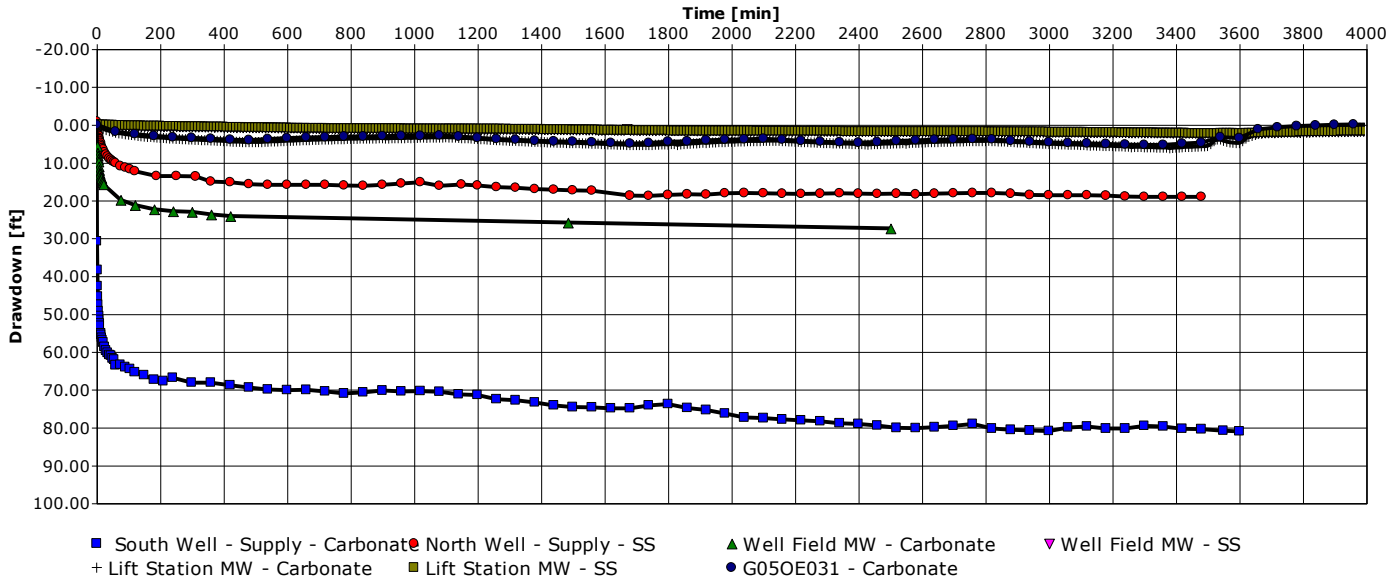


Figure 28 – Drawdown vs. Time for the South Production Well. The constant pumping rate is 440 U.S.G.P.M.

During the analysis, the $t_{critical}$ was assumed to be less than approximately 30 minutes for casing storage; therefore, the data previous to 30 minutes was not used in the analysis. There were also many fluctuations in the water levels that will be explained below.

The Cooper-Jacob (1946) method was used primarily, since emphasis is not placed on early time measurements. The aquifer is considered to be leaky, with significant leakage effects from the sandstone present, along with local pumping of both aquifers ongoing during the testing. It should be noted that the head in the Winnipeg Formation sandstone is higher than the overlying carbonate bedrock. The pumping well configuration was fully penetrating. Based on the test holes drilled in the area and the background data/reports, the aquifer is not isotropic, and displays a strong spatial variability. These conditions indicate a fundamental breech in the conditions of Theis (1935). Following standard practise, the aquifer was assumed to be Theissian. This may or may not be totally correct in this instance; however, as the Theis (1935) assumptions are almost never met in any real aquifer. This methodology is used following the standard practise. It was assumed that skin effects for the supply well would be minimal after the developing and jetting procedures.

The Theis (1935), Cooper – Jacob (1946), and Theis Recovery (1935) methods are shown below and on the following pages as Figure 29, 30 and 31.

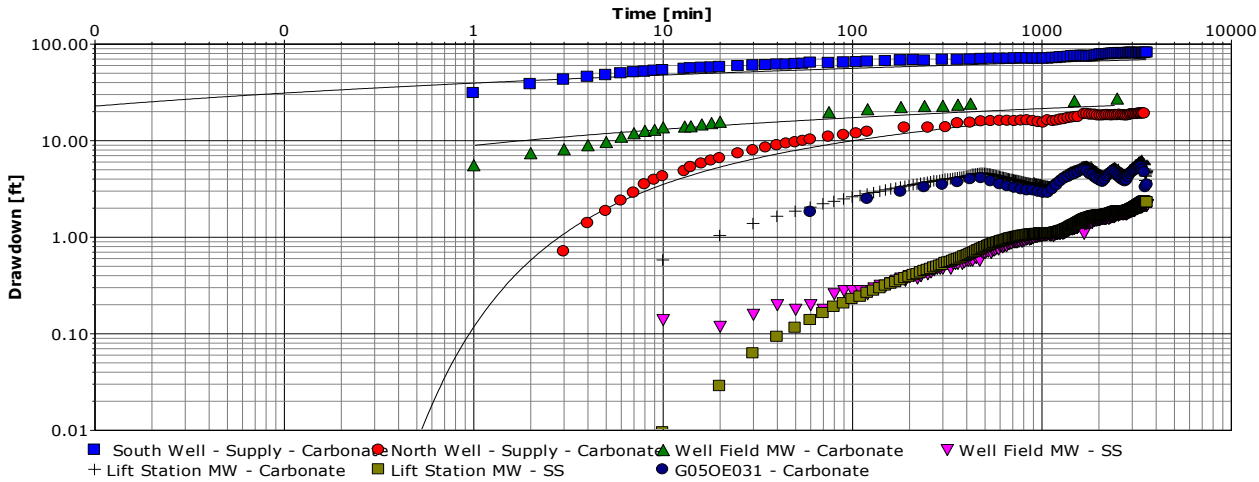


Figure 29 - The Theis (1935) plot for the South Production Well. The constant pumping rate is 440 U.S.G.P.M. It should be noted that the derivative was used in the analysis, although was not plotted for clarity.

Aquifer Testing Analysis (cont'd)

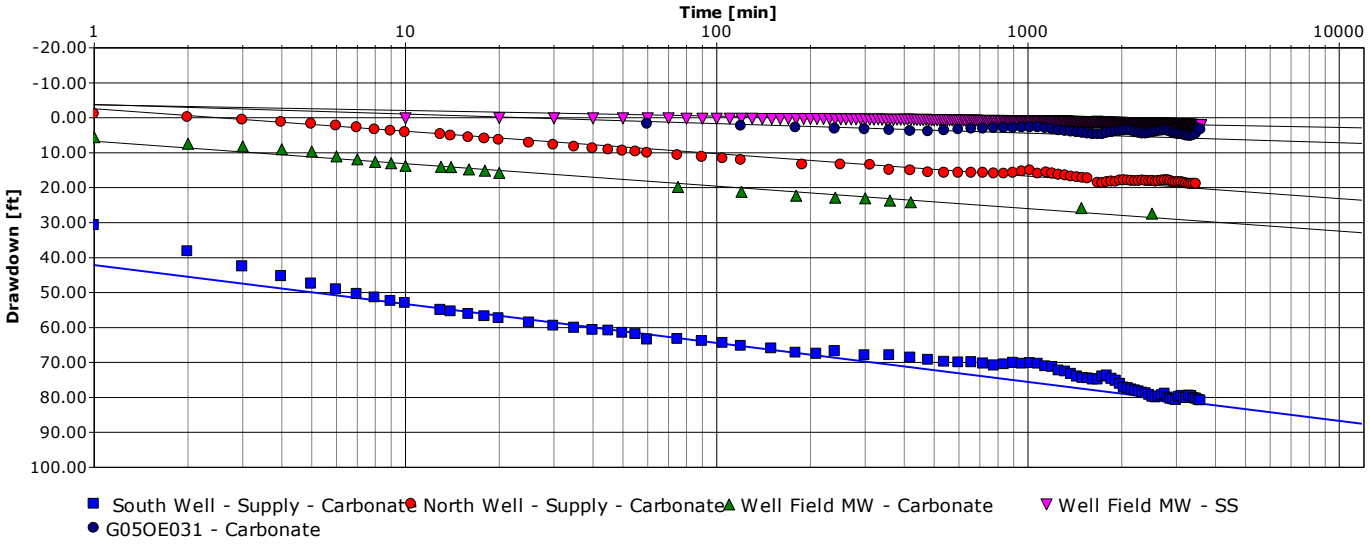


Figure 30 – The Cooper – Jacob (1946) plot for the South Production Well. The constant pumping rate is 440 U.S.G.P.M.

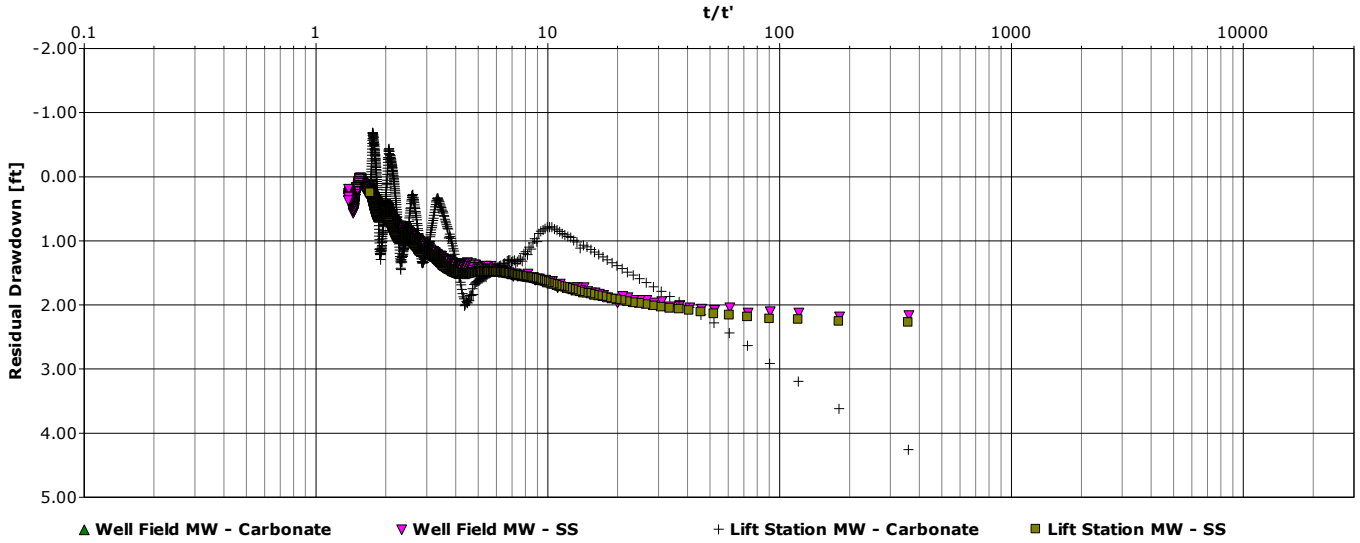


Figure 31 - The Theis Recovery (1935) plot for the South Production Well. Note the slope changes in the recovery with the sandstone versus the carbonate bedrock.

The results from the analysis indicate that there are several positive and negative boundaries in the Cooper-Jacob (1946) analysis, which appear as slope changes. Regionally, the transmissivity of the carbonate aquifer in the Steinbach area was estimated by Bell (2009) to be around 75,000 U.S.G./day/ft. The effect of the existing well field is substantial in the carbonate bedrock. Recently, Granny's Poultry also began developing the Winnipeg Formation sandstone aquifer to obtain all their water supply. The Winnipeg Formation transmissivity was estimated by Bell (2014) to be around 9,000 U.S.G/day/ft. These major transmissive differences and the effects of drawdown at distance, along with changing head conditions made for an extremely interesting analysis.

In order to determine the cause of the slope changes, the slopes were noted to occur at the following time steps:

- Slope #1 – Time 0 to ~ 10 minutes – Casing storage
- Slope #2 – ~ 10 minutes to ~ 700 minutes – Normal Cooper-Jacob (1946) slope
- Slope #3 - ~ 700 minutes to 1,000 minutes – Positive boundary with recovering conditions
- Slope #4 - ~ 1,000 minutes to ~ End of test – Changing slope of positive and negative boundary conditions.

Aquifer Testing Analysis (cont'd)

The distinct slopes are shown below as Figure 32.

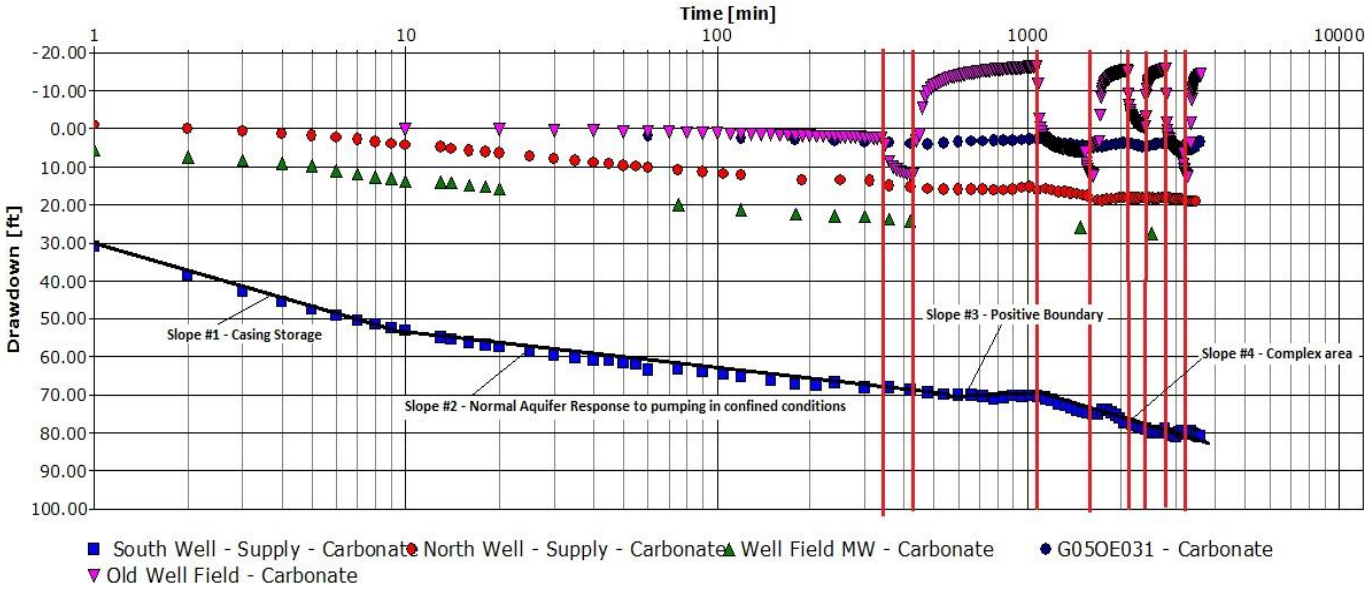


Figure 32 – Distinct Cooper-Jacob (1946) slopes for the City of Steinbach Park Road Site

Typically, slope changes in an aquifer water level drawdown analysis reveal encountering a boundary condition in the aquifer. These usually take effect, and stay in effect for the duration of the testing unless additional boundary conditions are encountered within the aquifer environment. The presence of a positive and negative boundary in an aquifer is common under certain geological conditions (Freeze and Cherry, 1979). For example, if the aquifer transmissivity changes drastically, or a positive recharge boundary occurs such as the presence of a river or lake, the slope of the Cooper-Jacob (1946) analysis will show a rise.

The results from the Steinbach area are extremely interesting. The frequent slope changes in the later part of the test are the result of influence from the existing pumping wells from the City of Steinbach. It is clear that the new well field has a significant effect on the aquifer in the area, as would be expected. The relatively rapid rate of recovery also is evident in the testing. It should also be noted that these pumping effects are a violation of the Theis (1935) analysis for aquifer response. In order to determine the closest aquifer transmissivity, the slope from t_{10} to t_{700} was deemed to be the most representative of the true aquifer parameters in the near area around the Park Road supply wells. Based on this analysis, the transmissivity was noted to be around 12,000 U.S.G.P.D./ft. It should be noted that this expected to include the effects of the sandstone leakage at the site as well, which will likely increase significantly as the drawdown cone develops at the site.

Overall, the drawdown at distance is very not detectable and indicates that the area is very transmissive regionally. The effects of the existing City of Steinbach well field and the Granny's Poultry operation appear to be more prolific in the area.

Geochemical Sampling and Results

During the pumping and recovery test on the Park Road Well Field South Supply Well, a total of five water samples were collected for analytical analysis. The groundwater samples were collected in laboratory supplied sample bottles. Upon collection, the sample was kept cool for delivery to the analytical laboratory. All samples were analyzed by ALS Laboratories in Winnipeg (L1420128). A formal copy of the laboratory analytical results is attached as Appendix K.

The major results are shown on the following page as Table 7. Figure 33, also shown on the following page, depicts the trilinear plot comparing the on-site results with the MCWS observation wells. Figure 34, shown on the subsequent page shows the isotopic results presented against the standard mean oceanic water line for the area (IAEA, 2012).

Geochemical Sampling and Results (cont'd)

Table 7
Groundwater Analytical Results – Park Road Well - 60 Hour Pumping Test
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba

Well Name	Total Dissolved Solids	Chloride	Turbidity	Conductivity	Sodium	Deuterium Dδ (‰ V- SMOW)	Oxygen 18 018δ (‰ V- SMOW)
12 hours	302 mg/L	14.5 mg/L	9.60 N.T.U.	520 umhos/cm	33.7 mg/L	N.A.	N.A.
24 hours	285 mg/L	14.6 mg/L	8.07 N.T.U.	524 umhos/cm	32.7 mg/L	N.A.	N.A.
36 hours	292 mg/L	14.8 mg/L	9.95 N.T.U.	529 umhos/cm	34.4 mg/L	-103.27	-13.82
48 hours	286 mg/L	14.8 mg/L	11.00 N.T.U.	526 umhos/cm	32.5 mg/L	-103.58	-13.83
60 hours	286 mg/L	15.0 mg/L	20.6 N.T.U.	525 umhos/cm	31.8 mg/L	-103.52	-13.69

Table 7 – Groundwater analytical results (source - ALS L1420128)

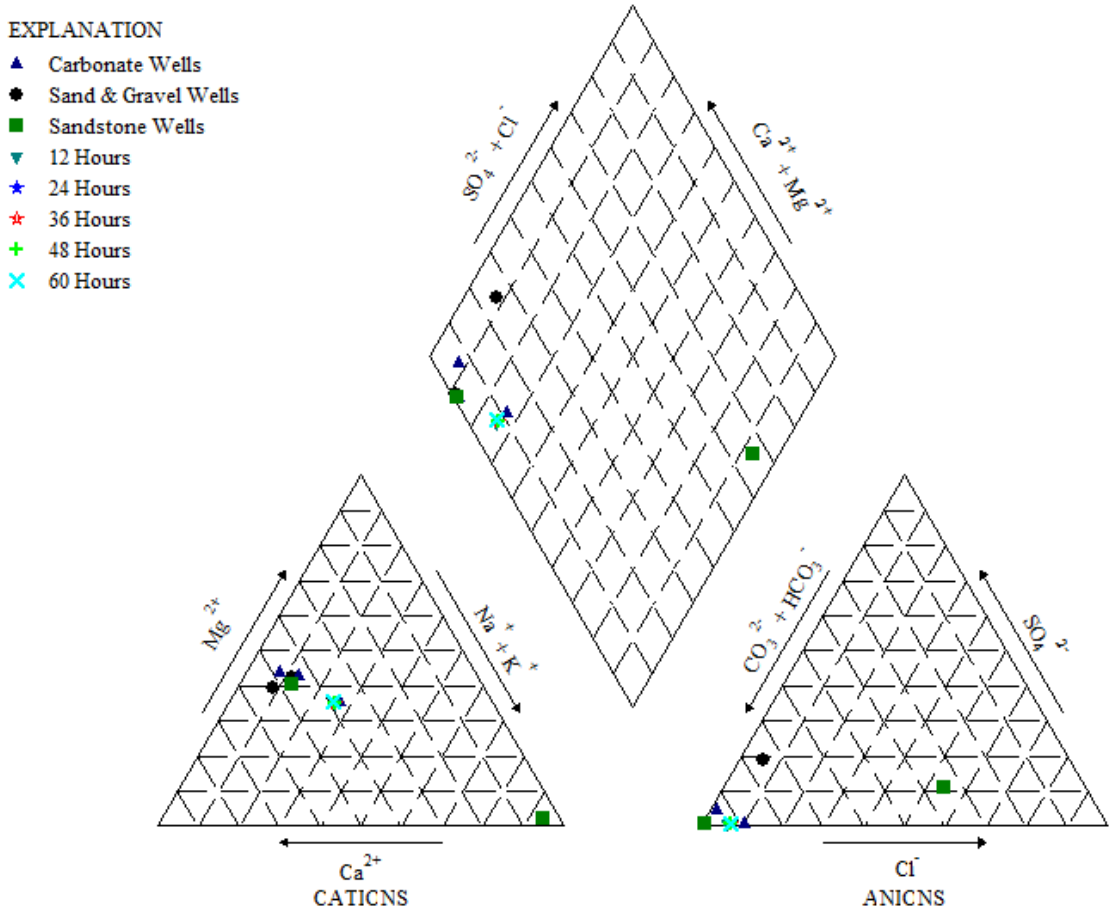


Figure 33 – Trilinear plot comparing MCWS hydrograph stations and the South Well analytical results. (source - ALS L1420128)

Geochemical Sampling and Results (cont'd)

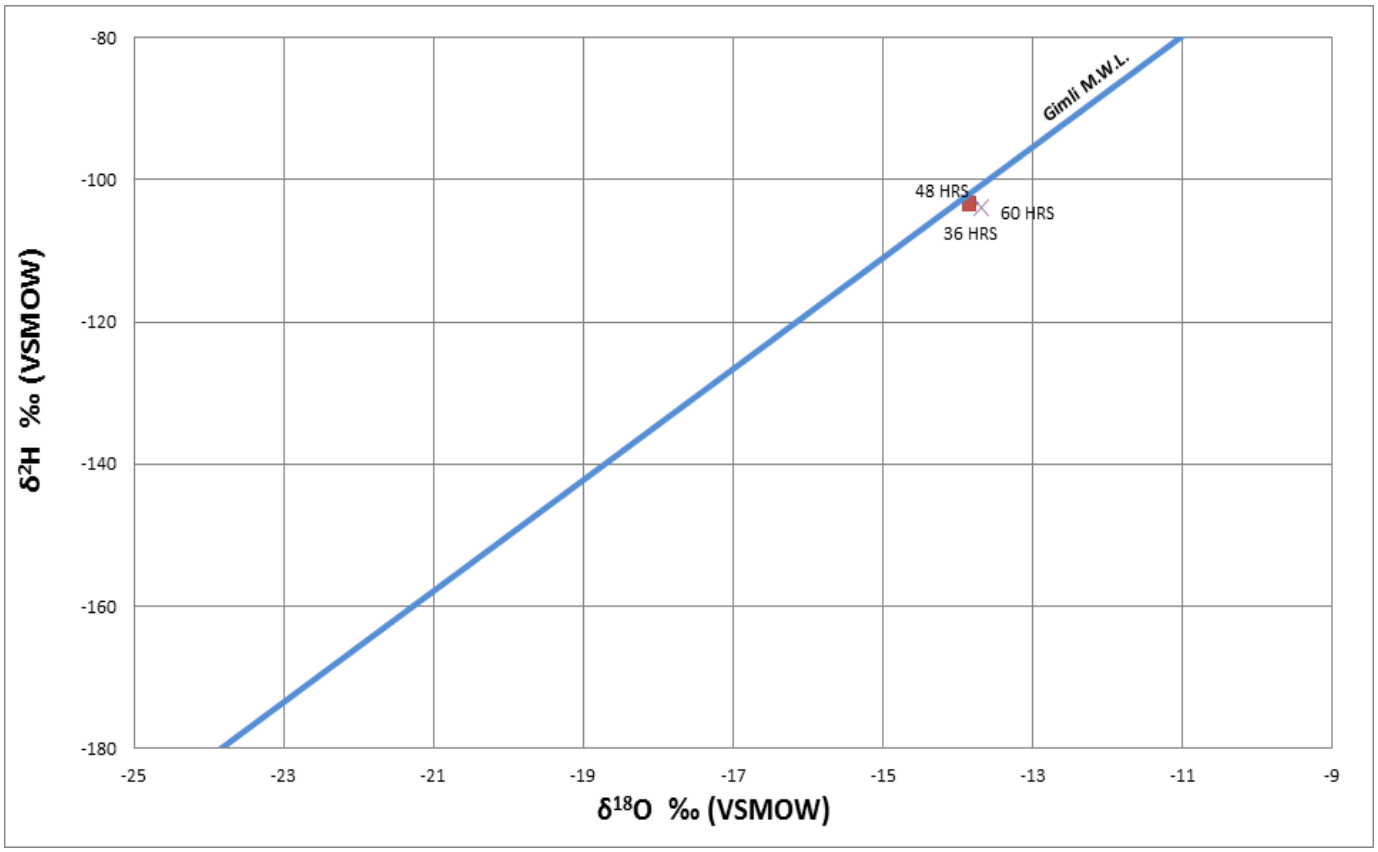


Figure 34 – South well plotted against the local Meteoric Water Line (IAEA, 2012)

The results in general compare very well with the regional water quality in the area. The groundwater is a Calcium/Magnesium/Bicarbonate/Sulphate type, which is expected for the area. The groundwater is very hard, and about 1.2 mg/L dissolved iron. The sampled groundwater is quite typical for the area in terms of the six major ions, and the results were expected.

During the test, the field turbidity remained consistent while the laboratory turbidity showed an increase. A slight amount of shale fragments and sediment was noted in sampling containers during the pumping test. This condition was also noted during the well developing. The sediment was not evident during the test well drilling, and the preliminary pumping tests at lower flow rates (less than 100 U.S.G.P.M.). The sediment was determined through borehole camera inspections to be originating from the main producing fracture in both production wells. Sediment infilling in carbonate bedrock fractures in the Steinbach area is extremely rare, and Friesen Drillers collected samples for analysis.

Due to the rarity of fracture in filling in the Red River Formation, Friesen Drillers submitted the sample to the University of Manitoba Geological Sciences Department for analysis. The results are contained in Appendix L. The results concluded that the origin of the sediment was difficult to determine, although it was able to be shown that the sample originated from the Red River Formation, and was most likely a sediment pool/depositional feature in this particular location.

The City of Steinbach should prepare the treatment system to deal with the sediment detailed in the attached report. It is likely that this problem will diminish through use of the well. The water quality should be closely monitored. The presence of the sediment was determined to be a geological issue, and is not coming from the casing seat or any other location in the well construction.

The water sample collected from the south well matches well with the regional results for the SMOW in the area. The deuterium level is -103.50 ‰, with an ^{18}O level of about -13.75 ‰. This, as expected, indicates recent meteoric groundwater. When these values were plotted in comparison to the Meteoric Water line for Gimli (IAEA, 2012), the results were noted to plot on the meteoric water line (shown above as Figure 34). This suggests that the groundwater has not undergone significant alteration since it fell as precipitation.

Discussions

Long Term Hydrograph Response

The City of Steinbach is located in a highly transmissive area of the carbonate bedrock aquifer. Through reviewing all of the regional hydrograph data, the following comments can be made:

- With two leaky aquifers present under the site, the Steinbach area aquifer hydraulics is complex. Further, the two major existing users (The City of Steinbach and Granny's Poultry in Blumenort) have created a regional drawdown cone around the city. This is shown below as Figure 35.

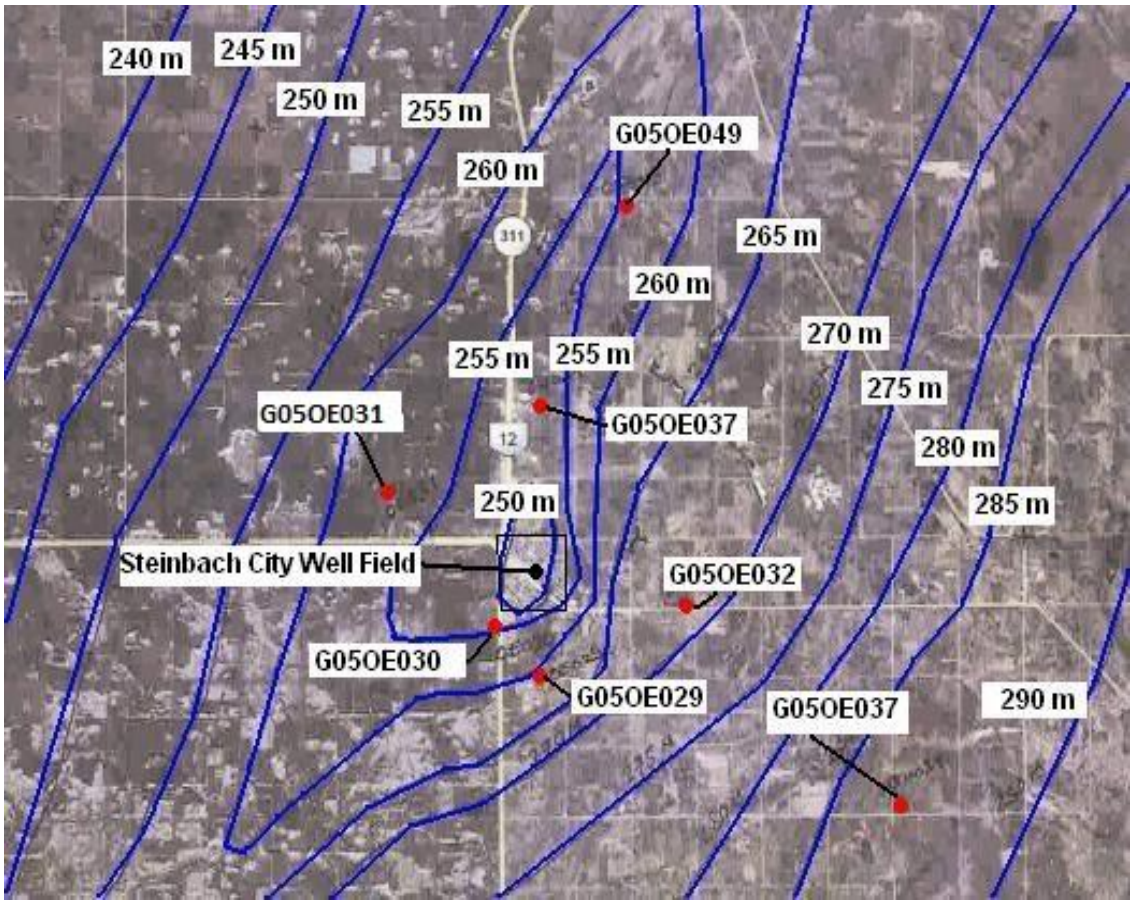


Figure 35 – Potentiometric surface around the City of Steinbach (data source - MCWS, 2014)

- The drawdown cone around the area is widespread, and shows the effects of seasonal and climatic variations. Regionally, over the last 7 years of extensive monitoring, there has not been any long term detectable decline in the static water levels that cannot be explained by seasonal and climatic changes.

- The aquifer is susceptible to seasonal and climatic variations. Water levels in the carbonate aquifer appear to decline very rapidly during prolonged dry periods. The aquifer appears to be very similar to an open reservoir and pipe analogy. When the water level in the reservoir falls, the potential in the pipe declines very rapidly. This means that during prolonged dry periods, static water levels in the area will respond very rapidly, and decline accordingly.

- During periods of recharge, the aquifer also responds very quickly.

- The hydrograph record generally reflects the effects of seasonal and climatic change, with no long term progressive drawdown, that cannot be explained through reviewing the precipitation records for the area. The record is relatively short and additional monitoring in the Steinbach area is needed. The hydrograph of G05OE031 and the total annual precipitation for the period is shown on the following page as Figure 36. A developing drawdown cone is present, although the local hydrograph network indicates that there is no long term progressive drawdown present in the area.

Long Term Hydrograph Response (cont'd)

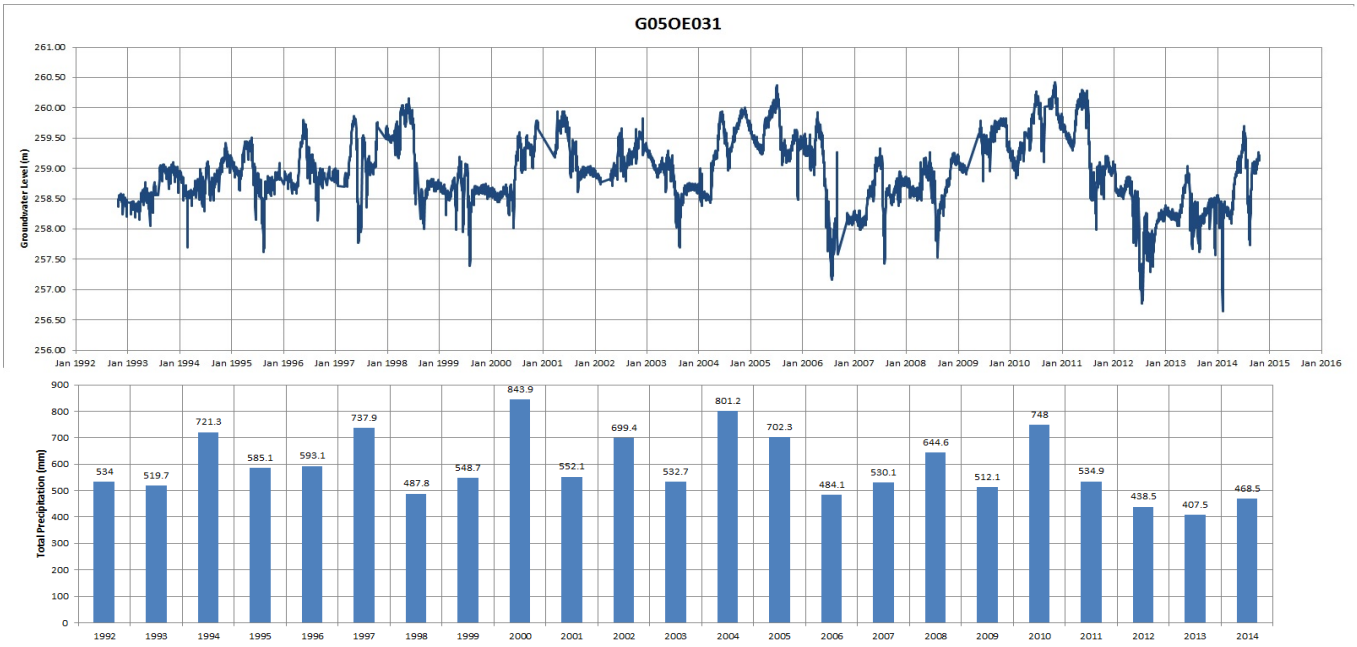


Figure 36 – G05OE031 vs. Total Annual Precipitation (1994 – present) – (source – MCWS, 2014 and Environment Canada, 2015)

Prediction of Long Term Regional Effects

In order to conservatively determine the long term effects of operating the Park Road well field at higher than the proposed pumping rate, the drawdown was calculated at a distance using the Theis equation at an average pumping rate of 500 U.S.G.P.M., after one year of operation for the site. The 500 U.S.G.P.M is greater than the requested allocation of 806.50 acre feet per year (994.81 dam^3/year). This allows for about 720,000 U.S. Gallons per day to be produced from the well field. These drawdowns follow all the assumptions of the Theis method.

For the purposes of the calculations, the following aquifer parameters were assumed:

- Within 2,000 feet radial distance from the production well – Transmissivity ~ 12,000 U.S.G.P.D./ft. with a storage of 1.00×10^{-5}
- Beyond 2,000 feet radial distance from the production well - Transmissivity ~ 75,000 U.S.G.P.D./ft. with a storage of 1.00×10^{-5}

Under a transmissivity of 12,000 U.S.G.P.D./ft drawdown at a radial distance of 2 miles from the production well field was calculated to be approximately 25 feet after pumping one year continuously at a rate of 500 U.S.G.P.M.. However a review of the potentiometric surface of the Carbonate Aquifer does not show any "pinching" together of the contour lines in the vicinity of the new wells. Therefore it is felt that the low transmissivity associated with the new wells is localized. In order to provide a conservative drawdown estimation, the local aquifer transmissivity was assumed to be uniform, outside the immediate vicinity of the new well field, across the regional area at 75,000 U.S.GPD/ft, with an assumed storage coefficient of 1.0×10^{-5}. Due to the aquifer parameters in the area, the drawdown cone development is expected to be complex. With the Park Road well field situated in a lower transmissive area, the actual drawdown cone is expected to be deep, within a 2,000 foot radius of the supply well. Beyond this distance, there are much higher transmissive conditions in the bedrock, with considerable leakage from the sandstone. It is also anticipated that as the Park Road well site develops, the created drawdown cone will cause additional interaction with the underlying sandstone aquifer, with considerable leakage occurring. The results are shown on the following page as Table 8.

The area is well populated, and to a large extent, the aquifer is well utilized by private residences. To the author's knowledge, a sustainable yield for the aquifer in this area has not been determined. In reviewing the local static water levels within a 2,000 foot radius of the well field, it can be assumed that some of the nearest private wells to the well field will not be capable of managing 25 feet or more of drawdown. The City of Steinbach may need to deepen these pump settings at the private residences as the well field comes on line. Long term performance monitoring of the drawdown cone will be critical in the area.

Prediction of Long Term Regional Effects (cont'd)

It should be noted that the estimated drawdown is without taking into account natural gradients and the effects of other unknown pumping wells that may be present.

Table 8
Drawdown Estimation at Distance after One Year of Pumping at 500 U.S.G.P.M.
Municipal Groundwater Well Field Investigation
NW ¼ 3 – 7- 6 EPM
Proposed Park Road Municipal Supply Well Field - City of Steinbach – Manitoba
All calculations following the Theis (1935) equation and assumptions

	Distance						
Well	**150 feet**	**300 feet**	**600 feet**	**900 feet**	**1.0 miles**	**2.0 miles**	**3.0 miles**
91.00 feet	67.00 feet	63.00 feet	60.00 feet	29.18 feet	7.86 feet	6.80 feet	6.18 feet

Table 5 – Expected drawdown resulting from 500 U.S.G.P.M. after one year of operation at the proposed Park Road Well Field site. It should be noted that this assumes both wells operating at 250 U.S.G.P.M.

* Transmissivity at 900 ft. ~ 12,000 U.S.G.P.D./ft.

* Transmissivity at >=1 mile ~ 75,000 U.S.G.P.D./ft.

It is not expected that the community of Mitchell private water wells will experience more than 5 feet of drawdown in this area due to the suspected high transmissive conditions that are present. Additional monitoring in this area is required for the future operation of the Park Road well field.

The area is well populated and to a large extent, the aquifer is well utilized. To the author's knowledge, a detailed sustainable yield for the aquifer in this area in this area has not been determined. However, Bell (2013) on page 23 of the Landmark Report provides the following assessment of the amount of recharge for this area.

"As discussed above the Sandilands area lying up gradient east of the Landmark site is a recharge area for the bedrock aquifer system lying to the west. This recharge area covers approximately 400 square miles. The following is an attempt to determine the long term average groundwater sustainability for this area.

The only area known to the author where the aquifer recharge has been determined in Manitoba is the Upper Pine Creek Basin of the Assiniboine Delta Aquifer (Render, 1986). Render determined that the average precipitation for the area during the time of evaluation was 482.82 mm (17.04 in). Render calculated that the average annual groundwater discharge from the basin over 17 years was 34.29 mm (1.35 in). This value was considered the sustainable yield of the aquifer in that area. Due to the importance of the determination for agricultural activities over the Assiniboine Delta Aquifer this work was reviewed by a committee chaired by R.N. Farvolden from the University of Waterloo.

While the Sandilands area is not a perfect replica of the Upper Pine Creek Basin, there are quite a few similarities. The author considered that if the Upper Pine Creek recharge value was adjusted for the current climatic precipitation average in the Sandilands area it would produce a reasonable estimate of the Sandilands sustainability. The current climatic average for precipitation provided by Environment Canada (2012) from 1981 to 2010 shows an average annual value of precipitation of 575 mm (22.64 in) for the Sandilands area. This value was used to adjust the Upper Pine Creek recharge rate to an approximate rate for the Sandilands area.

If this value is used for the long term average annual recharge, then the 400 square miles of the Sandilands would produce 1,666,814,197 cubic feet (47,198,921 cubic meters) of water per annum. This amount of water is considerably above the amount of water flowing westward through the carbonate and Winnipeg Sandstone aquifers. Which, from the view point of those aquifers, means that if there is a decline in water level in the carbonate aquifer due to an addition in withdrawals, the recharge area can likely supply the requested allocation."

The area is well populated, and to a large extent, the aquifers in the area are well utilized by agriculture, industry and private residences. The approximate sustainable yield for the recharge area up stream of the Blumenort – Steinbach area is in the order of 47,200,000 cubic meters per annum in a long term average basis; see above. The same document includes an estimate groundwater usage of 12,000,000 cubic meters per annum. There is estimated to be a flow of some 20 million cubic meters moving westerly through the bedrock aquifers. While there numbers by the nature of their derivation have to be approximations; they do indicate that there is substantially more groundwater in the system on an annual basis than is being used. A further indication of the fact that recharge exceeds usage is the continuance of many flowing wells in the area; some of which still exist in areas of considerable development. From this analysis, it is not possible to determine if the extensive, but shallow, drawdown cone that has developed around the Steinbach-Blumenort area has

Prediction of Long Term Regional Effects (cont'd)

reached a stage of equilibrium. Johnston and Charron have both assessed the area as being under artesian conditions (Johnston, 1934 and Charron, 1969). Due to the fact that flowing wells continue to exist suggests the system is at or close to equilibrium. In reviewing the local static water levels, it can be assumed that most private well systems in the area have taken current conditions as static for the area.

Well Field Development Plan

Due to the changing transmissive conditions in the carbonate bedrock aquifer and the leaky conditions with the Winnipeg Formation sandstone aquifer, water supply development will be extremely interesting. The vastly different transmissive conditions will likely result in a very narrow drawdown cone that will intersect with the regional drawdown cone. In addition, the sandstone aquifer is also likely expected to start leaking further into the carbonate aquifer, reducing the extent of drawdown in the carbonate aquifer.

As a result of the challenging conditions in the aquifers underlying the site, the following development plan is suggested for the proposed Park Road municipal well field:

- First five years of development – Well field limited to 403.25 acre feet/year (497.4 dam^3/year) – With annual reporting and monitoring, along with the completion of a numerical groundwater model within three years.

- Five to ten years of development – Well field limited to 604.88 acre feet/year (746.1 dam^3/year) – Assuming monitoring is showing acceptable drawdown cone development conditions with annual reporting.

- Ten years and beyond – Well field limited to of 806.50 acre feet per year (994.81 dam^3/year), with annual monitoring.

Additional monitoring is needed to the west near the community of Mitchell to monitor how the drawdown cone develops in this area. The existing monitoring wells installed during this investigation should be maintained for long term monitoring purposes in these areas. There is a lack of MCWS wells in the area to accurately map the drawdown cone around the City of Steinbach.

Integrated Water Supply and Watershed Planning Study

A water supply investigation and development of this size requires careful planning and assessment. Although it is assumed that groundwater supplies are the best option, an integrated water supply and watershed planning study is an important tool in the evaluation process.

An integrated planning study for water supply would identify future and prospective water supply sources, and the relative availability. This would document and address items such as river supplies, allocations, and other water supply alternatives. This is important for future water supply licensing and environment act licensing.

An integrated water supply and watershed planning study is recommended for the area.

Numerical Groundwater Model

During this investigation, attempts were made at the construction of a simple numerical groundwater model. The modelling effort was found to be extremely challenging due to the leakage effects from the sandstone aquifer, and the calibration became extremely challenging and not overly successful. It is suggested that with development of this well field, additional operational data can be collected to allow for the modeling effort to proceed.

Conclusions and Recommendations

Based on our study of the proposed Park Road municipal water supply, we offer the following conclusions and recommendations:

- The hydraulic conditions on the site are challenging, with vastly different transmissive conditions present. The Winnipeg Formation sandstone aquifer is also leaky into the overlying carbonate aquifer. The groundwater quality appears to be changing as a result of the interconnections in the two aquifers.

- Overall, the Park Road well field is located in an area that is generally less transmissive than regional conditions. The pumping test resulted in 80 feet of drawdown at the well after 60 hours, pumping 440 U.S.G.P.M. These results were highly affected by the pumping of the existing City wells along with Granny's Poultry. The drawdown cone around the site was noted to be very deep and did not extend very far out radially from the supply well. Few of the wells responded to the pumping, as the responses were masked by the existing pumping conditions.

- The monitoring wells completed in this study should be maintained, along with the installation of a further well closer to Mitchell. Multi-level wells should be used during the monitoring of the aquifer in this area.

- The city should develop an aquifer/well head protection program for all the municipal wells, and develop a contingency plan should the aquifer become impacted in some manner.

- According to our data collection and analysis, Park Road municipal well field is capable of providing the requested additional allocation of 806.50 acre feet per year (994.81 dam^3/year dam per annum, under normal seasonal and climatic conditions, with an annual monitoring program. Due to the complexity of the aquifers in the area, we recommend a staged development approach. Some of the private wells within 2,000 feet of the well field may require the pumps to be re-set deeper. The analysis indicates that the requested allocation will not result in a significant amount of additional drawdown one mile from the pumping wells.

- The groundwater quality in the well should be closely monitored. This should be done weekly during the operation of the floodway, and 4 times annually during the first few years of operation. This work should be conducted by a hydrogeologist/hydrogeological engineer.

- In the event of lower static water levels in the carbonate aquifer, water levels in the pumping wells should be closely monitored.

- Each well should be closely monitored for well performance. The city should continue performing a regular servicing/maintenance program for each well.

- A numerical groundwater model should be developed within three years.

- The city should undertake an annual review of the carbonate aquifer in the area. This work should be conducted by a hydrogeological engineer/hydrogeologist. The monitoring network should be reviewed, along with the water quality sampling program and municipal pumping records.

- The city should have a groundwater interference program designed by a hydrogeological engineer/hydrogeologist. The program would include the assessment of private water wells in the area that are most likely to be affected by the new well field. Within a specific radius from the proposed well field, if a private water wells develop issues during the development and operations of the new well field, immediate short term water supply will be provided. A third party contractor will then conduct an investigation and if the issues were proven to be caused by the proposed well field, it would be suggested that the city undertake any repairs or modifications in the well at their own cost.

References

Alberta Geological Survey, 2009. *Western Canadian Sedimentary Basin mapping.*

Bell, J.J., 2009. Environment Act Proposal, Proposed Increase in Municipal Water Usage, The City of Steinbach Municipal Well Field. – unpublished.

Bell, J.J., 2013. Municipal Groundwater Supply Investigation, Rural Municipality of Tache, Local Urban District of Landmark, Manitoba – unpublished.

Bell, J.J., 2014. Granny's Poultry Co-operative (Manitoba) Limited Groundwater Investigation for Industrial/Fire Protection Water Supply. - unpublished.

Betcher, R.N., 1986. *Groundwater Availability Series* – Manitoba Water Resources Branch

Betcher, R.N., and Fergusson, G.A. 2003. *Impacts from Boreholes Interconnecting Multiple Aquifers - A Case Study of Paleozoic Aquifers in Southeastern Manitoba.* 4th Annual Joint CGS-IAH Conference, Winnipeg, Manitoba, Sept. 29-Oct. 1, 2003.

Betcher, R.N., Grove, G. and Pupp, C., 1995. *Groundwater in Manitoba Hydrogeology, Quality Concerns, Management*. National Hydrology Research Institute Contribution No. CS-93017.

Bourdet, D. Ayoub, J., and Pirard, Y. 1989, *Use of Pressure Derivative in well test interpretation.* SPE Formation Evaluation, pp 293-302.

Clark, I.D. 2014. Groundwater Geochemistry and Isotopes. CRC Press. USA.

Charron, J.E. 1969. *Hydrogeochemical Interpretation of Groundwater Movement in the Red River Valley, Manitoba*. Department of Energy, Mines, and Resources, Water Resources Branch, Scientific series No.2.

City of Steinbach – Design Memo, 2014. – unpublished.

City of Steinbach, 2015. Chemistry Data.

City of Steinbach, 2015. Property Boundaries.

Cooper H.H., Jr. and Jacob, C.E. 1946, *A generalized graphical method for evaluating formation constants and summarizing well field history*. Transactions, American Geophysical Union, Vol. 27., No. 4.

Environment Canada, 1982. *Canadian Climatic Normals, Volume 3 : Precipitation, 1951-1980*. Canadian Climate Program, Atmospheric Environment Service.

Environment Canada. 2005. *Annual Precipitation: Steinbach*. http://www.climate.weatheroffice.ec.gc.ca

Environment Canada. 2012. *Climate Data Online*. http://www.climate.weatheroffice.ec.gc.ca

Freeze, R.A. and Cherry, J.A. (1979). *Groundwater.* Prentice Hall, Englewood Cliffs, New Jersey, U.S.A.

Friesen, J. 2007. Personal Communication.

Fritz, P.R. and Clark, I.D. 1997, *Environmental Isotopes in Hydrogeology.* CRC Press.

www.googleearth.com, 2015

Guidelines for Canadian Drinking Water Quality, 2008.

Hantush, M.S., and Jacob, C.E. 1955. *Nonsteady Radial Flow in an indefinite leaky aquifer.* Trans. American Geophysical Union 36. Pp.95-100.

References (cont'd)

International Atomic Energy Association. 2012. *Meteoric Water Line – Gimli Manitoba.*

Johnston, W.A. 1934, *Surface Deposits and Groundwater Supply of the Winnipeg Map Area – Memoir 174*, Canada Department of Mines – Geological Survey.

Kalyta, P. 2014. Personal Communication.

Kalyta, P. 2015. Personal Communication.

Manitoba Water Stewardship, 2014. GWDRILL Database.

Manitoba Water Stewardship, 2012/2013. Hydrograph Charts and Hydata Chemistry Database.

Manitoba Water Stewardship, 2012. *Map of Southeast Manitoba.*

Matile, G.L.D and G.R. Keller. 2007. *Surficial Geology of Manitoba*. Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series, SG-MB, scale 1:1,000,000.

Phipps, G., R.N. Betcher and J. Wang. 2008. *Geochemical and Isotopic Characterization of a Regional Bedrock/Surficial Aquifer System, Southeastern Manitoba*. Conference proceedings of GeoEdmonton'08: 61st Canadian Geotechnical Conference and 9th Joint CGS/IAH-CNC Groundwater Conference, September 21-24, 2008, Edmonton, Canada.

Render, F. W. 1970. *Geohydrology of the Metropolitan Winnipeg Area as Related to Groundwater Supply and Construction.* Canadian Geotechnical Journal, Vol. 7 No. 3, pp 243-374.

Statistics Canada, 2014.

Theis, C.V., 1935. The *Lowering of the Piezometer Surface and the rate and discharge of a well using ground-water storage*. Transactions, American Geophysical Union 16:519-24.

Vanjecek, A. 2014. *Analysis of sediment sludge from the Red River Formation at Steinbach,* Manitoba (NTS 62H). – unpublished.

Walton, W.C., 1979. *Progress in analytical groundwater modelling*. J Hydro 43:149-159.

Walton, W.C., 1983. *35 Basic Groundwater Model Programs for Desktop Microcomputers.* International Groundwater Modelling Center – Butler University, Indianapolis, Ind. USA.

Wang, J. 2014. Personal Communication.

Wang, J., R.N. Betcher and G.C. Phipps. 2008. *Groundwater Resource Evaluation in Southeastern Manitoba*. Conference proceedings of GeoEdmonton'08: 61st Canadian Geotechnical Conference and 9th Joint CGS/IAH-CNC Groundwater Conference, September 21-24, 2008, Edmonton, Canada.

Limitations

The scope of this report is limited to the matters expressly covered and is intended solely for the client to whom it is addressed. Friesen Drillers Limited makes no warranties, expressed or implied, including without limitation, as to the marketability of the site, or fitness to a particular use. The assessment was conducted using standard engineering and scientific judgment, principles, and practices, within a practical scope and budget. It is based partially on the observations of the assessor during the site visit in conjunction with archival information obtained from a number of sources, which is assumed to be correct. Except as provided, Friesen Drillers Limited has made no independent investigations to verify the accuracy or completeness of the information obtained from secondary sources or personal interviews. Generally, the findings, conclusions, and recommendations are based on a limited amount of data (e.g. number of boreholes drilled or water quality samples submitted for laboratory analysis) interpolated between sampling points and the actual conditions on the site may vary from that described above. Any findings regarding the site conditions different from those described above upon which this report was based will consequently change Friesen Drillers Limited's conclusions and recommendations.

Disclaimer

This Friesen Drillers Limited report has been prepared in response to the specific requests for services from the client to whom it is addressed. The content of this document is not intended to be relied upon by any person, firm, or corporation, other than the client of Friesen Drillers Limited, to who it is addressed. Friesen Drillers Limited denies any liability whatsoever to other parties who may obtain access to this document by them, without express prior written authority of Friesen Drillers Limited and the client who has commissioned this document.

Appendix A

Existing Water Rights Licenses

Licence to Use Water for Municipal Purposes

Manitoba

Manitoba Water Stewardship
Regulatory and Operational Services Division
200 Saulteaux Cresc.
Winnipeg, Manitoba
R3J 3W3

Issued in accordance with the provisions of
The Water Rights Act and regulations made thereunder.

Licence No.: 2009-073
(Original Lic. No.: 86-39)
U.T.M.: Zone 14 667609 E
5488491 N

Know all men by these presents that in consideration of and subject to the provisos, conditions and restrictions hereinafter contained, the Minister of Water Stewardship for the Province of Manitoba does by these presents give full right and liberty, leave and licence to **The City of Steinbach** in the Province of Manitoba (hereinafter called "the LICENSEE") to divert water from a **fractured limestone** aquifer by means of 3 water wells, pumps, pipeline(s) and other appurtenances (hereinafter called "the WORKS"), located on the following described lands: #316 Park Rd W

now Section 3-7-6E **the Southeast Quarter of Section 35, in Township 6 and Range 6, East of the Principal Meridian in Manitoba, more particularly described on Certificate of Title Nos. 886688, 886689 and 889616 WLTO,**

and more particularly shown on a plan filed in the office of the Executive Director, Regulatory and Operational Services Division, a copy of which plan is hereto attached and marked Exhibit "A" for **municipal** purposes on the following described lands:

Sections 26, 27, 34 and 35 in Township 6 and Sections 2 and 3 in Township 7, all in Range 6, East of the Principal Meridian in Manitoba.

Section 2, 3, 11, 10, 14 & 15 of 7-6E

This licence is issued upon the express condition that it shall be subject to the provisions of The Water Rights Act and Regulations and all amendments thereto and, without limiting the generality of the aforesaid, to the following terms and conditions, namely:

1. The water shall be used solely for **municipal** purposes.

2. The WORKS shall be operated in accordance with the terms herein contained.

3. a) The maximum rate at which water may be diverted pursuant hereto shall not exceed **0.105 cubic metres per second (3.7 cubic feet per second)** → 1660 GPM = 2.39 MGPD → 2.0 MIGPD → 9072 m³/day

   b) The total quantity of water diverted in any one year shall not exceed **2000 cubic decametres (1621.42 acre feet)**

4. Water shall not be diverted during any period when the water level in the aquifer as measured at:

   a) Well No. 1 is more than 35.17 metres (115.4 feet) beneath the surface of the ground.
   b) Well No. 2 is more than 37.80 metres (124.0 feet) beneath the surface of the ground.
   c) Well No. 3 is more than 35.97 metres (118.0 feet) beneath the surface of the ground.

5. The LICENSEE does hereby remise, release and forever discharge Her Majesty the Queen in Right of the Province of Manitoba, of and from all manner of action, causes of action, claims and demands whatsoever which against Her Majesty the LICENSEE ever had, now has or may hereafter have, resulting from the use of water for **municipal** purposes.

6. In the event that the rights of others are infringed upon and/or damage to the property of others is sustained as a result of the operation or maintenance of the WORKS and the rights herein granted, the LICENSEE shall be solely responsible and shall save harmless and fully indemnify Her Majesty the Queen in Right of the Province of Manitoba, from and against any liability to which Her Majesty may become liable by virtue of the issue of this Licence and anything done pursuant hereto.

7. This Licence is not assignable or transferable by the LICENSEE and when no longer required by the LICENSEE this Licence shall be returned to the Executive Director, Regulatory and Operational Services Division, for cancellation on behalf of the Minister.

8. Upon the execution of this Licence the LICENSEE hereby grants the Minister or the Minister's agents the right of ingress and egress to and from the lands on which the WORKS are located for the purpose of inspection of the WORKS and the LICENSEE shall at all times comply with such directions and/or orders that may be given by the Minister or the Minister's agents in writing from time to time with regard to the operation and maintenance of the WORKS.

9. This Licence may be amended, suspended or cancelled by the Minister in accordance with The Water Rights Act by letter addressed to the LICENSEE at **225 Reimer Avenue, Steinbach, MB, Canada, R5G 2J1** and thereafter this Licence shall be determined to be at an end.

10. Notwithstanding anything preceding in this Licence, the LICENSEE must have legal control, by ownership or by rental, lease, or other agreement, of the lands on which the WORKS shall be placed and the water shall be used.

11. The term of this Licence shall be **twenty (20) years** and this Licence shall become effective only on the date of execution hereof by a person so authorized in the Department of Water Stewardship. The LICENSEE may apply for renewal of this Licence not more than 365 days and not less than 90 days prior to the expiry date.

Manitoba

Conservation
Environmental Stewardship Division
Environmental Assessment and Licensing Branch
123 Main Street, Suite 160, Winnipeg, Manitoba R3C 1A5
T 204 945-7100 F 204 945-5229
www.gov.mb.ca/conservation/eal

FAXED
CLIENT FILE NO.: 5403.00

June 19, 2009

Jack Kehler, C.A.O.
City of Steinbach
225 Reimer Avenue
Steinbach, MB R5G 2J1

Dear Mr. Kehler,

Enclosed is **Environment Act Licence No. 2885** dated June 18, 2009 issued in accordance with he Environment Act to the **City of Steinbach** for the operation of the Development being a groundwater supply system for municipal purposes for the City of Steinbach, using two existing wells and a replaced third existing well in the municipal well field within K.R. Barkman Park at 515 Main Street in Steinbach, in accordance with The Environment Act Proposal dated March 30, 2009.

In addition to the enclosed Licence requirements, please be informed that all other applicable federal, provincial and municipal regulations and by-laws must be complied with.

For further information on the administration and application of the Licence, please feel free to contact Jason Lasiuk, Environment Officer at (204) 346-6359.

Pursuant to Section 27 of The Environment Act, this licensing decision may be appealed by any person who is affected by the issuance of this Licence to the Minister of Conservation within 30 days of the date of the Licence.

Yours truly,

Tracey Braun

Tracey Braun, M. Sc.
Director
Environment Act

Enc.
c: Don Labossiere, Director, Environmental Operations
Jason Lasuik, Environment Officer, Eastern Region
Jeffrey J. Bell, P.Eng., Friesen Drillers Ltd.
Frank Render
Public Registries

NOTE: **Confirmation of Receipt of this Licence No. 2885 *(by the Licencee only)* is required by the Director of Environmental Assessment and Licensing. Please acknowledge receipt by signing in the space provided below and faxing a copy (letter only) to the Department by July 6, 2009.**

_____ _____
On behalf of the City of Steinbach **Date**

****A COPY OF THE LICENCE MUST BE KEPT ON SITE AT THE DEVELOPMENT AT ALL TIMES****

THE ENVIRONMENT ACT
LOI SUR L'ENVIRONNEMENT

LICENCE

Manitoba

Licence No. / Licence n° 2885

Issue Date / Date de délivrance June 18, 2009

In accordance with The Environment Act (C.C.S.M. c. E125) /
Conformément à la Loi sur l'environnement (C.P.L.M. c. E125)

Pursuant to Section 11(1) / Conformément au Paragraphe 11(1)

THIS LICENCE IS ISSUED TO: / CETTE LICENCE EST DONNÉE À:

The City of Steinbach: "the Licencee"

for the operation of the Development being a groundwater supply system for municipal purposes for the City of Steinbach, using two existing wells and a replaced third existing well in the municipal well field within K.R. Barkman Park at 515 Main Street in Steinbach, in accordance with The Environment Act Proposal dated March 30, 2009, and subject to the following specifications, limits, terms and conditions:

DEFINITIONS

In this Licence,

"as constructed drawings" means engineering drawings complete with all dimensions which indicate all features of the Development as it has actually been built.

GENERAL TERMS AND CONDITIONS

This Section of the Licence contains requirements intended to provide guidance to the Licencee in implementing practices to ensure that the environment is maintained in such a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for present and future Manitobans.

1. The Licencee shall, in addition to any of the following specifications, limits, terms and conditions specified in this Licence, upon the request of the Director:
   (a) sample, monitor, analyze or investigate specific areas of concern regarding any segment, component or aspect of pollutant storage, containment, treatment, handling, disposal or emission systems, for such duration and at such frequencies as may be specified;
   (b) determine the environmental impact associated with the release of any pollutants from the Development;

(c) conduct specific investigations in response to the data gathered during environmental monitoring programs; or
(d) provide the Director, within such time as may be specified, with such reports, drawings, specifications, analytical data, flow rate measurements and such other information as may from time to time be requested.

2. The Licencee shall operate the water supply system in accordance with Manitoba Regulations under The Public Health Act, The Drinking Water Safety Act, and all operating requirements as recommended by Manitoba Conservation and Manitoba Water Stewardship.

3. The Licencee shall collect and dispose of all used oil products and other regulated hazardous wastes generated by the machinery used in the operation of the Development in accordance with applicable Manitoba Conservation and legislation requirements.

4. The Licencee shall maintain the water supply wells associated with the Development to prevent the contamination of groundwater by surface water:
(a) entering the well casings through the top of the casings; and
(b) entering the well casings through the sides of the casings.

5. The Licencee shall:
a) prepare "As Constructed" drawings for the Development and shall label the drawings "As Constructed"; and
b) provide to the Director, within one year of the completion of construction of the Development, two sets of "As Constructed" drawings.

SPECIFICATIONS, LIMITS, TERMS AND CONDITIONS

Respecting Operation:

6. The Licencee shall properly train or qualify individuals to carry out the operation of the Development pursuant to the requirements of ***Manitoba Regulation 77/2003*** respecting ***Water and Wastewater Facility Operators,*** or any future amendment thereof.

7. The Licencee shall not release chlorinated water from pipeline testing and startup activities associated with the Development to a surface water body until chlorine level concentrations are equal to or less than 0.1 milligrams per litre. Releases of chlorinated water at higher concentrations may be made to vegetated land or dry waterways, provided that chlorine level concentrations have decayed to 0.1

milligrams per litre or less before the released water reaches any body of surface water.

8. The Licencee shall not permit the interconnection of a private water supply system with the Development.

9. The Licencee shall operate the Development with respect to the volume and rate of water diverted in accordance with a Water Rights Licence issued pursuant to The Water Rights Act.

10. The Licencee shall decommission and seal private wells made redundant by the Development in accordance with Manitoba water well industry standards.

11. The Licencee shall actively participate in any watershed and/or aquifer based management study being undertaken by Manitoba Water Stewardship or any watershed planning authority.

Respecting Monitoring and Reporting:

12. The Licencee shall submit within ninety (90) days of the date of this Licence, for the approval of the Director, a detailed groundwater monitoring plan.

13. The Licencee shall implement and follow the groundwater monitoring plan as approved by the Director.

14. The Licencee shall, within five years of the date of this Licence, submit a comprehensive water conservation plan and implementation strategy for the approval of the Director, as proposed in the Environment Act Proposal, prepared by Friesen Drillers Ltd., March, 2009. The plan will include written agreements with the Licencee's customers respecting the implementation of water conservation measures.

15. The Licencee shall implement and follow the water conservation plan as approved by the Director.

REVIEW AND REVOCATION

A. If, in the opinion of the Director, the Licencee has exceeded or is exceeding or has or is failing to meet the specifications, limits, terms, or conditions set out in this Licence, the Director may, temporarily or permanently, revoke this Licence.

B. If, in the opinion of the Director, new evidence warrants a change in the specifications, limits, terms or conditions of this Licence, the Director may require the filing of a new proposal pursuant to Section 11 of The Environment Act.

Tracey Braun

Tracey Braun, M.Sc.
Director
Environment Act

FILE: 5403.00

Appendix B

Land Title Certificate for Park Road Site

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSTS (3 OF 9) TITLE DISPLAY - WINNIPEG

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

SUMMARY OF TITLE DATA

SELECT ONE OF THE FOLLOWING:

TITLE NOTES..... MORE? NO .... _

ORIGINATING REG. NUMBER.. 4055293/1 ..... MORE? NO .... _

FROM TITLE NUMBER..... 1762558/1 TYPE.... ALL MORE? NO .... _

RPA/CROWN GRANT NUMBER... ..... MORE? NO .... _

NAME FOR SERVICE..... TWO KNEW PROPERTIES LTD MORE? NO .... _

ADDRESS..... 85 PTH 12 N

STEINBACH MB

POSTAL CODE..... R5G1A7 EFFECT... ACTIVE

DUPLICATE PRODUCED ? .... MORE? NO .... _

ISSUED DATE.....

TX: ____ NEXT TITLE NUMBER... _____

DA: _____

NO MORE INFORMATION EXISTS REGARDING THIS SCREEN

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSEC (2 OF 9) TITLE DISPLAY - WINNIPEG PAGE: 01

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

ACTIVE CHARGE LIST: BEGINNING

235647/1 ACCEPTED CAVEAT REG'D: 1975/07/28

FROM/BY: MANITOBA TELEPHONE SYSTEM

TO:

CONSIDERATION: NOTES:

TX: ____ _____ REGISTRATION TO DISPLAY

DA: _____ F6-TSTC

*** NO MORE ACTIVE CHARGES FOUND FOR THIS TITLE ***

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSTL (1 OF 9) TITLE DISPLAY - WINNIPEG PAGE: 01

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

LEGAL DESCRIPTION:

TWO KNEW PROPERTIES LTD.

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON
IN THE FOLLOWING DESCRIBED LAND:

LOT 1 BLOCK 1 PLAN 17856 WLTO
IN NW 1/4 3-7-6 EPM

TX: ____

DA: _____

SCDC Minutes

Minutes of the meeting of the Board of Directors of the Steinbach Community Development Corporation held at City Hall on Tuesday, April 17, 2012.

The meeting started at 6:30 p.m. Present at the meeting were Chris Goertzen, Michael Zwaagstra, Susan Penner, Troy Warkentin and Jack Kehler.

No changes to directors – Chris Goertzen, Michael Zwaagstra, Susan Penner, Jack Kehler, and Troy Warkentin.

No change to auditor of the Corporation – Chambers, Fraser & Co.

No changes to the officers of the Corporation
Chris Goertzen – President
Jack Kehler – Secretary
Troy Warkentin - Treasurer

Susan Penner/Michael Zwaagstra resolved that the audited financial statements of the Corporation for the fiscal year ended December 31, 2011 as prepared by Chambers, Fraser and Co. be hereby approved,
And that this resolution may be assigned in counterparts, including by way of electronic or facsimile transmission, all of which when taken together shall be deemed to be one and the same instrument.

U.C.

It was noted that the City would continue to charge a 5% property management fee against the land rental revenue for handling the rentals income and contract work.

Susan Penner/Michael Zwaagstra resolved that the proposed land swap of two parcels of land between the Corporation and Two Knew Properties Ltd., both located along Park Rd W, be approved. Parcel currently owned by Two Knew Properties Ltd. Described as 316 Park Rd W – Lot 1 Blk 1 Plan 17856. Part of parcel currently owned by the Corporation described as Part of Lot 2 Plan 44490 to be subdivided to form a new parcel of land to be sold and to be of relatively equal size to the parcel being acquired. Each party responsible for their own land transfer costs.

U.C.

There was discussion regarding a past strategy of the Corporation to acquire larger parcels of land to the north and west of Steinbach in order to have an adequate land base available for future development opportunities. Suggestion was to review Corporation strategy in the future upon the completion of the Steinbach Growth Study later in 2012.

The next meeting would be at the call of the chair.

Meeting adjourned at 7:05 p.m.

Appendix C

Manitoba Conservation and Water Stewardship
Permit Application and
Authorization

Friesen Drillers Ltd.

307 PTH 12 N Steinbach, MB. R5G 1T8 Phone 204-326-2485 Fax 204-326-2483 Toll Free-1-888-794-9355

December 11, 2012

Ms. Kristina Anderson, P.Geo.
Groundwater Licensing Section
Manitoba Water Stewardship
200 Saulteaux Crescent
Winnipeg, MB R3J 3W2

Dear Kristina

Subject **Groundwater Investigation for Municipal Groundwater Supply**
316 Park Road West - NW1/4 3-7-6 EPM – City of Steinbach, Manitoba

Friesen Drillers Ltd. has been retained by the City of Steinbach to undertake a groundwater investigation for an expanded municipal water supply for the city. The city is proposing to develop a new well field on 316 Park Road West.

The City of Steinbach currently has water rights license no. 2009-073 in place for the East Well Field. This license authorizes the pumping of 2,000 cubic decameters/year., with a maximum instantaneous pumping rate of 0.105 m^3/s. This license was granted in 2009, along with an environment act license for the water supply system. Along with the environment act license, a number of recommendations were provided in the license application. These recommendations are currently being implemented by the City of Steinbach. The current water supply allocation will take the City of Steinbach to the year 2020, based on current population projections. The City is currently growing at 2.4% annually. The city is continuing in their aggressive water conservation programs, and the average daily per capita consumption is dropping annually.

In order to provide water supplies after 2020, the City of Steinbach has proposed a new well field to be located on the west side of the city. Land has been purchased on Park Road for this purpose (status of title attached). Figure 1, shown below, provides the well location.

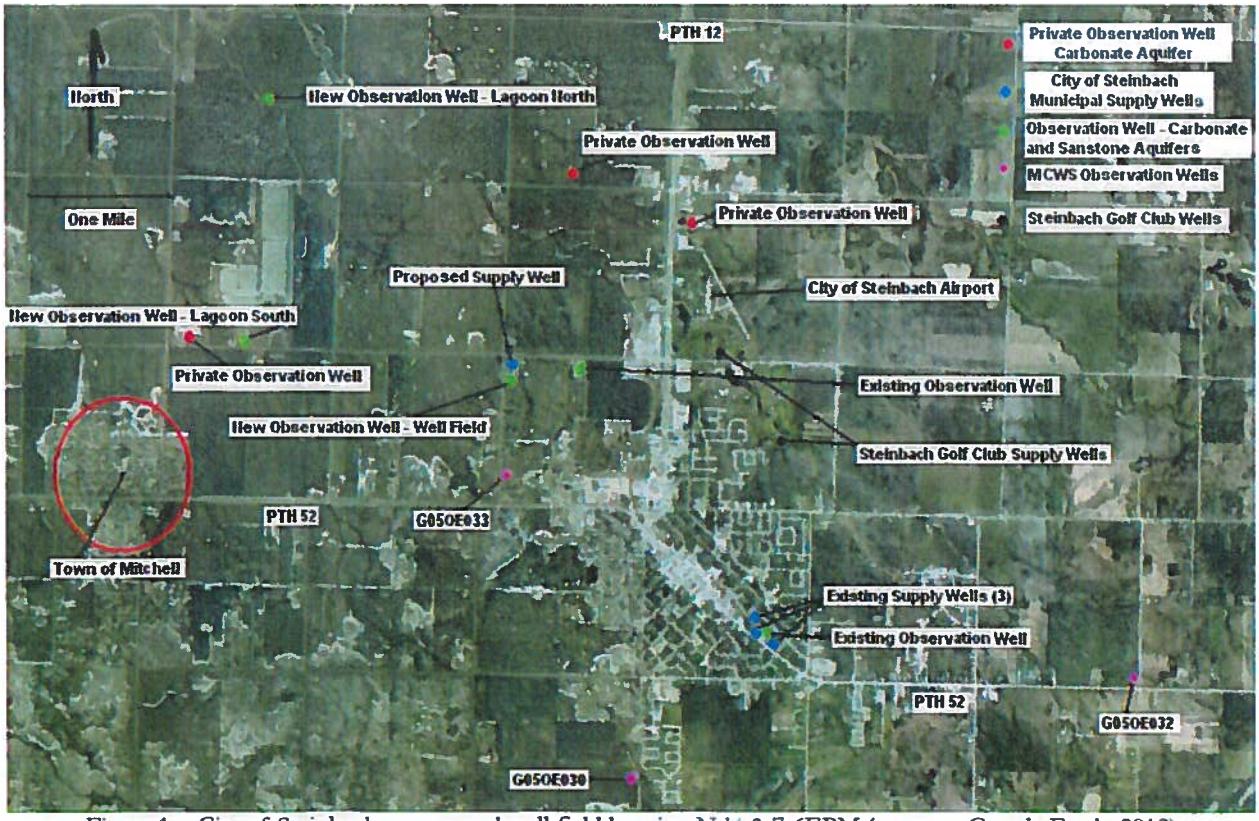


Figure 1 – City of Steinbach – proposed well field location N ¼ 3-7-6EPM (source – Google Earth, 2012)

Friesen Drillers has been retained to undertake the development of the water supply. The City of Steinbach has proposed a multi year project to develop this water supply. The following scope of work has been provided to the City of Steinbach for this project:

- 2012/2013
    - Obtain a groundwater exploration permit for the project from MCWS – Water Rights Licensing Section
    - Undertake the drilling and construction of three observation wells. These wells will be constructed to allow for the dedicated observation of both the carbonate and sandstone aquifer static water levels. Geochemical and stable isotope samples will be collected from both aquifers. Each observation well will be instrumented with automatic data recording pressure transducers.
    - The observation wells will be used as long term monitoring wells and for observation wells during the pumping test.
    - The three wells will supplement the existing observation well network that is present in the area. The locations of the observation wells are shown on Figure 1. The wells will be located in the following areas:
        - Near the proposed well field
        - Near the largest cluster of existing private well users in the area (the Town of Mitchell).
        - To the north of the site, at distance, where there is a lack of observation wells present.
- 2013
    - After a season of monitoring, two test wells will be drilled at the proposed well site. The target of the drilling program will be the carbonate aquifer. Short term yield testing will be undertaken on both wells.
    - After the completion of the test wells, a 12 inch diameter steel cased supply well will be constructed over one of the test well locations.
    - A long term, 72 hour pumping test will be conducted on the proposed supply well. Approximately 14 observation wells will be used to assist in the analysis of this aquifer testing. Five of these wells will be completed in both the sandstone and carbonate aquifers. Routine water quality and stable isotope samples will be collected on the proposed supply well every 12 hours.
    - A well inventory within 3 miles will be conducted using the GWDRILL database, and by visual inspections.
    - Due to the overlapping drawdown cones, numerical modeling will be utilized to model the long term pumping effects. The MS Access GWDRILL database will be used to develop this model. Since both aquifers are fresh, density dependent conditions will not be expected to be an issue. Therefore, the USGS MODFLOW code will be utilized, if possible.
    - A complete technical hydrogeology report will be prepared. The report would discuss the long term aquifer potential, and the numerical modeling results. The geochemical and stable isotope results would also be discussed. The aquifer response would also be reviewed on a regional scale, with respect to the long term aquifer sustainability.
    - An environment act proposal will be prepared.
- 2014
    - A second back up supply well will be planned for the second test well on the site.

Assuming this project is successful; the City of Steinbach would request an allocation of an additional 1,000 cubic decameters/year., with a maximum instantaneous pumping rate of 0.158 m^3/s. This would take the City of Steinbach to the design year 2039. A long term aquifer monitoring program will be implemented for the City of Steinbach for this project.

Pending your approval, we propose to commence this project in January, 2013. Due to the long term nature of the development, the City of Steinbach respectfully requests the groundwater exploration permit be held as active for a three year period, if this is possible.

The population projections are attached, along with the status of title, and the groundwater exploration permit application. We would be pleased to meet with you at your convenience to discuss this project further, if you require additional information or more detail in our scope of work.

Should you require anything further or have any additional questions, please call me at (204) 326-2485.

Sincerely

Friesen Drillers Limited

J.J.(Jeff) Bell, B.Sc.(G.E.), P.Eng.
Hydrogeological Engineer

Attachments

FORM E

Application for Licence to Construct A Well and Divert Groundwater

Manitoba Conservation
Water Branch
200 Saulteaux Crescent
Winnipeg MB R3J 3W3

Pursuant to The Water Rights Act

APPLICANT'S NAME: City of Steinbach	TELEPHONE: 204-326-9877
POST OFFICE ADDRESS: 225 Reimer Avenue Steinbach, Manitoba R5G 2J1	

hereby applies for authority to construct a water well on the following described lands:

LSD	OR QUARTER	SECTION	TOWNSHIP	RANGE	E OR W
Lot 1 Block 1 Plan 17856	NW 1/4	3	7	6	EPM

or otherwise described as 316 Park Road West - City of Steinbach

and divert groundwater for Municipal purposes on the following described land:
(domestic, municipal, agricultural, industrial, irrigation, other)

LSD	OR QUARTER	SECTION	TOWNSHIP	RANGE	E OR W
Lot 1 Block 1 Plan 17856	NW1/4	3	7	6	EPM

or otherwise described as 316 Park Road West - City of Steinbach

at the following rates: 0.053 cubic metres per second

_____ cubic decametres per day

1,000 cubic decametres per year

Number of hectares to be irrigated N A (if applicable)

The above described lands are held as follows: (check applicable box)

☐ Registered owner ☒ purchased under agreement for sale ☐ lessee

☐ to be negotiated

Copy(s) of Certificate(s) of Title or Title Numbers must be included.

Date: October 26 20 12

(signature of applicant)

FOR OFFICE USE ONLY

Application filed with the Director, Water Branch,

at Winnipeg, Manitoba on _____, 20 ____

_____
(Signature of Director)

**** PLEASE NOTE****

FEE OF$50.00 MUST ACCOMPANY THIS APPLICATION, CHEQUE AND APPLICATION TO BE MAILED TO:

**MANITOBA CONSERVATION
CASHIER'S OFFICE
BOX 42, 200 SAULTEAUX CRESCENT
WINNIPEG MB R3J 3W3**

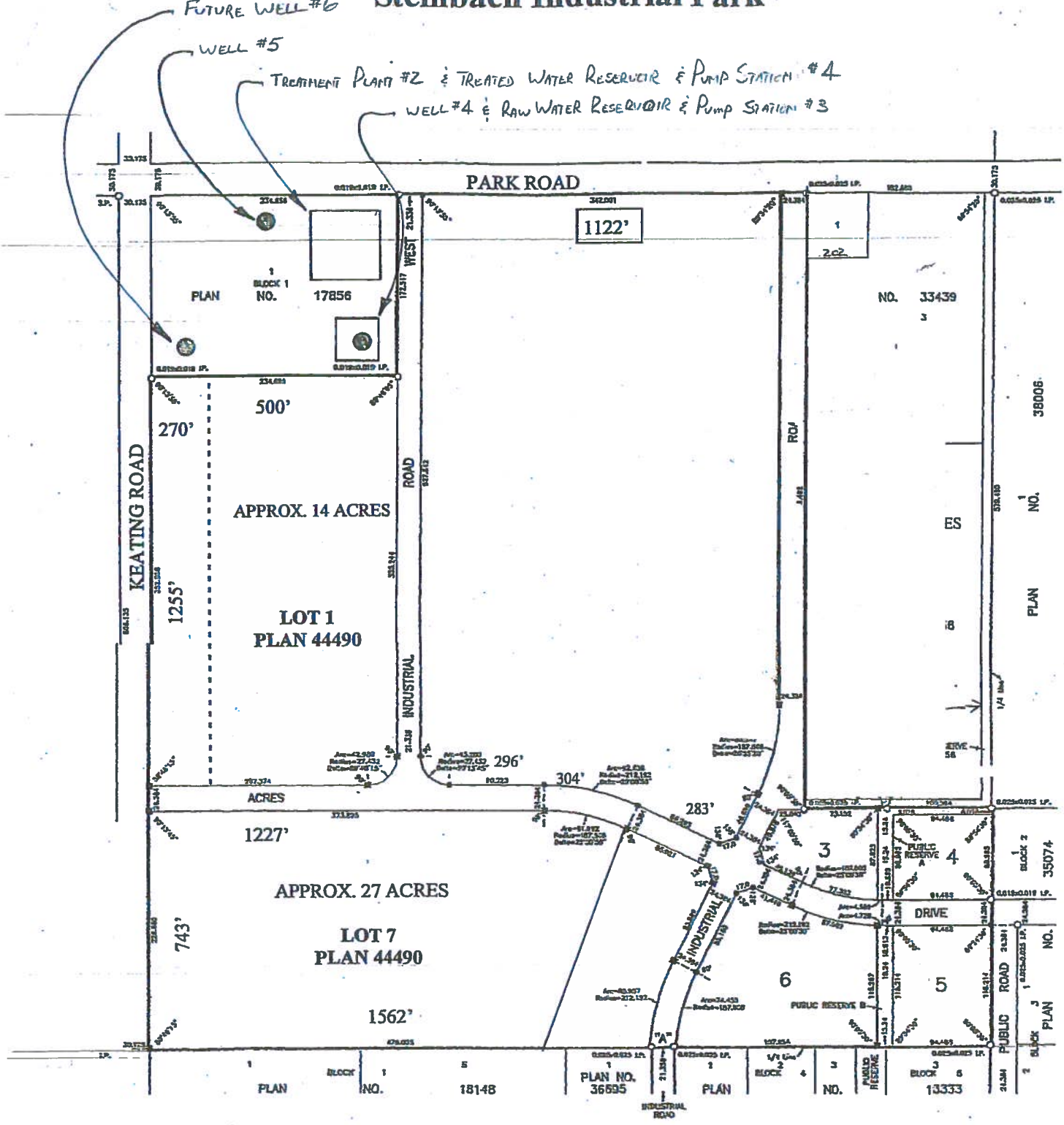
MG-14843 (English)

CHEQUES TO BE MADE PAYABLE TO MINISTER OF FINANCE

OPTION NO. 2

STEINBACH WATER SUPPLY SYSTEM #2

Steinbach Industrial Park



*Note all measurements and acreages are approximate.

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSTS (3 OF 9) TITLE DISPLAY - WINNIPEG

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

SUMMARY OF TITLE DATA

SELECT ONE OF THE FOLLOWING:

TITLE NOTES..... MORE? NO .... _

ORIGINATING REG. NUMBER.. 4055293/1 ..... MORE? NO .... _

FROM TITLE NUMBER..... 1762558/1 TYPE.... ALL MORE? NO .... _

RPA/CROWN GRANT NUMBER... ..... MORE? NO .... _

NAME FOR SERVICE..... TWO KNEW PROPERTIES LTD MORE? NO .... _

ADDRESS..... 85 PTH 12 N

STEINBACH MB

POSTAL CODE..... R5G1A7 EFFECT... ACTIVE

DUPLICATE PRODUCED ? .... MORE? NO .... _

ISSUED DATE.....

TX: ____ NEXT TITLE NUMBER... _____

DA: _____

NO MORE INFORMATION EXISTS REGARDING THIS SCREEN

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSEC (2 OF 9) TITLE DISPLAY - WINNIPEG PAGE: 01

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

ACTIVE CHARGE LIST: BEGINNING

235647/1 ACCEPTED CAVEAT REG'D: 1975/07/28

FROM/BY: MANITOBA TELEPHONE SYSTEM

TO:

CONSIDERATION: NOTES:

TX: ____ _____ REGISTRATION TO DISPLAY

DA: _____ F6-TSTC

*** NO MORE ACTIVE CHARGES FOUND FOR THIS TITLE ***

DATE: 2012/08/29 TITLE SEARCH PASWSC1

TSTL (1 OF 9) TITLE DISPLAY - WINNIPEG PAGE: 01

TITLE NUMBER..... 2519466/1 TITLE STATUS..... ACCEPTED

REGISTRATION DATE.. 2011/04/04 ASSESSMENT OFFICE.. ** MANITOBA **

COMPLETION DATE.... 2011/04/06 CONSOLIDATION..... NO

LEGAL DESCRIPTION:

TWO KNEW PROPERTIES LTD.

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON
IN THE FOLLOWING DESCRIBED LAND:

LOT 1 BLOCK 1 PLAN 17856 WLTO
IN NW 1/4 3-7-6 EPM

TX: _____

DA: _____

SCDC Minutes

Minutes of the meeting of the Board of Directors of the Steinbach Community Development Corporation held at City Hall on Tuesday, April 17, 2012.

The meeting started at 6:30 p.m. Present at the meeting were Chris Goertzen, Michael Zwaagstra, Susan Penner, Troy Warkentin and Jack Kehler.

No changes to directors – Chris Goertzen, Michael Zwaagstra, Susan Penner, Jack Kehler, and Troy Warkentin.

No change to auditor of the Corporation – Chambers, Fraser & Co.

No changes to the officers of the Corporation
Chris Goertzen – President
Jack Kehler – Secretary
Troy Warkentin - Treasurer

Susan Penner/Michael Zwaagstra resolved that the audited financial statements of the Corporation for the fiscal year ended December 31, 2011 as prepared by Chambers, Fraser and Co. be hereby approved,
And that this resolution may be assigned in counterparts, including by way of electronic or facsimile transmission, all of which when taken together shall be deemed to be one and the same instrument.

U.C.

It was noted that the City would continue to charge a 5% property management fee against the land rental revenue for handling the rentals income and contract work.

Susan Penner/Michael Zwaagstra resolved that the proposed land swap of two parcels of land between the Corporation and Two Knew Properties Ltd., both located along Park Rd W, be approved. Parcel currently owned by Two Knew Properties Ltd. Described as 316 Park Rd W – Lot 1 Blk 1 Plan 17856. Part of parcel currently owned by the Corporation described as Part of Lot 2 Plan 44490 to be subdivided to form a new parcel of land to be sold and to be of relatively equal size to the parcel being acquired. Each party responsible for their own land transfer costs.

U.C.

There was discussion regarding a past strategy of the Corporation to acquire larger parcels of land to the north and west of Steinbach in order to have an adequate land base available for future development opportunities. Suggestion was to review Corporation strategy in the future upon the completion of the Steinbach Growth Study later in 2012.

The next meeting would be at the call of the chair.

Meeting adjourned at 7:05 p.m.

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS

(January 23, 2012)

Table 1 - Actual Population Census Stats

YEAR	POPULATION (actual stats)	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (1.67 x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
1976	5979	415	2481	4144	1.67	906
1977	6346	415	2634	4398	1.67	961
1978	6429	415	2668	4456	1.67	974
1979	6513	415	2703	4514	1.67	987
1980	6597	415	2738	4572	1.67	999
1981	6676	415	2771	4627	1.67	1011
1982	6830	415	2834	4734	1.67	1035
1983	6987	415	2900	4842	1.67	1058
1984	7147	415	2966	4953	1.67	1083
1985	7311	415	3034	5067	1.67	1107
1986	7473	415	3101	5179	1.67	1132
1987	7778	415	3228	5391	1.67	1178
1988	7954	415	3301	5513	1.67	1205
1989	8094	415	3359	5610	1.67	1226
1990	8114	415	3367	5623	1.67	1229
1991	8213	415	3408	5692	1.67	1244
2006	11066	423	4685	8652	*1.85*	1710

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(January 23, 2012)

Table 2 - Projected Population Growth = 2.075%/Year

YEAR	POPULATION	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (PF x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
1992	8485	415	3521	5881	1.67	1285
1993	8663	415	3595	6004	1.67	1312
1994	8845	415	3671	6130	1.67	1340
1995	9030	415	3747	6258	1.67	1368
1996	9219	415	3826	6389	1.67	1396
1997	9412	415	3906	6523	1.67	1426
1998	9610	415	3988	6660	1.67	1456
1999	9812	415	4072	6800	1.67	1486
2000	10017	415	4157	6942	1.67	1517
2001	10227	415	4244	7088	1.67	1549
2002	10442	415	4333	7237	1.67	1582
2003	10661	415	4424	7389	1.67	1615
2004	10884	415	4517	7543	1.67	1649
2005	10966	362 (actual)	3970	10166	*2.56*	1449

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(January 23, 2012)

Table 3 - Projected Population Growth = 2.400%/Year

YEAR	POPULATION	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (PF x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
2006	11066 (actual)	423	4685	8652	*1.85*	1710
2007	11332	389	4406	7167	*1.63*	1608
2008	11604	356	4131	6316	*1.53*	1508
2009	11882	341	4047	6127	*1.51*	1477
2010	12168	337	4106	5788	*1.41*	1499
2011	13000 (est)	331	4297	7533	*1.75*	1568
2012	13312	330	4393	7468	1.70	1603
2013	13631	330	4498	7512	1.67	1642
2014	13959	330	4606	7693	1.67	1681
2015	14294	330	4717	7877	1.67	1722
2016	14637	330	4830	8066	1.67	1763
2017	14988	330	4946	8260	1.67	1805
2018	15348	330	5065	8458	1.67	1849
2019	15716	330	5186	8661	1.67	1893
2020	16093	330	5311	8869	1.67	1938
2021	16479	330	5438	9082	1.67	1985
2022	16875	330	5569	9300	1.67	2033
2023	17280	330	5702	9523	1.67	2081
2024	17695	330	5839	9752	1.67	2131
2025	18119	330	5979	9986	1.67	2182
2026	18554	330	6123	10225	1.67	2235
2027	19000	330	6270	10471	1.67	2288
2028	19456	330	6420	10722	1.67	2343
2029	19922	330	6574	10979	1.67	2400
2030	20401	330	6732	11243	1.67	2457
2031	20890	330	6894	11513	1.67	2516
2032	21392	330	7059	11789	1.67	2577
2033	21905	330	7229	12072	1.67	2638
2034	22431	330	7402	12362	1.67	2702
2035	22969	330	7580	12658	1.67	2767
2036	23520	330	7762	12962	1.67	2833
2037	24085	330	7948	13273	1.67	2901
2038	24663	330	8139	13592	1.67	2971
2039	25255	330	8334	13918	1.67	3042
2040	25861	330	8534	14252	1.67	3115
2041	26481	330	8739	14594	1.67	3190

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS

(January 23, 2012)

2042	27117	330	8949	14944	1.67	3266
2043	27768	330	9163	15303	1.67	3345
2044	28434	330	9383	15670	1.67	3425
2045	29117	330	9609	16046	1.67	3507
2046	29815	330	9839	16431	1.67	3591
2047	30531	330	10075	16826	1.67	3677
2048	31264	330	10317	17229	1.67	3766
2049	32014	330	10565	17643	1.67	3856
2050	32782	330	10818	18066	1.67	3949
2051	33569	330	11078	18500	1.67	4043
2052	34375	330	11344	18944	1.67	4140
2053	35200	330	11616	19399	1.67	4240
2054	36045	330	11895	19864	1.67	4342
2055	36910	330	12180	20341	1.67	4446
2056	37796	330	12473	20829	1.67	4552
2057	38703	330	12772	21329	1.67	4662
2058	39632	330	13078	21841	1.67	4774
2059	40583	330	13392	22365	1.67	4888
2060	41557	330	13714	22902	1.67	5006

Note : Peak Day Demand ratio for 2006 to 2011 is based on actual data
: Highlighted Cells Indicate Existing Licence Parameter Exceedance

Manitoba
Conservation and Water Stewardship

Water Use Licensing Section
Box 16, 200 Saulteaux Crescent
Winnipeg, Manitoba, Canada R3J 3W3
T 204-945-6118 F 204-945-7419
Rob.Matthews@gov.mb.ca

January 16, 2013

File: Steinbach, The City of -3

Phil Kalyta, City Engineer
The City of Steinbach
225 Reimer Avenue,
Steinbach, MB R5G 2J1

Dear Mr. Kalyta:

Attached herewith is a **Groundwater Exploration Permit** issued in response to The City of Steinbach application to construct well(s) and divert groundwater at 316 Park Road West – NW1/4 3-7-6EPM, for municipal purposes.

The Groundwater Exploration Permit authorizes The City of Steinbach to carry out exploration test drilling, construct supply wells, conduct a well inventory of area wells, and conduct an aquifer pump testing. The purpose of the pump testing is to determine if sufficient water is available from the wells and from the aquifer to support the project and to determine water level impacts on existing local wells and/or registered projects with earlier precedence dates than the proposed project. Please familiarize yourself with the terms and conditions of the Groundwater Exploration Permit.

A licensing decision on this project will be held pending submission of the required information. Please note that diversion of water without a Water Rights Licence or written authorization would constitute a violation of *The Water Rights Act* and may be subject to enforcement.

One important condition of any licence that may be issued for this project, in due course, is that a flow meter must be installed on the pipeline from the supply well(s), positioned to accurately measure instantaneous pumping rate and accumulative withdrawals

Please contact Ronaldo Miranda, directly at 204-945-6475 should you have any questions regarding the requirements outlined in this letter and the attached permit or the water rights licensing aspects of this project.

Yours truly,

ORIGINAL SIGNED BY:
ROB MATTHEWS

Rob Matthews
Manager, Water Use Licensing Section

cc. Ronaldo Miranda
Jeff Bell, Friesen Drillers Ltd.
Bruce Webb, CWS
CAO, RM of Hanover
Manager, Seine - Rat River Conservation District

Attachment - Form H / Permit

Manitoba
Manitoba Conservation & Water Stewardship
Water Use Licensing Section

FORM F

200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3

Groundwater Exploration Permit

Pursuant to The Water Rights Act

The City of Steinbach

is hereby permitted to construct a water well or wells on the following described lands to explore for groundwater at 316 Park Road West - NW1/4 3-7-6 EMP, particularly in Lot 1 Block 1 Plan 17856 WLTO for **municipal** purposes, subject, however, to the following conditions:

1. The permittee must have legal access to the site where the exploration work and project wells are to be located.

2. Prior to undertaking any work or construction of any works authorized by this permit the permittee is required to retain the services of a hydrogeologist registered with Association of Professional Engineers and Geoscientists of Manitoba, who would be required to:
   - Plan and supervise the drilling of boreholes, test wells, production wells, observation wells, and aquifer and well pump testing as authorized by this permit.
   - Conduct a minimum 72 hour constant rate aquifer pumping test on the proposed production well.
   - Conduct a recovery test with at least 90% recovery or as deemed satisfactory by the consulting hydrogeologist.
   - Record water levels in at least 2 or more pump test monitoring wells.
   - Carry out a desktop inventory, with field verification if deemed necessary by consulting hydrogeologist, of private and commercial wells within a 5.0 km. radius of the project well site.
   - Prepare and submit to the Water Use Licensing Section a technical report on the drilling of boreholes and wells, pump testing of wells, and well inventory. The report would contain, but not be limited to, such things as: well driller's reports for test wells, production wells and observation wells, a plan showing the location of these wells on the property and/or GPS locations of the wells, an analysis of aquifer pumping tests, calculations of transmissivity and storativity, and a description of the amount of water level interference that would be expected to occur at existing local wells with an emphasis on the wells within and near the Community of Mitchell. The report would also indicate if any local wells are expected to be adversely affected with an emphasis on cumulative withdrawals. Any potential adverse impact should be clearly located. Two copies of the report shall be submitted, one hardcopy and one digital copy.

3. During any pumping tests that may be conducted, pumping must cease immediately if any local water supplies are negatively impacted as a result of the tests. The permittee is also responsible to correct any water supply problems or provide temporary water supply to anyone whose water supplies are negatively impacted as a result of the tests.

4. This permit expires within thirty six (36) months of the date of issuance.

5. This permit is not transferable or assignable to any other third party.

6. Please note that diversion of water without a Water Rights Licence or written authorization would constitute a violation of The Water Rights Act and may be subject to enforcement.

Issued at the City of Winnipeg in the Province of Manitoba, this 16th day of January, A.D. 2013

for The Honourable Minister of Water Stewardship

FORM H

Requirements for High Capacity Aquifer Pumping Tests to Support Applications for a Water Rights Licence

Manitoba Conservation
Water Branch

200 Saulteaux Crescent
Winnipeg, Manitoba
R3J 3W3

FLOW RATE

The flow rate should be kept as constant as possible and should be monitored at least every hour during the test. The flow should be monitored by a device such as a standard orifice meter or a weir box capable of reading the rate to within five percent accuracy. Also, it is desirable that the pumping rate be as close to the desired licence pumping rate as conditions permit.

DISPOSAL OF WATER

Water from the pumped well should be disposed of in such a manner as to prevent recirculation to the water bearing zone being tested.

OBSERVATION WELLS

Where the water bearing zone being tested is buried under a substantial thickness of low permeability material, one observation well should be established at a distance from the pumped well equal to twice the thickness of the water bearing zone being tested, but not further than 91 metres.

Where the water bearing zone being tested is not buried under a substancial thickness of low permeability material, two observation wells should be established in the lower part of the water bearing zone being tested, one being 9 to 12 metres from the pumped well and the other being 24 to 30 metres from the pumped well. Preferably both wells should be established in the same direction from the pumped well.

WATER LEVEL READINGS

Timing:

Very careful observation of time is essential to obtaining accurate test data. The water level readings in the pumped and observation well(s) should be measured at the same instant for the first hour of the test and should be measured as close to the same time as possible for the remainder of the pumping time.

During the first ten minutes of the test the water levels should be read every minute. During the next ten minutes water levels should be read every two minutes. Thence, the water levels should be read once every five minutes until the first hour of testing has elapsed. For the next hour, readings should be taken every 15 minutes. Then for the following two hours, the water levels should be recorded once every half hour. Thence, water levels should be recorded once an hour until the test is completed.

Measurement:

The water level measurements within the observation wells should be recorded with engineering or construction type measuring tapes or preferably with electric measuring tapes commonly used in ground-water observation work. The readings in the observation wells should be measured to within 0.3 centimetres accuracy. In the pumping well, water levels should be recorded either with an electric water level measuring taped or with an airline water level measuring device. The readings in the pumping well should be measured to 3.0 centimetres.

DURATION OF THE TESTING

The pumping test should be run at the same continuous pumping rate until equilibrium conditions are reached or for a minimum of 24 hours. Equilibrium conditions exist when the waters levels in all observation wells have remained stable for at least six hours. If, at the end of the 24 hours equilibrium conditions have not been reached, the test should continue at the established pumping rate until these conditions are reached; or a total time of 48 hours has elapsed.

OR

The duration of the pumping test may be as otherwise directed by the Director, Water Branch or his Agents.

RECOVERY TEST

Once the pumping interval of the test has been completed, the recovery water levels in the pumping and the observation wells should be recorded in exactly the same manner, particularly with respect to timing of the readings, as the drawdown readings, for a period equal at least to the duration of the pumping test or until the water levels have returned to normal.

GENERAL

The above test work is required in order to assess the functioning of the pumping well and more importantly the capability of the aquifer to sustain the withdrawal rate that has been requested. The data collected will help make sure that a viable water supply system is established prior to proceeding with full scale development. The information will also be available should there be problems with the pumping well in the future. The original data can also be used to assess future aquifer problems.

MG-14846 (English)

Appendix D

Estimated Long Term Water Supply Requirements
And
Population Projections

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(November 05, 2015)

Table 1 - Actual Population Census Stats

YEAR	POPULATION (actual stats)	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (1.67 x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
1976	5979	415	2481	4144	1.67	906
1977	6346	415	2634	4398	1.67	961
1978	6429	415	2668	4456	1.67	974
1979	6513	415	2703	4514	1.67	987
1980	6597	415	2738	4572	1.67	999
1981	6676	415	2771	4627	1.67	1011
1982	6830	415	2834	4734	1.67	1035
1983	6987	415	2900	4842	1.67	1058
1984	7147	415	2966	4953	1.67	1083
1985	7311	415	3034	5067	1.67	1107
1986	7473	415	3101	5179	1.67	1132
1987	7778	415	3228	5391	1.67	1178
1988	7954	415	3301	5513	1.67	1205
1989	8094	415	3359	5610	1.67	1226
1990	8114	415	3367	5623	1.67	1229
1991	8213	415	3408	5692	1.67	1244
2006	*11066*	*423*	*4685*	*8652*	*1.85*	*1710*
2011	*13524*	*318*	*4297*	*7533*	*1.75*	*1568*

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(November 05, 2015)

Table 2 - Projected Population Growth = 2.075%/Year

YEAR	POPULATION	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (PF x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
1992	8485	415	3521	5881	1.67	1285
1993	8663	415	3595	6004	1.67	1312
1994	8845	415	3671	6130	1.67	1340
1995	9030	415	3747	6258	1.67	1368
1996	9219	415	3826	6389	1.67	1396
1997	9412	415	3906	6523	1.67	1426
1998	9610	415	3988	6660	1.67	1456
1999	9812	415	4072	6800	1.67	1486
2000	10017	415	4157	6942	1.67	1517
2001	10227	415	4244	7088	1.67	1549
2002	10442	415	4333	7237	1.67	1582
2003	10661	415	4424	7389	1.67	1615
2004	10884	415	4517	7543	1.67	1649
2005	10966	362 (actual)	3970	10166	*2.56*	1449

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(November 05, 2015)

Table 3 - Projected Population Growth = 2.400%/Year

YEAR	POPULATION	AVE. DAILY CONSUMPTION PER CAPITA (l/day)	TOTAL AVE. DAILY CONSUMPTION (cu.m/day)	Peak Day Demand (PF x Ave.Day) (cu.m/day)	Peaking Factor *(Actual)* (Estimated)	TOTAL ANNUAL CONSUMPTION (cu.decam/yr)
2006	11066 (actual)	*423*	*4685*	*8652*	*1.85*	*1710*
2007	11332	*389*	*4406*	*7167*	*1.63*	*1608*
2008	11604	*356*	*4131*	*6316*	*1.53*	*1508*
2009	11882	*341*	*4047*	*6127*	*1.51*	*1477*
2010	12168	*337*	*4106*	*5788*	*1.41*	*1499*
2011	13524 (actual)	*318*	*4297*	*7533*	*1.75*	*1568*
2012	13849	*352*	*4572*	*8582*	*1.88*	*1669*
2013	14181	*340*	*4423*	*6435*	*1.45*	*1614*
2014	14521	*333*	*4326*	*7005*	*1.62*	*1579*
2015	14870	330	4907	8195	1.67	1791
2016	15227	330	5025	8391	1.67	1834
2017	15592	330	5145	8593	1.67	1878
2018	15966	330	5269	8799	1.67	1923
2019	16350	330	5395	9010	1.67	1969
2020	16742	330	5525	9226	1.67	2017
2021	17144	330	5657	9448	1.67	2065
2022	17555	330	5793	9675	1.67	2115
2023	17976	330	5932	9907	1.67	2165
2024	18408	330	6075	10145	1.67	2217
2025	18850	330	6220	10388	1.67	2270
2026	19302	330	6370	10637	1.67	2325
2027	19765	330	6523	10893	1.67	2381
2028	20240	330	6679	11154	1.67	2438
2029	20725	330	6839	11422	1.67	2496
2030	21223	330	7004	11696	1.67	2556
2031	21732	330	7172	11977	1.67	2618
2032	22254	330	7344	12264	1.67	2680
2033	22788	330	7520	12558	1.67	2745
2034	23335	330	7700	12860	1.67	2811
2035	23895	330	7885	13168	1.67	2878
2036	24468	330	8075	13484	1.67	2947
2037	25056	330	8268	13808	1.67	3018
2038	25657	330	8467	14140	1.67	3090
2039	26273	330	8670	14479	1.67	3165
2040	26903	330	8878	14826	1.67	3240

CITY OF STEINBACH

POPULATION PROJECTIONS
AND
DESIGN WATER CONSUMPTION REQUIREMENTS
(November 05, 2015)

2041	27549	330	9091	15182	1.67	3318
2042	28210	330	9309	15547	1.67	3398
2043	28887	330	9533	15920	1.67	3479
2044	29580	330	9762	16302	1.67	3563
2045	30290	330	9996	16693	1.67	3648
2046	31017	330	10236	17094	1.67	3736
2047	31762	330	10481	17504	1.67	3826
2048	32524	330	10733	17924	1.67	3918
2049	33305	330	10991	18354	1.67	4012
2050	34104	330	11254	18795	1.67	4108
2051	34922	330	11524	19246	1.67	4206
2052	35760	330	11801	19708	1.67	4307
2053	36619	330	12084	20181	1.67	4411
2054	37498	330	12374	20665	1.67	4517
2055	38398	330	12671	21161	1.67	4625
2056	39319	330	12975	21669	1.67	4736
2057	40263	330	13287	22189	1.67	4850
2058	41229	330	13606	22721	1.67	4966
2059	42219	330	13932	23267	1.67	5085
2060	43232	330	14266	23825	1.67	5207

Note : Peak Day Demand ratio for 2006 to 2014 is based on actual data
: Highlighted Cells Indicate Existing Licence Parameter Exceedance

MEMO

January 23, 2012

TO: FILE

FROM: PHIL

Re: Future Steinbach Water Supply System Plans/Timelines

The City of Steinbach's current water supply system consists of three ground water wells and treatment facilities that are licenced to produce up to 2.0 Million gallons of water per day for the City's consumption. Using the City's current growth rate of 2.4% per year and the current trend of reduction in per capita water consumption, this system should meet Steinbach's needs until the year 2020.

A secondary water supply system has been conceptualized to meet the City's water needs beyond 2020. This system will be a stand-alone system that will serve to supplement the existing supply system. This secondary system would consist of the following:

- two new ground water supply wells
- new raw water pre-treatment/storage reservoir (250,000 gallons)
- new iron removal water treatment plant (1 million gallons per day capacity, expandable to 2 million gallons per day).
- new pumping station and 1.6 M gallon treated water reservoir (1 million gallon per day pumping capacity, expandable to 2 million gallons per day)

This secondary system is currently planned for the NW portion of the City, and would serve to "freshen" the water in the north portion of the water distribution system.

The first phase of the expansion would be to install two wells capable of at least 500 GPM each. These wells would feed an iron removal treatment plant rated at 1 million gpd. This configuration should satisfy the City's water supply needs until approx. 2038.

For Phase 1 expansion, the City's Water Rights Licence would have to be revised as follows:

a) "NW Section 3-7-6E" will have to be added to the "location of works" section
b) "Sections 2, 3, 10, 11, 14 & 16 of 7-6E" will have to be added to the "Lands served" section of the form
c) The maximum rate of water diversion will have to be revised from 0.105 cubic m/s (2.0 MIGPD) to 0.158 cubic m/s (3.0 MIGPD)
d) The maximum total annual water diversion volume will have to be revised from 2,000 to 3,000 cubic decameters/yr.

Phase 1 of this new secondary supply system implementation process is anticipated to cost $6.5M and should satisfy the Steinbach's needs to beyond 2035.

Page 2....

The second phase of the expansion would be to install one additional well capable of at least 500 GPM. The 3 wells would feed an expanded iron removal treatment plant now rated at 2 million gpd. This configuration should satisfy the City's water supply needs until approx. 2050.

For Phase 2 expansion, the City's Water Rights Licence would have to be revised as follows:

e) "The maximum rate of water diversion will have to be revised from 0.158 cubic m/s (3.0 MIGPD) to 0.210 cubic m/s (4.0 MIGPD)
f) The maximum total annual water diversion volume will have to be revised from 3,000 to 4,000 cubic decameters/yr.

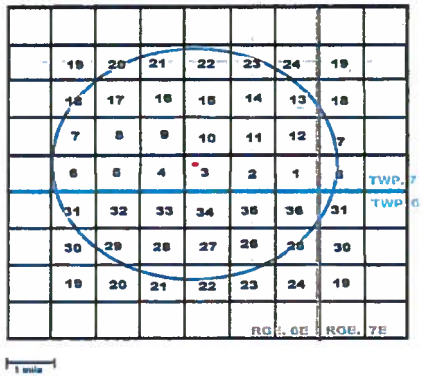
Phase 2 of this new secondary supply system implementation process is anticipated to cost $6.5M and should satisfy the Steinbach's needs to the year 2050.

Appendix E

Well Inventory

Well Inventory (5km radius) : **NW 1/4 3-7-6EPM**

Diagram:



	Location	Owner	Driller	Well Use	Water Use	Coordinates		Year	Casing Depth (ft.)	Well Diam. (in.)	Screen Length (ft.)	Total Depth (ft.)	Grout Type	Pumping Rate (I.G.P.M.)	Static Water Level (ft.)	Pumping Water Level (ft.)	Duration of test (hr.)
						UTMX	UTMY										
1	3-7-6E	SOUTHEAST TRANSFER	Friesen Drillers Ltd.	Production	Domestic	666424.8	5496362.0	1981	96.9	4.5	N.A.	164.9	N.A.	40	1	20	1
2	3-7-6E	WES REIMER	Echo Drilling Ltd.	Production	Domestic	666424.8	5489881.5	2002	100	5	N.A.	130	C.	20	5	2	N.A.
3	3-7-6E	WES REIMER	UNKNOWN	Production	Domestic	666425.0	5489882.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
4	NE3-7-6E	DENNIS GIROUARD	Paddock Drilling Ltd.	Production	Domestic,Livestock	666820.6	5490253.2	1999	9	30	10	20	N.A.	4	6	17	1
5	NE3-7-6E	SOUTH EAST EQUIP	Friesen Drillers Ltd.	Production	Domestic	666820.6	5490253.2	1980	99.9	4.25	N.A.	179.9	N.A.	20	N.A.	20	1
6	NW3-7-6E	SPRINGWOOD HOMES	Echo Drilling Ltd.	Production	Domestic	666414.0	5490000.0	2008	104	5	N.A.	178	C.	107	-4	-1	N.A.
7	NW3-7-6E	STEINBACH CAMPGROUND	Echo Drilling Ltd.	Production	Domestic	666015.1	5490238.2	1989	103.9	6	N.A.	207.9	N.A.	20	-2	-2	N.A.
8	NW3-7-6E	SPRINGWOOD HOMES	Echo Drilling Ltd.	Production	Domestic	666425.0	5489947.0	2008	108	5	N.A.	178	C.	75	-4	1.5	N.A.
9	NW3-7-6E	WRB	Friesen Drillers Ltd.	Observation	-	665612.0	5490070.0	1992	96.9	5	N.A.	102.4	C.	100	6	N.A.	1
10	SE3-7-6E	TOWN OF STEINBACH	Friesen Drillers Ltd.	Production	Domestic,Air Conditioning	666833.2	5489542.9	1995	100.9	5	N.A.	199.9	C.	75	1.5	N.A.	1
11	SE3-7-6E	TOWN OF STEINBACH	Friesen Drillers Ltd.	Production	Domestic,Air Conditioning	666833.2	5489542.9	1995	102.9	5	N.A.	199.9	C.	75	-3.5	-2	1
12	SE3-7-6E	EDEN EAST	UNKNOWN	Production	Domestic	667038.0	5489208.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
13	SE3-7-6E	P WIENS	Friesen Drillers Ltd.	Production	Domestic	666833.2	5489542.9	1977	104.9	4.25	N.A.	109.9	N.A.	20	7	2	N.A.
14	SW3-7-6E	B GIESBRECHT	Friesen Drillers Ltd.	Production	Domestic	666027.9	666027.9	1973	101.9	4	N.A.	114.9	N.A.	30	5	20	4
15	SW3-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	666027.9	5489517.7	1988	100.9	4.2	N.A.	109.9	N.A.	60	-0.5	10.5	2
16	SW3-7-6E	J GOERTZEN	Friesen Drillers Ltd.	Production	Domestic	666027.9	5489517.7	1972	97.9	4	N.A.	104.9	N.A.	149.9	-7	-2	24
17	SW3-7-6E	T SAWATZKY	Friesen Drillers Ltd.	Production	Domestic,Livestock	666027.9	5489517.7	1973	101.9	5	N.A.	106.9	N.A.	50	10	2	12
18	SW3-7-6E	D UNGER	MANKEY, EMIL	Production	Domestic	666027.9	5489517.7	1965	98.9	4	N.A.	106.9	N.A.	30	9	N.A.	N.A.
19	SW3-7-6E	G REMPEL	MANKEY, EMIL	Production	Domestic	666027.9	5489517.7	1964	97.9	4	N.A.	99.9	N.A.	13	3	N.A.	N.A.
20	SW3-7-6E	F M INVESTMENTS	Echo Drilling Ltd.	Production	Domestic	666027.9	5489517.7	1994	100.9	5	N.A.	139.9	C.	75	-2	N.A.	8
21	SW3-7-6E	RYAN KIANSKY	UNKNOWN	Production	Domestic	665852.0	5489187.0	1960	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
22	-7-6E	REMPLE	Friesen Drillers Ltd.	Production	Domestic,Livestock	664723.0	5493039.0	1974	154.9	4.25	N.A.	191.9	N.A.	20	13	24	1
23	-7-6E	M FRIESEN	Friesen Drillers Ltd.	Production	Domestic	664723.0	5493039.0	1973	98.9	4.25	N.A.	109.9	N.A.	-4	22	25	2
24	-7-6E	H THIEBERT	mondor drillers	Production	Domestic	664723.0	5493039.0	1973	99.9	4	N.A.	105.9	N.A.	N.A.	N.A.	N.A.	N.A.
25	1-7-6E	H GERBRANDT	Echo Drilling Ltd.	Production	Domestic	669711.8	5489963.3	1988	102.9	4.2	N.A.	174.9	N.A.	10	5	N.A.	N.A.
26	NE1-7-6E	DEMEN FARMS	UNKNOWN	Production	-	670108.8	5490324.5	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
27	NE1-7-6E	DENNIS THIESSEN	Echo Drilling Ltd.	Production	Domestic	670451.0	5490373.0	2001	110	5	N.A.	177	B.	75	10	80	N.A.
28	SW1-7-6E	DAN KEHLER	Echo Drilling Ltd.	Production	Domestic	669313.6	5489609.9	2002	110	5	N.A.	197	B.	50	8	70	N.A.
29	SW1-7-6E	DAN KEHLER	Echo Drilling Ltd.	Production	Domestic	669313.6	5489609.9	2004	116	5	N.A.	195	B.	100	7	80	N.A.
30	2-7-6E	SCHENKEL PROPERTIES	UNKNOWN	Other	-	668068.0	5489927.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
31	NE2-7-6E	DEREK STEFANYSHYN	UNKNOWN	Production	Domestic	668566.0	5490535.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

32	NE2-7-6E	6091319 MB LTD/ALLAN HUBERT	Kiansky Bros. Ltd.	Production	Domestic	668837.8	5490207.6	2011	112	5	N.A.	177	C.	90	8	14	1
33	NE2-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	668654.2	5490336.6	2010	105	5	N.A.	200	C.	75	N.A.	2	1
34	NE2-7-6E	DAVE JOHNSON	Friesen Drillers Ltd.	Production	Domestic	668469.0	5490515.0	2008	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
35	NE2-7-6E	5528080 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	668013.0	5489924.0	2008	110	5	N.A.	200	C.	60	12	13	N.A.
36	NE2-7-6E	REGAL HEIGHTS CORP	Echo Drilling Ltd.	Production	Domestic	668590.1	5490186.6	2011	108	5	N.A.	158	C.	22	19	24	1
37	NE2-7-6E	D HIEBERT	Echo Drilling Ltd.	Production	Domestic	668464.5	5490296.5	1990	104.9	5	N.A.	119.9	N.A.	50	3	11	2
38	NE2-7-6E	6091319 MB LTD - ALLAN HUBERT	Kiansky Bros. Ltd.	Production	Air conditioning	669378.0	5467947.7	2011	112	5	N.A.	177	C.	60	6	29	2
39	NE2-7-6E	RODERICK BACUAL	UNKNOWN	Production	Domestic	668574.0	5490237.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
40	NE2-7-6E	WALDAMAR ESAU	UNKNOWN	Production	Domestic	668481.0	5490257.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
41	NE2-7-6E	JESSE LOEWEN	Echo Drilling Ltd.	Production	Domestic	668482.0	5490122.0	2011	111	5	N.A.	158	C.	25	9	80	1
42	NE2-7-6E	ALLAN HIEBERT	Echo Drilling Ltd.	Production	Domestic	668466.0	5490291.0	2009	109	5	N.A.	198	C.	90	N.A.	10	1
43	NE2-7-6E	VALERIE HUND	Friesen Drillers Ltd.	Production	Domestic	668568.0	5490638.0	2007	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
44	NE2-7-6E	ANITA THIESSEN	Friesen Drillers Ltd.	Production	Domestic	668493.0	5490575.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
45	NE2-7-6E	VALENTINE DYCK	UNKNOWN	Production	Domestic	668570.0	5490314.0	2008	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
46	NE2-7-6E	D GIESBRECHT	Echo Drilling Ltd.	Production	Domestic	668464.5	5490296.5	1990	103.9	5.1	N.A.	164.9	N.A.	75	4	5	2
47	NE2-7-6E	JOSH SCREPNEK	UNKNOWN	Production	Domestic	668567.0	5490475.0	2007	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
48	NE2-7-6E	EWALD LENZ	UNKNOWN	Production	Domestic	668800.0	5490554.0	2009	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
49	NE2-7-6E	5528080 MB LTD.	Echo Drilling Ltd.	Recharge	-	668466.0	5490291.0	2010	105	5	N.A.	197	C.	110	5	2	1
50	NE2-7-6E	P LOEWEN	Friesen Drillers Ltd.	Production	Domestic	668464.5	5490296.5	1978	106.9	4.25	N.A.	119.9	N.A.	20	N.A.	6	2
51	NE2-7-6E	DALE SAWATZKY	UNKNOWN	Production	Domestic	668474.0	5490428.0	2007	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
52	NE2-7-6E	ANDREAS SEIBEL	Friesen Drillers Ltd.	Production	Domestic	668693.0	5490649.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
53	NE2-7-6E	6091319 MANITOBA LTD	Kiansky Bros. Ltd.	Production	Domestic	668788.8	5490106.0	2011	118	6	N.A.	177	N.A.	70	9	36	2
54	NE2-7-6E	LORI LEE	Echo Drilling Ltd.	Production	Domestic	668511.0	5490187.0	2009	110	5	N.A.	178	C.	80	-1	76	N.A.
55	NE2-7-6E	R & B PRYSTENSKI	Friesen Drillers Ltd.	PRODUCTION	Domestic,Livestock	668464.5	5490296.5	1977	107.9	4.25	N.A.	169.9	N.A.	40	1	2	2
56	NE2-7-6E	LORI LEE	Echo Drilling Ltd	Production	Domestic	668669.0	5490186.0	2009	102	5	N.A.	178	C.	100	-4	35	N.A.
57	NE2-7-6E	STEINBACH GOLF COURSE	Friesen Drillers Ltd.	PRODUCTION	Irrigation	668464.5	5490296.5	1982	100.9	7	N.A.	269.8	N.A.	274.9	-8	-2	12
58	NE2-7-6E	RUSS FAST	Echo Drilling Ltd.	Production	Domestic	668466.0	5490291.0	2007	110	5	N.A.	175	C.	100	1	60	N.A.
59	NW2-7-6E	GORDON CONSTRUCTION	Perimeter Drilling Ltd.	Production	Domestic	667657.1	5490276.0	1988	126.9	5	N.A.	164.9	N.A.	40	15	N.A.	1
60	NW2-7-6E	B MCLEAN	GUY'S WELL DRILLING	Production	Domestic	667657.1	5490276.0	1982	165.9	4.25	N.A.	166.3	N.A.	40	20	N.A.	1
61	NW2-7-6E	CITY OF STEINBACH PARKS DEPT	Friesen Drillers Ltd.	PRODUCTION	Municipal	667657.1	5490276.0	1978	96.9	6	N.A.	226.9	N.A.	169.9	6	2	N.A.
62	SE2-7-6E	LEN NEUFELD	Echo Drilling Ltd.	Recharge	-	668476.5	5489591.8	2004	101	5	N.A.	178	C.	20	5	2	N.A.
63	SE2-7-6E	REMPEL & FUNK	MANKEY, EMIL	Production	Domestic	668476.5	5489591.8	1974	127.9	5	N.A.	184.9	N.A.	8	-4	25	48
64	SE2-7-6E	RAY FAST	Echo Drilling Ltd.	Production	Domestic	668476.5	5489591.8	2004	112	5	N.A.	175	N.A.	100	3	80	N.A.
65	SE2-7-6E	BUTCH BARKOWSKY	Echo Drilling Ltd.	Production	Domestic	668717.2	5489415.4	2011	114	5	N.A.	177	B.	100	7	60	1
66	SE2-7-6E	GREG PENNER	UNKNOWN	Production	Domestic	668855.0	5489378.0	2004	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
67	SE2-7-6E	CURT LOEWEN	Echo Drilling Ltd.	Recharge	-	668173.0	5489744.0	2005	108	5	N.A.	218	C.	100	3	75	N.A.
68	SE2-7-6E	CURT LOEWEN	Echo Drilling Ltd.	Production	Domestic,Air conditioning	668194.0	5489713.0	2005	105	5	N.A.	218	C.	100	1	55	N.A.
69	SE2-7-6E	LEN NEUFELD	Echo Drilling Ltd.	Production	Domestic,Air conditioning	668476.5	5489591.8	2004	101	5	N.A.	178	C.	20	5	2	N.A.
70	SW2-7-6E	DAN SALTEL	Echo Drilling Ltd.	Production	Domestic	667672.0	5489560.0	2006	103	5	N.A.	158	N.A.	85	8	75	N.A.
71	SW2-7-6E	REYNOLD PETERS	Echo Drilling Ltd.	Recharge	-	667892.6	5488386.8	2006	111	5.5	N.A.	178	C.	85	9	12	N.A.
72	SW2-7-6E	REYNOLD PETERS	Echo Drilling Ltd.	Production	Domestic,Air conditioning	667892.6	5488386.8	2006	108	5	N.A.	198	C.	80	9	15	N.A.
73	SW2-7-6E	JOHN FEHR & JAEK HIRBERT	Echo Drilling Ltd.	Recharge	Domestic	667672.0	5489560.0	2007	103	5	N.A.	177	C.	75	2	7	N.A.
74	SW2-7-6E	HENRY TOEWS	Echo Drilling Ltd.	Production	Domestic	667672.0	5489560.0	2007	110	5	N.A.	197	C.	50	5.3	11.4	N.A.
75	SW2-7-6E	SOUTHEAST FARM EQUIPMENT	Echo Drilling Ltd.	Production	Air conditioning	667669.7	5489565.7	2005	95	5	N.A.	202	C.	100	-12	-2	N.A.
76	SW2-7-6E	SOUTHEAST FARM EQUIPMENT	Echo Drilling Ltd.	Production	Air conditioning	667669.7	5489565.7	2005	96	5	N.A.	210	C.	100	-12	-1.5	N.A.
77	SW2-7-6E	SOUTHEAST FARM EQUIPMENT	Echo Drilling Ltd.	Recharge	-	667669.7	5489565.7	2005	91	5	N.A.	240	C.	100	-12	-4	N.A.
78	SW2-7-6E	SOUTHEAST FARM EQUIPMENT	Echo Drilling Ltd.	Recharge	-	667669.7	5489565.7	2005	92	5	N.A.	240	C.	100	-12	3	N.A.
79	SW2-7-6E	JOHN FEHR & JAKE HIRBERT	Echo Drilling Ltd.	Production	Domestic	667672.0	5489560.0	2007	103	5	N.A.	165	C.	75	2	5	N.A.

80	SW2-7-6E	HENRY TOEWS	Echo Drilling Ltd	Production	Domestic	667672.0	5489560.0	2007	102	5	N.A.	197	C.	50	6.1	11.3	N.A.
81	4-7-6E	MURRAY SCHROEDER	UNKNOWN	Production	-	664534.0	5489887.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
82	4-7-6E	E HARDER	L. Mondor Drilling	Production	Domestic	664781.5	5489840.8	1995	20	5	10	30	N.A.	0.3	-4	N.A.	3.5
83	NW4-7-6E	R BERGMAN	Friesen Drillers Ltd.	Production	Domestic,Livestock	664370.3	5490192.5	1984	41	4.3	5	52	N.A.	25	8	2	2
84	SE4-7-6E	LAURIE DODGE	UNKNOWN	Production	Domestic,Livestock	665034.0	5489188.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
85	SE4-7-6E	MATTHEW FRIESEN	UNKNOWN	Production	Domestic	665565.0	5489443.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
86	SE4-7-6E	RUTH MCNEIL	Friesen Drillers Ltd.	Production	Domestic	664835.0	5489218.0	1977	109.9	4.25	N.A.	119.9	N.A.	30	-3	2	2
87	SE4-7-6E	MELINDA & RON HANCOCK	UNKNOWN	Production	-	665575.0	5489395.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
88	SE4-7-6E	H KEHLER	Friesen Drillers Ltd.	Production	Domestic	665191.2	5489497.4	1979	119.9	4.25	N.A.	139.9	N.A.	8	-1.5	5	2
89	SE4-7-6E	MANITOBA HYDRO	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1972	98.9	4	N.A.	106.9	N.A.	N.A.	N.A.	N.A.	N.A.
90	SE4-7-6E	FRANK & LINDA TOEWS	UNKNOWN	Production	-	680319.0	5488376.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
91	SE4-7-6E	J PREIS	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1968	94.9	4	N.A.	94.9	C.	8	12	N.A.	N.A.
92	SE4-7-6E	G LOEWEN	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1969	95.9	4	N.A.	95.9	N.A.	2	2	N.A.	N.A.
93	SE4-7-6E	FRANK FROESE	Echo Drilling Ltd.	Production	Domestic	664957.0	5489218.0	2004	125	5	N.A.	195	C.	100	1	80	N.A.
94	SE4-7-6E	MARTIN DIESEL SERVICE LTD.	Friesen Drillers Ltd.	Production	Domestic	665227.0	5489189.0	1986	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
95	SE4-7-6E	EARL MARTINS	UNKNOWN	Production	Domestic	665565.0	5489358.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
96	SE4-7-6E	A ENNS	Friesen Drillers Ltd.	Production	Domestic	665191.2	5489497.4	1983	35	4	5	43	N.A.	N.A.	N.A.	N.A.	N.A.
97	SE4-7-6E	P FUNK	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1969	103.9	4		103.9	N.A.	6	-6	N.A.	N.A.
98	SE4-7-6E	H S PENNER	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1967	102.9	4	N.A.	102.9	N.A.	10	15	N.A.	N.A.
99	SE4-7-6E	MARIA MILLER	UNKNOWN	Production	Domestic	66557.0	5489405.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
100	SE4-7-6E	E PENNER	MANKEY, EMIL	Production	Domestic	665191.2	5489497.4	1968	97.9	4	N.A.	100.9	N.A.	12	9	N.A.	N.A.
101	SE4-7-6E	JOHN FRIESEN & BRENT THOMPSON	UNKNOWN	Production	Domestic	665546.0	5489289.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
102	SW4-7-6E	RAM EQUIPMENT	Echo Drilling Ltd.	Production	Domestic	664383.5	5489471.6	1994	103.9	5	N.A.	119.9	C.	50	-1.5	N.A.	2
103	SW4-7-6E	DOREEN ELEK	UNKNOWN	Production	Domestic	664333.0	5489761.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
104	SW4-7-6E	MURRAY SCHROEDER	UNKNOWN	Production	-	664584.0	5489822.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
105	5-7-6E	VIC PETERS	Echo Drilling Ltd.	Production	Domestic	661174.0	5489561.0	2009	121	5	N.A.	137	C.	25	-6	-2	N.A.
106	NE5-7-6E	WILLIAM G FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663530.8	5490166.9	1998	110	5	N.A.	120	N.A.	45	-10	N.A.	1
107	NE5-7-6	J TOEWS	Friesen Drillers Ltd	Production	Domestic,Livestock	663530.8	5490166.9	1977	97.9	4.25	N.A.	119.9	N.A.	7	-12	25	2
108	SE5-7-6E	V POETKER	MANKEY, EMIL	Production	Domestic	663544.1	5489446.0	1970	104.9	4	N.A.	105.9	N.A.	90	12	N.A.	N.A.
109	SW5-7-6E	H PETERS	Echo Drilling Ltd.	Production	Domestic	662733.6	5489420.0	1992	103.9	5	N.A.	199.9	C.	100	2	N.A.	N.A.
110	SW5-7-6E	SKY PROM MARKETING INC	Echo Drilling Ltd.	Production	Domestic	662536.0	5489233.0	2005	113	5	N.A.	218	C.	250	10	2	N.A.
111	SW5-7-6E	H PETERS	Echo Drilling Ltd.	Production	Domestic	662733.6	5489420.0	1990	97.9	4.25	N.A.	119.9	C.	30	-2	N.A.	N.A.
112	SW5-7-6E	SKY PROM MARKETING	Echo Drilling Ltd.	Production	Domestic	662733.6	5489420.0	2003	104	5	N.A.	197	C.	75	-7	-2	N.A.
113	SW5-7-6E	H PETERS	Echo Drilling Ltd.	Production	Domestic	662733.6	5489420.0	1990	100.9	4.25	N.A.	119.9	C.	149.9	-2	N.A.	N.A.
114	6-7-6E	MAURICE LUSSIER	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2003	119	5	N.A.	195	C.	100	N.A.	N.A.	N.A.
115	6-7-6E	J CROWN	L. Mondor Drilling	Production	Domestic	661633.8	5489750.3	1989	82.9	4.25	N.A.	219.9	N.A.	6	35	N.A.	N.A.
116	6-7-6E	M KOOP	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1990	113.9	4	N.A.	154.9	C.	15	5	N.A.	10
117	6-7-6E	PRAIRIE PROPERTIES	Paul Slusarchuk Well Drilling LTd.	Production	Domestic	661633.8	5489750.3	1998	115	5	N.A.	217	B.	30	N.A.	N.A.	N.A.
118	6-7-6E	RANDY THEBERT	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2002	124	5	N.A.	140	C.	100	2	N.A.	N.A.
119	6-7-6E	G FRIESEN	L. Mondor Drilling	Production	Domestic	661633.8	5489750.3	1991	114.9	4.2	N.A.	124.9	N.A.	40	N.A.	10	N.A.
120	6-7-6E	C FRIESEN	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1979	97.9	4.25	N.A.	119.9	N.A.	30	10	2	N.A.
121	6-7-6E	SKY PROM MARKETING INC	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1998	107	5	N.A.	218	C.	100	-6	N.A.	N.A.
122	6-7-6E	E KEHLER	Kiansky Bros. Ltd.	Production	Domestic	661633.8	5489750.3	1993	111.9	5	N.A.	131.9	C.	25	-5	70	1
123	6-7-6E	LARISSA BOXHORN & LIDIA HODELMAN	Echo Drilling Ltd.	Production	Domestic	661748.7	5489429.4	2011	118	5	N.A.	218	C.	100	5	2	1
124	6-7-6E	H DYCK	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1990	111.9	4.25	N.A.	119.9	C.	20	1.5	N.A.	2
125	6-7-6E	GOLD KEY HOMES	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2004	118	5	N.A.	218	C.	150	-8	-2	N.A.
126	6-7-6E	A & E Homes	Kiansky Bros. Ltd.	Production	Domestic	661633.8	5489750.3	1992	106.9	5	N.A.	135.9	C.	10	-5	60	1
127	6-7-6E	STAN SUESS	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1996	121	5	N.A.	179	C.	100	N.A.	N.A.	N.A.
128	6-7-6E	H LOEPPKY	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1974	112.9	4.25	N.A.	229.8	N.A.	50	-4	-1	1
129	6-7-6E	HILLSIDE CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2001	113	5	N.A.	157	C.	25	-8	-1	N.A.
130	6-7-6E	M H R C	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1985	109.9	4.2	N.A.	174.9	N.A.	10	-7	25	0.5
131	6-7-6E	G D REMPEL	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1973	108.9	4	N.A.	122.9	N.A.	5	N.A.	N.A.	N.A.
132	6-7-6E	P HARDER	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1974	110.9	4.25	N.A.	204.9	N.A.	149.9	-15	-1.5	1

133	6-7-6E	E FREY	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1989	109.9	4.25	N.A.	279.8	C.	149.9	-5	N.A.	N.A.
134	6-7-6E	HABITAT FOR THE HUMANITIES	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2003	118	5	N.A.	137	C.	30	-6	-1	N.A.
135	6-7-6E	RICK KORNELSON	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2002	102	5	N.A.	145	C.	8	1.5	N.A.	N.A.
136	6-7-6E	PRAIRIE HOMES	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1998	140	5	N.A.	230	C.	40	N.A.	N.A.	N.A.
137	6-7-6E	KEN LOEPPKY	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2007	115	5	N.A.	218	C.	25	N.A.	N.A.	N.A.
138	6-7-6E	DAN REIMER	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2003	118	5	N.A.	218	C.	50	-8	-2	N.A.
139	6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2004	112	5	N.A.	198	C.	80	-2	-2	N.A.
140	6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661887.0	5489846.0	2006	111	5	N.A.	218	C.	200	-10	-1.5	N.A.
141	6-7-6E	R KLASSEN	KIANSKY BROS	Production	Domestic	661633.8	5489750.3	1991	108.9	4.5	N.A.	207.9	N.A.	20	-7.5	-1.9	2
142	6-7-6E	P PETERS	Friesen Drillers Ltd.	Production	Domestic	661633.8	661633.8	1979	110.9	4.25	N.A.	119.9	N.A.	15	N.A.	-2	2
143	6-7-6E	M H R C	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1984	109.9	4.3	N.A.	204.9	N.A.	50	-10	N.A.	N.A.
144	6-7-6E	H ENNS	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1984	112.9	4.3	N.A.	214.9	N.A.	50	-10	N.A.	N.A.
145	6-7-6E	ALEXANDER GEORGE	Echo Drilling Ltd.	Production	Domestic	661634.0	5489750.0	2011	133	5	N.A.	198	C.	40	13	14	1
146	6-7-6E	E KLIPPENSTEIN	LOUIS MONDOR WELL DRILLING	Production	Domestic	661633.8	5489750.3	1982	108.9	4.5	N.A.	125.9	N.A.	10	N.A.	2	2
147	6-7-6E	PRAIRIE HOMES INC	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1996	118	5	N.A.	210	C.	25	N.A.	N.A.	N.A.
148	6-7-6E	6290311 MB LTD.	Echo Drilling Ltd.	Production	Domestic	661386.8	5489156.1	2011	109	5	N.A.	220	C.	100	4.7	6	1
149	6-7-6E	J KEHLER	Echo Drilling Ltd.	Production	Domestic	661386.8	5489750.3	1992	113.9	5	N.A.	119.9	N.A.	75	-2	N.A.	4
150	6-7-6E	M GIEBRONT	L. Mondor Drilling	Production	Domestic	661633.8	5489750.3	1989	108.9	4.25	N.A.	219.9	N.A.	15	10	N.A.	0.5
151	6-7-6E	S SCHULER	Kiansky Bros. Ltd.	Production	Domestic	661633.75	5489750.3	1992	115.9	5	N.A.	118.9	C.	30	-5	N.A.	3
152	6-7-6E	B FRIESEN	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1991	114.9	4.1	N.A.	216.9	N.A.	30	-5	N.A.	N.A.
153	6-7-6E	6285326 MB LTD	Echo Drilling Ltd.	Production	Domestic	661634.0	5489750.0	2011	111	5	N.A.	159	C.	25	-6	-2	1
154	6-7-6E	JOHN STAHN	Echo Drilling Ltd	Production	Domestic	661633.8	5489750.3	2004	108	5	N.A.	218	C.	75	-7	-2	N.A.
155	6-7-6E	DAN REIMER	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2002	114	5	N.A.	157	C.	75	-8	-2	N.A.
156	6-7-6E	MITCHELL MIDDLE SCHOOL	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	2003	120	5	N.A.	218	C.	40	N.A.	N.A.	N.A.
157	6-7-6E	SKY PROM MARKETING INC	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1998	108	5	N.A.	218	C.	150	N.A.	N.A.	N.A.
158	6-7-6E	VOGT BUILDERS	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2006	109	5	N.A.	157	C.	50	4	60	N.A.
159	6-7-6E	J HARDER	LOUIS MONDOR WELL DRILLING	Production	Domestic	661633.8	5489750.3	1984	N.A.	4.5	N.A.	N.A.	N.A.	6	-2	N.A.	1.5
160	6-7-6E	W FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	661633.8	5489750.3	1994	113.9	5	N.A.	118.9	N.A.	65	-7	N.A.	0.5
161	6-7-6E	G DIRKSEN	mondor drillers	Production	Domestic	661633.8	5489750.3	1974	113.9	4	N.A.	131.9	N.A.	35	2	4	2
162	6-7-6E	JAMAN HOLDINGS	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	2002	106	5	N.A.	160	C.	50	-2.5	N.A.	N.A.
163	6-7-6E	JAKE WIENS	Echo Drilling Ltd.	Production	Domestic	661633.8	5489750.3	1996	108	5	N.A.	178	C.	30	-5	N.A.	N.A.
164	6-7-6E	M H R C	Friesen Drillers Ltd.	Production	Domestic	661633.8	5489750.3	1985	109.9	4.2	N.A.	206.9	N.A.	50	-12	-2	N.A.
165	6-7-6E	G S TOEWS	MANKEY, EMIL	Production	Domestic	661633.8	5489750.3	1963	108.9	3	N.A.	108.9	N.A.	N.A.	N.A.	N.A.	N.A.
166	NE6-7-6E	J STAHN	Friesen Drillers Ltd.	Production	Domestic,Livestock	661962.1	5490129.3	1982	99.9	4.25	N.A.	199.9	N.A.	149.9	-12	-1	2
167	NE6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	662215.0	5490041.0	2005	104	5	N.A.	218	C.	100	-12	-2	N.A.
168	NE6-7-6E	M STEFFAN	MANKEY, EMIL	Production	Domestic	661962.1	5490129.3	1971	119.9	4	N.A.	129.9	N.A.	5	14	18	12
169	NE6-7-6E	J FRIESEN	Echo Drilling Ltd.	Production	Domestic	661962.1	5490129.3	1988	119.9	4.2	N.A.	189.9	N.A.	15	-7	-2	2
170	NE6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661962.1	5490129.3	2006	107	5	N.A.	218	C.	75	-2.5	N.A.	N.A.
171	NE6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661897.0	5489770.0	2005	110	5	N.A.	197	C.	100	2.5	N.A.	N.A.
172	NE6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661959.0	5490125.0	2005	111	5	N.A.	218	C.	100	-2	N.A.	N.A.
173	NW6-7-6E	J HARDER	Friesen Drillers Ltd.	Production	Domestic	661282.6	5490108.8	1976	114.9	4.25	N.A.	133.9	N.A.	15	10	N.A.	N.A.
174	NW6-7-6E	SPRINGWOOD HOMES	Echo Drilling Ltd.	Production	Domestic	661282.6	5490108.8	2002	106	5	N.A.	140	C.	100	-1.5	N.A.	N.A.
175	SE6-7-6E	MITCHELL REC ASC	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1978	122.9	4.25	N.A.	217.9	N.A.	100	-8	-1	N.A.
176	SE6-7-6E	W FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	661969.1	5489400.4	1993	112.9	5	N.A.	119.9	N.A.	35	-9	84	0.5
177	SE6-7-6E	K THIEBERT	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1991	117.4	4	N.A.	211.9	N.A.	60	-1	0.33	N.A.
178	SE6-7-6E	D F DOERKSON	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1996	118	5	N.A.	218	C.	30	-4	N.A.	N.A.
179	SE6-7-6E	LORNE VOTH	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	116	5	N.A.	218	C.	N.A.	N.A.	N.A.	N.A.
180	SE6-7-6E	FRIESEN	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1991	111.9	5	N.A.	206.9	C.	100	7	N.A.	N.A.
181	SE6-7-6E	P K PENNER	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1973	112.9	4	N.A.	219.9	N.A.	30	1	5	N.A.
182	SE6-7-6E	J GIESBRECHT	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1976	115.9	4.25	N.A.	119.9	N.A.	40	-10	-2	1
183	SE6-7-6E	C F SCHELENBERG	mondor drillers	Production	Domestic	661969.1	5489400.4	1971	103.9	4	N.A.	113.9	N.A.	N.A.	-2	N.A.	N.A.
184	SE6-7-6E	M PATRAM	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1987	115.9	4.2	N.A.	215.9	N.A.	149.9	-5	-3	N.A.
185	SE6-7-6E	J KLASSEN	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1974	109.9	4.25	N.A.	115.9	N.A.	15	-9	N.A.	N.A.
186	SE6-7-6E	PRAIRIE PROPERTIES INC	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	117	5	N.A.	155	C.	40	N.A.	N.A.	N.A.
187	SE6-7-6E	H DEORKIN	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1985	29	4	5	38	N.A.	109.9	4	30	4

188	SE6-7-6E	J HIEBERT	EMIL MANKEY & SON	Production	Domestic	661969.1	5489400.4	1976	107.9	4.2	N.A.	110.9	N.A.	20	N.A.	N.A.	N.A.
189	SE6-7-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	118	5	N.A.	218	C.	50	N.A.	N.A.	N.A.
190	SE6-7-6E	H SCHMIDT	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1994	116.9	5	N.A.	209.9	N.A.	30	2	N.A.	N.A.
191	SE6-7-6E	E MARTINS	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1971	107.9	4	N.A.	N.A.	N.A.	15	8	N.A.	N.A.
192	SE6-7-6E	D WARKENTIN	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1994	107.9	5	N.A.	139.9	C.	15	-2	N.A.	8
193	SE6-7-6E	G BARKMAN	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1970	116.9	4	N.A.	214.9	N.A.	12	-6	6	12
194	SE6-7-6E	S DEARBORN	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1973	107.9	4	N.A.	107.9	N.A.	25	N.A.	N.A.	N.A.
195	SE6-7-6E	CHORTITZER CHURCH	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1974	115.9	4.25	N.A.	214.9	N.A.	70	-10	4	1
196	SE6-7-6E	HILLSIDE CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	2003	108	5	N.A.	218	C.	50	-7	-2	N.A.
197	SE6-7-6E	K FRIESEN	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1990	104.9	4.25	N.A.	119.9	C.	40	-1	N.A.	N.A.
198	SE6-7-6E	W HARDER	EMIL MANKEY & SON	Production	Domestic	661969.1	5489400.4	1976	91.9	4.2	N.A.	206.9	N.A.	2	N.A.	30	N.A.
199	SE6-7-6E	A DUECK	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1987	110.9	4.1	N.A.	139.9	C.	15	-7	-3	N.A.
200	SE6-7-6E	JIM KROEKER	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1999	114	5	N.A.	220	C.	50	1	40	N.A.
201	SE6-7-6E	K HEIBERT	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1988	120.9	4	N.A.	205.9	N.A.	30	-5	N.A.	N.A.
202	SE6-7-6E	R REMPEL	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1993	110.9	5	N.A.	159.9	N.A.	20	-2	N.A.	N.A.
203	SE6-7-6E	STEVE HRUDA	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	113	5	N.A.	137	C.	35	-1	40	N.A.
204	SE6-7-6E	KRAHN	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1990	120.4	4	N.A.	123.4	C.	80	N.A.	45	2
205	SE6-7-6E	J KROEKER	EMIL MANKEY & SON	Production	Domestic	661969.1	5489400.4	1976	96.9	4.2	N.A.	115.9	N.A.	6	N.A.	N.A.	N.A.
206	SE6-7-6E	GEROLD FRIESEN	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1997	118	5	N.A.	217	C.	50	-7	80	N.A.
207	SE6-7-6E	D THIESSEN	Echo Drilling Ltd	Production	Domestic	661969.1	5489400.4	1988	109.9	4.2	N.A.	214.9	N.A.	50	-8	N.A.	N.A.
208	SE6-7-6E	J GINTES	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1975	107.9	4.25	N.A.	214.9	N.A.	100	-10	-2.5	2
209	SE6-7-6E	R FAST	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1976	109.9	4.25	N.A.	119.9	N.A.	50	2	2	N.A.
210	SE6-7-6E	BUCHHOLZ BROTHERS	Echo Drilling Ltd	Production	Domestic	661715.0	5489589.8	2011	115	5	N.A.	137	N.A.	100	4	20	1
211	SE6-7-6E	WILLIE FRIESEN	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1996	114	N.A.	N.A.	190	N.A.	10	-8	-2.5	-2
212	SE6-7-6E	B STAHN	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1986	110.9	4	N.A.	118.9	C.	12	-6	N.A.	1
213	SE6-7-6E	ALEXANDER KONRADI	L. Mondor Drilling	Production	Domestic	661969.1	5489400.4	2003	104	5	N.A.	120	N.A.	15	10	10	N.A.
214	SE6-7-6E	W PETERS	Echo Drilling Ltd	Production	Domestic	661969.1	5489400.4	1987	110.9	4.1	N.A.	206.9	N.A.	60	-7	-2	2
215	SE6-7-6E	SKY PROM HOMES	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1995	108.9	5	N.A.	206.9	C.	50	-1.5	N.A.	4
216	SE6-7-6E	RANDY FUNK	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1997	108	5	N.A.	138	C.	40	N.A.	N.A.	N.A.
217	SE6-7-6E	A KROEKER	Echo Drilling Ltd	Production	Domestic	661969.1	5489400.4	1995	115.9	5	N.A.	209.9	C.	25	-2	N.A.	2
218	SE6-7-6E	G D REMPEL	EMIL MANKEY & SON	Production	Domestic	661969.1	5489400.4	1975	98.9	4.25	N.A.	109.9	N.A.	15	-5	30	N.A.
219	SE6-7-6E	P PETERS	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1977	114.4	4.25	N.A.	219.9	N.A.	70	-6	-1	N.A.
220	SE6-7-6E	J HIEBERT	MANKEY WATER WELL DRILLING	Production	Domestic	661969.1	5489400.4	1988	113.9	4.2	N.A.	119.9	N.A.	10	N.A.	40	24
221	SE6-7-6E	P ELIAS	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1972	110.9	4	N.A.	127.9	N.A.	2.5	N.A.	12	N.A.
222	SE6-7-6E	J W NUEFELD	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1969	111.9	4	N.A.	124.9	N.A.	5	-5	16	24
223	SE6-7-6E	BEN PETERS	Echo Drilling Ltd.	Production	Domestic	662015.0	5489094.7	2010	N.A.	5	N.A.	140	C.	50	10	N.A.	1
224	SE6-7-6E	RUDY KOOP	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1997	113	5	N.A.	137	C.	20	-7	30	N.A.
225	SE6-7-6E	MITCHELL COMM CENTRE	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1994	101.9	5	N.A.	194.9	C.	149.9	2	N.A.	N.A.
226	SE6-7-6E	J DUECK	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1975	110.9	4.25	N.A.	217.9	N.A.	35	-10	-1.5	2
227	SE6-7-6E	JASON FEHR	Echo Drilling Ltd.	Production	Domestic	661968.7	5489396.9	2009	110	5	N.A.	206	C.	100	-10	-2	N.A.
228	SE6-7-6E	PRAIRIE PROPERTIES INC	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	113	5	N.A.	167	C.	80	-1	100	N.A.
229	SE6-7-6E	LAVERGNE PENNER	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	2003	114	5	N.A.	217	C.	100	-10	-2	N.A.
230	SE6-7-6E	CORY LOEPPKY	Kransky Bros. Ltd.	Production	Domestic	661969.0	5489397.0	2009	116	5	N.A.	216	C.	50	-4	N.A.	N.A.
231	SE6-7-6E	E MARTINS	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1989	116.9	4	N.A.	194.9	N.A.	20	-3.5	-2	N.A.
232	SE6-7-6E	ENNS	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1981	112.9	4.5	N.A.	199.9	N.A.	100	-10	N.A.	N.A.
233	SE6-7-6E	MRS H DUECK	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1966	110.9	4	N.A.	116.9	N.A.	20	-13	N.A.	N.A.
234	SE6-7-6E	G & E HOMES	Kransky Bros. Ltd.	Production	Domestic	661969.1	5489400.4	1993	116.4	5	N.A.	204.9	N.A.	20	-6	N.A.	1.5
235	SE6-7-6E	A D KELHER	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1973	115.9	4.5	N.A.	210.9	N.A.	25	N.A.	N.A.	N.A.
236	SE6-7-6E	R KLASSEN	KIANSKY BROS	Production	Domestic	661969.1	5489400.4	1987	90.9	4	5	99.9	N.A.	14	7	60	N.A.
237	SE6-7-6E	C THIESSEN	KIANSKY BROS.	Production	Domestic	661969.1	5489400.4	1989	17	4	10	39	N.A.	12	4	5	2.5
238	SE6-7-6E	A HEIBERT	L. Mondor Drilling	Production	Domestic	661969.1	5489400.4	1988	108.9	4.2	N.A.	164.9	N.A.	2	-3	N.A.	30.5
239	SE6-7-6E	DICK PENNER	Echo Drilling Ltd	Production	Domestic	661969.1	5489400.4	2003	110	5	N.A.	157	N.A.	20	N.A.	N.A.	N.A.
240	SE6-7-6E	SKY PROM MARKTING INC	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	2004	108	5	N.A.	157	C.	40	N.A.	N.A.	N.A.
241	SE6-7-6E	D NEUFELD	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1974	112.9	4.5	N.A.	218.9	N.A.	224.9	-18	-2	1.5
242	SE6-7-6E	G D REMPEL	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1972	105.9	4	N.A.	110.9	N.A.	15	N.A.	N.A.	N.A.

243	SE6-7-6E	JORMEL ENTERPRISES-HARV BARKMAN	Echo Drilling Ltd.	Production	Domestic	662227.7	5489159.5	2011	116	5	N.A.	217	C.	75	-6	-2	1
244	SE6-7-6E	G KEHLER	MANKEY, EMIL	Production	Domestic	661969.1	5489400.4	1972	106.9	4	N.A.	122.9	N.A.	2.5	-10	-10	N.A.
245	SE6-7-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1995	116.9	5	N.A.	214.9	C.	100	-1	N.A.	4
246	SE6-7-6E	C FUNK	mondor drillers	Production	Domestic	661969.1	5489400.4	1972	101.9	4	N.A.	105.9	N.A.	N.A.	N.A.	N.A.	N.A.
247	SE6-7-6E	A N FELAR	EMIL MANKEY & SON	Production	Domestic	661969.1	5489400.4	1977	105.9	4.1	N.A.	126.9	N.A.	2	N.A.	N.A.	N.A.
248	SE6-7-6E	FRIESEN AND TOEWS	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1991	116.9	4.2	N.A.	204.9	N.A.	40	-4	N.A.	N.A.
249	SE6-7-6E	MARYANN HILDEBRANDT	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	2000	115	5	N.A.	158	C.	100	-6	2	N.A.
250	SE6-7-6E	CHRIS KROEKER	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1998	110	5	N.A.	217	C.	150	-10	N.A.	N.A.
251	SE6-7-6E	M KROEZE	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	116.9	4.2	N.A.	209.9	N.A.	30	2	10	1
252	SE6-7-6E	P S KEHLER	Friesen Drillers Ltd.	Production	Domestic	661969.1	5489400.4	1964	112.9	4	N.A.	119.9	N.A.	6	-5	40	0.25
253	SE6-7-6E	VIC HOLSTEIN	Echo Drilling Ltd.	Production	Domestic	660970.0	5487787.1	2003	114	5	N.A.	137	C.	100	-8	N.A.	N.A.
254	SE6-7-6E	J KEHLER	Echo Drilling Ltd.	Production	Domestic	661969.1	5489400.4	1987	111.9	4	N.A.	214.9	N.A.	10	-7	-2	N.A.
255	SE6-7-6E	SKY PIOM HOMES	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1995	117.9	5	N.A.	217.9	C.	20	N.A.	N.A.	N.A.
256	SE6-7-6E	HANOVER SCHOOL DIVISION	Friesen Drillers Ltd.	Production	GEOTHERMAL	661463.0	5489378.0	1986	115.9	6.2	N.A.	219.9	N.A.	100	-6	-2	2
257	SE6-7-6E	HANOVER SCHOOL DIVISION	Friesen Drillers Ltd.	RECHARGE	-	661421.0	5489446.0	1986	117.9	6.2	N.A.	241.8	N.A.	90	-6	-2	2
258	SE6-7-6E	HANOVER SCHOOL DIVISON	Friesen Drillers Ltd.	Production	Domestic	661969.0	5489397.0	1986	116.9	5	N.A.	219.9	N.A.	50	-6	-2	2
259	SE6-7-6E	MITCHELL SENIORS	Echo Drilling Ltd.	RECHARGE	Air Conditioning	661969.1	5489400.4	1991	108.9	4.25	N.A.	204.9	C.	8	-2	10	1
260	SE6-7-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	661920.0	5489647.0	2005	115	5	N.A.	218	C.	250	2	N.A.	N.A.
261	SW6-7-6E	H. KLASSEN	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	2002	113	5	N.A.	217	C.	20	-7	-3	N.A.
262	SW6-7-6E	E K DUECK	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1989	111.9	4.25	N.A.	119.9	C.	20	N.A.	N.A.	N.A.
263	SW6-7-6E	J THEISSEN	KIANSKY BROS.	Production	Domestic	661304.4	5489379.1	1988	113.9	4	N.A.	116.9	N.A.	149.9	-1	30	2
264	SW6-7-6E	G P SCHROEDER	MANKEY, EMIL	Production	Domestic	661304.4	5489379.1	1969	91.9	4	N.A.	205.9	N.A.	20	-16	N.A.	N.A.
265	SW6-7-6E	WM C S FRIESEN	MANKEY, EMIL	Production	Domestic	661304.4	5489379.1	1969	114.9	4	N.A.	118.9	N.A.	9	-6	6	2
266	SW6-7-6E	B D R REIMER	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1994	114.9	5	N.A.	157.9	N.A.	15	-2	2	N.A.
267	SW6-7-6E	WILLY FRIESEN	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	2001	112	5	N.A.	218	C.	50	-7	N.A.	N.A.
268	SW6-7-6E	JAKE BERGEN	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	1996	114	5	N.A.	155	N.A.	30	-7	-2	1
269	SW6-7-6E	W FRIESEN	MANKEY, EMIL	Production	Domestic	661304.4	5489379.1	1974	104.9	4.25	N.A.	124.9	N.A.	2.5	-8	N.A.	N.A.
270	SW6-7-6E	H&F CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	2003	121	5	N.A.	157	C.	30	N.A.	N.A.	N.A.
271	SW6-7-6E	GARRY MCLEAN	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	1996	108	5	N.A.	130	C.	50	-2	N.A.	N.A.
272	SW6-7-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	1995	111.9	5	N.A.	134.9	C.	100	-3	N.A.	4
273	SW6-7-6E	D F DOERKSEN	mondor drillers	Production	Domestic	661304.4	5489379.1	1972	114.9	N.A.	N.A.	210.9	N.A.	N.A.	N.A.	N.A.	N.A.
274	SW6-7-6E	DO WALT CUSTOM HOMES INC	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	2004	110	5	N.A.	157	C.	30	-7	-2	N.A.
275	SW6-7-6E	PETER K PENNER	Echo Drilling Ltd.	Production	Domestic	661304.4	5489379.1	1996	107	4	N.A.	140	C.	40	-2.5	N.A.	4
276	7-7-6E	A H NEUFELD	LOUIS MONDOR WELL DRILLING	Production	Domestic	661595.0	5491315.5	1984	118.9	4.3	N.A.	129.9	N.A.	12	6	8	15
277	NE7-7-6E	N BURKETT	Echo Drilling Ltd.	Production	Domestic	661925.7	5491732.4	1993	31	5	5	41	N.A.	30	5	7	2
278	NE7-7-6E	MARTHA PENNER	UNKNOWN	Production	Domestic	662227.0	5491473.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
279	NE7-7-6E	GORD BLATZ	UNKNOWN	Production	-	661925.7	5491732.4	1999	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
280	SW7-7-6E	RICK BERGMAN	UNKNOWN	Production	-	660966.0	5490673.0	1985	N.A.	36	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
281	SW7-7-6E	JIM PENNER	Friesen Drillers Ltd.	Production	Domestic	661263.3	5490906.5	1985	106.9	4.2	N.A.	234.8	N.A.	20	3	30	2
282	8-7-6E	J NEUFELD	mondor drillers	Production	Domestic	663111.8	5491355.3	1978	98.9	4	N.A.	117.9	N.A.	N.A.	N.A.	N.A.	N.A.
283	NE8-7-6E	H KRAHN	KIANSKY BROS.	Production	Domestic,Livestock	663506.3	5491771.5	1991	92.9	5	N.A.	174.9	N.A.	46	-1	N.A.	5
284	NE8-7-6E	LOEWEN CHEV OLDS	Friesen Drillers Ltd.	Production	Domestic	663506.3	5491771.5	1974	93.9	4.25	N.A.	119.9	N.A.	100	-5	-1	10
285	NW8-7-6E	G TOPNIK	MANKEY, EMIL	Production	Domestic	662699.1	5491752.3	1974	149.9	7.25	N.A.	194.9	N.A.	20	25	40	30
286	NW8-7-6E	VERN NEUFELD	UNKNOWN	Production	-	662405.0	5491807.0	1989	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
287	NW8-7-6E	MYRNA WAERLEN	Friesen Drillers Ltd.	Production	Domestic	662378.0	5491882.0	1977	84.9	4.25	N.A.	99.9	N.A.	30	5	7	N.A.
288	SE8-7-6E	CITY OF STEINBACH	UNKNOWN	OBSERVATION	-	663523.0	5490960.0	1993	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
289	SW8-7-6E	A K BUHLER	MANKEY, EMIL	Production	Domestic	662716.1	5490946.9	1973	95.9	N.A.	N.A.	117.9	N.A.	7	12	N.A.	N.A.
290	SW8-7-6E	C REMPLE LANGLOIS	Echo Drilling Ltd.	Production	Domestic	662716.1	5490946.9	1989	82.9	4.25	N.A.	99.9	N.A.	25	2	60	1
291	NE9-7-6E	ANNE SCHWENG	UNKNOWN	Production	Domestic	665507.0	5491608.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
292	NE9-7-6E	W FRIESEN	Friesen Drillers Ltd.	Production	Domestic	665149.7	5491815.8	1976	79.9	4.25	N.A.	134.9	N.A.	15	-7	24	1
293	NE9-7-6E	W KROEKER	Friesen Drillers Ltd.	Production	Domestic	665149.7	5491815.8	1985	84.9	4.2	N.A.	174.9	N.A.	15	4	28	1
294	NE9-7-6E	K FARMS/CLARENCE KROEKER	Paul Slusarchuk Well Drilling LTd.	Production	Domestic	665149.7	5491815.8	1998	83	5	N.A.	137	C.	25	1	80	N.A.

295	NE9-7-6E	NIKOLAJ DIK	UNKNOWN	Production	Domestic	665152.0	5491811.0	1962	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
296	NW9-7-6E	EMANUEL BUNK	UNKNOWN	Production	-	663991.0	5491166.0	1985	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
297	SW9-7-6E	D MARTIN	Friesen Drillers Ltd.	Production	Domestic	664356.3	5490985.6	1985	45	4.2	5	50	N.A.	30	-4	2	2
298	SW9-7-6E	ELEANOR PENNER	UNKNOWN	Production	-	665592.0	5490451.0	1935	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
299	NE10-7-6E	P J PENNER	Friesen Drillers Ltd.	Production	Domestic,Livestock	666792.4	5491850.9	1976	92.9	4.25	N.A.	99.9	N.A.	179.9	-10	-1.5	2
300	NE10-7-6E	REIMER FARM SUPPLY	Echo Drilling Ltd.	Production	Air conditioning	666795.0	5491846.0	2007	90	5	N.A.	197	C.	90	-3.5	-3	N.A.
301	NE10-7-6E	REIMER FARM SUPPLY	Echo Drilling Ltd.	Production	Air conditioning	666795.0	5491846.0	2007	90	5	N.A.	197	C.	100	-3	14	N.A.
302	NW10-7-6E	B CHORNOBOY	Echo Drilling Ltd.	Production	Domestic	665986.8	5491835.9	1990	76	4.2	4.9	84.9	N.A.	20	10	14	2
303	SE10-7-6E	FRIENDLY FAMILY FARM	Friesen Drillers Ltd.	Production	Industrial	666806.9	5491046.0	1964	96.9	8	N.A.	149.9	N.A.	149.9	-15	N.A.	N.A.
304	SE10-7-6E	FRIENDLY FAMILY FARM	Friesen Drillers Ltd.	Production	Industrial	666806.9	5491046.0	1970	91.9	8	N.A.	224.8	N.A.	199.9	-22	6	12
305	11-7-6E	WOSTCO CONTRACTORS	Echo Drilling Ltd.	Production	Domestic	668039.3	5491473.8	2000	93	5	N.A.	200	C.	250	-7.5	-2	N.A.
306	11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	668039.0	5491474.0	2011	105	5	N.A.	198	C.	80	11	80	1
307	11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	668039.0	5491474.0	2011	106	5	N.A.	200	C.	60	1	2.5	N.A.
308	11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	668039.0	5491474.0	2011	106	5	N.A.	198	C.	25	6	7	1
309	NE11-7-6E	J FRIESEN	Friesen Drillers Ltd.	Production	Domestic,Livestock	668434.6	5491891.0	1982	99.9	4	N.A.	119.9	N.A.	50	-10	-2	12
310	NE11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	-	668438.0	5491885.0	2011	106	5	N.A.	198	C.	80	5	75	0.5
311	NE11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	668438.0	5491885.0	2011	106	5	N.A.	199	C.	100	6	8	1
312	NE11-7-6E	FRIESEN FARMS INC	Paul Shusarchuk Well Drilling LTd.	Production	Livestock	668434.6	5491891.0	1992	97.4	5	N.A.	184.9	C.	80	3	7	N.A.
313	NE11-7-6E	THREE WAY BUILDERS	Echo Drilling Ltd.	Production	Domestic	668438.0	5491885.0	2011	104	5	N.A.	198	C.	100	6	8	1
314	NE11-7-6E	J FRIESEN FARMS	Friesen Drillers Ltd.	Production	Domestic	668434.6	5491891.0	1986	99.9	4.2	N.A.	139.9	N.A.	20	-4	-1	2
315	NW11-7-6E	JOHN DYCK	Echo Drilling Ltd.	Production	Air conditioning	667878.0	5491677.0	2007	88	5	N.A.	200	C.	70	5	N.A.	N.A.
316	SE11-7-6E	ROY LOEWEN	Echo Drilling Ltd.	Production	Domestic	668450.3	5491084.9	1998	104	5	N.A.	120	C.	20	2	N.A.	N.A.
317	SW11-7-6E	MENNONITE VILLAGE	MANKEY, EMIL	Production	Domestic	667642.9	5491064.4	1966	92.9	5	N.A.	95.9	N.A.	30	N.A.	N.A.	N.A.
318	SW11-7-6E	STEINBACH FLY-IN GOLF CLUB	Friesen Drillers Ltd.	Production	Irrigation	668451.0	5489855.0	2007	108.9	10	N.A.	258	N.A.	165	5	8	N.A.
319	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	105	5	N.A.	180	C.	90	6	71	N.A.
320	SW11-7-6E	JOBET ENTERPRISES INC	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2004	99	5	N.A.	257	C.	100	6	60	N.A.
321	SW11-7-6E	GILMER PENNER	Echo Drilling Ltd.	Production	Domestic	667645.9	5491057.3	2009	106	5	N.A.	177	C.	75	3	80	N.A.
322	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	667646.0	5491057.0	2010	N.A.	N.A.	N.A.	N.A.	N.A.	100	1	60	1
323	SW11-7-6E	MENNONITE MUSEUM	Friesen Drillers Ltd.	Production	Livestock	667642.9	5491064.4	1979	20	4.25	5	28	N.A.	35	8	20	3
324	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd	Production	Domestic	668696.0	5490554.0	2009	108	5	N.A.	178	C.	100	N.A.	75	N.A.
325	SW11-7-6E	MENNONITE MUSEUM	Friesen Drillers Ltd.	Production	Domestic,Livestock	667642.9	5491064.4	1976	94.9	6	N.A.	239.8	N.A.	299.9	5	1.5	2
326	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	105	5	N.A.	180	C.	80	6	13	N.A.
327	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	667646.0	5491057.0	2010	104	5	N.A.	177	C.	100	1	80	1
328	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	107	5	N.A.	180	C.	80	11	13	N.A.
329	SW11-7-6E	STEINBACK FLYING C	Friesen Drillers Ltd.	Production	Domestic	667642.9	5491064.4	1981	20	4.25	5	30	N.A.	45	7	12	2
330	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	105	5	N.A.	180	C.	90	5	11	N.A.
331	SW11-7-6E	TRUCKS UNLIMITED C/O JOHN FEHR	Echo Drilling Ltd.	Production	Domestic	667337.0	5493060.0	2003	99	5	N.A.	175	C.	50	5	80	N.A.
332	SW11-7-6E	PAUL GODIN	Echo Drilling Ltd.	RECHARGE	Domestic	667646.0	5491057.0	2007	99	5	N.A.	197	C.	100	1	14	N.A.
333	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	110	5	N.A.	180	C.	60	7.6	12	N.A.
334	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd	Production	Domestic	667646.0	5491057.0	2008	105	5	N.A.	180	B.	100	3	75	N.A.
335	SW11-7-6E	147368	Echo Drilling Ltd.	Production	Domestic	668695.0	5490646.0	2008	107	5	N.A.	130	C.	50	2	40	N.A.
336	SW11-7-6E	PAUL GODIN	Echo Drilling Ltd.	Production	Domestic	667646.0	5491057.0	2007	99	5	N.A.	197	C.	100	-2	3	N.A.
337	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	105	5	N.A.	200	C.	90	8	11	N.A.
338	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	104	5	N.A.	180	C.	90	6	13	N.A.
339	SW11-7-6	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	104	5	N.A.	180	C.	50	6	15	N.A.
340	SW11-7-6E	STEINBACH FLY-IN GOLF CLUB	Friesen Drillers Ltd.	Production	Domestic	667815.8	5490686.7	2010	92.5	8	N.A.	260	N.A.	600	2.5	N.A.	1

341	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	668828.0	5490663.0	2008	106	5	N.A.	180	C.	100	4	75	N.A.
342	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	127	5	N.A.	180	C.	100	6.6	12	N.A.
343	SW11-7-6E	JOBET ENTERPRISES INC	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2004	99	5	N.A.	257	C.	10	6	60	N.A.
344	SW11-7-6E	GOLDMARK DEVELOPMENT	Echo Drilling Ltd.	Production	Domestic	667642.9	5491064.4	2006	100	5	N.A.	180	C.	80	6	13	N.A.
345	SW11-7-6E	STEINBACH GOLF COURSE	Friesen Drillers Ltd.	Production	Domestic	668033.0	5490619.0	1983	99.9	4.3	N.A.	154.9	N.A.	15	10	20	1
346	SW11-7-6E	STEINBACH GOLF COURSE	MANKEY, EMIL	Production	Irrigation	667559.0	5490742.0	1970	95.9	6	N.A.	159.9	N.A.	90	6	N.A.	N.A.
347	SW11-7-6E	STEINBACH GOLF	MANKEY, EMIL	Production	Domestic	667598.0	5491014.0	1970	32.9	4	N.A.	96.9	N.A.	20	12	N.A.	N.A.
348	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	667646.0	5491057.0	2010	105	5	N.A.	177	C.	100	1	80	1
349	SW11-7-6E	GOLDMARK DEVELOPMENTS	Echo Drilling Ltd.	Production	Domestic	667646.0	5491057.0	2010	105	5	N.A.	177	C.	100	1	80	1
350	NE12-7-6E	GORD BARTEL	Echo Drilling Ltd.	Production	Domestic	670389.0	5491862.0	2008	95	5	N.A.	178	N.A.	25	1	10	N.A.
351	NE12-7-6E	G BARTE	Echo Drilling Ltd.	Production	Domestic	670080.7	5491923.0	1990	93.9	4.25	N.A.	174.9	N.A.	15	6	13	2
352	NW12-7-6E	E LAING	MANKEY, EMIL	Production	Domestic	669272.5	5491908.5	1972	100.9	6	N.A.	109.9	N.A.	40	N.A.	N.A.	N.A.
353	NW12-7-6E	NOT REPORTED	UNKNOWN	Production	-	669502.0	5491751.0	1998	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
354	SE12-7-6E	D. BAIRSTON	UNKNOWN	Production	-	670095.4	5491112.4	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
355	SE12-7-6E	RICHARD MARTIN	Echo Drilling Ltd.	Production	Domestic	670095.4	5491112.4	2002	102	5.5	N.A.	197	C.	50	3	60	N.A.
356	SE12-7-6E	W DEARBORN	EMIL MANKEY & SON	Production	Domestic	670095.4	5491112.4	1976	186	4.2	N.A.	186.9	N.A.	10	2	10	1
357	SW12-7-6E	DOUGLAS BAIRSTOW	Echo Drilling Ltd.	Production	Domestic	669288.3	5491102.4	2001	101	5	N.A.	180	C.	16	2	4	N.A.
358	13-7-6E	ROB BRANDT	Paul Shsarchuk Well Drilling LTd.	Production	Domestic	669654.3	5493157.0	1998	95	5	N.A.	135	C.	5	3	50	N.A.
359	NE13-7-6E	B SAWATZKY	Echo Drilling Ltd.	Production	Domestic	670050.3	5493574.2	1987	169.9	4.2	N.A.	212.9	N.A.	15	25	30	N.A.
360	NE13-7-6E	DAN BACKMAN	EMIL MANKEY & SON	Production	Domestic	669990.0	5493033.0	1943	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
361	SW13-7-6E	J BARTEL	mondor drillers	Production	Domestic	669257.1	5492747.7	1970	N.A.	N.A.	N.A.	N.A.	N.A.	3	6	N.A.	1
362	SW13-7-6E	A FAST	FRIESEN, TONY	Production	Domestic	669257.1	5492747.7	1969	76.2	5	N.A.	77.7	N.A.	90	5	N.A.	N.A.
363	SW13-7-6E	ROBIN & JEN BRANDT	UNKNOWN	Production	Domestic	669754.0	669754.0	1975	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
364	SW13-7-6E	ROBERT WARKENTIN	MANKEY, EMIL	Production	Domestic	669257.1	5492747.7	1972	79.9	4	N.A.	79.9	N.A.	2.5	1	28	24
365	SW13-7-6E	D BARTEL	Friesen Drillers Ltd	Production	Domestic	669257.1	5492747.7	1984	96.9	4.3	N.A.	114.9	N.A.	50	1	5	N.A.
366	SW13-7-6E	J LOEWS	MANKEY, EMIL	Production	Domestic	669257.1	5492747.7	1971	80.9	4	N.A.	80.9	N.A.	6	8	N.A.	N.A.
367	SW13-7-6E	TIFFANY SAWATSKY	UNKNOWN	Production	Domestic	669172.0	5492932.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
368	14-7-6E	M DIEFEL	Friesen Drillers Ltd.	Production	Domestic	668010.5	5493124.0	1985	62	4.2	5	70	N.A.	15	2	20	N.A.
369	SE14-7-6E	JOHN AND MARINA FROESE	Echo Drilling Ltd.	Production	Domestic	668420.2	5492731.3	2006	104	5	N.A.	180	C.	40	-2.6	-2	N.A.
370	SE14-7-6E	RUSS PENNER	Echo Drilling Ltd.	OBSERVATION	Air conditioning	668771.0	5492497.0	2006	90	5	N.A.	180	C.	27	5	1	N.A.
371	SE14-7-6E	M PENNER	Friesen Drillers Ltd.	Production	Domestic	668420.2	5492731.3	1969	87.1	5	N.A.	129.9	N.A.	20	2	N.A.	N.A.
372	SE14-7-6E	RUSS PENNER	Echo Drilling Ltd.	Production	Domestic,Air conditioning	668771.0	5492497.0	2006	91	5	N.A.	180	C.	100	5	1	N.A.
373	SE14-7-6E	K P PENNER	Friesen Drillers Ltd.	Production	Domestic	668420.2	5492731.3	1978	96.9	4.25	N.A.	159.9	N.A.	20	7	1	N.A.
374	SW14-7-6E	HDM HOLDINGS	Echo Drilling Ltd.	Production	Domestic	667614.0	5492709.5	2002	86	5	N.A.	157	C.	200	-12	-2	N.A.
375	SW14-7-6E	C T LOEWNS	Friesen Drillers Ltd.	Production	Domestic	667614.0	5492709.5	1977	96.4	4.25	N.A.	114.9	N.A.	10	6	1	N.A.
376	SW14-7-6E	C T LOEWEN & SONS	Friesen Drillers Ltd.	Production	Industrial	667614.0	5492709.5	1976	89.9	4.25	N.A.	229.8	N.A.	299.868	-10	-2	12
377	SW14-7-6E	STEINBACH SOIL	Friesen Drillers Ltd.	Production	Domestic	667614.0	5492709.5	1982	94.9	4.25	N.A.	149.9	N.A.	19.987	-8	-2	1
378	SW-14-7-6E	C T LOEWNS	Friesen Drillers Ltd.	Production	Domestic	667614.0	5492709.5	1977	96.4	4.25	N.A.	114.9	N.A.	10	-6	-1	N.A.
379	SW14-7-6E	HDM HOLDINGS	Echo Drilling Ltd.	Production	Domestic	667614.0	5492709.5	2002	86	5	N.A.	157	C.	200	-12	-2	N.A.
380	SW-14-7-6E	CON PRO INDUSTRIES	Echo Drilling Ltd.	Production	Industrial	667614.0	5492709.5	1990	100.9	4.1	N.A.	117.9	N.A.	24.987	-4	N.A.	8
381	SW14-7-6E	ELDEN FUCHS - CHABOT	UNKNOWN	Production	Geothermal, Air conditioning	667244.0	5493020.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
382	SW14-7-6E	DIAMOND READY MIX - CONSTRUCTION	Friesen Drillers Ltd	Production	Industrial	667459.0	5442571.0	1976	93.9	4.25	N.A.	239.8	N.A.	149.934	-10	-2.5	1
383	NW15-7-6E	REIMER	Friesen Drillers Ltd	Production	Domestic,Livestock	665957.0	5493473.0	1982	85.9	4.25	N.A.	239.8	N.A.	34.987	-6	-2	N.A.
384	NW16-7-6E	DENNIS REIMER	Echo Drilling Ltd.	Production	Domestic	664311.8	5493434.9	2002	93	5	N.A.	257	C.	50	-1	80	N.A.
385	NE17-7-6E	DENVER REIMER	EMIL MANKEY & SON	Production	-	663760.0	5493156.0	1920	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
386	18-7-6E	R BERAMANN	Echo Drilling Ltd.	Production	Domestic	661557.3	5492955.8	1995	86.9	5	N.A.	197.9	C.	59.974	6	22	N.A.
387	NW18-7-6E	JOHN DYCK	UNKNOWN	Production	Domestic	661360.0	5493232.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
388	NW-18-7-6E	V KRAHN	EMIL MANKEY & SON	Production	Domestic	661196.1	5493354.0	1976	95.9	4.5	N.A.	125.9	N.A.	1	2	119.9	N.A.

389	SE18-7-6E	FRIENDLY FAMILY FARMS	Echo Drilling Ltd.	Production	Domestic	661909.0	5492564.0	2010	95	5	N.A.	237	N.A.	75	6	80	1
390	SE18-7-6E	ALANA PENNER	UNKNOWN	Production	Domestic	661525.0	5493239.0	1918	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
391	SE-20-7-6E	K REIMER	Echo Drilling Ltd.	Production	Domestic	663459.8	5494253.9	1988	91.9	4.2	N.A.	249.8	N.A.	49.974	0	20	2
392	SW20-7-6E	LAYNE PENNER	UNKNOWN	Production	Domestic	662981.0	5495400.0	1940	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
393	SE21-7-6E	WILLOW BEND FARMS	Echo Drilling Ltd.	Production	Domestic	665101.3	5494293.7	2004	79	5	N.A.	250	B.	75	2	70	N.A.
394	NE-21-7-6E	P BARKMAN	EMIL MANKEY & SON	Production	Domestic	665084.6	5495099.7	1978	83.9	4.25	N.A.	171.9	N.A.	2.005	8	99.9	N.A.
395	NW21-7-6E	WILLOW BEND FARMS	Echo Drilling Ltd	Production	Livestock	664279.6	5495084.7	1992	86.9	5	N.A.	259.8	N.A.	149.934	6	75	2
396	NW21-7-6E	TWIN CREEK BROILER FARMS	Echo Drilling Ltd	Production	Livestock	664279.6	5495084.7	2004	105	5	N.A.	257	B.	75	10	80	N.A.
397	SW21-7-6E	SHERRY WIEWEL	UNKNOWN	Production	Domestic	663908.0	5493920.0	1951	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
398	SW-21-7-6E	A REIMER	Friesen Drillers Ltd.	Production	Domestic	664295.9	5494271.2	1983	88.9	4.3	N.A.	189.9	N.A.	6.992	15	70	N.A.
399	SW21-7-6E	M REIMER	Friesen Drillers Ltd.	Production	Domestic,Livestock	664295.9	5494271.2	1980	121.9	4.25	N.A.	244.8	N.A.	19.987	-5	-1	2
400	22-7-6E	LOEWEN HILL FARMS	Echo Drilling Ltd.	Production	Domestic,Livestock	666337.1	5494720.0	1989	140.9	5	N.A.	254.8	N.A.	99.96	20	50	1
401	NE22-7-6E	EILEEN REIMER	Friesen Drillers Ltd.	Production	-	667883.0	5494794.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
402	NE-22-7-6E	C P PENNER	EMIL MANKEY & SON	Production	Domestic	666733.6	5495134.9	1977	88.9	4.25	N.A.	176.9	N.A.	15	14	28	N.A.
403	NW22-7-6E	LOEWEN HILL FARM	Echo Drilling Ltd.	Production	Domestic	666172.0	5495175.0	2009	97	5	N.A.	233	C.	50	21	45	N.A.
404	SE22-7-6E	M REIMER	Echo Drilling Ltd.	Production	Domestic	666748.2	5494334.0	1990	86.9	5	N.A.	239.8	N.A.	49.974	15	N.A.	N.A.
405	SW-22-7-6E	J PLETT	DAVIE, LESLIE W.	Production	Domestic,Livestock	665939.6	5494313.0	1980	76	4.25	N.A.	82.9	N.A.	39.987	7	12	N.A.
406	SW22-7-6E	L PLETT	Friesen Drillers Ltd.	Production	Domestic,Livestock	665939.6	5494313.0	1986	88.9	4.2	N.A.	259.8	N.A.	24.987	0.5	6	N.A.
407	SW-22-7-6E	B L REIMER	MANKEY, EMIL	Production	Domestic	665939.6	5494313.0	1970	81.9	4	N.A.	125.9	N.A.	47.982	3	5	48
408	SW23-7-6E	ALBERT LOEWEN	MANKEY, EMIL	Production	Domestic	667585.1	5494357.0	1970	91.9	4	N.A.	95.9	N.A.	19.987	12	N.A.	N.A.
409	SW-23-7-6E	J LOEWEN	Echo Drilling Ltd.	Production	Domestic,Livestock	667585.1	5494357.0	1989	100.9	4.25	N.A.	139.9	N.A.	19.987	3	16	1
410	NE21-6-6E	GRACE KRAHN	UNKNOWN	Production	Domestic,Livestock	664965.0	5485675.0	1969	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
411	NE21-6-6E	EDUARD WINTERFELD	Echo Drilling Ltd.	Production	Domestic	665111.0	5485419.0	2007	139	5	N.A.	220	B.	100	14	75	N.A.
412	NE21-6-6E	BRIAN & JOANNE GROSS	Kiansky Bros. Ltd.	Production	Domestic	665105.6	5485425.4	2005	124	5	N.A.	228	B.	150	2	N.A.	N.A.
413	NW-21-6-6E	D BLATZ	MANKEY, EMIL	Production	Domestic	664299.4	5485400.2	1974	132.9	4.25	N.A.	145.9	N.A.	15	10	25	N.A.
414	NW21-6-6E	JUDY FELFER/RHF BUILDERS LTD	Kiansky Bros. Ltd.	Production	Domestic	663946.8	5485697.2	2011	134	5	N.A.	226	C.	50	6	10	1
415	NW21-6-6E	MARGARITA BLOCK	UNKNOWN	Production	Livestock	664606.0	5485756.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
416	NW21-6-6E	MARGARITA BLOCK	UNKNOWN	Production	Domestic	664629.0	5485166.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
417	22-6-6E	P SCHMIDT	Echo Drilling Ltd.	Production	Domestic	666360.2	5485060.3	1993	147.9	5	N.A.	217.9	N.A.	49.974	18	50	N.A.
418	22-6-6E	SPRUCE TREE NURSERY	Echo Drilling Ltd.	Production	Irrigation	666360.2	5485060.3	1988	149.9	4.2	N.A.	169.9	N.A.	29.987	25	50	1
419	22-6-6E	WARDROP ENGINEERING INC.	Friesen Drillers Ltd.	OBSERVATION	Other	666360.2	5485060.3	2002	149	5	N.A.	210	B.	N.A.	N.A.	N.A.	N.A.
420	NE-22-6-6E	O SCHINKELL	MANKEY, EMIL	Production	Domestic,Livestock	666749.0	5485480.0	1974	133.9	4.25	N.A.	144.9	N.A.	10	15	45	15
421	NE22-6-6E	GORDON TOPNIK	Echo Drilling Ltd.	Production	Domestic	666749.0	5485480.0	1998	136	5	N.A.	300	B.	100	19	115	N.A.
422	NE-22-6-6E	A P HARDER	Friesen Drillers Ltd.	Production	Domestic	666749.0	5485480.0	1963	131.9	4	N.A.	136.9	N.A.	15	14	25	2
423	NE-22-6-6E	A STAHN	MANKEY, EMIL	Production	Domestic	666749.0	5485480.0	1966	111.9	4	N.A.	132.9	N.A.	2.493	2	50	N.A.
424	NW22-6-6E	KEN WIEBE	Echo Drilling Ltd.	Production	Domestic	665942.6	5485452.3	2000	138	5	N.A.	217	B.	100	15	100	N.A.
425	NW22-6-6E	ANDRES DICK	UNKNOWN	Production	Domestic	665591.0	5485557.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
426	NW22-6-6E	E GOERTZEN	Echo Drilling Ltd.	Production	Livestock	665942.6	5485452.3	1991	129.9	5	N.A.	139.9	N.A.	249.894	18	99.9	2
427	25-6-6E	W F SCHELLENBURG	FRIESEN, TONY	Production	Domestic	669583.8	5486798.0	1967	80.4	5	2.5	82.9	N.A.	2.493	5	55	12
428	25-6-6E	GUY'S AUTOBODY	Echo Drilling Ltd.	Production	Domestic	669584.0	5486798.0	2012	132	5	N.A.	197	B.	75	24	100	1
429	25-6-6E	CLYDE LOEWEN-HEARTWORK HOMES	Echo Drilling Ltd.	Production	Domestic	669583.8	5486798.0	2000	159	5	N.A.	207	B.	100	8	100	N.A.
430	25-6-6E	L ROI	L. Mondor Drilling	Production	Domestic	669583.8	5486798.0	1988	115.9	4.2	N.A.	139.9	N.A.	0.501	2	20	0.5
431	25-6-6E	CLYDE LOEWEN - HEARTWORK HOME	UNKNOWN	Production	-	669583.8	5486798.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
432	NE25-6-6E	CATHERINE SULIPA	Friesen Drillers Ltd.	Production	Domestic	670188.0	5487444.0	1977	130.9	4.25	N.A.	179.9	N.A.	29.987	15	30	2
433	NE-25-6-6E	DEPT OF HIGHWAYS	Friesen Drillers Ltd.	Production	Domestic,Industrial	669972.1	5487215.4	1974	129.9	4.25	N.A.	189.9	N.A.	19.987	6	15	12
434	NE25-6-6E	WILL MARTENS	Echo Drilling Ltd.	Production	Domestic	669854.8	5487571.0	2012	131	5	N.A.	197	C.	20	24.5	25	1
435	NE25-6-6E	JEAN-LUC SABOURIN	Friesen Drillers Ltd.	Production	Domestic	670054.0	5487540.0	2008	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
436	NE25-6-6E	VERN PETERS	UNKNOWN	Production	Domestic	670098.0	5487377.0	1992	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
437	NE25-6-6E	GENE FRIESEN	UNKNOWN	Production	Domestic	670074.0	5487495.0	1987	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
438	NE25-6-6E	SIGN-EX	UNKNOWN	Production	-	669578.0	5487573.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
439	NE25-6-6E	GUY'S AUTOBODY SUPPLIES	UNKNOWN	Production	Domestic	670165.0	5487554.0	1900	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
440	NE25-6-6E	CHRISTY FROESE	Friesen Drillers Ltd.	Production	Domestic	669976.0	5487487.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
441	NE-25-6-6E	FEHR & REMPEL	MANKEY, EMIL	Production	Domestic	669972.1	5487215.4	1973	127.9	4	N.A.	147.9	N.A.	10	30	12	48

442	NE-25-6-6E	HIGHWAY DEPT	GUY'S WELL DRILLING	Production	Domestic	669972.1	5487215.4	1984	129.9	4.3	N.A.	194.9	N.A.	39.987	15	25	1
443	NE-25-6-6E	H SCHROEDER	Friesen Drillers Ltd.	Production	Domestic	669972.1	5487215.4	1976	16	4.25	5	50	N.A.	15	6	9	2
444	NE-25-6-6E	C W FRIESEN	MANKEY, EMIL	Production	Domestic	669972.1	5487215.4	1964	127.9	4	N.A.	167.9	N.A.	6.992	6	N.A.	24
445	NE-25-6-6E	J D FUNK	Friesen Drillers Ltd	Production	Domestic	669972.1	5487215.4	1964	133.9	4	N.A.	142.9	N.A.	10	8	14	2
446	NE-25-6-6E	A SOBERING	Friesen Drillers Ltd.	Production	Domestic	669972.1	5487215.4	1963	129.9	4	N.A.	N.A.	N.A.	17.995	4	10	5
447	NE25-6-6E	GORDON REIMER	EMIL MANKEY & SON	Production	Domestic	670017.0	5487445.0	1976	121.9	4	N.A.	131.9	N.A.	29.987	12	15	2
448	NE-25-6-6E	WM FRIESEN	MANKEY, EMIL	Production	Domestic	669972.1	5487215.4	1965	64	4	N.A.	64	N.A.	10	2	25	N.A.
449	NE-25-6-6E	A SOBERING	KIANSKY BROS.	Production	Domestic	669972.1	5487215.4	1990	77.9	4	5	86.9	N.A.	54.974	4	30	1
450	NW-25-6-6E	G SCHMIDTKE	Friesen Drillers Ltd.	Production	Domestic	669167.6	5487191.7	1983	176.9	4.3	N.A.	199.9	N.A.	10	10	50	1
451	NW25-6-6E	R HARDER	Kiansky Bros. Ltd.	Production	Domestic	669167.6	5487191.7	1996	132	5	N.A.	183	N.A.	100	17	100	0.5
452	NW25-6-6E	V PANKRATZ	Echo Drilling Ltd.	Production	Domestic	669167.6	5487191.7	1987	117.4	5	N.A.	155.9	N.A.	49.974	8	2	N.A.
453	NW-25-6-6E	G SCIALLA	Paul Slusarchuk Well Drilling LTd.	Production	Irrigation	669167.6	5487191.7	1983	127.9	4.3	N.A.	203.9	N.A.	55.976	8	9	0.33
454	NW25-6-6E	JAKE DOERKSEN	Friesen Drillers Ltd.	Production	Domestic	669379.0	5487575.0	1964	123.9	4	N.A.	177.9	N.A.	15	1	10	1
455	NW-25-6-6E	W NEUSTAEDTER	Echo Drilling Ltd.	Production	Domestic	669167.6	5487191.7	1994	107.9	5	N.A.	174.9	N.A.	49.974	2	25	1
456	NW25-6-6E	SUNSHINE GREENHOUSE	Echo Drilling Ltd.	Production	Domestic	669463.7	5487521.0	2013	127	5.5	N.A.	198	C.	20	16	17	1
457	NW-25-6-6E	R GINGORICH	Friesen Drillers Ltd.	Production	Domestic	669167.6	5487191.7	1991	134.9	5	N.A.	181.9	N.A.	24.987	12	18	N.A.
458	NW-25-6-6E	T HEOKERT	MANKEY, EMIL	Production	Domestic	669167.6	5487191.7	1963	124.9	4	N.A.	124.9	N.A.	10	4	20	24
459	NW-25-6-6E	A FRIESEN	MANKEY, EMIL	Production	Domestic	669167.6	5487191.7	1972	126.9	4	N.A.	130.9	N.A.	49.974	5	8	4
460	NW-25-6-6E	J ESAU	Echo Drilling Ltd.	Production	Domestic,Livestock	669167.6	5487191.7	1989	124.9	4.25	N.A.	139.9	N.A.	15	7	35	4
461	NW-25-6-6E	H UNGER	Friesen Drillers Ltd.	Production	Domestic	669167.6	5487191.7	1968	131.9	4.25	N.A.	179.9	N.A.	7.995	2	15	19
462	26-6-6E	MANKEY W W DRILLING	MANKEY WATER WELL DRILLING	Production	Domestic	667945.8	5486749.8	1979	99.9	5	N.A.	201.9	N.A.	94.96	5	15	2
463	NE-26-6-6E	L FRIESEN	MANKEY, EMIL	Production	Domestic	668333.6	5487167.5	1969	115.6	4	N.A.	119.9	N.A.	10	1	8	12
464	NE-26-6-6E	M RUSH	Friesen Drillers Ltd.	Production	Domestic	668333.6	5487167.5	1977	135.9	4.5	N.A.	159.9	N.A.	24.987	15	50	0.5
465	NE-26-6-6E	SOMMERFELDER CHURCH	Echo Drilling Ltd.	Production	Domestic	668333.6	5487167.5	1987	143.9	5	N.A.	189.9	N.A.	29.987	8	15	N.A.
466	NE-26-6-6E	G KRUNTZ	Friesen Drillers Ltd.	Production	Domestic	668333.6	5487167.5	1967	142.9	4	N.A.	179.9	N.A.	19.987	1	8	24
467	NE-26-6-6E	A FRINK	MANKEY, EMIL	Production	Domestic	668333.6	5487167.5	1970	126.9	4	N.A.	149.9	N.A.	5	0	70	24
468	NE-26-6-6E	K TAYLOR	Friesen Drillers Ltd.	Production	Domestic	668333.6	5487167.5	1986	159.9	4.2	N.A.	120.9	N.A.	19.987	5	24	2
469	NE-26-6-6E	J SAWATSKEY	Ford Drilling Ltd.	Production	Domestic	668333.6	5487167.5	1977	149.9	4	N.A.	216.9	N.A.	34.987	0	24	2
470	NE-26-6-6E	WM BERGEN	MANKEY, EMIL	Production	Domestic	668333.6	5487167.5	1969	146.9	4	N.A.	149.9	N.A.	0	0	4	12
471	NE-26-6-6E	F SCIALLA	Friesen Drillers Ltd.	Production	Domestic	668333.6	5487167.5	1973	140.9	4	N.A.	204.9	N.A.	59.974	6	10	2
472	NE-26-6-6E	L NUEFELD	Echo Drilling Ltd.	Production	Domestic	668333.6	5487167.5	1993	139.9	5	N.A.	197.9	N.A.	49.974	8	20	0.5
473	NE26-6-6E	BRUCE MARTENS	Echo Drilling Ltd.	Production	Domestic	668149.0	5487404.0	2008	119	5	N.A.	208	B.	50	6	13	N.A.
474	NE26-6-6E	BRUCE MARTENS	Echo Drilling Ltd.	Production	Domestic	668149.0	5487404.0	2008	119	5	N.A.	210	C.	45	6	11	N.A.
475	NE-26-6-6E	B R DYCK	MANKEY, EMIL	Production	Domestic	668333.6	5487167.5	1971	137.9	4	N.A.	154.9	N.A.	7.995	2	22	1
476	NE-26-6-6E	J K BARKMAN	MANKEY, EMIL	Production	Domestic	668333.6	5487167.5	1966	130.9	4	N.A.	130.9	N.A.	7.995	2	8	12
477	NE26-6-6E	BEN BRANDT	Echo Drilling Ltd.	Production	Domestic	668718.6	5487392.2	2011	N.A.	5	N.A.	157	B.	40	10	80	1
478	NE-26-6-6E	H KRAHN	EMIL MANKEY & SON	Production	Domestic	668333.6	5487167.5	1978	113.9	4.25	N.A.	207.9	N.A.	59.974	0	N.A.	N.A.
479	NW-26-6-6E	E FRIESEN	Friesen Drillers Ltd.	Production	Domestic	667529.3	5487143.6	1978	115.9	4.25	N.A.	179.9	N.A.	29.987	14	20	N.A.
480	NW26-6-6E	KATHY DOERKSEN	UNKNOWN	Production	-	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
481	NW-26-6-6E	P J FUNK	MANKEY, EMIL	Production	Domestic	667529.3	5487143.6	1969	113.9	4	N.A.	116.9	N.A.	7.995	6	10	24
482	SW-26-6-6E	J FRIESEN	Friesen Drillers Ltd.	Production	Domestic	667556.9	5486339.9	1978	54	4.25	N.A.	70	N.A.	10	26	36	2
483	SW26-6-6E	WRB	UNKNOWN	OBSERVATION	-	667556.9	5486339.9	1990	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
484	SW26-6-6E	WRB	Friesen Drillers Ltd.	OBSERVATION	-	667420.9	5485936.2	1992	137.9	5	N.A.	191.9	C.	119.947	6	4	0.25
485	27-6-6E	J REIMER	Echo Drilling Ltd.	Production	Domestic	666304.9	5486698.1	1987	42	4.2	5	50	N.A.	15	13	19	1
486	27-6-6E	A FUNK	ASSINIBOINE DRILLING CO. LTD.	Production	Domestic	666304.9	5486698.1	1983	22	30	N.A.	51	N.A.	N.A.	N.A.	N.A.	N.A.
487	NE27-6-6E	BACHMAN PROPERTY MANAGEMENT INC	Echo Drilling Ltd.	Production	Domestic	666693.8	5487117.8	1998	121	5	N.A.	198	B.	30	5	40	N.A.
488	NE-27-6-6E	P ENNS	MANKEY, EMIL	Production	Domestic	666693.8	5487117.8	1965	113.9	4	N.A.	113.9	N.A.	7.995	0	5	N.A.
489	NE-27-6-6E	P J KIRK	NOWICKI, EDWARD	Production	Domestic	666693.8	5487117.8	1980	39	4	5	44	N.A.	10	14	30	N.A.
490	NE27-6-6E	WRB	Friesen Drillers Ltd.	OBSERVATION	-	667089.0	5487114.0	1992	117.9	5	N.A.	159.9	C.	59.974	12	19	0.25
491	NW27-6-6E	APRIL PETERS	UNKNOWN	Production	-	665542.0	5486866.0	2009	N.A.	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
492	NW27-6-6E	AGATHA CURE	UNKNOWN	Production	Domestic	665551.0	5486998.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

493	NW27-6-6E	MANUEL PENNER	Kiansky Bros. Ltd.	Production	Domestic	665888.2	5487091.2	2005	119	5	N.A.	185	B.	30	6	N.A.	2
494	NW-27-6-6E	P B KEHLER	MANKEY, EMIL	Production	Domestic	665888.2	5487091.2	1965	79.9	4	N.A.	79.9	N.A.	11.992	5	8	12
495	SE-27-6-6E	J N DYCK	Echo Drilling Ltd.	Production	Domestic	666721.4	5486314.0	1989	124.9	4.1	N.A.	199.9	N.A.	6.003	19	20	2
496	SW-27-6-6E	M LESKA	Friesen Drillers Ltd.	Production	Domestic	665915.0	5486286.3	1971	30.9	4	9.1	40	N.A.	5	7	24	6
497	SW27-6-6E	PANKRATZ FARM	Friesen Drillers Ltd.	Production	-	665915.0	5486286.3	1998	121	12	N.A.	220	N.A.	250	2.3	3.3	2
498	28-6-6E	L BARKMAN	MANKEY, EMIL	Production	Domestic	664663.0	5486646.3	1970	117.9	4	N.A.	120.9	N.A.	11.992	3	6	24
499	28-6-6E	HARVEY PENNER	Kiansky Bros. Ltd	Production	Domestic	667139.1	5484492.9	2013	183	5	N.A.	192	B.	70	19	36	3
500	28-6-6E	FERIEN ZUR VERTURUNG-DES GLAUBENS INC	Echo Drilling Ltd.	Production	Domestic	664663.0	5486646.3	2005	108	5	N.A.	175	B.	75	5	60	N.A.
501	NE28-6-6E	ARTHUR LENZ	Echo Drilling Ltd.	Production	Domestic	665052.2	5487065.3	2002	62	5	5	77	C.	25	3	60	N.A.
502	NE28-6-6E	TONY TRIMBLE	Friesen Drillers Ltd.	Production	Domestic	665294.0	5486926.0	2003	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
503	NE-28-6-6E	P FRIESEN	Friesen Drillers Ltd.	Production	Domestic	665052.2	5487065.3	1977	26	4.25	5	N.A.	N.A.	29.987	10	15	N.A.
504	NE28-6-6E	RUDY & BETTY ENNS	Friesen Drillers Ltd.	Production	-	665124.0	5487201.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
505	NE28-6-6E	BRYCE MARMUS	Echo Drilling Ltd.	Production	Domestic	665303.4	5487208.5	2011	124	5	N.A.	220	B.	75	6	75	1
506	NE-28-6-6E	J PLETT	MANKEY, EMIL	Production	Domestic	665052.2	5487065.3	1973	111.9	4	N.A.	115.9	N.A.	69.974	6	N.A.	4
507	NE-28-6-6E	J PELT	EMIL MANKEY & SON	Production	Domestic	665052.2	5487065.3	1977	115.5	4.1	N.A.	120.9	N.A.	24.987	8	21	2
508	NE-28-6-6E	G LOEWS	MANKEY, EMIL	Production	Domestic	665052.2	5487065.3	1970	112.9	4	N.A.	112.9	N.A.	7.995	3	15	24
509	NE-28-6-6E	P ESAU	Friesen Drillers Ltd.	Production	Domestic,Livestock	665052.2	5487065.3	1976	119.9	N.A.	N.A.	199.9	N.A.	79.96	1	2	1
510	NE28-6-6E	EARL & EDNA WIEBE	UNKNOWN	Production	Domestic	665406.0	5487062.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
511	NE28-6-6E	RALPH TOEWS	UNKNOWN	Production	Domestic	665158.0	5487291.0	1970	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
512	NE28-6-6E	ABE & AGNES THIESSEN	UNKNOWN	Production	Domestic	664893.0	5487382.0	1976	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
513	NE28-6-6E	D. WILLER	Friesen Drillers Ltd.	Production	Domestic,Livestock	664930.0	5486817.0	1972	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
514	NE28-6-6E	LYNELLE SENDER	UNKNOWN	Production	-	665402.0	5487304.0	1972	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
515	NE28-6-6E	TONY PENNER	Friesen Drillers Ltd.	Production	Domestic	665038.0	5486804.0	1985	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
516	NE28-6-6E	CINDY KLASSEN-KRAHN	Friesen Drillers Ltd.	Production	Domestic	665397.0	5486785.0	1989	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
517	NE28-6-6E	ISBRANDT HIEBERT	Friesen Drillers Ltd.	Production	-	664778.0	5486842.0	1976	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
518	NE28-6-6E	TIMOTHY FRY	Friesen Drillers Ltd.	Production	-	664940.0	5487132.0	1981	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
519	NE28-6-6E	LAWRENCE FRIESEN	Friesen Drillers Ltd.	Production	Domestic	664921.0	5487268.0	1980	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
520	NE28-6-6E	RUDY & BETTY ENNS	Friesen Drillers Ltd.	Production	Domestic,Air conditioning	665150.0	5487211.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
521	NE28-6-6E	DAVE CHRISTIUK	UNKNOWN	Production	Domestic	664768.0	5487396.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
522	NE-28-6-6E	W WEIBE	Friesen Drillers Ltd.	Production	Domestic	665052.2	5487065.3	1983	88.9	4.3	5	109.9	N.A.	39.987	1	2	0.5
523	NE28-6-6E	COLLIN LOEWEN	Echo Drilling Ltd	Production	Domestic	665060.0	5487427.0	2009	114	5	N.A.	158	C.	80	3	75	N.A.
524	NE28-6-6E	LAURIE REMPEL	Echo Drilling Ltd	Production	Domestic	664860.0	5486967.0	2011	116	5	N.A.	157	C.	100	1	60	N.A.
525	NE28-6-6E	ED & MARLENE SILINSKY	Friesen Drillers Ltd.	Production	Domestic	664756.0	5487175.0	2009	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
526	NE-28-6-6E	J DICK	Friesen Drillers Ltd.	Production	Domestic	665052.2	5487065.3	1972	114.9	4	N.A.	274.8	N.A.	99.96	2	6	2
527	NE-28-6-6E	D SMITH	Echo Drilling Ltd.	Production	Domestic	665052.2	5487065.3	1989	37	4.5	N.A.	50	N.A.	94.96	0	13	N.A.
528	NE-28-6-6E	J PENNER	Friesen Drillers Ltd.	Production	Domestic	665052.2	5487065.3	1978	41	4.25	N.A.	52	N.A.	21.992	10	12	2
529	NW28-6-6E	DAVE GOERTZEN	Friesen Drillers Ltd.	Production	Domestic,Livestock	664246.0	5487039.5	1972	122.9	4	N.A.	136.9	N.A.	99.96	8	15	N.A.
530	NW28-6-6E	HELEN & BEN FUNK	Echo Drilling Ltd.	Production	Domestic	663891.0	5487378.0	1988	24	4.2	5	35	N.A.	17.995	7	15	1
531	NW-28-6-6E	P F GEORTZEN	MANKEY, EMIL	Production	Domestic	664246.0	5487039.5	1969	129.9	4	N.A.	N.A.	N.A.	6	8	15	12
532	NW-28-6-6E	J HIEBERT	Friesen Drillers Ltd.	Production	Domestic	664246.0	5487039.5	1974	114.9	4.25	N.A.	119.9	N.A.	5	3	1	5
533	NW28-6-6E	BORIS SANZEN/DAVEY CONSTRUCTION	Kiansky Bros. Ltd.	Production	Domestic	663995.5	5487388.2	2011	50	5	5	60	B.	40	8	13	N.A.
534	NW-28-6-6E	P DYCK	Friesen Drillers Ltd.	Production	Domestic	664246.0	5487039.5	1976	37	4.25	5	50	N.A.	10	10	24	2
535	NW-28-6-6E	J REIMER	Friesen Drillers Ltd.	Production	Domestic	664246.0	5487039.5	1976	43	4.25	5	48	N.A.	10	6	20	2
536	NW-28-6-6E	K TOEWS	Friesen Drillers Ltd.	Production	Domestic	664246.0	5487039.5	1983	122.9	4.3	N.A.	134.9	N.A.	15	6	20	1
537	NW-28-6-6E	E.G. PENNER	DAVIE, LESLIE W.	Production	Domestic	664246.0	5487039.0	1976	19	4.5	5	32	N.A.	29.987	5	15	N.A.
538	NW-28-6-6E	RUDY ENNS	Echo Drilling Ltd	Production	Domestic	664250.0	5487033.0	2007	121	5	N.A.	198	B.	50	7	15	N.A.
539	SE28-6-6E	HENRY & LOIS FEHR	Echo Drilling Ltd	Production	Domestic	665078.9	5486260.4	2001	135	5	N.A.	210	B.	50	10	50	N.A.
540	SE-28-6-6E	F SCHALLA	MANKEY, EMIL	Production	Domestic	665078.9	5486260.4	1969	125.9	4	N.A.	126.9	N.A.	7.995	9	20	24
541	SE28-6-6E	GERARD SIMARD	Echo Drilling Ltd.	Production	Domestic	665078.9	5486260.4	2000	161	5	N.A.	197	B.	50	35	60	N.A.
542	SE28-6-6E	J & M UNRAU	Echo Drilling Ltd.	Production	Domestic, Livestock	665078.9	5486260.4	2000	35	5	5	49	B.	20	12	35	N.A.
543	SE-28-6-6E	WM UNRAU	MANKEY, EMIL	Production	Domestic	665078.9	5486260.4	1967	34	4	N.A.	36	N.A.	8.997	6	14	48
544	SE28-6-6E	W K SHALLA	Friesen Drillers Ltd	Production	Domestic	665078.9	5486260.4	1974	132.9	4.25	N.A.	269.8	N.A.	35.989	11	11	2
545	SE-28-6-6E	J J PLETT	MANKEY, EMIL	Production	Domestic	665078.9	5486260.4	1973	110.9	4	N.A.	125.9	N.A.	5	4	4	54
546	SE-28-6-6E	ADAM SMITH	UNKNOWN	Production	-	665140.0	5485894.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
547	SE28-6-6E	TED EWONCHUK	Kiansky Bros. Ltd.	Production	-	664892.0	5485976.0	1988	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
548	SE-28-6-6E	K LOEWEN	Friesen Drillers Ltd.	Production	Domestic	665078.9	5486260.4	1982	128.9	4.25	N.A.	154.9	N.A.	24.987	8	25	1

549	SE28-6-6E	JOHN & MARY UNRAU	Echo Drilling Ltd.	Production	Domestic	664771.0	5485884.0	1995	131.9	5	N.A.	199.9	N.A.	24.987	13	16	1
550	SE28-6-6E	MARILYN & RANDY GEISBRECHT	Echo Drilling Ltd.	Production	Domestic	665167.0	5486067.0	2006	48	5	5	58	C.	50	6	40	N.A.
551	SE-28-6-6E	H KLASSEN	Echo Drilling Ltd.	Production	Domestic	665078.9	5486260.4	1990	37	4.25	5	43	N.A.	24.987	10	14	2
552	SE-28-6-6E	A ABLING	MANKEY, EMIL	Production	Domestic	665078.9	5486260.4	1966	130.9	4	N.A.	133.9	N.A.	19.987	12	15	4
553	SE-28-6-6E	T SWANCHUCK	KIANSKY BROS.	Production	Domestic	665078.9	5486260.4	1988	150.9	4	10	150.9	N.A.	15.989	9	51	2
554	SW28-6-6E	DAVE KREUGER	Echo Drilling Ltd.	Production	Domestic	664272.8	5486235.1	2001	138	5	N.A.	157	B.	100	10	80	N.A.
555	SW-28-6-6E	E FRIESEN	Echo Drilling Ltd.	Production	Domestic	664272.8	5486235.1	1988	21	4.2	5	32	N.A.	19.987	11	18	3
556	SW28-6-6E	OTTO SCHMIDT	Kiansky Bros. Ltd.	Production	Domestic	664272.8	5486235.1	2000	37	5	5	47	N.A.	10	4	5	N.A.
557	SW-28-6-6E	E ROEKER	Friesen Drillers Ltd.	Production	Domestic	664272.8	664272.8	1985	17	4	5	30	N.A.	29.987	6	12	1
558	SW-28-6-6E	H PETERS	Friesen Drillers Ltd.	Production	Domestic	664272.8	5486235.1	1985	22	4	5	30	N.A.	29.987	8	15	1
559	SW28-6-6E	EMMA GIESBRECHT	UNKNOWN	Production	Domestic	664326.0	5485912.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
560	SW-28-6-6E	WM GERBRANDT	Friesen Drillers Ltd.	Production	Domestic	664272.8	5486235.1	1983	23	4.3	5	32	N.A.	19.987	10	20	0.5
561	SW28-6-6E	BILL & DORIS GERBRANDT	Friesen Drillers Ltd.	Production	Domestic	663981.0	5485848.0	1983	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
562	SW-28-6-6E	P KEHLER	Echo Drilling Ltd.	Production	Domestic	664272.8	5486235.1	1991	41	5.1	5	52	N.A.	74.974	6	11	1
563	SW28-6-6E	ANTON GOSSEN	Echo Drilling Ltd.	Production	Domestic	664131.6	5486595.8	2011	126	5	N.A.	177	C.	60	5	80	1
564	SW28-6-6E	TIM & CATHY FRIESEN	Friesen Drillers Ltd.	Production	Domestic	664272.8	5486235.1	1977	129.9	4.25	N.A.	139.9	N.A.	8	35	49.974	1
565	29-6-6E	VICTOR & NELLY HOLSTEIN	Echo Drilling Ltd.	Production	Domestic	663680.3	5487366.5	2013	130	5.5	N.A.	217	C.	75	6	8	1
566	29-6-6E	HANNU NURKKALA	Kiansky Bros. Ltd	Production	Domestic	664781.0	5487019.1	2013	119	5	N.A.	190	B.	250	6	31	3
567	29-6-6E	BILL SCHWARZ	Echo Drilling Ltd	Production	Domestic	663022.0	5486597.0	2011	136	5	N.A.	218	C.	100	5	80	1
568	29-6-6E	G REIMER	Friesen Drillers Ltd.	Production	Domestic	663021.5	5486597.3	1984	39	4	5	49	N.A.	15	7	25	1
569	29-6-6E	T PIDSADNY	Echo Drilling Ltd.	Production	Domestic	663021.5	5486597.3	1994	130.9	5	N.A.	157.9	N.A.	49.974	3	50	N.A.
570	29-6-6E	J TODD	L. Mondor Drilling	Production	Domestic	663021.5	5486597.3	1989	106.9	4.25	N.A.	164.9	N.A.	19.987	25	N.A.	N.A.
571	29-6-6E	WILLIE NICKEL/BILL SCHWARZ	Echo Drilling Ltd.	Production	Domestic	663022.0	5486597.0	2011	170	5	N.A.	237	B.	80	26	80	1
572	NE29-6-6E	DUSTIN VOGT	Echo Drilling Ltd.	Production	Domestic	663410.2	5487015.0	1999	37	5	5	48	C.	30	4	40	N.A.
573	NE29-6-6E	WALDEMAR ALBERTIN	Echo Drilling Ltd.	Production	Domestic	663467.4	5486954.0	2013	129	5.5	N.A.	138	C.	100	5	57	1
574	NE29-6-6E	JOHN SCHROEDER	Echo Drilling Ltd.	Production	Domestic	663470.8	5486841.7	2012	127	5.5	N.A.	127	C.	80	4	57	1
575	NE29-6-6E	VICTOR FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663365.8	5486790.7	2011	48	5	10	60	B.	60	5	14	1
576	NE29-6-6E	DAVID PENNER/DAVEY CONSTRUCTION	Kiansky Bros. Ltd.	Production	Domestic	663076.4	5486948.9	2011	28	5	5	36	B.	35	8	N.A.	1
577	NE29-6-6E	WALTER HOLSTEIN	Kiansky Bros. Ltd.	Production	Domestic	663203.1	5486758.0	2011	64	5	10	74	B.	80	9	12	2
578	NE29-6-6E	ROMAN ESAU	Kiansky Bros. Ltd.	Production	Domestic	663583.8	5486671.5	2011	71	5	10	92	B.	40	4	7	1
579	NE29-6-6E	I HEADINGS	Friesen Drillers Ltd.	Production	Domestic	663410.2	5487015.0	1977	126.9	4.25	N.A.	139.9	N.A.	26.992	7	15	2
580	NE29-6-6E	ANTON GOSEN	Kiansky Bros. Ltd.	Production	Domestic	663571.0	5486904.8	2012	77	5	10	90	B.	70	13	31	2
581	NE-29-6-6E	H WIENS	Friesen Drillers Ltd.	Production	Domestic	663410.2	5487015.0	1984	22	4	5	32	N.A.	29.987	3	4	2
582	NE-29-6-6E	J FRIES	EMIL MANKEY & SON	Production	Domestic	663410.2	5487015.0	1977	34	4.1	5	39	N.A.	39.987	5	9	1
583	NE-29-6-6E	FRANK REIMER	Kiansky Bros. Ltd	Production	Domestic	663413.0	5487009.0	2010	122	5	N.A.	178	C.	80	5	80	1
584	NE-29-6-6E	H FUNK	Echo Drilling Ltd.	Production	Domestic	663410.2	5487015.0	1989	60	4.25	5	72	N.A.	21.992	4	15	1
585	NE-29-6-6E	PAUL SHEWA/ JAKOB KISSER	Echo Drilling Ltd.	Production	Domestic	663214.1	5486871.9	2010	125	5	N.A.	220	C.	75	1	75	1
586	NE29-6-6E	ANTON GOSSEN	Echo Drilling Ltd.	Production	Domestic	663518.2	5486805.3	2010	128	5	N.A.	217	C.	50	30	80	1
587	NE29-6-6E	J KLASSEN	MANKEY WATER WELL DRILLING	Production	Domestic	663410.2	5487015.0	1988	39	4.2	5	52	N.A.	8.997	0	40	24
588	NE29-6-6E	J WIEBE	Friesen Drillers Ltd.	Production	Domestic	663410.2	5487015.0	1983	51	4	N.A.	60	N.A.	10	2	20	5
589	NE29-6-6E	KEVIN TOEWS	UNKNOWN	Production	Domestic	663425.0	5487377.0	1988	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
590	NE29-6-6E	JIM KEHLER	Friesen Drillers Ltd.	Production	Domestic	663372.0	5487319.0	1980	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
591	NE29-6-6E	DANIEL WALL	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2010	89	5	10	105	B.	50	3	0	1
592	NE29-6-6E	RUDY EIFFER	Kiansky Bros. Ltd.	Production	Domestic,Air conditioning	663413.0	5487009.0	2009	59	5	10	73	B.	50	3	45	0.5
593	NE29-6-6E	ANDREAS SPURNER	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2009	68	5	10	85	N.A.	60	3	50	1
594	NE29-6-6E	WILHELM PENNER	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2009	64	5	10	87	B.	47.995	5	5	1
595	NE29-6-6E	RUDY FELFER	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2009	65	5	10	90	B.	60	4	4	1
596	NE-29-6-6E	M LEPP	Echo Drilling Ltd.	Production	Domestic	663410.2	5487015.0	1993	117.9	5	N.A.	216.9	C.	49.974	0	N.A.	N.A.
597	NE29-6-6E	NICKOLEI SCHEWA	Echo Drilling Ltd.	Production	Domestic	663767.0	5486841.0	2009	129	5	N.A.	217	C.	100	4	80	N.A.
598	NE29-6-6E	JURI HERMANN	Echo Drilling Ltd.	Production	Domestic	663135.0	5487182.0	2008	120	5	N.A.	218	B.	100	4	7	N.A.
599	NE29-6-6E	WES NICKOL	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2008	43	5	10	55	B.	47.995	4	46	N.A.
600	NE29-6-6E	ANTOINE GOSSEN	Echo Drilling Ltd.	Production	Domestic	663554.2	5487006.7	2013	125	5.5	N.A.	137	B.	20	13	14	1
601	NE29-6-6E	DAVID REIMER	Echo Drilling Ltd.	Production	Domestic	663068.0	5486878.0	2006	120	5	N.A.	220	C.	80	5	75	N.A.

602	NE29-6-6E	RUDY SESLER	Echo Drilling Ltd.	Production	Domestic	663043.0	5487037.0	2006	119	5	N.A.	220	C.	80	5	75	N.A.
603	NE29-6-6E	DAVID REIMER/DAVEY CONSTRUCTION	Kiansky Bros. Ltd.	Production	Domestic	663085.4	5486742.3	2013	122	5	N.A.	235	B.	6	6	31	1
604	NE-29-6-6E	B W DUECK	Friesen Drillers Ltd.	Production	Domestic,Livestock	663410.2	5487015.0	1978	61	4.25	5	70	N.A.	29.987	4	6	2
605	NE29-6-6E	FRANK KAUENHOFEN	UNKNOWN	Production	Domestic	663766.0	5487407.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
606	NE29-6-6E	WES NICKEL	Kiansky Bros. Ltd.	Production	Domestic	663413.0	5487009.0	2009	40	5	15	57	C.	30	3	14	2
607	NW-29-6-6E	M VOGT	Friesen Drillers Ltd.	Production	Livestock	662604.5	5486992.8	1986	123.9	4.1	N.A.	219.9	N.A.	59.974	5	6	0.5
608	NW-29-6-6E	WALLY HOLSTEIN	Echo Drilling Ltd.	Production	Domestic	662608.0	5486986.0	2007	121	5	N.A.	220	C.	100	4	80	N.A.
609	SE29-6-6E	J & A ADRIAN	Kiansky Bros. Ltd.	Production	Domestic	663436.9	5486210.6	1999	11	5	N.A.	119	N.A.	50	0.6	N.A.	2
610	SE29-6-6E	SOLOMAN BUDALA	Kiansky Bros. Ltd.	Production	Domestic	663215.0	5485947.3	2013	128	5	N.A.	227	B.	100	6	8	2
611	SE29-6-6E	ARBIN FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663534.1	5486444.2	2013	88	5	10	110	B.	30	9	37	2
612	SE29-6-6E	VIKTOR SANZEN	Kiansky Bros. Ltd.	Production	Domestic	663642.6	5486232.7	2013	75	5	10	96	B.	40	8	26	2
613	SE29-6-6E	SHAWYN FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663767.8	5486433.4	2013	28	5	10	40	B.	12	6	18	4.5
614	SE29-6-6E	JEFF ENNS	Kiansky Bros. Ltd.	Production	Domestic	663191.3	5486255.9	2013	74	5	10	100	B.	47	7	19	1
615	SE29-6-6E	GHF BUILDERS	Kiansky Bros. Ltd.	Production	-	663188.8	5486555.1	2013	70	5	5	81	B.	40	6	24	1
616	SE29-6-6E	WILLIAM SCHEWA	Echo Drilling Ltd.	Production	Domestic	663093.9	5486194.0	2012	118	5.5	N.A.	218	B.	75	10	75	1
617	SE29-6-6E	ANTON GOSSEN	Kiansky Bros. Ltd.	Production	Domestic	663093.6	5486276.3	2012	84	5	10	95	B.	80	8	14	1
618	SE29-6-6E	DANIEL & MAINA MARTENS	Kiansky Bros. Ltd.	Production	Domestic	663114.6	5486107.8	2012	74	5	10	86	B.	40	6	33	2
619	SE29-6-6E	RHT BUILDING LTD/FELLER	Kiansky Bros. Ltd.	Production	Domestic	663075.8	5486530.6	2012	55	4	5	75	B.	20	4	28	2
620	SE29-6-6E	JAKIE HILDERBRAND	Kiansky Bros. Ltd.	Production	Domestic	663201.8	5486123.8	2012	96	5	10	112	B.	32	13	40	2
621	SE29-6-6E	DAVID & ELIZABETH BERGMANN	Kiansky Bros. Ltd.	Production	Domestic	663105.8	5486037.5	2012	96	5	10	110	B.	60	10	21	1
622	SE29-6-6E	STEPHAN SCHEWA	Echo Drilling Ltd.	Production	Domestic	663320.2	5486547.9	2012	124	5.5	N.A.	236	C.	100	7	57	1
623	SE29-6-6E	NIKOLA HODEIMANN	Echo Drilling Ltd.	Production	Domestic	663097.4	5485931.5	2012	127	5.5	N.A.	178	C.	20	9	11	1
624	SE29-6-6E	SOLOMON BRIDALA HOLDINGS	Kiansky Bros. Ltd.	Production	Domestic	663046.8	5486361.7	2011	70	5	5	91	B.	60	8	21	2
625	SE29-6-6E	ART PENNER	Kiansky Bros. Ltd.	Production	Domestic	663058.4	5486436.6	2011	68	5	5	77	B.	10	9	34	2
626	SE29-6-6E	ANTON GOSSEN	Echo Drilling Ltd.	Production	Domestic	663616.2	5486583.5	2011	127	5	N.A.	217	C.	100	50	80	1
627	SE29-6-6E	ANTON GOSSEN	Echo Drilling Ltd.	Production	Domestic	663738.1	5486561.2	2010	124	5	N.A.	220	C.	12.005	6	10	1
628	SE29-6-6E	VICTOR DUERKSEN	Kiansky Bros. Ltd.	Production	Domestic	663560.7	5486233.6	2013	65	5	10	90	B.	50	9	31	2
629	SE-29-6-6E	G ESAU	Echo Drilling Ltd.	Production	Domestic,Livestock	663436.9	5486210.6	1992	37	5	5	43	N.A.	19.987	6	35	1
630	SE-29-6-6E	J WARKENTINE	KIANSKY BROS.	Production	Domestic	663436.9	5486210.6	1991	23	4	N.A.	40	N.A.	29.987	6	20	1
631	SE-29-6-6E	OLGA SEIBEL	UNKNOWN	Production	-	663664.0	5485963.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
632	SE29-6-6E	LEO RODA	Echo Drilling Ltd.	Production	Domestic	663441.0	5486204.0	2009	121	5	N.A.	222	B.	100	5	80	1
633	SE29-6-6E	WALDEMAN JANZEN	Kiansky Bros. Ltd.	Production	Domestic	663496.7	5486122.6	2013	98	5	10	112	B.	10	8	36	4
634	SE29-6-6E	LNS CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	663715.3	5486128.1	2013	130	5.5	N.A.	197	C.	100	11	57	1
635	SE29-6-6E	LNS CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	663417.4	5486253.8	2013	130	5.5	N.A.	197	C.	80	11	57	1
636	SW29-6-6E	ALBERT SIEBERT	Echo Drilling Ltd.	Production	Domestic	662635.0	5486181.0	2012	136	5.5	N.A.	221	C.	1.517	1.8	2.1	1
637	SW-29-6-6E	J DRIEDGER	Friesen Drillers Ltd.	Production	Domestic	662631.8	5486187.4	1977	26	4.25	N.A.	36	N.A.	39.987	6	15	N.A.
638	SW29-6-6E	JAKE SCHELLENBERG	UNKNOWN	N.A.	Other	662279	5486438	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
639	SW29-6-6E	LARISSA BOXHORN	Friesen Drillers Ltd	Production	Domestic	662288	5485799	2004	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
640	SW29-6-6E	DAVID TSCHRITTER	UNKNOWN	Production	Domestic,Livestock	662300.0	5486014.0	1977	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
641	SW29-6-6E	ANNA TURNER	UNKNOWN	Production	Domestic	662307.0	5486503.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
642	SW29-6-6E	COREY MOURTRAY	Echo Drilling Ltd.	Production	Domestic	662635.0	5486181.0	2012	81	5.5	N.A.	218	B.	20	17	18	1
643	SW29-6-6E	KIM DEFRIES	Echo Drilling Ltd.	Production	Domestic	662635.0	5486181.0	2007	218	5	5	230	B.	15	37	48	N.A.
644	SW29-6-6E	NIKLAS FRIESEN	Echo Drilling Ltd.	Production	Domestic	662635.0	5486181.0	2007	125	5	N.A.	230	B.	85	5	75	N.A.
645	SW29-6-6E	A KLASSEN	Friesen Drillers Ltd.	Production	Domestic	662631.8	5486187.4	1980	17	4.25	N.A.	35	N.A.	39.987	5	6	2
646	SW29-6-6E	JAKE SCHELLENBERG	EMIL MANKEY & SON	Production	Domestic	662292.0	5486418.0	1988	59	4.2	N.A.	66	B.	19.987	0	N.A.	N.A.
647	SW29-6-6E	ALEX BOXHORN	Echo Drilling Ltd.	Production	Domestic	662631.8	5486187.4	2003	136	5	N.A.	180	C.	50	8	55	N.A.
648	SW29-6-6E	POPLAR LANE LIVESTOCK	Echo Drilling Ltd.	Production	Domestic	662631.8	5486187.4	2003	135	5	N.A.	235	B.	100	15	80	N.A.
649	SW-29-6-6E	B KRAUSE	KIANSKY BROS.	Production	Domestic	662631.8	5486187.4	1988	46	4	5	57	N.A.	5	9	42	1.5
650	31-6-6E	McLEAN	Echo Drilling Ltd	Production	Domestic	661351.0	5488190.8	1988	111.9	4.2	N.A.	124.9	N.A.	24.987	3	N.A.	N.A.
651	31-6-6E	B SUDERMAN	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1999	114	5	N.A.	137	C.	50	0	60	N.A.
652	31-6-6E	PRECISION HOMES LTD	Echo Drilling Ltd.	Production	Domestic	661955.0	5488602.2	2013	116	5.5	10	216	C.	100	1	40	1
653	31-6-6E	T & T PROPERTIES	Echo Drilling Ltd.	Production	Domestic	680568.8	5488308.3	2013	125	5	40	256	C.	45	6	27	1
654	31-6-6E	A PLETT	Friesen Drillers Ltd	Production	Domestic	661351.0	5488190.8	1986	114.4	4.2	N.A.	134.9	N.A.	6.992	10	N.A.	N.A.
655	31-6-6E	RANDY GULLICKSON	Echo Drilling Ltd.	Production	Domestic	661351.0	5488191.0	2010	121	5	N.A.	220	C.	108.997	-80	-2	1
656	31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661351.0	5488191.0	2011	107	5	N.A.	219	C.	75	5	60	1

657	31-6-6E	G KOOP	Friesen Drillers Ltd.	Production	Domestic	661351.0	5488190.8	1979	105	4.25	N.A.	194.9	N.A.	29.987	5	25	1
658	31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661351.0	5488191.0	2011	106	5	N.A.	219	C.	200	5	2	1
659	NE31-6-6E	DARRYL KEHLER	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	2001	114	5	N.A.	135	C.	15	10	1	N.A.
660	NE-31-6-6E	E FRIESEN	Friesen Drillers Ltd.	Production	Domestic	661730.9	5488602.3	1967	111.5	4	N.A.	219.9	N.A.	19.987	6	5	16
661	NE-31-6-6E	J KROEKER	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	114.9	4.2	N.A.	204.9	N.A.	34.987	0	N.A.	N.A.
662	NE31-6-6E	W FRIESEN	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	116.9	4.2	N.A.	209.9	N.A.	34.987	5	N.A.	N.A.
663	NE-31-6-6E	E KEHLER	Friesen Drillers Ltd.	Production	Domestic	661730.9	5488602.3	1978	116.9	4.25	N.A.	209.9	N.A.	79.96	12	1	N.A.
664	NE31-6-6E	VICTOR RIECH	Echo Drilling Ltd.	Production	Domestic	662124.8	5488834.2	2011	108	5	N.A.	210	C.	80	3	8	1
665	NE-31-6-6E	C MARTINS	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	1987	110.9	4.2	N.A.	139.9	C.	29.987	-6	-2	N.A.
666	NE31-6-6E	AMBERFIELD	Echo Drilling Ltd	Production	Domestic	661410.9	5488707.3	2011	107	5	N.A.	228	B.	100	2	60	1
667	NE31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661518.1	5488709.4	2011	110	5	N.A.	218	B.	100	2	60	1
668	NE31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661495.5	5488819.4	2011	109	5	N.A.	217	C.	75	5	60	1
669	NE31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661595.5	5488838.4	2011	108	5	N.A.	217	C.	75	5	60	1
670	NE-31-6-6E	J KEHLER	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	1987	115.9	4.2	N.A.	214.9	N.A.	15	8	N.A.	N.A.
671	NE31-6-6E	JOHN REMPEL	Kransky Bros. Ltd.	Production	Domestic	661730.9	5488602.3	1995	115	5	N.A.	209	B.	16.003	3	N.A.	N.A.
672	NE-31-6-6E	J FRIESEN	Friesen Drillers Ltd.	Production	Domestic	661730.9	5488602.3	1985	106.9	4.2	N.A.	139.9	N.A.	5	6	2	2
673	NE31-6-6E	KEN HEIBERT	K. LARSEN'S WELL DRILLING	Production	Domestic	661730.9	5488602.3	1995	116.5	5	N.A.	207	B.	50	7	90	1.5
674	NE31-6-6E	B HARDER	Friesen Drillers Ltd.	Production	Domestic	661730.9	5488602.3	1983	100.9	4.3	N.A.	219.9	N.A.	24.987	0	N.A.	N.A.
675	NE-31-6-6E	P TOEWS	GUY'S WELL DRILLING	Production	Domestic	661730.9	5488602.3	1984	115.9	4	N.A.	224.9	N.A.	10	0	N.A.	N.A.
676	NE31-6-6E	ALLAN WIEBE	Friesen Drillers Ltd.	Production	Domestic	661408.0	5488620.0	1970	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
677	NE-31-6-6E	B W HIEBERT	EMIL MANKEY & SON	Production	Domestic	661730.9	5488602.3	1977	110.9	41	N.A.	205.9	N.A.	19.987	8	N.A.	N.A.
678	NE-31-6-6E	W FRIESEN	Kransky Bros. Ltd.	Production	Domestic	661730.9	5488602.3	1922	113.9	4	N.A.	117.9	N.A.	29.987	3.5	1	1
679	NE-31-6-6E	G TOEWS	MANKEY, EMIL	Production	Domestic	661730.9	5488602.3	1964	110.9	4	N.A.	114.9	N.A.	10	5	N.A.	N.A.
680	NE31-6-6E	FEHR SHEET METAL	Echo Drilling Ltd.	Production	Domestic	661777.2	5486971.3	1995	114.9	5	N.A.	139.9	C.	49.997	3	N.A.	8
681	NE-31-6-6E	P PETERS	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	1994	115.9	5	N.A.	214.9	C.	49.974	2	N.A.	4
682	NE-31-6-6E	J TOEWS	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	1993	111.9	5	N.A.	119.9	C.	5	2.5	N.A.	N.A.
683	NE31-6-6E	CECIL FAST	Echo Drilling Ltd.	Production	Domestic	669443.0	5523674.0	2009	118	5	N.A.	220	C.	50	2	2	N.A.
684	NE-31-6-6E	N PETERS & A FRIESEN	MANKEY, EMIL	Production	Domestic	661730.9	5488602.3	1971	113.9	4	N.A.	114.9	N.A.	49.974	10	N.A.	N.A.
685	NE-31-6-6E	E FRIESEN	mondor drillers	Production	Domestic	661730.9	5488602.3	1965	82.9	4	N.A.	121.9	N.A.	N.A.	4.5	N.A.	N.A.
686	NE31-6-6E	A HARDER	Kransky Bros. Ltd.	Production	Domestic	661730.9	5488602.3	1992	108.4	4	N.A.	165.4	N.A.	8.997	4.5	N.A.	2
687	NE-31-6-6E	W REIMER	Friesen Drillers Ltd.	Production	Domestic	661730.9	5488602.3	1980	111.9	4.25	N.A.	209.9	N.A.	49.974	-8	-3	2
688	NE31-6-6E	ABE ENNS	Selkirk Drillers	Production	Air conditioning	661730.9	5488602.3	2005	118	5	N.A.	118	N.A.	50	6	N.A.	N.A.
689	NE31-6-6E	C T LOEWEN & SON	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1990	110.9	4.25	N.A.	119.9	C.	10	0	N.A.	N.A.
690	NE31-6-6E	KARL NOLL	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	2004	122	5	N.A.	200	C.	25	7	2	N.A.
691	NE31-6-6E	JACK KEHLER	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	2004	118	5	N.A.	237	C.	60	5	2	N.A.
692	NE-31-6-6E	C LOEWEN	MANKEY WATER WELL DRILLING	Production	Domestic	661730.9	5488602.3	1978	115.9	4.25	N.A.	209.9	N.A.	19.987	8	N.A.	N.A.
693	NE-31-6-6E	A FEHR	MANKEY WATER WELL DRILLING	Production	Domestic	661730.9	5488602.3	1978	109.9	4.25	N.A.	115.9	N.A.	19.987	6	N.A.	N.A.
694	NE-31-6-6E	G H TOPNIK	EMIL MANKEY & SON	Production	Domestic	661730.9	5488602.3	1978	110.9	4.25	N.A.	111.9	N.A.	11.992	0	N.A.	N.A.
695	NE31-6-6E	WARREN BIEDLER	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	2002	114	5	N.A.	155	C.	30	N.A.	N.A.	N.A.
696	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661413.2	5488484.9	2013	108	5	N.A.	237	C.	100	5	57	1
697	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661367.7	5488701.6	2013	108	5	N.A.	237	C.	100	2	57	1
698	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661385.1	5488602.0	2013	109	5	N.A.	237	C.	100	2	77	1
699	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661496.5	5488605.3	2013	113	5	N.A.	217	C.	100	2	77	1
700	NW31-6-6E	E PENNER	Friesen Drillers Ltd.	Production	Domestic	660943.8	5488577.8	1986	109.9	4.2	N.A.	206.9	N.A.	15	-5	-2	2
701	NW31-6-6E	J PETERS	Friesen Drillers Ltd.	Production	Domestic	660943.8	5488577.8	1984	390	4	5	50	N.A.	15	8	25	0.5
702	NW31-6-6E	CHARLES REIMER	Kransky Bros. Ltd.	Production	Domestic	660947.0	5488571.0	2010	120	5	N.A.	124	C.	35	-2	N.A.	N.A.
703	NW31-6-6E	LEON REIMER	Echo Drilling Ltd	Production	Domestic	660947.0	5488571.0	2007	115	5	N.A.	240	C.	100	1.5	4	N.A.
704	NW31-6-6E	EVANGELICAL LUTHERAN CHURCH	Echo Drilling Ltd.	RECHARGE	-	660943.8	5488577.8	2006	114	5	N.A.	217	C.	30	-10	-2	N.A.
705	NW31-6-6E	EVANGELICAL LUTHERAN CHURCH	Echo Drilling Ltd.	Production	Domestic	660943.8	5488577.8	2006	118	5	N.A.	220	C.	100	-10	-2	N.A.
706	NW31-6-6E	ED'S EQUIPMENT EXPORT	Kransky Bros. Ltd.	Production	Domestic	660943.8	5488577.8	2006	107.5	5	N.A.	110	C.	60	1	2	2
707	NW31-6-6E	P PETERS	EMIL MANKEY & SON	Production	Domestic	660943.8	5488577.8	1975	100.9	4.1	N.A.	104.9	N.A.	19.987	4	N.A.	N.A.
708	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	660947.0	5488571.0	2013	110	5	N.A.	238	C.	20	-1	0	N.A.

709	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661571.2	5488701.0	2013	106	5	N.A.	237	C.	100	-2	57	1
710	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661370.5	5488484.7	2013	108	5	N.A.	237	C.	100	-2	57	1
711	NW31-6-6E	AMBERFIELD	Echo Drilling Ltd.	Production	Domestic	661546.9	5488495.5	2013	111	5	N.A.	237	C.	100	-2	57	1
712	SE-31-6-6E	D MOORE	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1988	113.9	4.2	N.A.	219.9	C.	29.987	0	10	2
713	SE-31-6-6E	C FROESE	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	116.9	4.2	N.A.	159.9	N.A.	15	-1	25	1
714	SE31-6-6E	I FEHR	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	117.9	4.2	N.A.	211.9	N.A.	15	-1	3	2
715	SE31-6-6E	P FRIESEN	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1987	112.9	4.2	N.A.	209.9	C.	19.987	-5	-2	2
716	SE31-6-6E	SCOTT HIEBERT	Echo Drilling Ltd.	Production	Domestic	661730.9	5488602.3	1997	110	5	N.A.	138	C.	75	4	N.A.	N.A.
717	SE31-6-6E	GARY & SANDRA BLAD	Echo Drilling Ltd.	Production	Domestic,Livestock	661398.0	5488015.0	1987	122.9	4.2	N.A.	139.9	C.	11.992	3	2	2
718	SE31-6-6E	A KEHLER	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1987	113.9	4.2	N.A.	119.9	N.A.	29.987	-3	-2	1
719	SE31-6-6E	N FEHR	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1987	116.9	4.2	N.A.	139.9	C.	10	-2	5	1
720	SE-31-6-6E	M VOST	EMIL MANKEY & SON	Production	Domestic	661754.2	5487804.6	1977	111.9	4.1	N.A.	166.9	N.A.	5	0	89.9	N.A.
721	SE31-6-6E	DAVE STOBBE	Kiansky Bros. Ltd.	Production	Domestic	661351.0	5488190.8	1997	119	5	N.A.	134	C.	20	-3	80	0.5
722	SE31-6-6E	JACK P KEHLER	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1996	119	5	N.A.	158	C.	30	N.A.	N.A.	N.A.
723	SE31-6-6E	J WIEBE	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1987	118.9	4.2	N.A.	259.8	N.A.	7.995	23	24	2
724	SE-31-6-6E	J GUNTER	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1987	40	4.2	N.A.	47	C.	19.987	4	20	N.A.
725	SE31-6-6E	J HIEBERT	Echo Drilling Ltd.	Production	Domestic	661351.0	5488190.8	1988	113.9	4.2	N.A.	119.9	N.A.	24.987	2	15	1
726	SE-31-6-6E	H S KEHLER	MANKEY, EMIL	Production	Domestic	661754.2	5487804.6	1964	49	4	N.A.	49	N.A.	10	6	20	N.A.
727	SE31-6-6E	TERRENCE ISAAC	UNKNOWN	Production	Domestic	661417.0	5487431.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
728	SE31-6-6E	HELEN HERTWIG	UNKNOWN	Production	Domestic	661410.0	5487723.0	1988	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
729	SE31-6-6E	ULGA BARNOWSKI	UNKNOWN	Production	Domestic	661395.0	5488135.0	1996	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
730	SE31-6-6E	J HIEBERT	Kiansky Bros. Ltd.	Production	Domestic	661754.2	5487804.6	1992	114.9	5	N.A.	119.9	C.	13.997	-3.5	30	1
731	SE31-6-6E	DON WORONIUK	Echo Drilling Ltd.	Production	Domestic	661972.0	5487461.0	2009	118	5	N.A.	200	C.	75	1	75	N.A.
732	SE-31-6-6E	D RICHTER	Echo Drilling Ltd	Production	Domestic	661754.2	5487804.6	1991	111.9	5	N.A.	129.9	C.	79.96	-1	1	2
733	SE-31-6-6E	P KELHER	MANKEY WATER WELL DRILLING	Production	Domestic	661754.2	5487804.6	1980	106.9	4.25	N.A.	179.9	N.A.	10	0	25	4
734	SE-31-6-6E	B SUDERMAN	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1990	116.9	4.1	N.A.	209.9	C.	24.987	0	40	1
735	SE-31-6-6E	J HIEBERT	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1989	114.9	4.25	N.A.	167.9	N.A.	7.995	0	15	1
736	SE-31-6-6E	E HIEBERT	MANKEY WATER WELL DRILLING	Production	Domestic	661754.2	5487804.6	1978	118.5	4.25	N.A.	120.9	N.A.	2.95	0	N.A.	N.A.
737	SE-31-6-6E	J VOTH	KIANSKY BROS.	Production	Domestic,Livestock	661754.2	5487804.6	1988	121.9	4	N.A.	150.9	N.A.	10	-1	16	1
738	SE-31-6-6E	K STAHL	Echo Drilling Ltd.	Production	Domestic	661754.2	5487804.6	1988	118.9	4.2	N.A.	139.9	N.A.	24.987	-2	-1	1
739	32-6-6E	L D VOGT	Echo Drilling Ltd.	Production	Domestic	662969.8	5488234.3	1988	108.4	4.2	N.A.	209.9	N.A.	99.96	-4	N.A.	N.A.
740	32-6-6E	H BERGEN	Echo Drilling Ltd.	Production	Domestic	662969.8	5488234.3	1988	110.9	4.2	N.A.	209.9	N.A.	74.974	5	N.A.	N.A.
741	32-6-6E	ANDY SCHELLING	Echo Drilling Ltd.	RECHARGE	-	661633.8	5488640.5	2013	111	5.5	N.A.	220	C.	100	-2	-0.2	1
742	32-6-6E	ANDY SCHELLING	Echo Drilling Ltd.	Production	Domestic, GEOTHERMAL	661688.4	5488632.1	2013	111	5.5	N.A.	220	C.	100	-2	-1.5	N.A.
743	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	662969.8	5488234.3	1998	122	5	N.A.	198	B.	60	6	50	N.A.
744	32-6-6E	JOHN STAHN	Echo Drilling Ltd.	Production	Domestic	662969.8	5488234.3	1997	111	5	N.A.	137	C.	30	-8	50	N.A.
745	32-6-6E	WALDEMAR WERNET	Echo Drilling Ltd.	Production	Domestic	662970.0	5488234.0	2011	114	5	N.A.	130	C.	100	1.5	15	1
746	32-6-6E	E LACROIX	GUY'S WELL DRILLING	Production	Domestic	662969.8	5488234.3	1984	118.9	4	N.A.	179.9	N.A.	6.992	-7	35	1.5
747	32-6-6E	S KEHLER	Echo Drilling Ltd.	Production	Domestic	662969.8	5488234.3	1995	115.9	5	N.A.	217.9	C.	19.987	0	N.A.	N.A.
748	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669546.0	5488125.0	2008	138	5	N.A.	157	B.	75	12	80	N.A.
749	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669680.0	5488269.0	2008	119	5	N.A.	200	B.	66.003	12	13	N.A.
750	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669624.0	5488043.0	2008	117	5	N.A.	160	B.	50	16	30	N.A.
751	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669848.0	5488288.0	2006	128	5	N.A.	198	O.	100	12	75	N.A.
752	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669788.0	5488149.0	2006	121	5	N.A.	198	O.	100	14	75	N.A.
753	32-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669736.0	5488173.0	2006	121	5	N.A.	175	O.	100	12	75	N.A.
754	NE-32-6-6E	F FROESE	Friesen Drillers Ltd	Production	Domestic	663359.8	5488650.0	1977	111.9	4.25	N.A.	129.9	N.A.	15	-2.5	2	2
755	NE-32-6-6E	DARELL WORONAYOW	Kiansky Bros. Ltd.	Production	Domestic	663024.2	5488134.5	2013	63	5	10	80	B.	12.005	1	36	3
756	NE-32-6-6E	RUSS FUNK	Kiansky Bros. Ltd.	Production	Domestic	663359.8	5488650.0	2000	118	5	N.A.	202	C.	150	-2	-2	N.A.
757	NE-32-6-6E	H KLASSEN	Friesen Drillers Ltd.	Production	Domestic	663359.8	5488650.0	1984	46	4.3	5	51	N.A.	7.995	-2	23	N.A.
758	NE32-6-6E	C KLASSEN	Friesen Drillers Ltd.	Production	Domestic	663359.8	5488650.0	1984	52	4.3	5	65	N.A.	5	-4	1	2
759	NE32-6-6E	S YAREMUS	Friesen Drillers Ltd.	Production	Domestic	663359.8	5488650.0	1984	115.9	4.3	N.A.	216.9	N.A.	89.96	-5	-2	N.A.
760	NE32-6-6E	A A PETERS	EMIL MANKEY & SON	Production	Domestic	663359.8	5488650.0	1977	35	4.1	5	40	N.A.	10	13	24	2
761	NE32-6-6E	F DYCK	Friesen Drillers Ltd.	Production	Domestic	663359.8	5488650.0	1973	104.9	5	N.A.	119.9	N.A.	5	4	2	N.A.
762	NE32-6-6E	C F SCHELLENBERG	Friesen Drillers Ltd.	Production	Domestic	663359.8	5488650.0	1983	57	4.3	5	70	N.A.	19.987	-5	25	0.5
763	NE32-6-6E	VITALY BURGEN	UNKNOWN	Production	Domestic	663656.0	5488534.0	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

764	NE32-6-6E	A FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663359.8	5488650.0	1993	109.9	5	N.A.	111.9	N.A.	49.974	-3	18	1.5
765	NE32-6-6E	W WINKLER	Kiansky Bros. Ltd.	Production	Domestic	663359.8	5488650.0	1989	115.9	4	N.A.	117.9	C.	199.921	1	16	1
766	NE32-6-6E	PETER WIEBE	Kiansky Bros. Ltd.	Production	Domestic	663359.8	5488650.0	2004	116	5	N.A.	130	C.	75	-4	-3	N.A.
767	NE32-6-6E	B MARTIN	Echo Drilling Ltd.	Production	Domestic	663359.8	5488650.0	1988	104.9	4.2	N.A.	116.9	N.A.	19.987	2	25	1
768	NW32-6-6E	KEN FRIESEN	Echo Drilling Ltd.	Production	Domestic,Livestock	662555.4	5488624.0	1999	121	5	N.A.	218	C.	150	N.A.	N.A.	N.A.
769	NW-32-6-6E	STEINBACH FARMS	MANKEY, EMIL	Production	Domestic	662555.4	5488624.0	1964	134.9	4	N.A.	136.9	N.A.	49.974	12	15	N.A.
770	SE32-6-6E	WALDEMAR	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2002	117	5	N.A.	175	C.	2.005	-1.5	27.5	N.A.
771	SE32-6-6E	ANDY FRIESEN	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2001	78	5	N.A.	90	C.	25	4	70	N.A.
772	SE32-6-6E	AVEX HOMES	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2001	115	5	N.A.	180	C.	50	-1	3	N.A.
773	SE32-6-6E	MARLENE VOGY	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	1999	31	5	5	39	B.	20	5	25	N.A.
774	SE-32-6-6E	D HEINRICKS	MANKEY WATER WELL DRILLING	Production	Domestic	663384.3	5487848.6	1988	190.9	5	N.A.	209.9	N.A.	24.987	-1	25	2
775	SE-32-6-6E	JOHANN LITORE	Kiansky Bros. Ltd.	Production	Domestic	663255.6	5487638.6	2012	86	5	5	95	B.	70	2	13	1
776	SE-32-6-6E	DUVEY CONSTRUCTION	Kiansky Bros. Ltd.	Production	Domestic	663040.3	5488058.3	2012	50	5	10	70	B.	12	2	11	3
777	SE-32-6-6E	WILLIE FRIESEN	Kiansky Bros. Ltd.	Production	Domestic	663384.3	5487848.6	1996	117	5	N.A.	119	C.	100	-2	50	1
778	SE-32-6-6E	B THIEBERT	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	1991	127.9	5	N.A.	199.9	N.A.	29.987	3	35	1
779	SE-32-6-6E	G WOHLGEMUTH	MANKEY, EMIL	Production	Domestic	663384.3	5487848.6	1965	28	4	5	33	N.A.	3.997	0	25	N.A.
780	SE32-6-6E	HILLSIDE CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	663226.0	5488027.0	2009	115	5	N.A.	177	C.	50	-8	-2	N.A.
781	SE32-6-6E	EDWARD STILLER	Perimeter Drilling Ltd.	Production	Domestic	663315.0	5487965.0	2008	119	5	N.A.	140	N.A.	25	-2.5	3	N.A.
782	SE32-6-6E	SERGE STENKE	Echo Drilling Ltd.	Production	Domestic	663213.0	5488140.0	2005	115	5	N.A.	185	C.	50	-5	-1.5	N.A.
783	SE32-6-6E	ANDY FRIESEN	Echo Drilling Ltd.	Production	Domestic	663045.0	5487702.0	2005	118	5	N.A.	218	C.	20	-4	-2	N.A.
784	SE32-6-6E	HEINRICH AND HELENE BERG	Echo Drilling Ltd.	Production	Domestic	663243.0	5487540.0	2006	118	5	N.A.	200	C.	55	2	40	N.A.
785	SE32-6-6E	EDUARD STILLER	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2004	114	5	N.A.	218	C.	100	-3	2	N.A.
786	SE32-6-6E	JUERGEN SCHULZ	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2004	116	5	N.A.	178	C.	100	1	60	N.A.
787	SE32-6-6E	WALDO STANG	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2004	124	5	N.A.	218	C.	90	5	75	N.A.
788	SE32-6-6E	E.S. CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2004	120	5	N.A.	218	C.	20	-3	-2	N.A.
789	SE32-6-6E	VICTOR SCHULZ	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2004	118	5	N.A.	218	C.	50	-4	-2	N.A.
790	SE32-6-6E	G REIMER	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	1988	108.9	4.2	N.A.	119.9	N.A.	99.96	-1	4	1.5
791	SE32-6-6E	NIKOLAJ & ANNALIESA SCHIENDRIECK	Echo Drilling Ltd.	Production	Domestic	663384.3	5487848.6	2003	117	5	N.A.	197	C.	50	-3	8	N.A.
792	SW32-6-6E	N WARKENTINE	Echo Drilling Ltd	Production	Domestic	662578.6	5487826.4	1988	113.9	4.2	N.A.	116.9	N.A.	59.974	-2	5	1
793	SW32-6-6E	ANDREAS ISAU	Perimeter Drilling Ltd.	Production	Domestic	662241.7	5487660.5	2013	120	5	N.A.	240	N.A.	80	0	0	N.A.
794	SW32-6-6E	D LORETTE	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	1994	111.9	5	N.A.	134.9	N.A.	99.96	-5	0	N.A.
795	SW32-6-6E	DORA VOGT	UNKNOWN	Production	-	662933.0	5487505.0	1976	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
796	SW32-6-6E	M VOGT	Echo Drilling Ltd.	Production	Livestock	662578.6	5487826.4	1988	33	4.2	5	50	N.A.	15	4	12	1
797	SW32-6-6E	D PENNER	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	1989	117.9	4.25	N.A.	159.9	N.A.	29.987	0	5	1
798	SW32-6-6E	J KEHLER	Kiansky Bros. Ltd.	Production	Domestic	662578.6	5487826.4	1993	115.4	5	N.A.	119.9	C.	199.921	-6	2	2
799	SW32-6-6E	J NEUFELD	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	1994	114.9	5	N.A.	124.9	C.	29.987	-2	N.A.	6
800	SW32-6-6E	E THIEBERT	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	1992	106.9	5	N.A.	139.9	C.	2.995	-1.5	N.A.	4
801	SW32-6-6E	W PETERS	Kiansky Bros. Ltd.	Production	Domestic	660943.8	5488577.8	1992	112.9	4	N.A.	132.9	C.	15.989	-3	60	2.5
802	SW32-6-6E	W PETERS	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	1990	113.9	5	N.A.	134.9	N.A.	99.96	0	8	2.25
803	SW32-6-6E	PATRICK PETERS	Echo Drilling Ltd.	Production	Domestic	662528.0	5487502.0	2005	116	5	N.A.	165	C.	75	2.5	55	N.A.
804	SW32-6-6E	G KORNELSON	Friesen Drillers Ltd.	Production	Domestic	662578.6	5487826.4	1975	119.9	4.25	N.A.	209.9	N.A.	19.987	-2.5	N.A.	2
805	SW32-6-6E	PERRY KAITA	Echo Drilling Ltd.	Production	Domestic	662578.6	5487826.4	2004	123	5	N.A.	218	C.	75	-1	75	N.A.
806	33-6-6E	GARY HARDER	Echo Drilling Ltd.	Production	Domestic	664611.3	5488282.3	1999	110	5	N.A.	195	C.	75	1	55	N.A.
807	33-6-6E	ABE MARTENS	Echo Drilling Ltd.	Production	Domestic	664611.3	5488282.3	1999	125	5	N.A.	197	B.	100	6	100	N.A.
808	33-6-6E	C LOEWEN	Friesen Drillers Ltd.	Production	Domestic	664611.3	5488282.3	1981	41	4.25	5	57	N.A.	29.987	10	25	1
809	33-6-6E	B KLIEWER	Friesen Drillers Ltd.	Production	Domestic	664611.3	5488282.3	1976	17	4.25	5	34	N.A.	29.987	8	12	N.A.
810	33-6-6E	JOHN DYCK	Echo Drilling Ltd.	Production	Domestic	664611.0	5488282.0	2007	116	5	N.A.	135	C.	50	-3	60	N.A.
811	33-6-6E	OAKRIDGE NURSERY	Echo Drilling Ltd.	Production	Domestic	664611.3	5488282.3	2002	111	5	N.A.	195	C.	100	-5	-2	N.A.
812	NE-33-6-6E	P BROESKY	MANKEY, EMIL	Production	Domestic	665001.3	5488699.8	1974	104.9	4.25	N.A.	105.9	N.A.	19.987	0	N.A.	N.A.
813	NE33-6-6E	TIM UNGER	Echo Drilling Ltd.	Production	Domestic	665001.3	5488699.8	1997	45	5	5	50	C.	20	-2	35	N.A.
814	NE33-6-6E	SARAH HADER	Friesen Drillers Ltd.	Production	Domestic	665287.0	5488777.0	2000	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
815	NE33-6-6E	DAVID ESAU	UNKNOWN	Production	Domestic	664765.0	5488822.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
816	NE-33-6-6E	J SUDERMAN	Friesen Drillers Ltd.	Production	Domestic	665001.3	5488699.8	1983	112.9	4.3	N.A.	119.9	N.A.	7.995	-4	30	N.A.
817	NE-33-6-6E	HIDDEN VALLEY FARMS	Friesen Drillers Ltd.	Production	Domestic	665001.3	5488699.8	1983	35	4.3	5	46	C.	39.987	-2.5	10	1
818	NE-33-6-6E	C NEUFELD	Friesen Drillers Ltd.	Production	Livestock	665001.3	5488699.8	1982	25	4.25	5	50	N.A.	15	-1	25	1
819	NE-33-6-6E	P E HILDEBRAND	MANKEY, EMIL	Production	Domestic	665001.3	5488699.8	1965	102.9	4	N.A.	102.9	N.A.	10	0	N.A.	N.A.

820	NE-33-6-6E	OLGA FRANZ	Friesen Drillers Ltd.	Production	-	664625.0	5488759.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
821	NE-33-6-6E	HERMAN DYCK	Echo Drilling Ltd.	Production	Domestic	664944.0	5488961.0	2007	122	5	N.A.	218	C.	100	-1.5	75	N.A.
822	NE33-6-6E	KINGSWAY INTERIORS INC	Echo Drilling Ltd.	Production	Domestic	665306.0	5488760.0	2005	119	5	N.A.	198	C.	50	6	2	N.A.
823	NE33-6-6E	W PENNER	KIANSKY BROS.	Production	Domestic	665001.3	5488699.8	1988	46	4	N.A.	55	C.	27.995	1	30	1
824	NE33-6-6E	C HILDEBRANT	Friesen Drillers Ltd.	Production	Domestic	665001.3	5488699.8	1972	117.9	4	N.A.	219.9	N.A.	39.987	-7	2	24
825	NE33-6-6E	JOHN FUNK	Echo Drilling Ltd.	Production	Domestic	664195.6	5488674.0	2000	113	5	N.A.	200	C.	20	-1	1	N.A.
826	NW33-6-6E	E C CHURCH	Kiansky Bros. Ltd.	Production	Domestic	664485.4	5488867.2	2012	119	5	N.A.	205	C.	100	-3	8	2
827	NW33-6-6E	DAVE HIEBERT	Kiansky Bros. Ltd.	Production	Domestic	664195.6	5488674.0	1997	108	5	N.A.	112	N.A.	30	-3	60	1
828	NW-33-6-6E	C F SHELDENBERG	mondor drillers	Production	Domestic	664195.6	5488674.0	1972	102.9	4	N.A.	114.9	N.A.	0	0	N.A.	N.A.
829	SE33-6-6E	REG FAST	Echo Drilling Ltd	Production	Domestic	665407.0	5487547.0	1988	121.9	4.2	N.A.	139.9	N.A.	19.987	5	2	1
830	SE-33-6-6E	COUNTRY VIEW SCHOOL	Friesen Drillers Ltd.	Production	Domestic	665026.3	5487898.4	1977	45	4.25	5	53	N.A.	19.987	10	24	N.A.
831	SE33-6-6E	PETER GERZEN	Kiansky Bros. Ltd.	Production	Domestic	665026.3	5487898.4	2000	48	5	10	64	N.A.	50	7	8	N.A.
832	SE33-6-6E	VOYT CONSTRUCTION-DANNY VOYT	Kiansky Bros. Ltd.	Production	Domestic	665026.3	5487898.4	2000	45	5	10	64	B.	50	7	8	N.A.
833	SE33-6-6E	VICTOR HOLSTEIN	Kiansky Bros. Ltd.	Production	Domestic	665026.3	5487898.4	2000	48	5	11	66	B.	45	8	8	N.A.
834	SE33-6-6E	DAVE PETERS	Echo Drilling Ltd.	Production	Domestic	664833.9	5487715.0	2012	111	5.5	N.A.	137	C.	100	4	57	1
835	SE33-6-6E	JAKOB REDEKOP	Echo Drilling Ltd.	Production	Domestic	665026.3	5487898.4	2002	130	5	N.A.	130	C.	20	-5	-2	N.A.
836	SW-33-6-6E	D WIEBE	Echo Drilling Ltd.	Production	Livestock	664220.1	5487872.6	1988	27	4.2	5	38	N.A.	10	11	17	1
837	SW-33-6-6E	VIC & HEAN KLASSEN	Kiansky Bros. Ltd	Production	Domestic	664220.1	5487872.6	2004	117	5	N.A.	129	C.	70	-4	10	2
838	34-6-6E	JOHN REMPEL	Echo Drilling Ltd.	Production	Domestic	666250.0	5488333.3	2001	124	5	N.A.	197	C.	20	-4	-1	N.A.
839	34-6-6E	W PAULS	Echo Drilling Ltd.	Production	Domestic	666250.0	5488333.3	1988	37	4.2	5	50	N.A.	49.974	7	20	1
840	34-6-6E	WESTWOOD MECHANICAL	Friesen Drillers Ltd.	Production	Other	666250.0	5488333.3	2000	113	5	N.A.	157	B.	30	-5	0	N.A.
841	34-6-6E	BOBBY LOEWEN	Echo Drilling Ltd.	Production	Domestic	666250.0	5488333.3	2003	108	5	N.A.	195	C.	100	-2	80	N.A.
842	34-6-6E	WALDAMAR & OLGA FRANZ	Echo Drilling Ltd.	Production	Domestic	666250.0	5488333.3	2003	118	5	N.A.	197	C.	75	1	80	N.A.
843	34-6-6E	JOHN WEIBE	Echo Drilling Ltd.	Production	Domestic	666250.0	5488333.3	2002	118	5	N.A.	197	C.	20	-60	-2	N.A.
844	NE34-6-6E	DAN VOTH	Kiansky Bros. Ltd.	Production	Domestic	666736.0	5488669.0	1999	41	5	10	60	B.	47.995	8	8	1
845	NW34-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	Production	Irrigation	665941.0	5488622.0	2007	106.5	5	N.A.	200	N.A.	100	7.6	8.4	N.A.
846	NW-34-6-6E	J BLATZ	Friesen Drillers Ltd.	Production	Domestic	665835.8	5488725.3	1975	151.9	4.25	N.A.	154.9	N.A.	19.987	30	55	N.A.
847	SE34-6-6E	PAUL NEUSTAEDTER	Echo Drilling Ltd.	Production	Domestic	666666.3	5487950.5	1996	127	5	N.A.	199	B.	30	6	15	1
848	SE34-6-6E	BARKMAN CONCRETE	Echo Drilling Ltd.	Production	Domestic	666988.0	5487690.0	2006	117	5	N.A.	240	C.	60	13	21.6	N.A.
849	SE34-6-6E	BARKMAN CONCRETE	Echo Drilling Ltd.	Production	Domestic	666988.0	5487690.0	2006	118	5	N.A.	220	C.	71.003	13	17.6	N.A.
850	SW34-6-6E	MARVIN VOGT HOMES LTD	Kiansky Bros. Ltd.	Production	Domestic	665860.8	5487923.9	2006	48	5	10	60	B.	80	3	12	2
851	35-6-6E	GEORGE MCCONNELL	Maple Leaf Enterprises LTD.	Production	Domestic	667892.6	5488386.8	1999	71	5	N.A.	255	B.	16.003	-6	13	1
852	35-6-6E	G PACHAL	Friesen Drillers Ltd.	Production	Domestic	667892.6	5488386.8	1985	135.9	4.2	N.A.	186.9	N.A.	29.987	6	7	2
853	35-6-6E	PRAIRIE HOMES	Echo Drilling Ltd.	Production	Domestic	667892.6	5488386.8	1995	120.9	5	N.A.	175.9	N.A.	24.987	10	75	N.A.
854	35-6-6E	LUBA CHORNOBOY	Echo Drilling Ltd.	Production	Domestic	667341.0	5478441.0	2009	178	5	N.A.	278	B.	75	36	75	N.A.
855	35-6-6E	DERRICK DAVIES	Echo Drilling Ltd.	Production	Domestic	667892.6	5488386.8	2003	137	5	N.A.	157	B.	100	8	60	N.A.
856	NE35-6-6E	5528080 MANITOBA LTD	UNKNOWN	Production	-	668166.0	5488871.0	1978	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
857	NE35-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd	Production	Domestic	668281.5	5488804.3	1997	121	5	N.A.	190	B.	50	11	50	N.A.
858	NE-35-6-6E	J SUDERMAN	FRIESEN, TONY	Production	Domestic	668281.5	5488804.3	1968	128.9	5	N.A.	137.9	N.A.	10.989	1	28	20
859	NW35-6-6E	MYRON HIEBERT	Perimeter Drilling Ltd.	Production	Domestic	667214.0	5488360.0	1999	143	5	N.A.	160	N.A.	50	15	N.A.	1
860	NW35-6-6E	BETHESDA HOSPITAL	Echo Drilling Ltd.	Production	Air Conditioning	667890.0	5488944.0	1987	111.9	10	N.A.	219.9	N.A.	599.749	3	28	12
861	NW35-6-6E	SOUTHWOOD SCHOOL	Echo Drilling Ltd.	Production	Air Conditioning	667474.6	5488777.3	1987	117.9	6.5	N.A.	241.8	N.A.	199.921	17	32	24
862	NW35-6-6E	KINDER CORNER DAYCARE	Echo Drilling Ltd.	Production	Air conditioning	667474.6	5488777.3	2003	115	5	N.A.	197	C.	50	6	80	N.A.
863	NW35-6-6E	KINDER CORNER DAYCARE	Echo Drilling Ltd.	Production	Air conditioning	667474.6	5488777.3	2003	115	5	N.A.	197	C.	50	5	80	N.A.
864	NW35-6-6E	BETHESDA HOSPITAL	Echo Drilling Ltd.	RETURN WELL	RECHARGE	667829.0	5488840.0	1987	112.9	7	N.A.	219.9	N.A.	152.942	3	19	12
865	SE35-6-6E	S PATRAM	Echo Drilling Ltd.	Production	Domestic	668307.0	5488001.2	1988	124.9	4.2	N.A.	179.9	N.A.	19.987	10	11	1
866	SE35-6-6E	G & E HOMES	Echo Drilling Ltd.	Production	Domestic	667945.8	5486749.8	2001	151	5	N.A.	208	C.	50	15	80	N.A.
867	SE35-6-6E	STEINBACH	MANKEY, EMIL	Production	-	668307.0	5488001.2	1973	135.9	10	N.A.	136.9	N.A.	N.A.	N.A.	N.A.	N.A.
868	SE35-6-6E	ROLLY'S WOODWORKING	Echo Drilling Ltd.	Production	Domestic	668307.0	5488001.2	1998	147	5	N.A.	198	N.A.	40	9	50	N.A.
869	SE35-6-6E	EAST END GARAGE	UNKNOWN	Production	-	668636.0	5487702.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
870	SE-35-6-6E	J W SEWATZHEY	MANKEY, EMIL	Production	Domestic	668307.0	5488001.2	1965	130.9	4	N.A.	N.A.	N.A.	7.995	3	8	24
871	SE-35-6-6E	G STENKE	MANKEY, EMIL	Production	Domestic	668307.0	5488001.2	1967	127.9	4	N.A.	134.9	N.A.	8.997	6	12	12
872	SE35-6-6E	CALVIN TRIPP	Echo Drilling Ltd.	RECHARGE	-	668516.0	5488394.0	2005	118	5	N.A.	198	C.	40	11	27	N.A.
873	SE35-6-6E	ALEXANDER GOSSEN	Kiansky Bros. Ltd.	Production	Domestic	668307.0	5488001.2	2004	134	5	N.A.	182	B.	105	10.5	N.A.	N.A.

874	SE35-6-6E	WILBERT FALK	Kiansky Bros. Ltd.	Production	Domestic	668307.0	5488001.2	2002	134	5	N.A.	165	B.	20	5	N.A.	N.A.
875	SE35-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	OBSERVATION	-	668391.0	5487946.0	2007	118	5	N.A.	178	B.	25	33.4	95	N.A.
876	SE35-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	Production	Municipal	668127.0	5488082.0	1956	156	16	N.A.	251.8	C.	124.947	25	33	N.A.
877	SE35-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	Production	Other	668122.0	5488094.0	2008	124	12	N.A.	220	N.A.	732	20	92	N.A.
878	SE35-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	Production	Municipal	668216.0	5488029.0	1956	119.9	12	N.A.	251.8	C.	N.A.	16	N.A.	N.A.
879	SE35-6-6E	CITY OF STEINBACH	Friesen Drillers Ltd.	Production	Municipal	668089.0	5488169.0	1985	117.9	12	N.A.	229.8	N.A.	449.802	10	79.9	5
880	SW35-6-6E	SOUTHWOOD SCHOOL	Echo Drilling Ltd.	RECHARGE	Air Conditioning	667502.7	5487977.3	1987	118.9	6.5	N.A.	244.8	N.A.	199.921	12	20	24
881	SW-35-6-6E	P H FROESE	MANKEY, EMIL	Production	Domestic	667502.7	5487977.3	1970	111.9	4	N.A.	114.9	N.A.	11.992	4	6	12
882	SW35-6-6E	KEVIN TOEWS	Friesen Drillers Ltd.	Production	Domestic	667445.0	5488146.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
883	SW35-6-6E	ROBERT HAMM	UNKNOWN	Production	Domestic	667450.0	5488139.0	2009	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
884	SW-35-6-6E	J FUNK	Friesen Drillers Ltd.	Production	Domestic	667502.7	5487977.3	1971	124.9	4	N.A.	189.9	N.A.	N.A.	N.A.	N.A.	N.A.
885	SW35-6-6E	J PETERS	Friesen Drillers Ltd.	Production	Domestic	667502.7	5487977.3	1967	113.9	4	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
886	36-6-6E	DICK ENNS	Echo Drilling Ltd.	Production	Domestic	669758.0	5487760.0	2002	136	5	N.A.	177	B.	50	10	80	N.A.
887	36-6-6E	TIM KOOP	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	1999	120	5	N.A.	180	C.	45	8	75	N.A.
888	36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	1999	118	5	N.A.	200	C.	50	10	55	N.A.
889	36-6-6E	ED RICHE	Echo Drilling Ltd.	Production	Domestic	669531.0	5488435.0	2012	130	5	N.A.	180	B.	50	17	75	1
890	36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2011	74	5	N.A.	178	B.	40	7	27	1
891	36-6-6E	CAROL BRAUN	Friesen Drillers Ltd.	Production	Domestic	669653.0	5488726.0	2003	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
892	36-6-6E	MAX SCHALLA	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2002	117	5	N.A.	139	B.	50	11	13	N.A.
893	36-6-6E	R LESSARD	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	1995	121.9	5	N.A.	157.9	C.	49.974	12	40	N.A.
894	36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670096.0	5488049.0	2009	118	5	N.A.	161	B.	100	18	80	N.A.
895	36-6-6E	ABE WIEBE	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2006	128	5	N.A.	197	O.	75	18	80	N.A.
896	36-6-6E	ABE WIEBE	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2006	128	5	N.A.	197	O.	75	22	80	N.A.
897	36-6-6E	ABE WIEBE	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2006	127	5	N.A.	197	O.	75	15	80	N.A.
898	36-6-6E	ABE WIEBE	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	2006	150	5	N.A.	190	O.	100	18	80	N.A.
899	36-6-6E	J FEHR	Echo Drilling Ltd.	Production	Domestic	669530.8	5488435.0	1991	148.9	5	N.A.	174.9	N.A.	99.96	16	50	1
900	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2002	118	5	N.A.	157	B.	100	16	80	N.A.
901	NE36-6-6E	SHELLY REIMER	Echo Drilling Ltd.	Production	Domestic	669986.0	5488532.0	2001	118	5	N.A.	162	B.	45	8	100	N.A.
902	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2001	118	5	N.A.	180	C.	50	8	35	N.A.
903	NE36-6-6E	HILLSIDE CONSTRUCTION	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2000	117	5	N.A.	160	C.	50	9	55	N.A.
904	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2000	118	5	N.A.	178	B.	100	9	60	N.A.
905	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2000	130	5	N.A.	217	C.	50	10	75	N.A.
906	NE36-6-6E	LOUIS BALCAEN	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	1988	140.9	5	N.A.	159.9	N.A.	29.987	5	30	1
907	NE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	671059.0	5454346.0	2009	123	5	N.A.	190	B.	60	13	80	1
908	NE36-6-6E	CINDY GUNTHER	UNKNOWN	Production	Domestic	670193.0	5488472.0	2005	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
909	NE36-6-6E	ALBERT & HERTA FUNK	UNKNOWN	Production	Domestic	670287.0	5488560.0	1976	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
910	NE36-6-6E	MARLENE STEVENS	Friesen Drillers Ltd.	Production	Domestic	669747.0	5488765.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
911	NE36-6-6E	BOUN PHOWMARATCH	Friesen Drillers Ltd.	Production	Domestic	670153.0	5488748.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
912	NE36-6-6E	CAPRICE LEDINGHAM	Friesen Drillers Ltd.	Production	Domestic	670243.0	5488742.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
913	NE36-6-6E	HENDRICH FAST	Friesen Drillers Ltd.	Production	Domestic	669851.0	5488712.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
914	NE36-6-6E	LUCIE BLEKINSOPP	Friesen Drillers Ltd.	Production	Domestic	670300.0	5488634.0	2003	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
915	NE36-6-6E	WENDY BERGEN	Friesen Drillers Ltd.	Production	Domestic	669939.0	5488649.0	2003	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
916	NE36-6-6E	ALEX	UNKNOWN	OTHER	-	669970.0	5488777.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
917	NE36-6-6E	ANNA FRIESEN	Friesen Drillers Ltd.	Production	Domestic	670320.0	5488573.0	2005	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
918	NE36-6-6E	DEB WILL	Friesen Drillers Ltd.	Production	Domestic	669786.0	5488605.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
919	NE36-6-6E	HEATHER LOEWEN	Friesen Drillers Ltd.	Production	Domestic	669855.0	5488661.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
920	NE36-6-6E	FERN CHOUINARD	Friesen Drillers Ltd.	Production	Domestic	669839.0	5488481.0	2003	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
921	NE36-6-6E	KRISTIE BOUCHARD	Friesen Drillers Ltd.	Production	Domestic	669881.0	5488551.0	2003	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
922	NE36-6-6E	JOHN WYRYTIA	Friesen Drillers Ltd.	Production	Domestic	670113.0	5488642.0	2004	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
923	NE36-6-6E	JOHN SCHEPER	Friesen Drillers Ltd.	Production	Domestic	670128.0	5488572.0	2003	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
924	NE36-6-6E	DIANE FRIESEN	UNKNOWN	Production	Domestic	670141.0	5488454.0	1994	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
925	NE36-6-6E	ANNIE PETKAU	Friesen Drillers Ltd.	Production	Domestic	669685.0	5488527.0	2006	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
926	NE36-6-6E	JOSHELYN DOERKSEN (MONA HILDEBRAND)	UNKNOWN	Production	-	670290.0	5488475.0	2010	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
927	NE36-6-6E	MONA HILDEBRAND	Friesen Drillers Ltd.	Production	Domestic	670290.0	5488475.0	2006	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
928	NE36-6-6E	M J KLASSEN	MANKEY, EMIL	Production	Domestic	669919.3	5488852.7	1973	117.9	4.25	N.A.	175.9	N.A.	N.A.	N.A.	N.A.	N.A.
929	NE36-6-6E	JIM & NAOMI FRIESEN	Echo Drilling Ltd.	Production	Domestic	670034.0	5488621.0	2003	118	5	N.A.	177	B.	50	18	60	N.A.
930	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2006	111	5	N.A.	178	O.	100	12	5	N.A.
931	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2006	113	5	N.A.	200	O.	75	12	75	N.A.
932	NE36-6-6E	KEVIN FRIESEN	Echo Drilling Ltd.	Production	Domestic	669697.0	5488616.0	2005	115	5	N.A.	180	C.	75	10	19	N.A.

933	NE36-6-6E	KEVIN FRIESEN	Echo Drilling Ltd.	Production	Domestic	669697.0	5488616.0	2005	120	5	N.A.	160	C.	75	10	17	N.A.
934	NE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2005	122	5	N.A.	178	B.	100	10	60	N.A.
935	NE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2005	119	5	N.A.	195	B.	100	10	60	N.A.
936	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2004	116	5	N.A.	175	B.	100	9	80	N.A.
937	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2004	117	5	N.A.	175	B.	100	9	80	N.A.
938	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2004	120	5	N.A.	178	C.	100	10	80	N.A.
939	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2004	118	5	N.A.	178	B.	100	10	80	N.A.
940	NE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2004	117	5	N.A.	175	B.	75	7	80	N.A.
941	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	115	5	N.A.	177	B.	60	13	70	N.A.
942	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	128	5	N.A.	150	B.	40	12	22	N.A.
943	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	139	5	N.A.	177	B.	60	13	70	N.A.
944	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	118	5	N.A.	177	B.	50	10	80	N.A.
945	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	123	5	N.A.	178	B.	100	10	80	N.A.
946	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	118	5	N.A.	177	B.	50	15	80	N.A.
947	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2003	117	5	N.A.	190	B.	75	9	75	N.A.
948	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2002	120	5	N.A.	190	B.	80	9.5	55	N.A.
949	NE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669919.3	5488852.7	2002	125	5	N.A.	175	B.	100	9	70	N.A.
950	NW36-6-6E	YURI HOLSTEIN	Echo Drilling Ltd.	Production	Domestic	669115.6	5488828.4	2003	112	5	N.A.	195	C.	30	N.A.	N.A.	N.A.
951	NW36-6-6E	PAUL HORATAL	Kansky Bros. Ltd.	Production	Domestic	669115.6	5488828.4	1995	136	5	N.A.	185	N.A.	25	16	90	1
952	NW36-6-6E	J REMPEL	Friesen Drillers Ltd.	Production	Domestic	669115.6	5488828.4	1977	109.9	4.25	N.A.	139.9	N.A.	19.987	8	16	2
953	NW36-6-6E	DANIEL HOFMANN	Echo Drilling Ltd.	Production	Domestic	669118.0	5488821.0	2007	144	5	N.A.	180	B.	50	16	25	N.A.
954	NW36-6-6E	RANDY KEHLER	Echo Drilling Ltd.	Production	Domestic	669115.6	5488828.4	2003	129	5	N.A.	185	B.	100	25	60	N.A.
955	NW36-6-6E	BRIAN WATCHORN	Echo Drilling Ltd.	Production	Domestic	669115.6	5488828.4	2002	58	5	N.A.	73	C.	100	2	50	N.A.
956	NW36-6-6E	JOHN REMPEL	Echo Drilling Ltd.	Production	Domestic	669115.6	5488828.4	2002	121	5	N.A.	195	C.	50	1	50	N.A.
957	SE-36-6-6E	A DOUKSEN	Friesen Drillers Ltd.	Production	Domestic	669945.6	5488049.0	1978	125.9	4.25	N.A.	134.9	N.A.	59.974	0	10	N.A.
958	SE-36-6-6E	MEL REMPEL	Echo Drilling Ltd.	Production	Domestic	670000.0	5488322.0	2001	117	5	N.A.	150	B.	25	9	75	N.A.
959	SE-36-6-6E	PETER WIEBE	MANKEY, EMIL	Production	Domestic	669945.6	5488049.0	1974	118.9	4.1	N.A.	125.9	N.A.	15	4	25	N.A.
960	SE-36-6-6E	DENIS FUNK	Friesen Drillers Ltd.	Production	Domestic,Livestock	670174.0	5487805.0	1977	118.9	4.25	N.A.	149.9	N.A.	29.987	7	20	2
961	SE-36-6-6E	CURT RIEMER	Perimeter Drilling Ltd.	Production	Domestic	669945.6	5488049.0	1998	126	5	N.A.	140	N.A.	100	12	N.A.	0.5
962	SE-36-6-6E	PAUL TURENNE	UNKNOWN	Production	Domestic	670232.0	5488098.0	2006	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
963	SE36-6-6E	IRINA FRIESEN	Friesen Drillers Ltd.	Production	Domestic	670302.0	5487975.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
964	SE36-6-6E	ANDREA EWONCHUK	Friesen Drillers Ltd.	Production	Domestic	670087.0	5487932.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
965	SE36-6-6E	SHEILA ARDIES	Friesen Drillers Ltd.	Production	Domestic	670191.0	5488067.0	2010	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
966	SE36-6-6E	ROBERT WILLIAM DESMOND	UNKNOWN	Production	Domestic	669884.0	5487749.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
967	SE36-6-6E	ALLAN & EDIE BUTLAND	Friesen Drillers Ltd.	Production	Domestic	669669.0	5487738.0	2005	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
968	SE36-6-6E	ROLANDA FRIESEN	Friesen Drillers Ltd.	Production	Domestic	670019.0	5487954.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
969	SE36-6-6E	BRANDY ENNS	Friesen Drillers Ltd.	Production	Domestic	670115.0	5488057.0	2009	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
970	SE36-6-6E	KATHY ENGEL	UNKNOWN	Production	Domestic	670072.0	5487771.0	1900	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
971	SE36-6-6E	KARL ZIBELL	UNKNOWN	Production	Domestic	670294.0	5488051.0	2007	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
972	SE36-6-6E	JAMES & NITA SOBERING	UNKNOWN	Production	Domestic	669681.0	5487674.0	1920	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
973	SE36-6-6E	THELMA FUNK	UNKNOWN	Production	Domestic	669653.0	5487670.0	1975	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
974	SE36-6-6E	THERESA DYCK	UNKNOWN	Production	-	669814.0	5487700.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
975	SE36-6-6E	CHARLENE TURNER	Friesen Drillers Ltd	Production	Domestic	669839.0	5488287.0	2006	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
976	SE36-6-6E	MARINA SCHLEININ	UNKNOWN	Production	Domestic	669579.0	5488321.0	2008	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
977	SE36-6-6E	CAROL PETERS	Friesen Drillers Ltd.	Production	Domestic	669926.0	5488160.0	2006	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
978	SE36-6-6E	JEN LAVALLEE	UNKNOWN	Production	Domestic	669654.0	5488097.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
979	SE36-6-6E	LUDMILLA KOSOWSKI	Friesen Drillers Ltd.	Production	Domestic	669696.0	5488406.0	2006	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
980	SE36-6-6E	SHELLY FRIESEN	UNKNOWN	Production	Domestic	669807.0	5488174.0	2006	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
981	SE36-6-6E	SHEILA FRIESEN	UNKNOWN	Production	Domestic	669551.0	5488232.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
982	SE36-6-6E	JULIE FRIESEN	UNKNOWN	Production	Domestic	669743.0	5488099.0	2004	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
983	SE36-6-6E	MEAGAN FONTAINE	UNKNOWN	Production	Domestic	669645.0	5488201.0	2007	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
984	SE36-6-6E	OLGA BLUMENSTEIN	UNKNOWN	Production	Domestic	669795.0	5488348.0	2006	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
985	SE36-6-6E	JANELLE WOLLMANN	UNKNOWN	Production	Domestic	670035.0	5488195.0	2010	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
986	SE36-6-6E	HELEN REDKO	UNKNOWN	Production	Domestic	669929.0	5488399.0	2000	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
987	SE36-6-6E	SHAWNA KROEKER	UNKNOWN	Production	Domestic	670191.0	5488213.0	1997	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
988	SE36-6-6E	MAULLA FRIESEN	Friesen Drillers Ltd.	Production	Domestic	670192.0	5488296.0	1998	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
989	SE36-6-6E	KERRI MENDEL	UNKNOWN	Production	Domestic	669907.0	5487870.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
990	SE36-6-6E	GARNET ISAAC	Friesen Drillers Ltd.	Production	Domestic	669999.0	5487885.0	2008	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

991	SE36-6-6E	LOUELLA KROEKER	UNKNOWN	Production	Domestic	669772.0	5487812.0	2004	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
992	SE36-6-6E	DAVE STEVENS	UNKNOWN	Production	Domestic	670123.0	5488348.0	1997	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
993	SE36-6-6E	JERRY RANCE	UNKNOWN	Production	Domestic	670031.0	5488442.0	2010	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
994	SE36-6-6E	CANDICE NEUFELD	Friesen Drillers Ltd.	Production	Domestic	670326.0	5488431.0	1995	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
995	SE36-6-6E	GARY HOLDEN	Friesen Drillers Ltd.	Production	Domestic	670174.0	5487867.0	2008	N.A.	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
996	SE36-6-6E	JEONGWON HA	UNKNOWN	Production	Domestic	670242.0	5487812.0	2010	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
997	SE36-6-6E	SUZANNA STURZBECHAR	UNKNOWN	Production	Domestic	669659.0	5487903.0	2006	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
998	SE36-6-6E	CHRISTINE HORSFIELD	UNKNOWN	Production	Domestic	669671.0	5487990.0	2007	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
999	SE36-6-6E	DARYL FRIESEN	Friesen Drillers Ltd.	Production	Domestic	669715.0	5487962.0	2003	N.A.	6	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1000	SE36-6-6E	TARA DYCK	UNKNOWN	Production	Domestic	669723.0	5487923.0	2004	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1001	SE36-6-6E	PRAIRIE HOMES INC	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	1996	119	5	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1002	SE36-6-6E	RICHARD LISKA	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	1996	144	5	N.A.	177	N.A.	5	N.A.	N.A.	1
1003	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670111.1	5488061.9	2010	116	5	N.A.	160	B.	30	13	60	1
1004	SE36-6-6E	MELISSA JOLICOEUR	Echo Drilling Ltd.	Production	Domestic	670334.0	5487792.0	1995	124.9	5	N.A.	174.9	N.A.	74.974	8	55	2
1005	SE36-6-6E	COLIN KHN	Echo Drilling Ltd.	Production	Domestic	669574.0	5487703.0	1994	145.9	5	N.A.	174.9	N.A.	49.974	0	50	1
1006	SE36-6-6E	JIM PETERS	Echo Drilling Ltd.	Production	Domestic	669897.0	5488082.0	2005	123	5	N.A.	190	B.	100	10	80	N.A.
1007	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2007	119	5	N.A.	200	B.	40	12	20	N.A.
1008	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2007	125	5	N.A.	160	B.	40	13	23	N.A.
1009	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2007	119	5	N.A.	160	B.	50	18	26	N.A.
1010	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2007	155	5	N.A.	198	B.	75	15	75	N.A.
1011	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2007	120	5	N.A.	160	B.	40	14	30	N.A.
1012	SE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669553.0	5488200.0	2008	118	5	N.A.	197	B.	100	12	80	N.A.
1013	SE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669546.0	5488339.0	2008	118	5	N.A.	197	B.	100	11	100	N.A.
1014	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670076.0	5487767.0	2008	133	5	N.A.	180	B.	40	18	40	N.A.
1015	SE36-6-6E	A GIESBERCT	Friesen Drillers Ltd.	Production	Domestic	669945.6	5488049.0	1980	124.9	4.25	N.A.	179.9	N.A.	19.987	12	30	2
1016	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670003.0	5497975.0	2008	139	5	N.A.	155	B.	50	16	75	N.A.
1017	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670137.0	5487902.0	2008	120	5	N.A.	198	B.	25	14	16	N.A.
1018	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	670011.0	5487873.0	2008	129	5	N.A.	178	B.	25	14	51	N.A.
1019	SE36-6-6E	GEORGE NEUFELD	Echo Drilling Ltd.	Production	Domestic	669950.0	5488045.0	2008	171	5	N.A.	217	B.	100	14	80	N.A.
1020	SE36-6-6E	4364679 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2006	132	5	N.A.	178	C.	100	6	75	N.A.
1021	SE36-6-6E	ABE WIEBE	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2006	122	5	N.A.	197	O.	50	15	60	N.A.
1022	SE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2005	123	5	N.A.	190	O.	75	10	80	N.A.
1023	SE36-6-6E	GRANT LAZARUK	Echo Drilling Ltd.	Production	Domestic	669926.0	5488160.0	2005	122	5	N.A.	190	O.	75	10	80	N.A.
1024	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669738.0	5487938.0	2005	128	5	N.A.	218	O.	75	12	75	N.A.
1025	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669677.0	5487967.0	2005	126	5	N.A.	218	O.	75	11	75	N.A.
1026	SE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669680.0	5488541.0	2006	123	5	N.A.	180	O.	80	8	75	N.A.
1027	SE36-6-6E	JAKE DYCK	Echo Drilling Ltd.	Production	Domestic	670184.0	5487694.0	2006	129	5	N.A.	195	O.	50	20	80	N.A.
1028	SE36-6-6E	DEERFIELD ESTATES	Echo Drilling Ltd.	Production	Domestic	669934.0	5488098.0	2005	123	5	N.A.	178	N.A.	75	11	55	N.A.
1029	SE36-6-6E	4364679 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2005	120	5	N.A.	138	B.	100	10	55	N.A.
1030	SE36-6-6E	4364679 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2005	130	5	N.A.	195	B.	75	16	80	N.A.
1031	SE36-6-6E	4364679 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2005	128	5	N.A.	128	B.	100	10	75	N.A.
1032	SE36-6-6E	4364679 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2005	128	5	N.A.	155	B.	100	10	75	N.A.
1033	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	129	5	N.A.	192	B.	75	11	70	N.A.
1034	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	127	5	N.A.	195	B.	100	12	80	N.A.
1035	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	129	5	N.A.	178	B.	75	14	75	N.A.
1036	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	140	5	N.A.	178	B.	100	10	60	N.A.
1037	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	131	5	N.A.	218	B.	75	13	75	N.A.
1038	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	131	5	N.A.	157	B.	100	10	60	N.A.
1039	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	127	5	N.A.	197	B.	70	13	100	N.A.
1040	SE36-6-6E	VANESSA KILMISTER	Echo Drilling Ltd.	Production	Domestic	669845.0	5487857.0	2004	114	5	N.A.	187	B.	50	16	80	N.A.
1041	SE36-6-6E	4159552 MANITOBA LTD	Echo Drilling Ltd.	Production	Domestic	669945.6	5488049.0	2004	118	5	N.A.	197	B.	50	16	80	N.A.
1042	SE-36-6-6E	N WALLBANK	MANKEY, EMIL	Production	Domestic	669945.6	5488049.0	1968	117.9	4	N.A.	120.9	N.A.	8.997	14	22	24
1043	SW-36-6-6E	J WARKENTINE	KIANSKY BROS.	Production	Domestic	669141.1	5488025.2	1986	119.9	4	N.A.	225.9	N.A.	40.976	1	70	0.5
1044	SW-36-6-6E	BRENDA BROWN	MANKEY, EMIL	Production	Domestic	669374.0	5487665.0	1970	119.9	4	N.A.	119.9	N.A.	8.997	8	14	48
1045	SW-36-6-6E	MILLIE SCHALL	UNKNOWN	Production	-	669145.0	5488017.0	1980	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1046	SW-36-6-6E	PRAIRIE HOMES INC	Echo Drilling Ltd.	Production	Domestic	669141.1	5488025.2	1996	117	5	N.A.	160	B.	75	7	13	2
1047	SW-36-6-6E	KEVIN TOEWS	Echo Drilling Ltd.	Production	Domestic	669141.1	5488025.2	1996	121	5	N.A.	160	B.	75	7	14	2
1048	SW36-6-6E	M SCHALLA	Friesen Drillers Ltd.	Production	Domestic	669396.0	5487684.0	1963	117.9	4	N.A.	117.9	N.A.	10	1	1	2
1049	SW36-6-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	669145.0	5488017.0	2007	117	5	N.A.	160	B.	100	15	45	N.A.

1050	SW36-6-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	669145.0	5488017.0	2007	116	5	N.A.	116	B.	75	10	80	N.A.
1051	SW36-6-6E	PRAIRIE PROPERTIES	Echo Drilling Ltd.	Production	Domestic	669145.0	5488017.0	2007	116	5	N.A.	195	B.	75	10	80	N.A.
1052	SW36-6-6E	TRUSTEES OF CGF STEINBACH	Friesen Drillers Ltd.	Production	Air conditioning	668933.6	5488584.1	2010	121	5	N.A.	155	C.	106.003	10.2	13.4	2
1053	SW36-6-6E	TRUSTEES OF CGF STEINBACH	Friesen Drillers Ltd.	Production	Air conditioning	668910.3	5488490.6	2010	116	5	N.A.	197	C.	106.003	10.2	14.4	3
1054	SW36-6-6E	TRUSTEES OF CGF STEINBACH	Friesen Drillers Ltd.	Production	Air conditioning	668892.4	5488545.9	2010	111	5	N.A.	197	C.	106.003	10.5	13.5	2
1055	SW36-6-6E	TRUSTEES OF CGF STEINBACH	Friesen Drillers Ltd.	Production	Air conditioning	668891.0	5488592.2	2010	115	5	N.A.	197	C.	106.003	9.1	10.5	2
1056	NW31-6-7E	PENNWOOD DAIRY INC	Echo Drilling Ltd	Production	Domestic	670461.0	5488528.0	2007	125	5	N.A.	180	B.	100	10	80	N.A.
1057	NW31-6-7E	MICHETTE WEISS	UNKNOWN	Production	Domestic,Livestock	671071.0	5489174.0	1900	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
1058	NW-31-6-7E	M REMPAL	KIANSKY BROS.	Production	Domestic	670746.1	5488878.0	1989	52	4	4	58	N.A.	27.995	4	41	1.5
	Notes	All data contained in table as presented in Manitoba Water Stewardship GWDRILL database – 2014 Edition.															
		Friesen Drillers Limited has not verified or field confirmed any data present in this table. All yields and static water levels are as reported and have not been verified by Friesen Drillers Limited. Current well use or operations are															
		N.A. = Not available or not provided in reference										Grout type: C = Cement B = Bentonite O = Other					

Appendix F

Borehole Logs – Production Wells

Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Chris Loeppky | Assistant: Chris Wilson

Date well completed: October 2, 2015

Well Location

QTR NW SEC 3 TWP 7 RGE 6 E [X] W [ ]

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.54501

Lon W° 96.70776

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB R5G 2J1 Phone:

Accuracy: ± 27

Sat Count:

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Well Identification: Well 1 / North Well - Test Well

Well Use	Production		Test Well	X	Recharge		Irrigation		
	Domestic		Livestock		Industrial				
	Municipal		Dewatering		Not Used				
Water Use	Geothermal				Observation				
	Other (Specify)								

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	16	Clay			
16	43	Till			
43	86	Blue Clay			
86	92	Till			
92	217	Limestone			

Water Temperature F° / C°:

Depth Below Ground Level From	To	Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	94	x					5 "	5.5"		Insert Glued	PVC	
94	217		x					4.75"		open hole		
10	90					x				Grout	Cement	

Top of Casing: 2 [X] Feet above [ ] Below Ground Level [ ] [ ] Well must be vented [ ] [ ]

Pitless Unit: [ ] Feet above [ ] Below Ground Level [ ] Not Installed [X]

Remarks: **Overdrilled into a 12 inch diameter well. Report by Friesen Drillers**

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [X] Rate [ ] IGPM

Other (Specify) _____ Pumping [X] [ ] 80 IGPM

Water level before pumping (Static) Feet Above 3.5 Below N/A

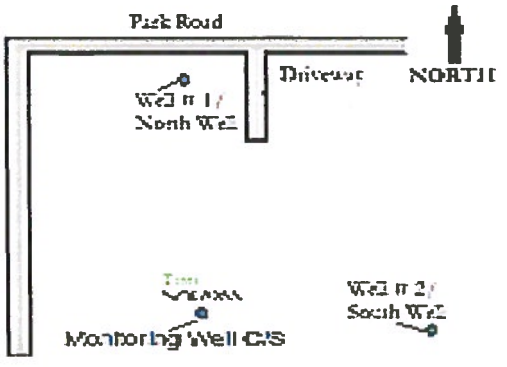
Pumping level at end of test Feet Above N/A Below 12

Duration of test 1 HRS N/A Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Driller's Report

Contractor	Friesen Drillers Ltd.	License #:	607-15	Phone:	(204) 326-2485
Address: 307 PTH 12 N Steinbach, MB R5G 1T8		Driller: Peter Friesen		Assistant:	
Date well completed:	October 2, 2015				

Well Location

QTR NW SEC 3 TWP 7 RGE 6 E [X] W

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.54501

Lon W° 96.70939

Well Owner

Name City of Steinbach c/o Phil Kalyta, P.Eng.

Address 225 Reimer Avenue, Steinbach, MB Phone

R5G 2J1

Accuracy: ± 27

Sat Count:

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Well Identification Well 1 (North Well)- Production Well

Well Use								
	Production	X	Test Well		Recharge		Irrigation	
	Domestic		Livestock		Industrial			
	Municipal	X	Dewatering		Not Used			
Water Use	Geothermal				Observation			
	Other (Specify)							

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	16	Clay			
16	43	Till			
43	86	Blue Clay			
86	91	Till			
91	222	Limestone			

Water Temperature F° / C°:

Depth Below Ground Level From	To	Casing	Open Hole	Perfor-ations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	92	x					12"	12 3/4"		Welded	Black Steel	
92	162						12"			Open Hole		
162	222						11"			Open Hole		
0	35					x				Grout	Cement	

Top of Casing: 2 [X] Feet above [ ] Below Ground Level [ ] [ ] Well must be vented [ ] [ ]

Pitless Unit: [ ] Feet above [ ] Below Ground Level [ ] Not Installed [X]

Remarks: Overdrilled from a 5 inch test well. Far northwest corner of property.

Water table went down 3' below ground when drilling Well #2

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [ ] Rate [ ] IGPM

Other (Specify) [ ] Pumping [x] [400] IGPM

Water level before pumping (Static) Feet Above [4] Below [N/A]

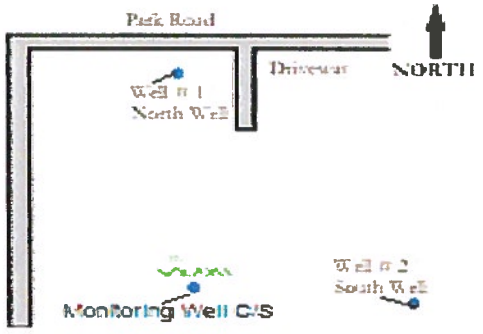
Pumping level at end of test Feet Above [ ] Below [72]

Duration of test [2] HRS [0] Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Chris Loeppky | Assistant: Chris Wilson

Date well completed: October 2, 2015

Well Location

QTR NW SEC 3 TWP 7 RGE 6 E [X] W [ ]

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.54501

Lon W° 96.70939

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB Phone

R5G 2J1

Accuracy: ± 27

Sat Count:

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Well Identification: Well 2 / South Well - Test Well

Well Use							
Production		Test Well	X	Recharge		Irrigation	
Domestic		Livestock		Industrial			
Municipal		Dewatering		Not Used			
Water Use: Geothermal				Observation			
Other (Specify)							

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	22	Clay			
22	43	Till			
43	87	Blue Clay			
87	94	Till			
94	216	Limestone			

Water Temperature F° / C°:

Depth Below Ground Level		Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	96	x					5 "	5.5"		Insert Glued	PVC	
96	216		x					4.75"		Open Hole		
10	96					x				Grout	Cement	

Top of Casing: 2 | X | Feet above | | Below Ground Level | | | Well must be vented | |

Pitless Unit: | | Feet above | | Below Ground Level | | | Not Installed | X

Remarks: Overdrilled into a 12 inch diameter well

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [X] Rate [ ] IGPM

Other (Specify) _____ Pumping [X] [ ] 80 IGPM

Water level before pumping (Static) Feet Above [0.5] Below [ ]

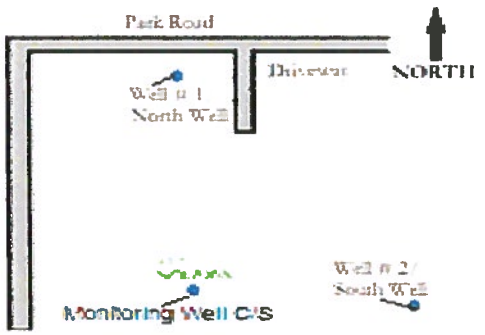
Pumping level at end of test Feet Above [ ] Below [12.6]

Duration of test [1] HRS [0] Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Peter Friesen | Assistant: Chris Wilson

Date well completed: October 6, 2015

Well Location

QTR NW SEC 3 TWP 7 RGE 6 E [X] W [ ]

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.54501

Lon W° 96.70939

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB R5G 2J1 Phone:

Accuracy: ± 27

Sat Count:

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Well Identification: Well 2 / South Supply Well

Well Use	Production	X	Test Well		Recharge		Irrigation				
	Domestic		Livestock		Industrial						
Water Use	Municipal	X	Dewatering		Not Used						
	Geothermal				Observation						
	Other (Specify)										

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	22	Clay			
22	43	Till			
43	87	Blue Clay			
87	94	Brown Till			
94	223	Limestone			

Water Temperature F° / C°:

Depth Below Ground Level From	To	Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	96	x					12"	12 3/4"		Welded Black	Steel	
96	223		x				11"			Open Hole		
0	30					x				Grout	Cement	

Top of Casing: 2 [X] Feet above [ ] Below Ground Level [ ] [ ] Well must be vented [ ] [ ]

Pitless Unit: [ ] Feet above [ ] Below Ground Level [ ] Not Installed [X]

Remarks: **Overdrilled from a 5 inch diam. test well . Report by Friesen Drillers Ltd.**

Fractures at 170, 180, 210 and 218 ft. below ground

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: October 6, 2015 Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [X] Rate [ ] IGPM

Other (Specify) _____ Pumping [X] 440 IGPM

Water level before pumping (Static) Feet Above 1.05 Below [ ]

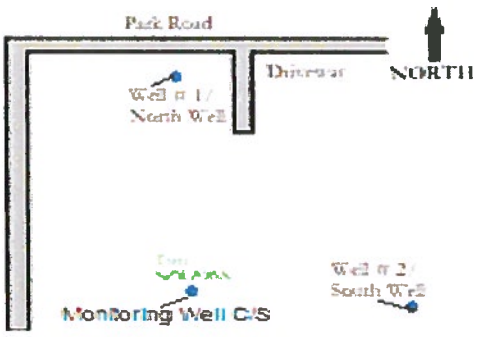
Pumping level at end of test Feet Above [ ] Below 80

Duration of test 60 HRS 0 Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Appendix G

Borehole Logs – Monitoring Wells

Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Chris Loeppky | Assistant: Chris Wilson

Date well completed: October 2, 2015

Well Location

QTR NW SEC 3 TWP 7 RGE 6 E [X] W

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.54368

Lon W° 96.70944

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB R5G 2J1 Phone

Accuracy: ±

Sat Count:

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Well Identification: New Well Field Monitoring Well (Park Road)

Well Use		Water Use	
Production		Test Well		Recharge		Irrigation	
Domestic		Livestock		Industrial		
Municipal		Dewatering		Not Used		
Geothermal				Observation	X	
Other (Specify)						

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	12	Clay			
12	38	Till			
38	84	Blue Clay			
84	93	Till			
93	228	Limestone			
228	232	Shale			
232	249	Sandstone			

Water Temperature F° / C°:

Depth Below Ground Level From	To	Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	95	x					5 "	5.5"		Insert Glued	PVC	
95	249		x					4.75"		open hole		
10	95					x				Grout	Cement	
0	230	x					2"	2 1/2"		Insert Glued	PVC	
226	230									3 Shale Traps	Rubber	
230	249			x					10	screen	PVC	

Top of Casing: 2 [X] Feet above Below Ground Level [ ] Well must be vented [ ]

Pitless Unit: [ ] Feet above Below Ground Level [ ] Not Installed [X]

Remarks: **Static water level of limestone - 6.6 ft. above ground**

Static water level of sandstone - 4 ft. above ground 2 bags of sand and 1 bag holeplug on top of shale traps

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [X] Rate [ ] IGPM

Other (Specify) _____ Pumping [ ] Rate [ ] IGPM

Water level before pumping (Static) Feet Above 6.6 Below N/A

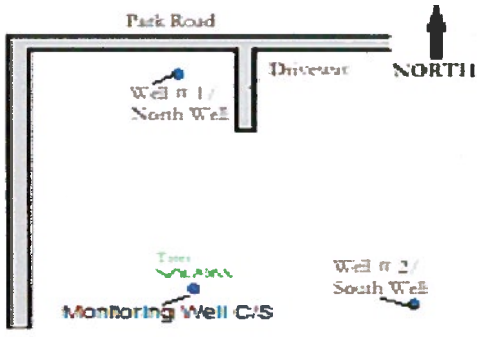
Pumping level at end of test Feet Above N/A Below N/A

Duration of test N/A HRS N/A Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Chris Loeppky | Assistant: Chris Wilson

Date well completed: October 2, 2015

Well Location

QTR SE SEC 8 TWP 7 RGE 6 E [X] W [ ]

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.5462

Lon W° 96.73975

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB R5G 2J1 Phone:

Accuracy: ±

Sat Count:

Well Identification: South Lagoon Monitoring Well

Well Use / Water Use

Production		Test Well		Recharge		Irrigation	
Domestic		Livestock		Industrial			
Municipal		Dewatering		Not Used			
Geothermal				Observation	X		
Other (Specify)							

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To	Water Record
0	8	Clay			
8	46	Till			
46	91	Sand and Gravel			
91	98	Till			
98	237	Limestone			
237	241	Shale			
241	258	Sandstone			

Water Temperature F° / C°:

Depth Below Ground Level		Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	100	x					5 "	5.5"		Insert Glued	PVC	
100	258		x					4.75"		open hole		
10	100					x				Grout	Cement	
0	241	x					2"	2 1/2"		Insert Glued	PVC	
237	241									3 Shale Traps	Rubber	

Top of Casing: 2 | X | Feet above | | Below Ground Level | | Well must be vented | |

Pitless Unit: | | Feet above | | Below Ground Level | | Not Installed | X

Remarks: **Static water level of limestone - 9 ft. above ground**

Static water level of sandstone - 6 ft. above ground

2 bags of sand and 1 bag holeplug on top of shale traps

Pump Installation By Drilling Contractor: Yes [ ] No [X]

Field Test: Iron [ ] Grains Hardness [ ]

PUMPING TEST

Date of Test: Air Lifting [ ]

Bailing [ ] Recovery [ ] Flowing [X] Rate [ ] IGPM

Other (Specify) _____ Pumping [ ] [ ] IGPM

Water level before pumping (Static) Feet Above 9 Below [ ]

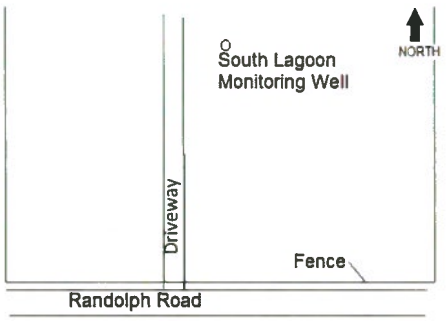
Pumping level at end of test Feet Above N/A Below N/A

Duration of test N/A HRS N/A Minutes

Recommended pumping rate I.G.P.M. N/A

With pump intake at (feet) below ground level N/A

Location Sketch of Well



Driller's Report

Contractor: Friesen Drillers Ltd. License #: 607-15 Phone: (204) 326-2485

Address: 307 PTH 12 N Steinbach, MB R5G 1T8 | Driller: Paul Sharples Assistant: Jay St. Godard

Date well completed: October 2, 2015

Well Location

QTR SE SEC 20 TWP 7 RGE 6 E [X] W [ ]

R.L. Parish

Address of Well

GPS Reading

Lat. N° 49.567089

Lon W° 96.73384

Accuracy: ±

Sat Count:

Well Owner

Name: City of Steinbach c/o Phil Kalyta, P.Eng.

Address: 225 Reimer Avenue, Steinbach, MB R5G 2J1 Phone

Well Identification: North Lagoon Monitoring Well

Well Use	Production		Test Well		Recharge		Irrigation	
	Domestic		Livestock		Industrial			
	Municipal		Dewatering		Not Used			
Water Use	Geothermal				Observation	X		
	Other (Specify)							

CONTRACTOR AFFADAVIT

I certify that to the best of my knowledge the information provided herein is accurate and true and complies with The Ground Water ans Water Well Act and Well Drilling Regulation

Signature of Contractor

Depth Below Ground in Feet From	To	DESCRIPTION WELL LOG	From	To		Water Record
0	8	Clay				
8	91	Till				
91	229	Limestone				
229	234	Shale				
234	260	Sandstone				

Water Temperature F° / C°:

Depth Below Ground Level From	To	Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	94	x					5 "	5.5"		Insert Glued	PVC	
94	260		x					4.75"		open hole		
10	60					x				Grout	Cement	
0	234	x					2"	2 1/2"		Insert Glued	PVC	
228	234									3 Shale Traps	Rubber	

Top of Casing: 2 X Feet above [ ] Below Ground Level [ ] Well must be vented [ ]

Pitless Unit: [ ] Feet above [ ] Below Ground Level [ ] Not Installed X

Remarks: **Static water level of limestone - 1.00 ft. below ground**

Static water level of sandstone - 4.33 ft. above ground

2 bags of sand and 1 bag holeplug on top of shale traps

Pump Installation By Drilling Contractor: Yes [ ] No X

Field Test: Iron [ ] Grains Hardness

PUMPING TEST

Date of Test: Air Lifting

Bailing [ ] Recovery [ ] Flowing X Rate IGPM

Other (Specify) Pumping IGPM

Water level before pumping (Static) Feet Above N/A Below 1.0

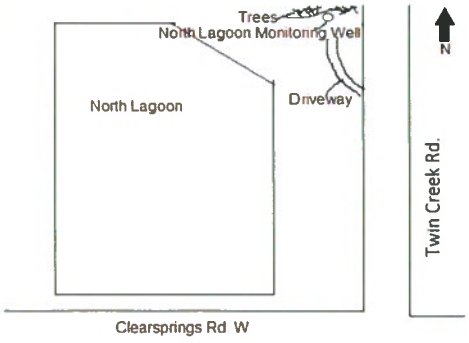
Pumping level at end of test Feet Above N/A Below N/A

Duration of test N/A HRS N/A Minutes

Recommended pumping rate I.G.P.M. N/A

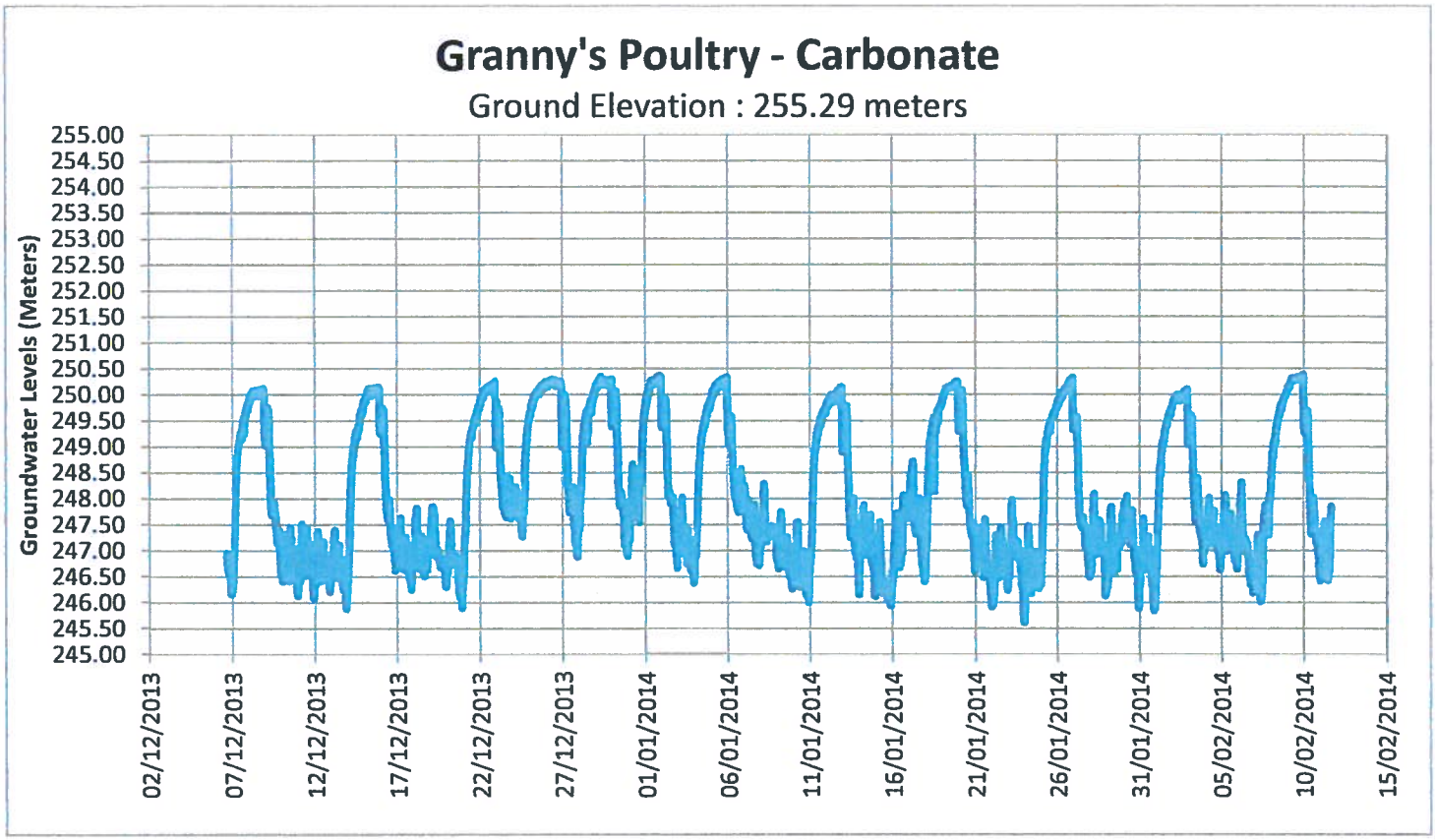
With pump intake at (feet) below ground level N/A

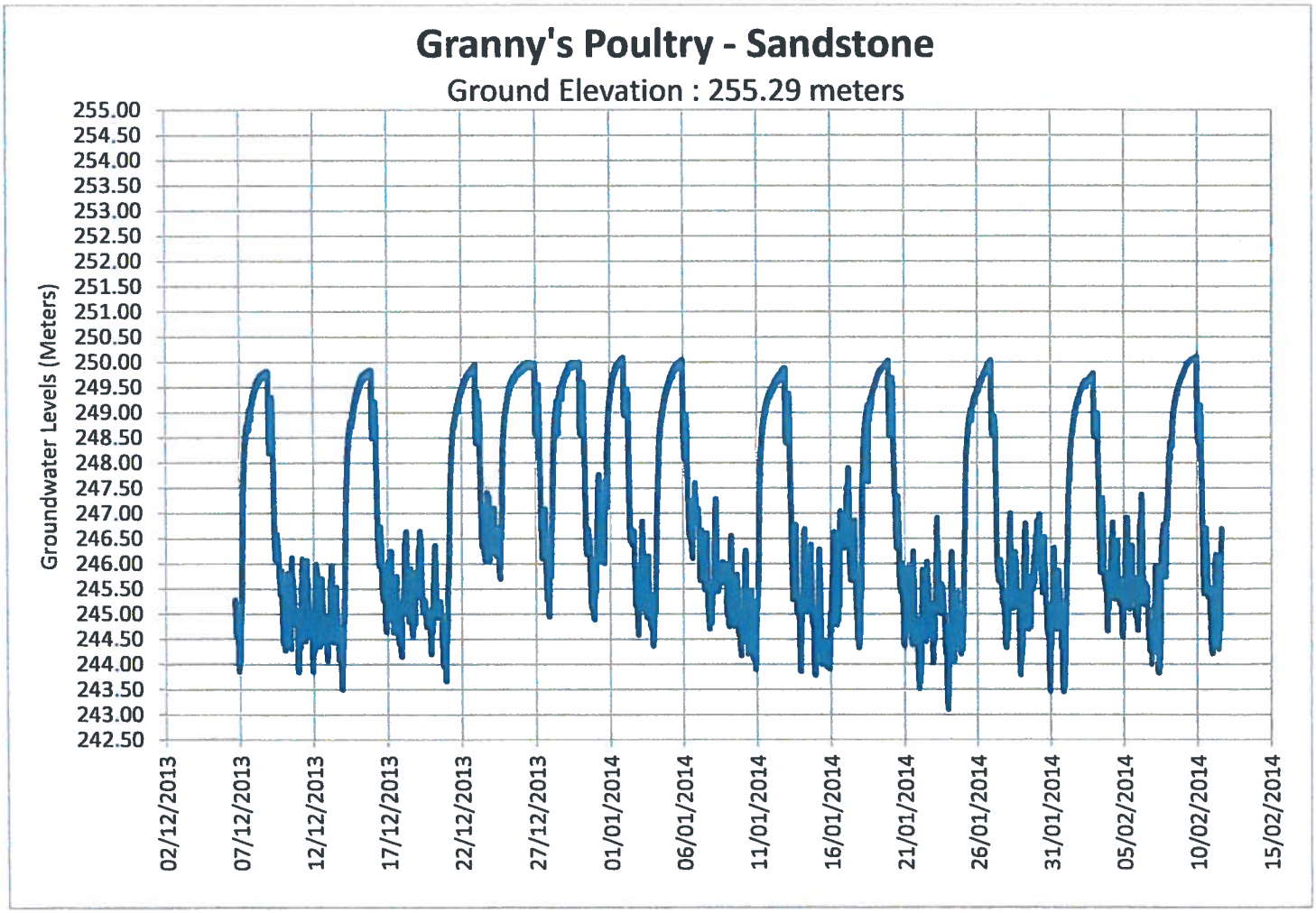
Location Sketch of Well

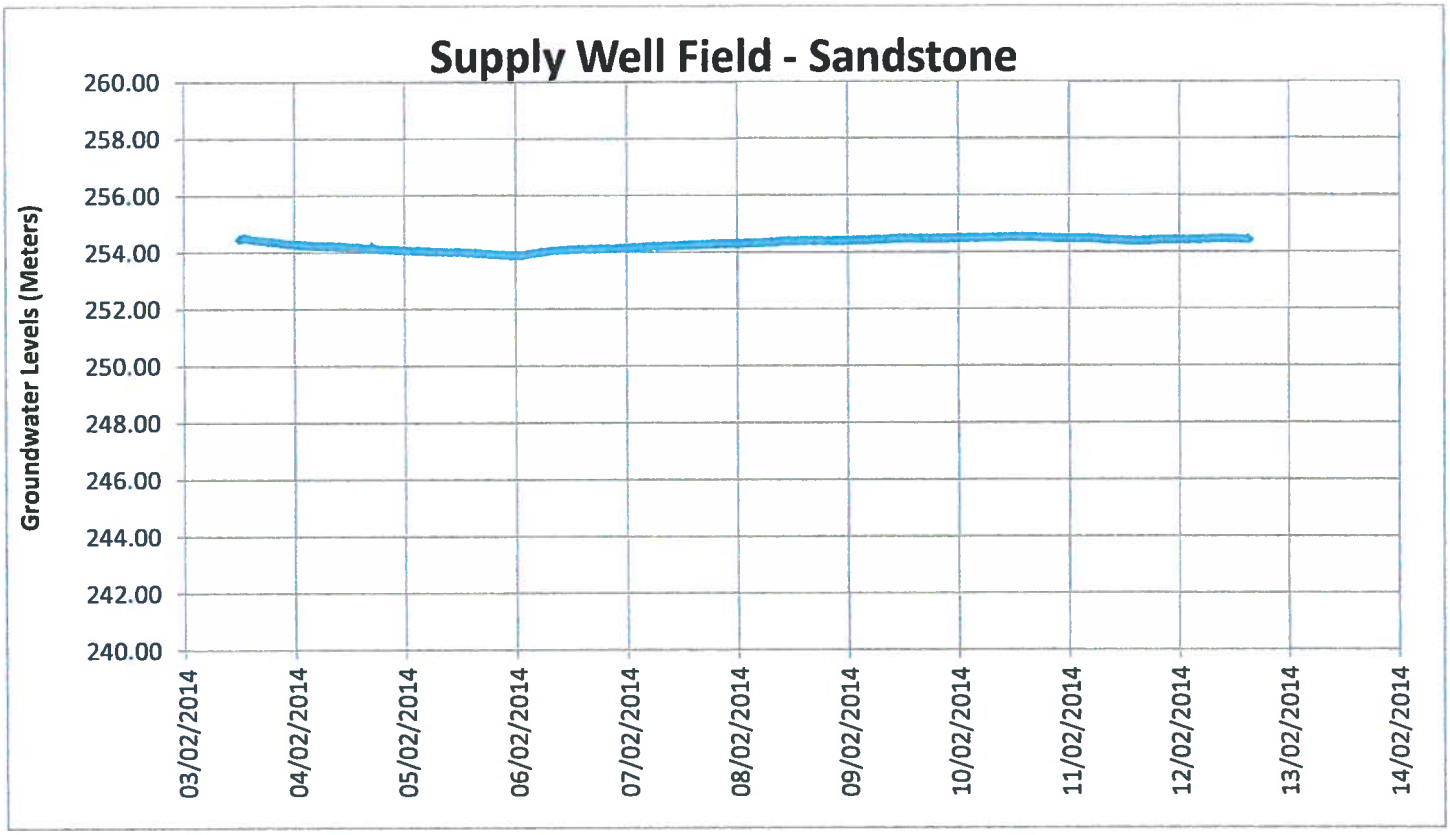


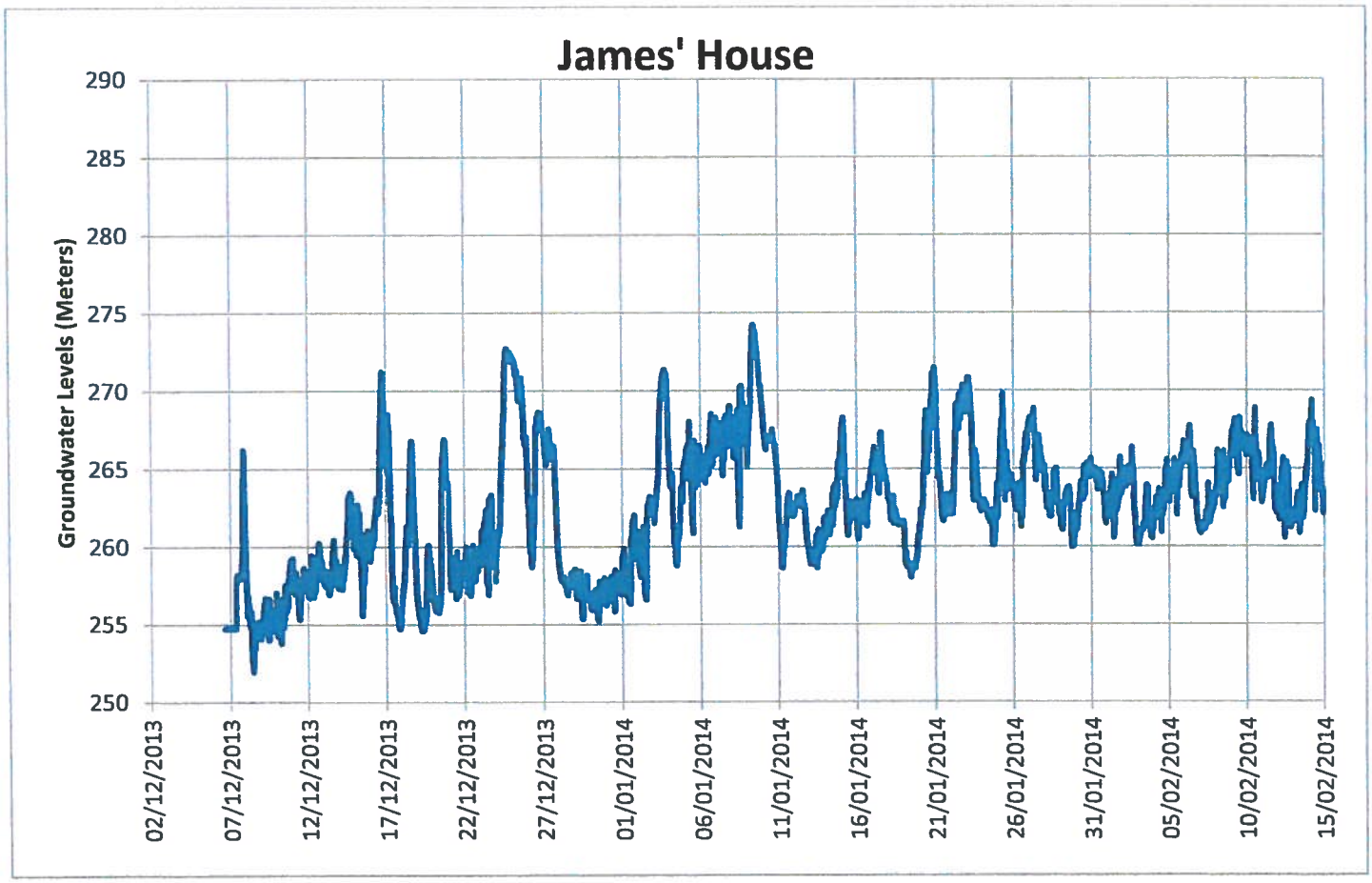
Appendix H

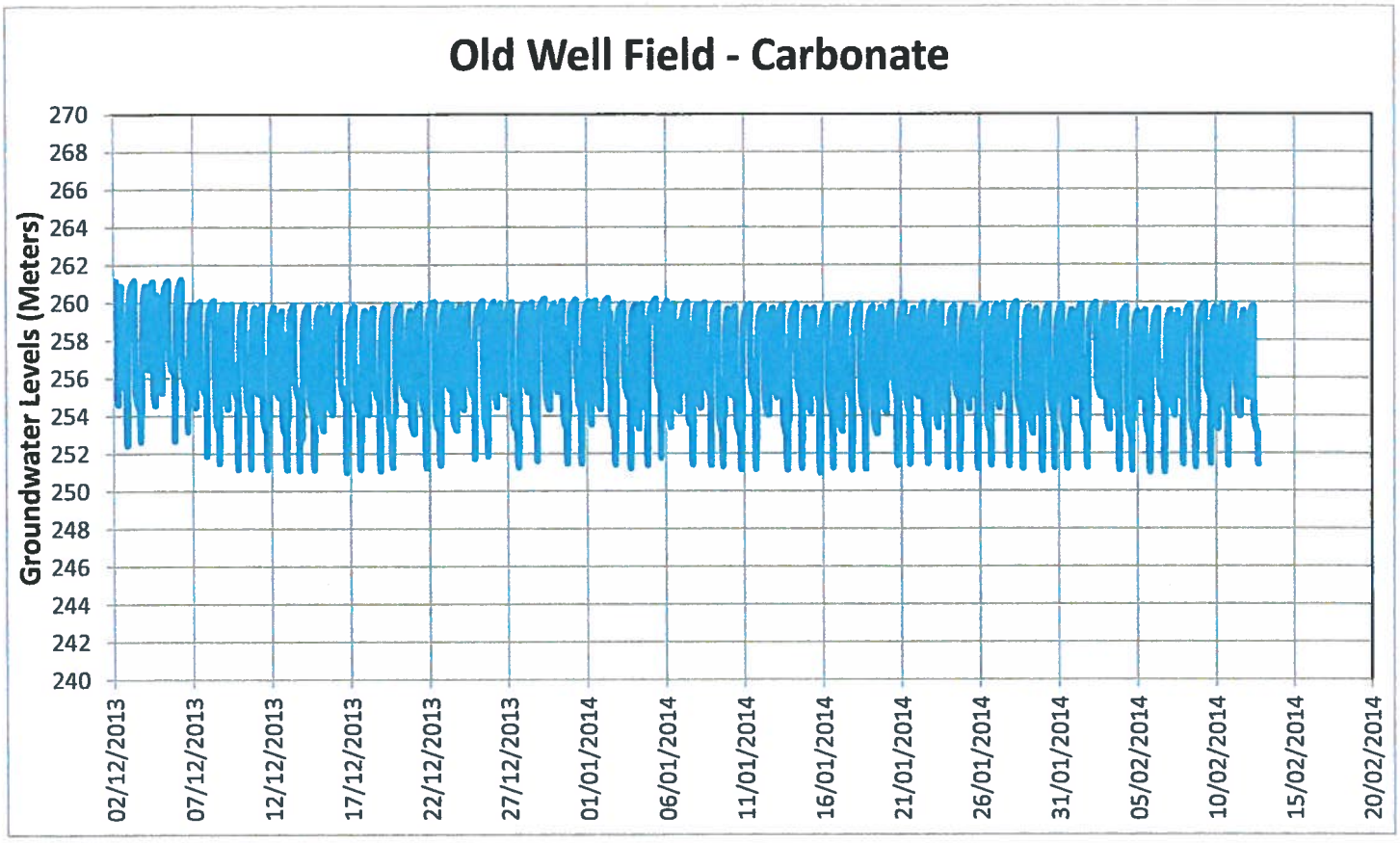
Transducer Plots

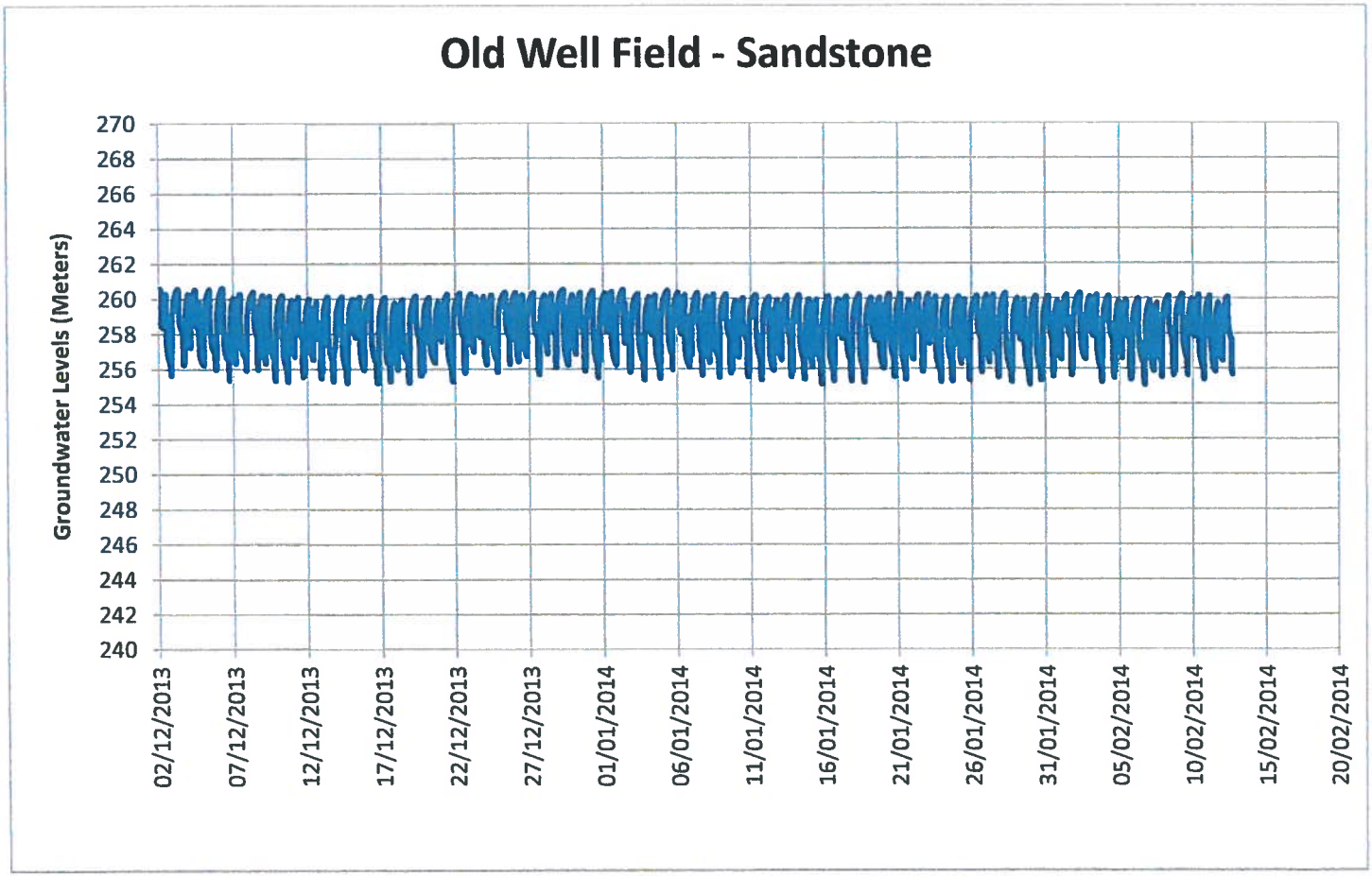

Granny's Poultry - Carbonate
Ground Elevation : 255.29 meters
Groundwater Levels (Meters)
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
246.50
246.00
245.50
245.00
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014

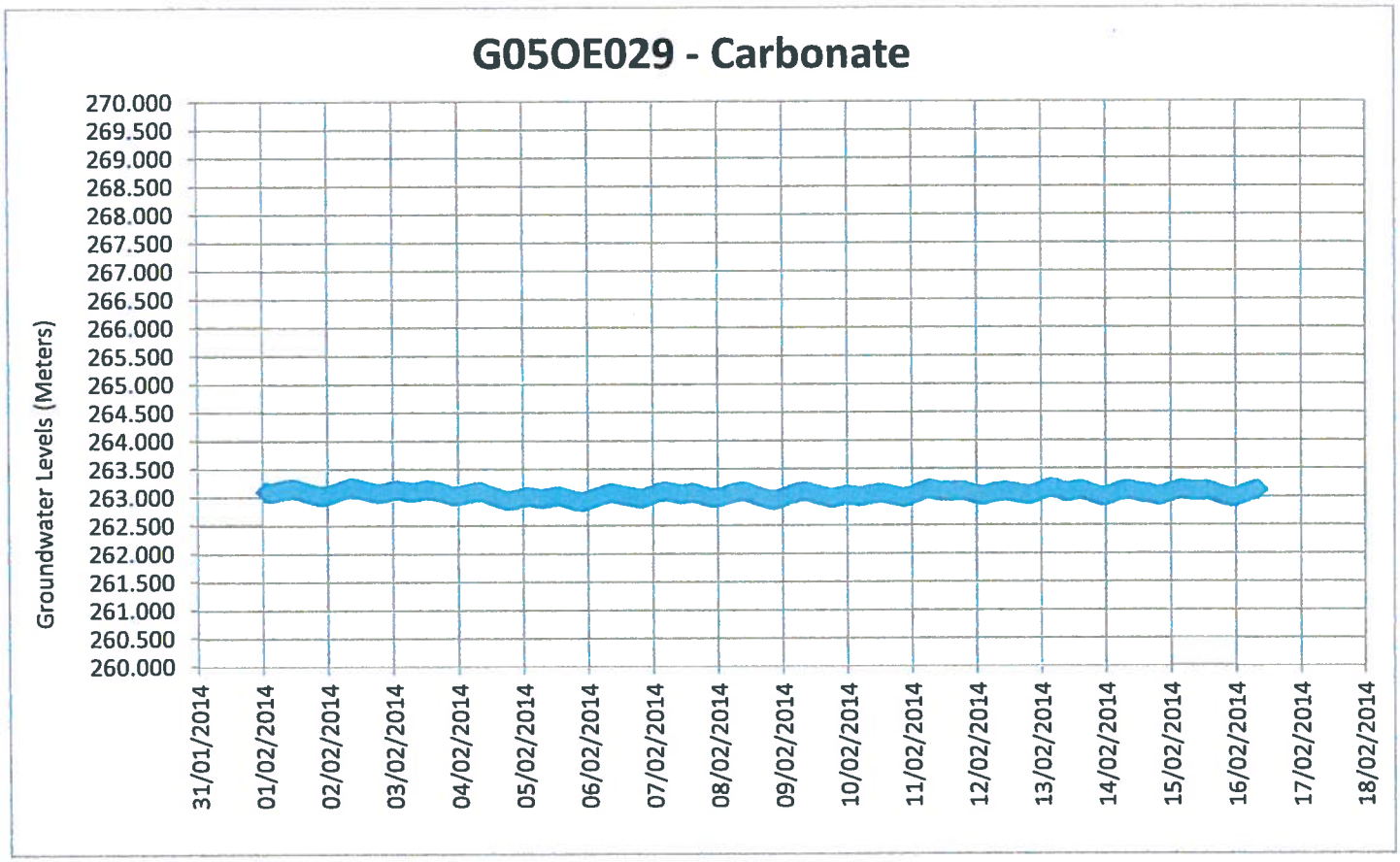

Granny's Poultry - Sandstone
Ground Elevation : 255.29 meters
Groundwater Levels (Meters)
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
246.50
246.00
245.50
245.00
244.50
244.00
243.50
243.00
242.50
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014

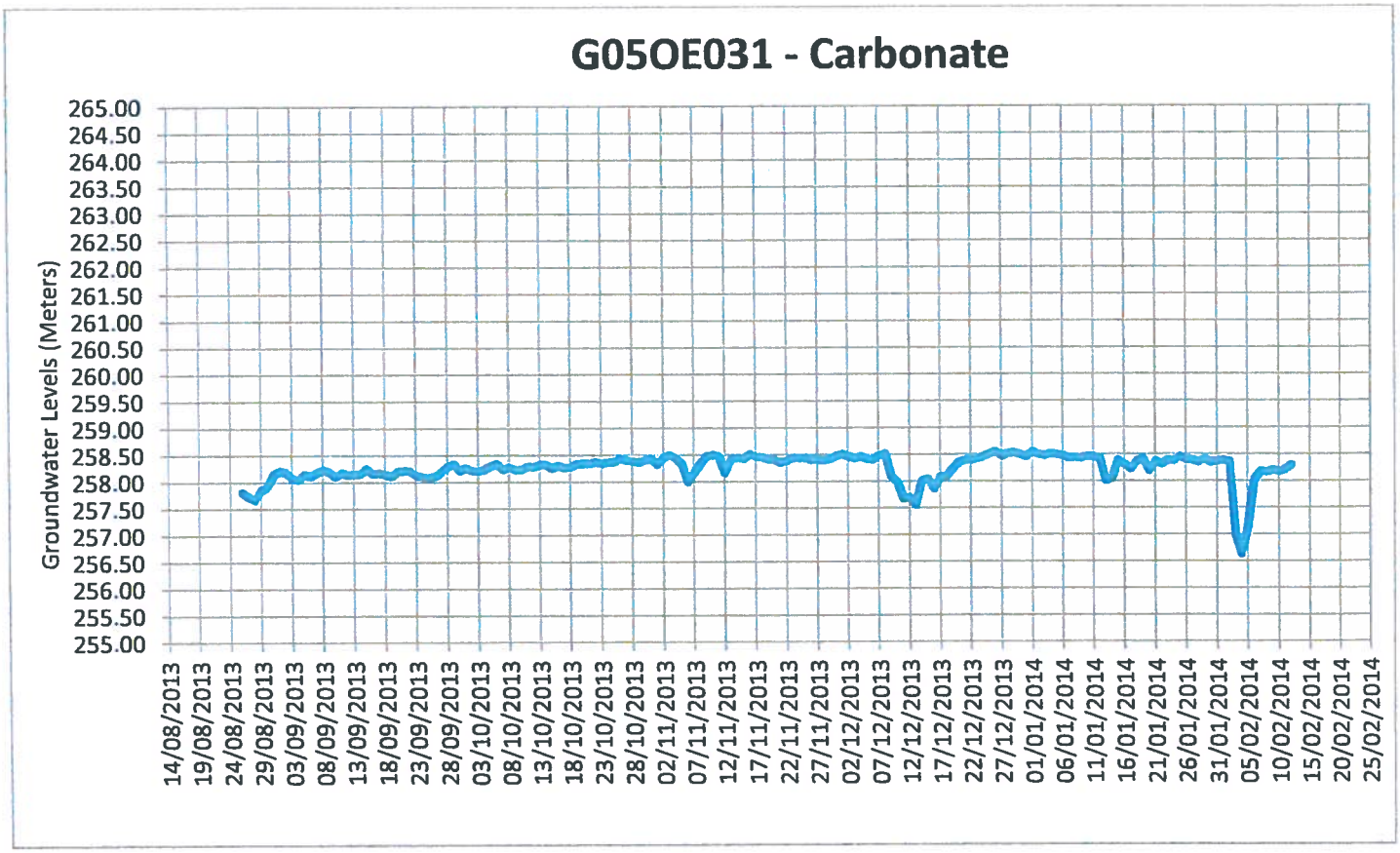

Supply Well Field - Sandstone
Groundwater Levels (Meters)
260.00
258.00
256.00
254.00
252.00
250.00
248.00
246.00
244.00
242.00
240.00
03/02/2014
04/02/2014
05/02/2014
06/02/2014
07/02/2014
08/02/2014
09/02/2014
10/02/2014
11/02/2014
12/02/2014
13/02/2014
14/02/2014

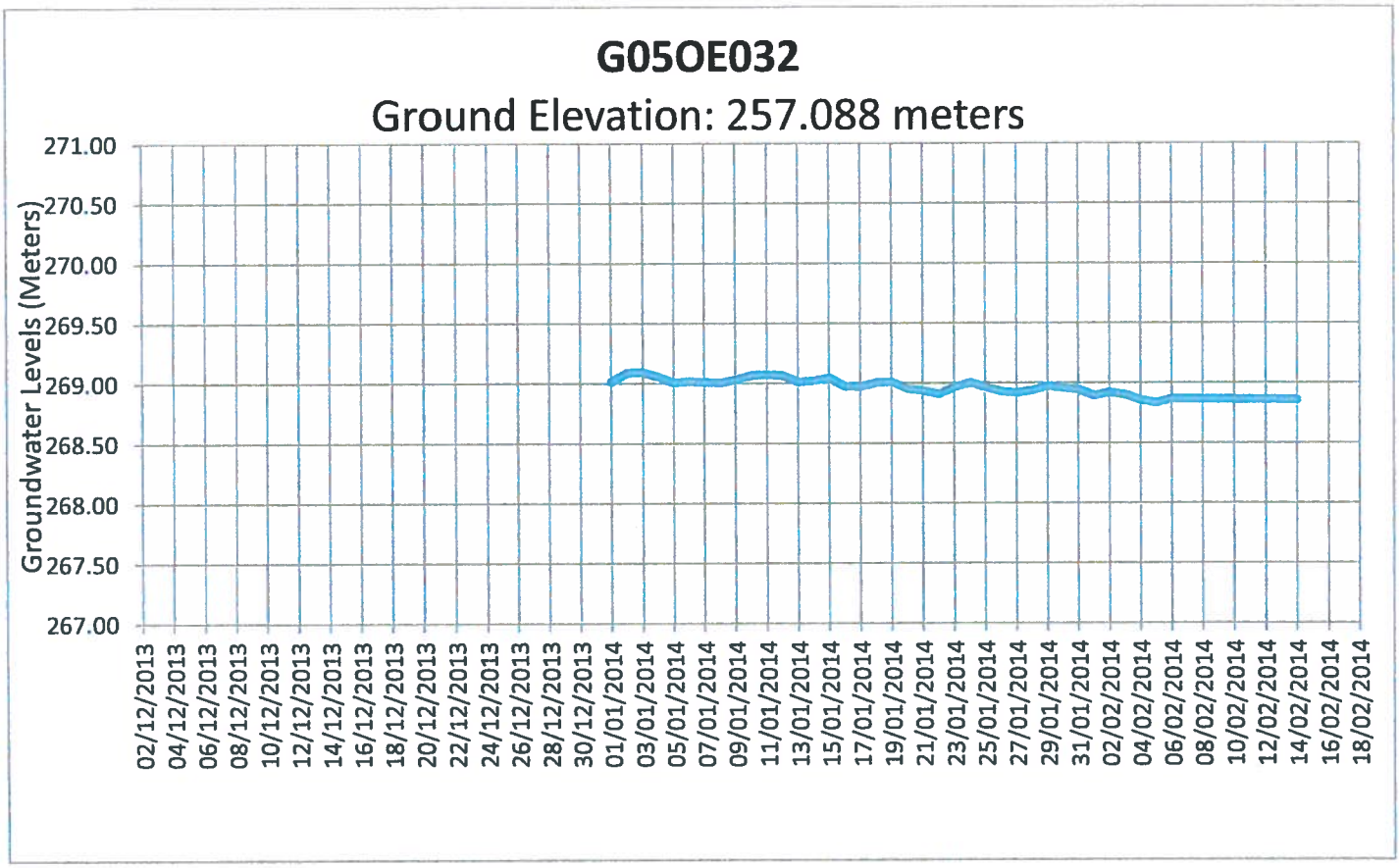

James' House
Groundwater Levels (Meters)
290
285
280
275
270
265
260
255
250
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014

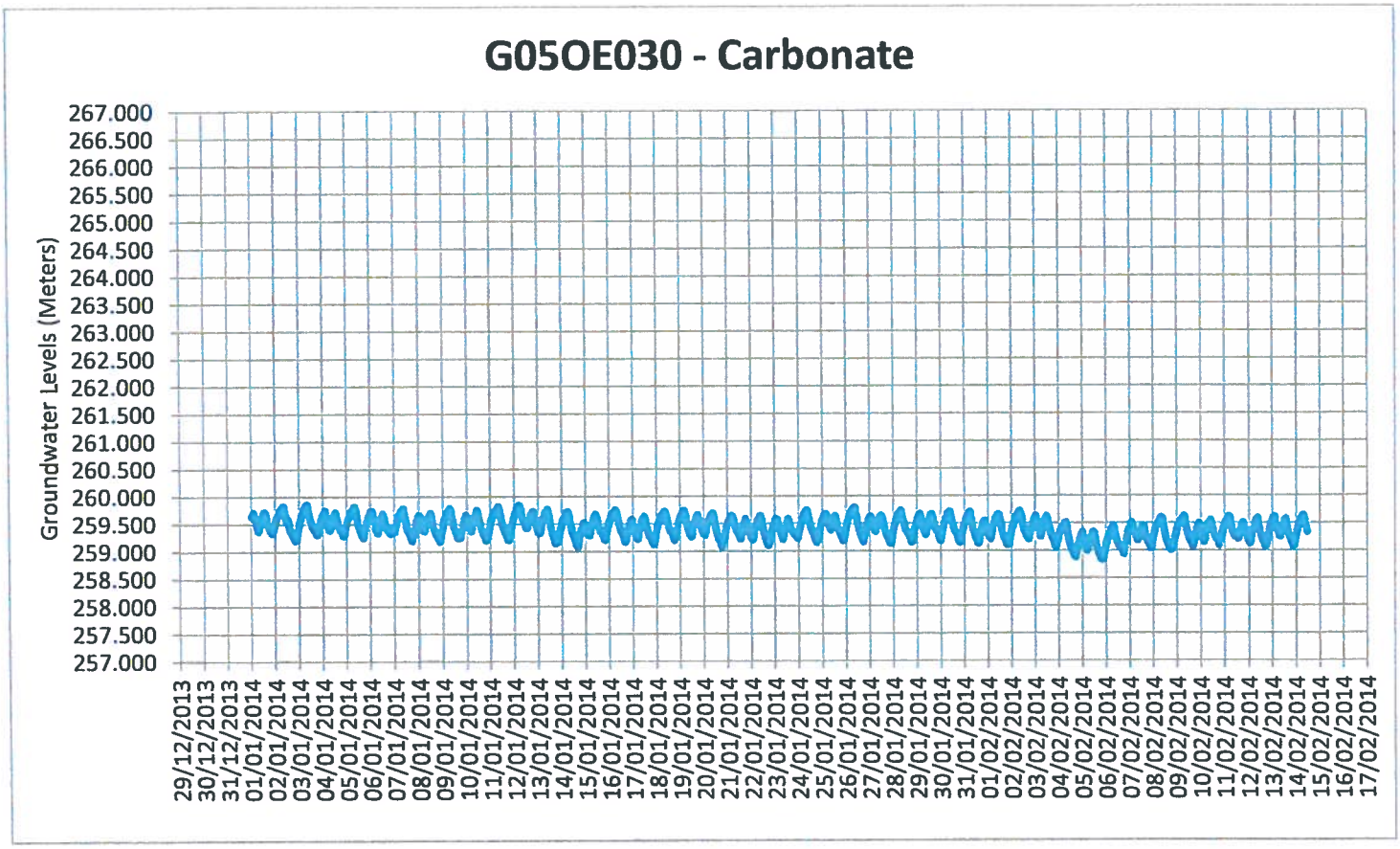

Old Well Field - Carbonate
Groundwater Levels (Meters)
270
268
266
264
262
260
258
256
254
252
250
248
246
244
242
240
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014

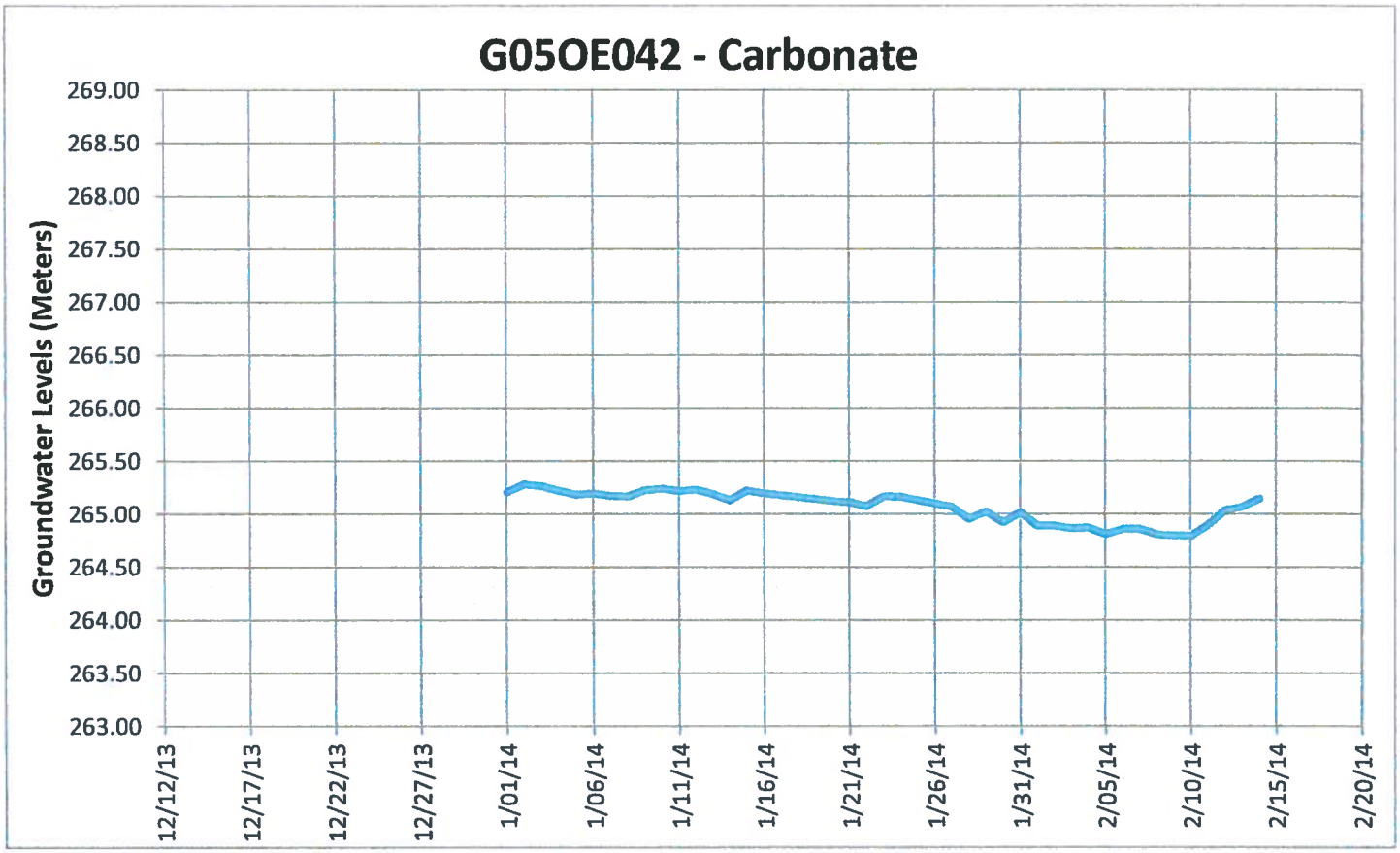

Old Well Field - Sandstone
Groundwater Levels (Meters)
270
268
266
264
262
260
258
256
254
252
250
248
246
244
242
240
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014

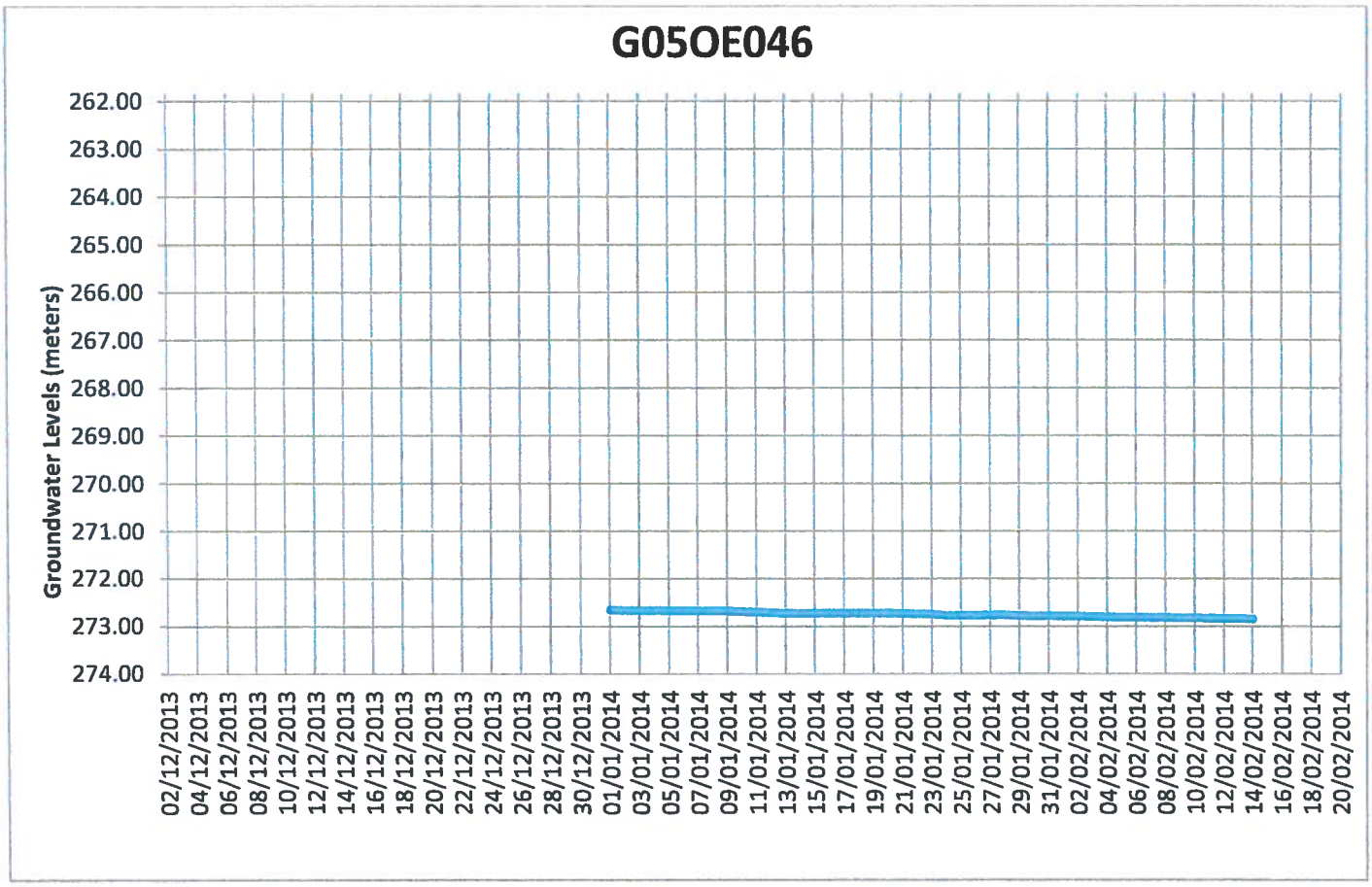

G05OE029 - Carbonate
Groundwater Levels (Meters)
270.000
269.500
269.000
268.500
268.000
267.500
267.000
266.500
266.000
265.500
265.000
264.500
264.000
263.500
263.000
262.500
262.000
261.500
261.000
260.500
260.000
31/01/2014
01/02/2014
02/02/2014
03/02/2014
04/02/2014
05/02/2014
06/02/2014
07/02/2014
08/02/2014
09/02/2014
10/02/2014
11/02/2014
12/02/2014
13/02/2014
14/02/2014
15/02/2014
16/02/2014
17/02/2014
18/02/2014

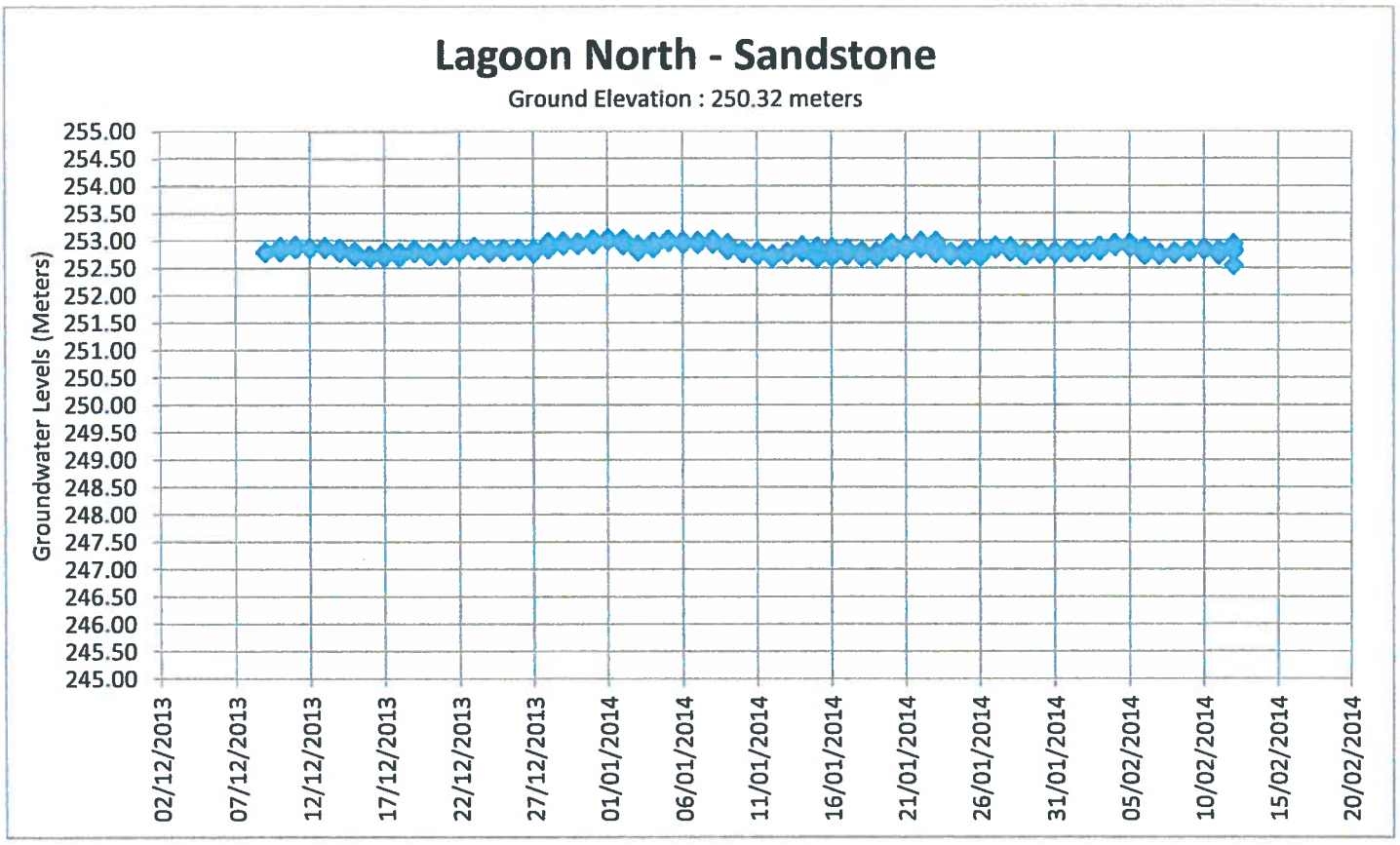

G05OE031 - Carbonate
Groundwater Levels (Meters)
265.00
264.50
264.00
263.50
263.00
262.50
262.00
261.50
261.00
260.50
260.00
259.50
259.00
258.50
258.00
257.50
257.00
256.50
256.00
255.50
255.00
14/08/2013
19/08/2013
24/08/2013
29/08/2013
03/09/2013
08/09/2013
13/09/2013
18/09/2013
23/09/2013
28/09/2013
03/10/2013
08/10/2013
13/10/2013
18/10/2013
23/10/2013
28/10/2013
02/11/2013
07/11/2013
12/11/2013
17/11/2013
22/11/2013
27/11/2013
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014
25/02/2014

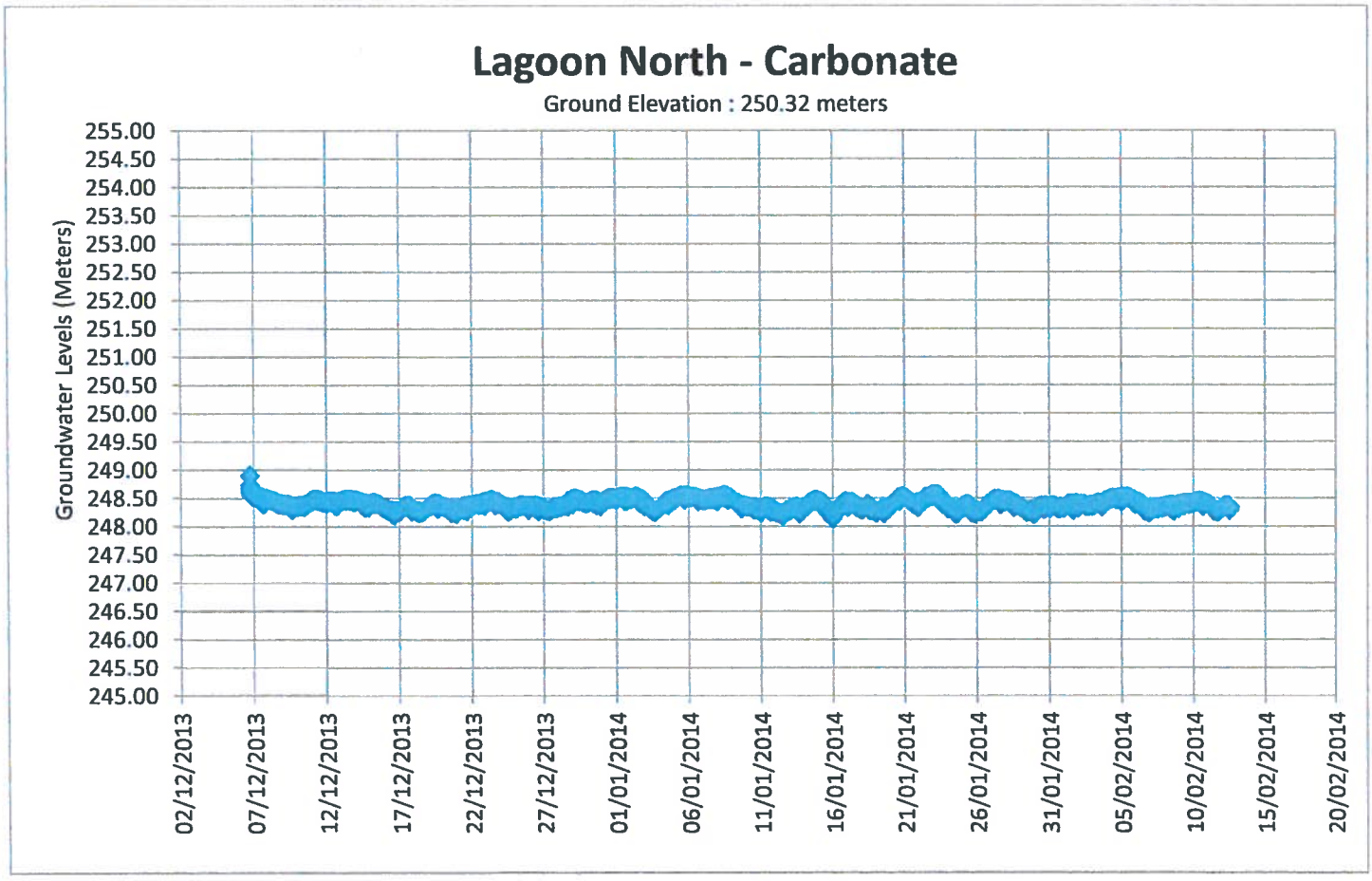

G05OE032
Ground Elevation: 257.088 meters
Groundwater Levels (Meters)
271.00
270.50
270.00
269.50
269.00
268.50
268.00
267.50
267.00
02/12/2013
04/12/2013
06/12/2013
08/12/2013
10/12/2013
12/12/2013
14/12/2013
16/12/2013
18/12/2013
20/12/2013
22/12/2013
24/12/2013
26/12/2013
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014
16/02/2014
18/02/2014

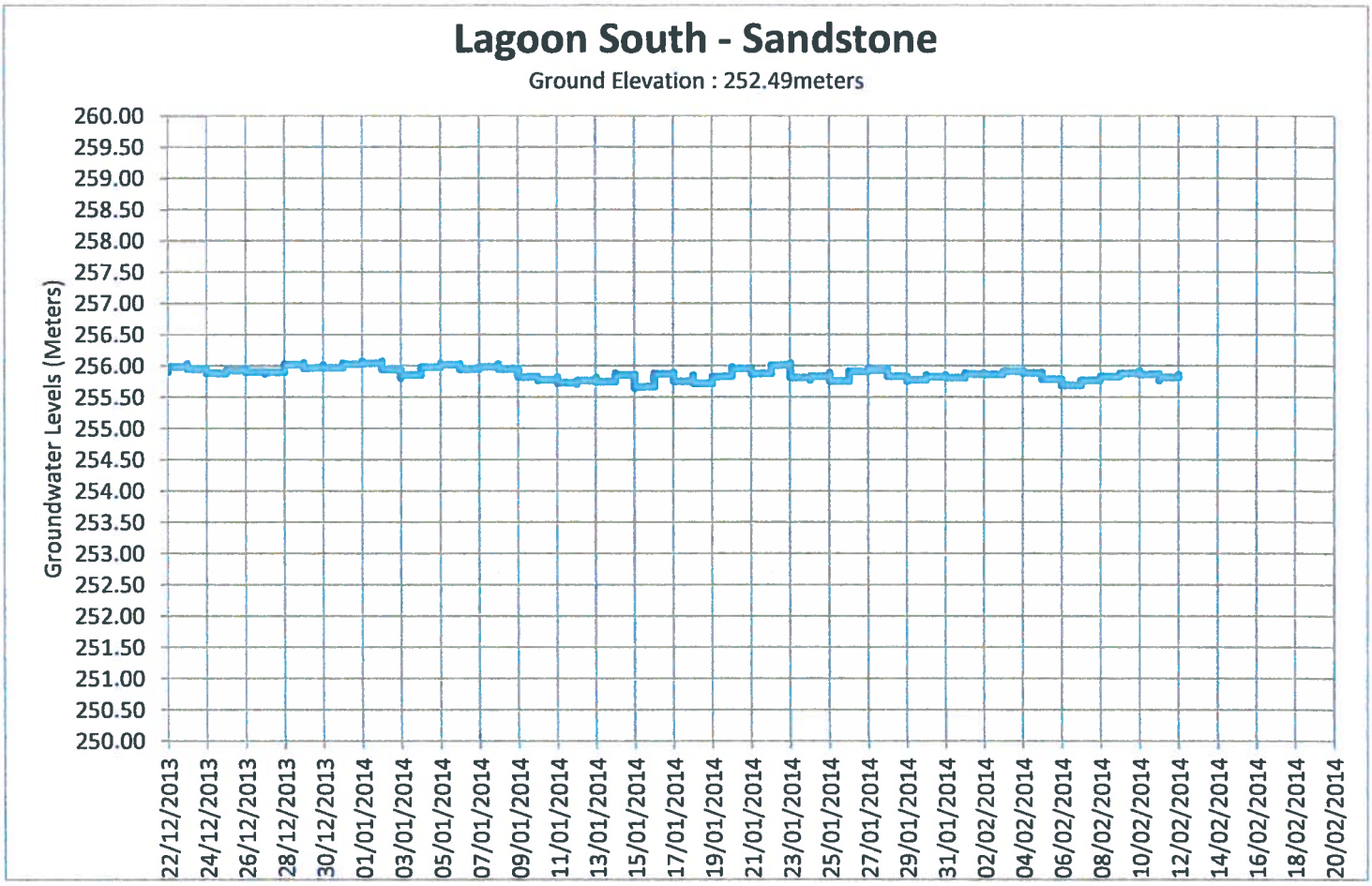

G05OE030 - Carbonate
Groundwater Levels (Meters)
267.000
266.500
266.000
265.500
265.000
264.500
264.000
263.500
263.000
262.500
262.000
261.500
261.000
260.500
260.000
259.500
259.000
258.500
258.000
257.500
257.000
29/12/2013
30/12/2013
31/12/2013
01/01/2014
02/01/2014
03/01/2014
04/01/2014
05/01/2014
06/01/2014
07/01/2014
08/01/2014
09/01/2014
10/01/2014
11/01/2014
12/01/2014
13/01/2014
14/01/2014
15/01/2014
16/01/2014
17/01/2014
18/01/2014
19/01/2014
20/01/2014
21/01/2014
22/01/2014
23/01/2014
24/01/2014
25/01/2014
26/01/2014
27/01/2014
28/01/2014
29/01/2014
30/01/2014
31/01/2014
01/02/2014
02/02/2014
03/02/2014
04/02/2014
05/02/2014
06/02/2014
07/02/2014
08/02/2014
09/02/2014
10/02/2014
11/02/2014
12/02/2014
13/02/2014
14/02/2014
15/02/2014
16/02/2014
17/02/2014

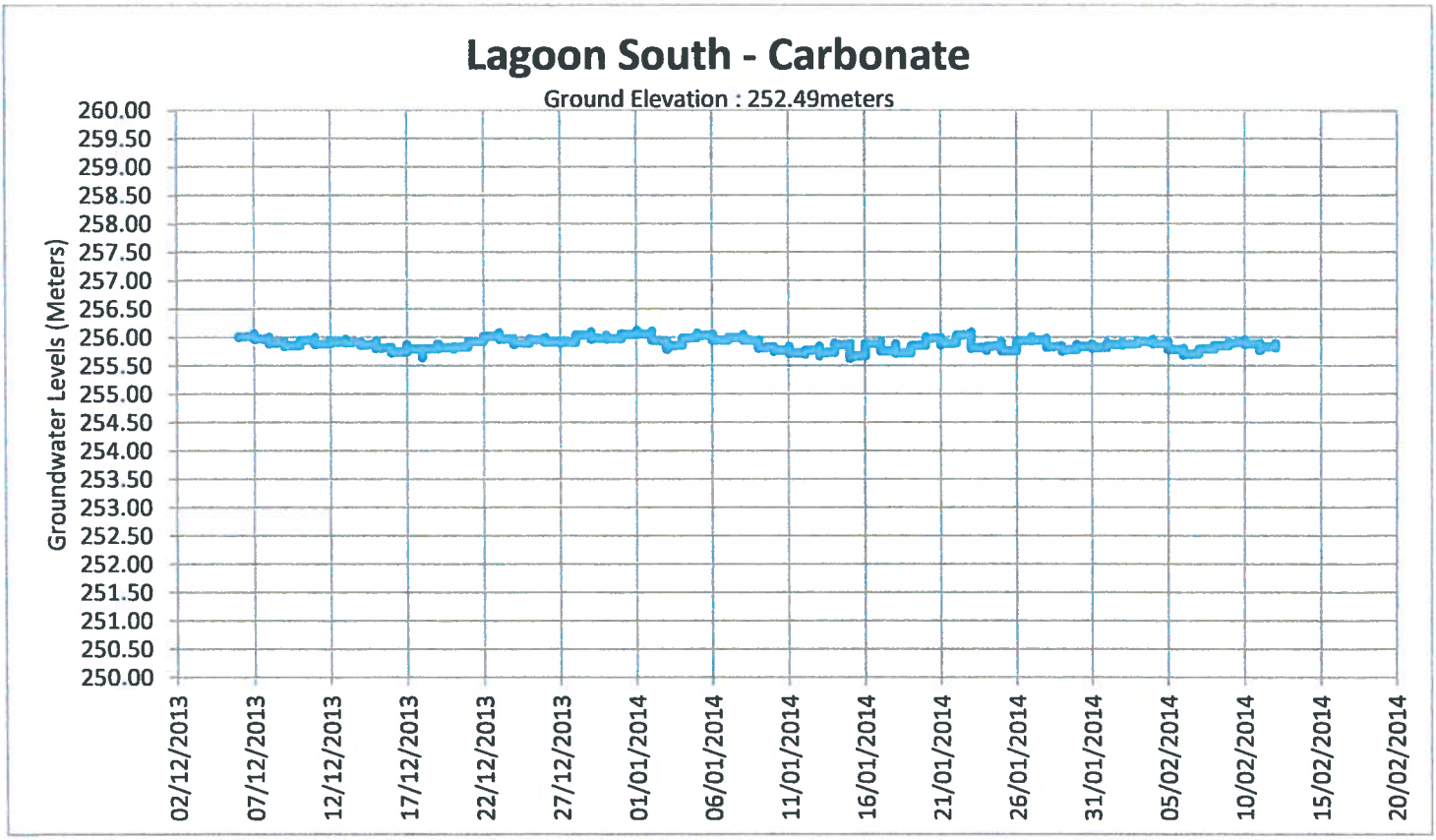

G05OE042 - Carbonate
Groundwater Levels (Meters)
269.00
268.50
268.00
267.50
267.00
266.50
266.00
265.50
265.00
264.50
264.00
263.50
263.00
12/12/13
12/17/13
12/22/13
12/27/13
1/01/14
1/06/14
1/11/14
1/16/14
1/21/14
1/26/14
1/31/14
2/05/14
2/10/14
2/15/14
2/20/14

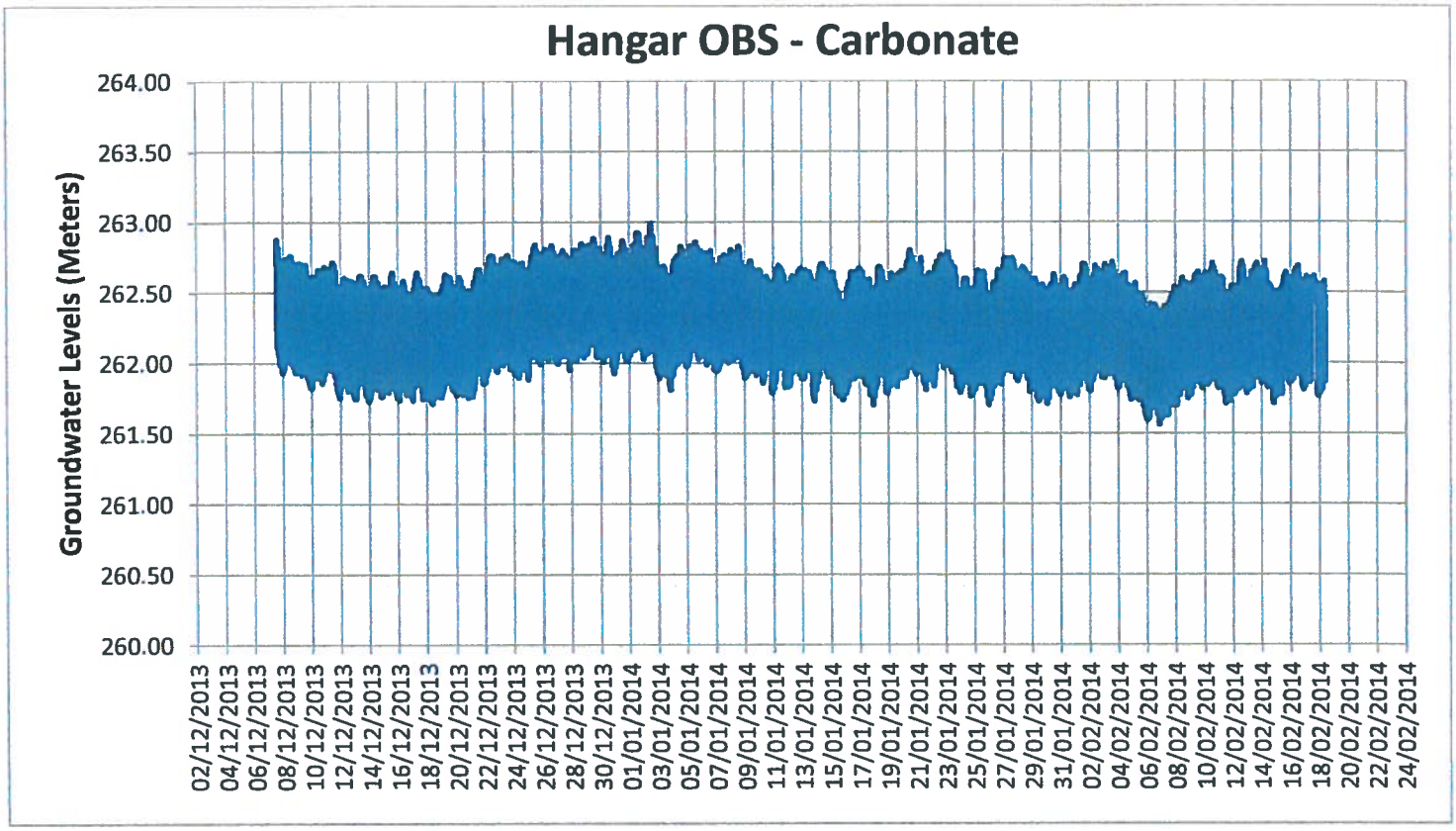

G05OE046
Groundwater Levels (meters)
262.00
263.00
264.00
265.00
266.00
267.00
268.00
269.00
270.00
271.00
272.00
273.00
274.00
02/12/2013
04/12/2013
06/12/2013
08/12/2013
10/12/2013
12/12/2013
14/12/2013
16/12/2013
18/12/2013
20/12/2013
22/12/2013
24/12/2013
26/12/2013
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014
16/02/2014
18/02/2014
20/02/2014

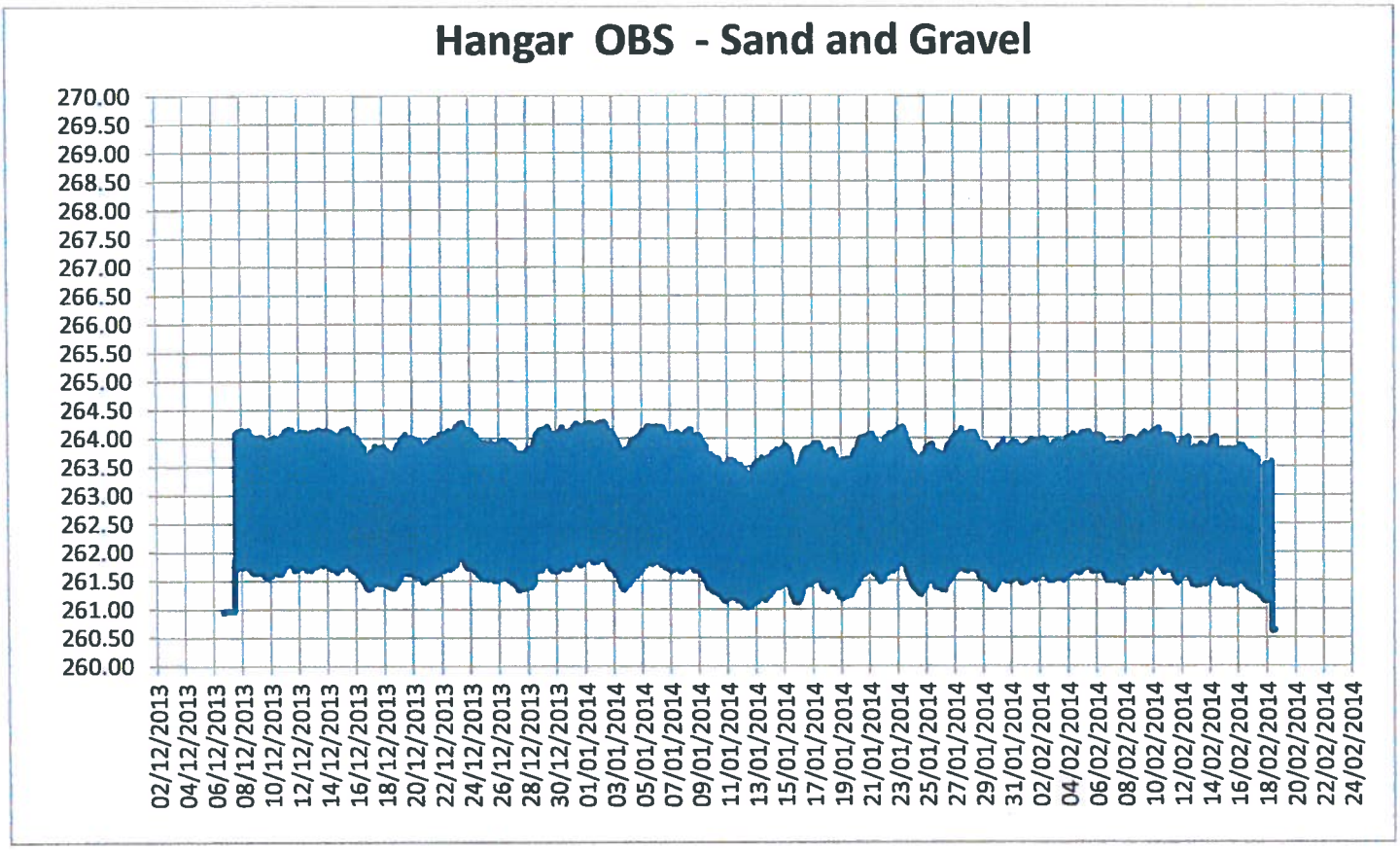

Lagoon North - Sandstone
Ground Elevation : 250.32 meters
Groundwater Levels (Meters)
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
246.50
246.00
245.50
245.00
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014


Lagoon North - Carbonate
Ground Elevation : 250.32 meters
Groundwater Levels (Meters)
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
246.50
246.00
245.50
245.00
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014

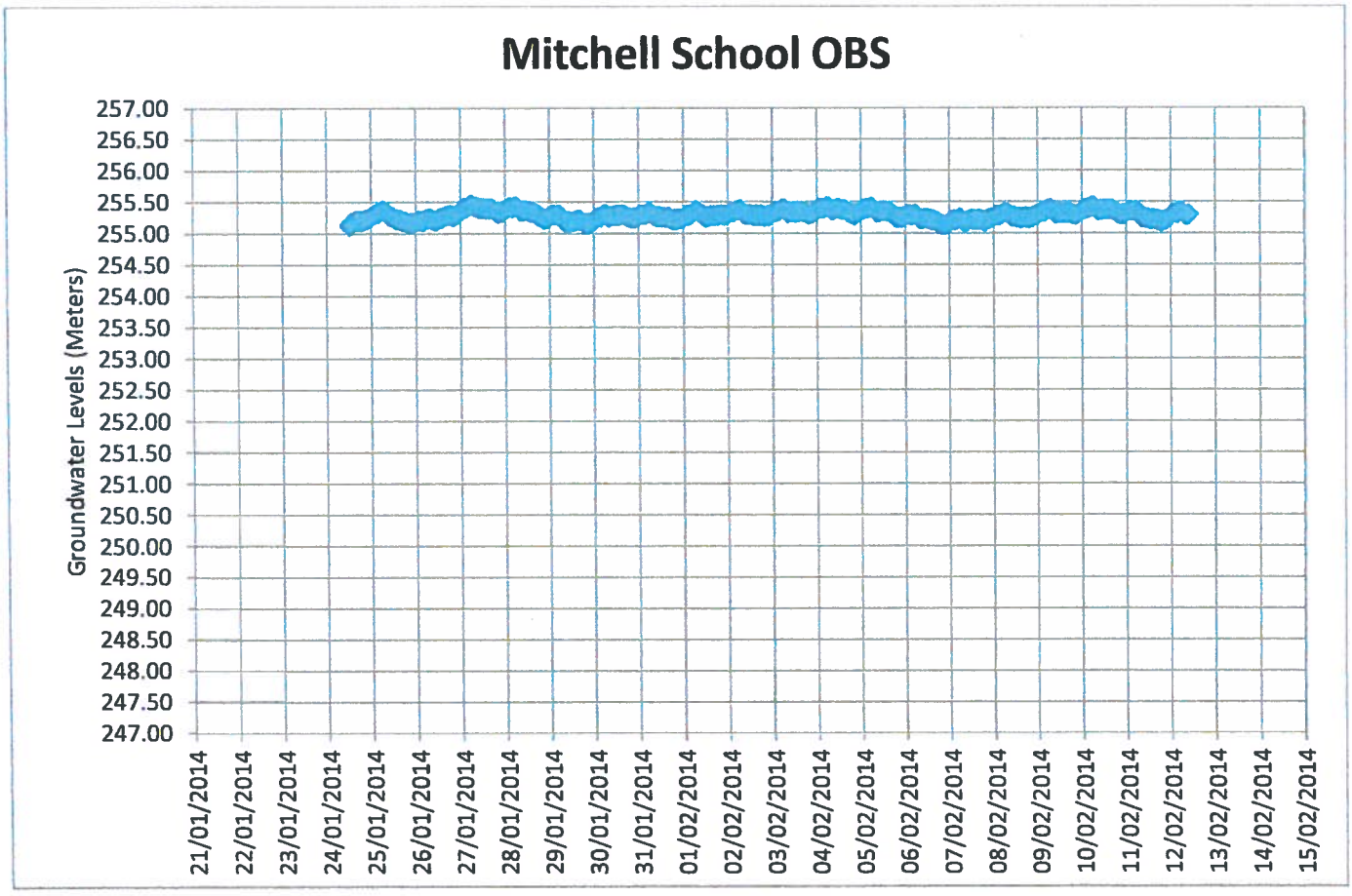

Lagoon South - Sandstone
Ground Elevation : 252.49meters
Groundwater Levels (Meters)
260.00
259.50
259.00
258.50
258.00
257.50
257.00
256.50
256.00
255.50
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
22/12/2013
24/12/2013
26/12/2013
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014
16/02/2014
18/02/2014
20/02/2014

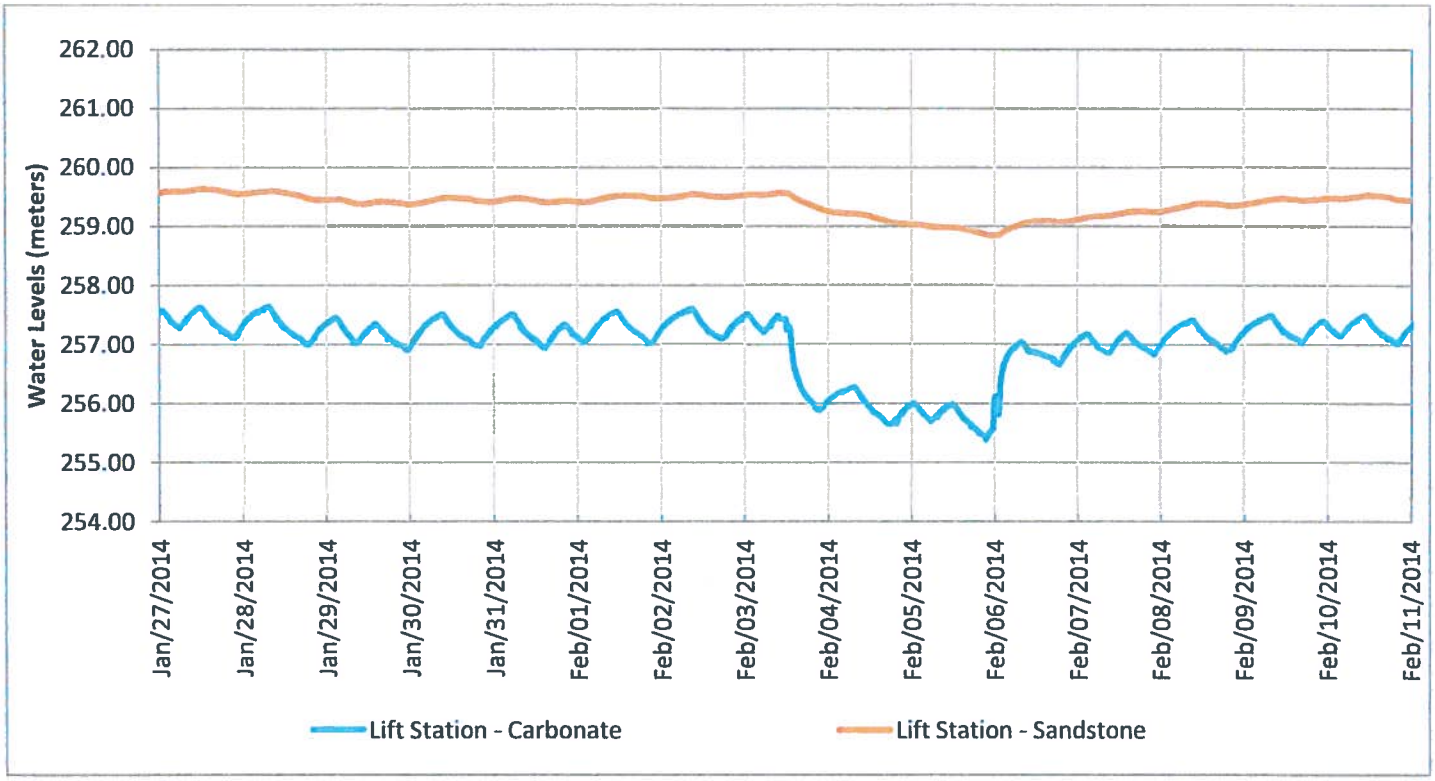

Lagoon South - Carbonate
Ground Elevation : 252.49meters
Groundwater Levels (Meters)
260.00
259.50
259.00
258.50
258.00
257.50
257.00
256.50
256.00
255.50
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
02/12/2013
07/12/2013
12/12/2013
17/12/2013
22/12/2013
27/12/2013
01/01/2014
06/01/2014
11/01/2014
16/01/2014
21/01/2014
26/01/2014
31/01/2014
05/02/2014
10/02/2014
15/02/2014
20/02/2014

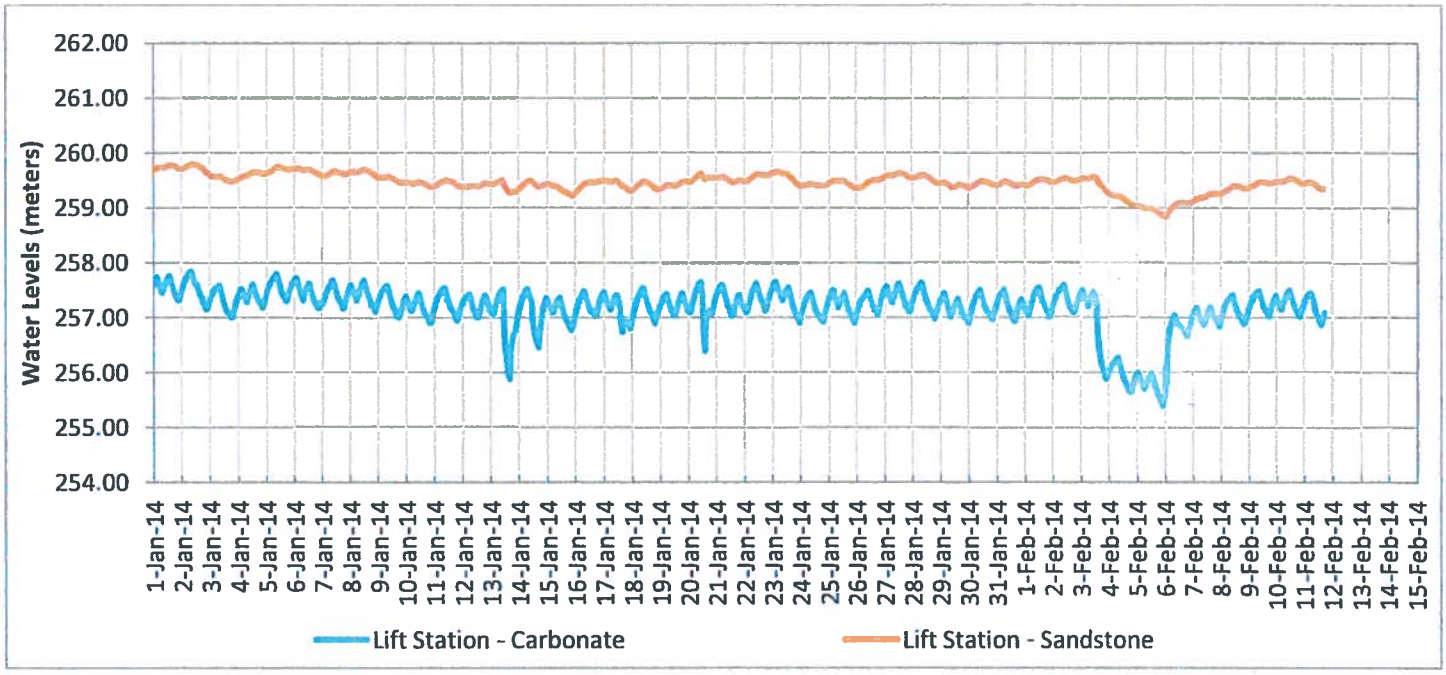

Hangar OBS - Carbonate
Groundwater Levels (Meters)
264.00
263.50
263.00
262.50
262.00
261.50
261.00
260.50
260.00
02/12/2013
04/12/2013
06/12/2013
08/12/2013
10/12/2013
12/12/2013
14/12/2013
16/12/2013
18/12/2013
20/12/2013
22/12/2013
24/12/2013
26/12/2013
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014
16/02/2014
18/02/2014
20/02/2014
22/02/2014
24/02/2014

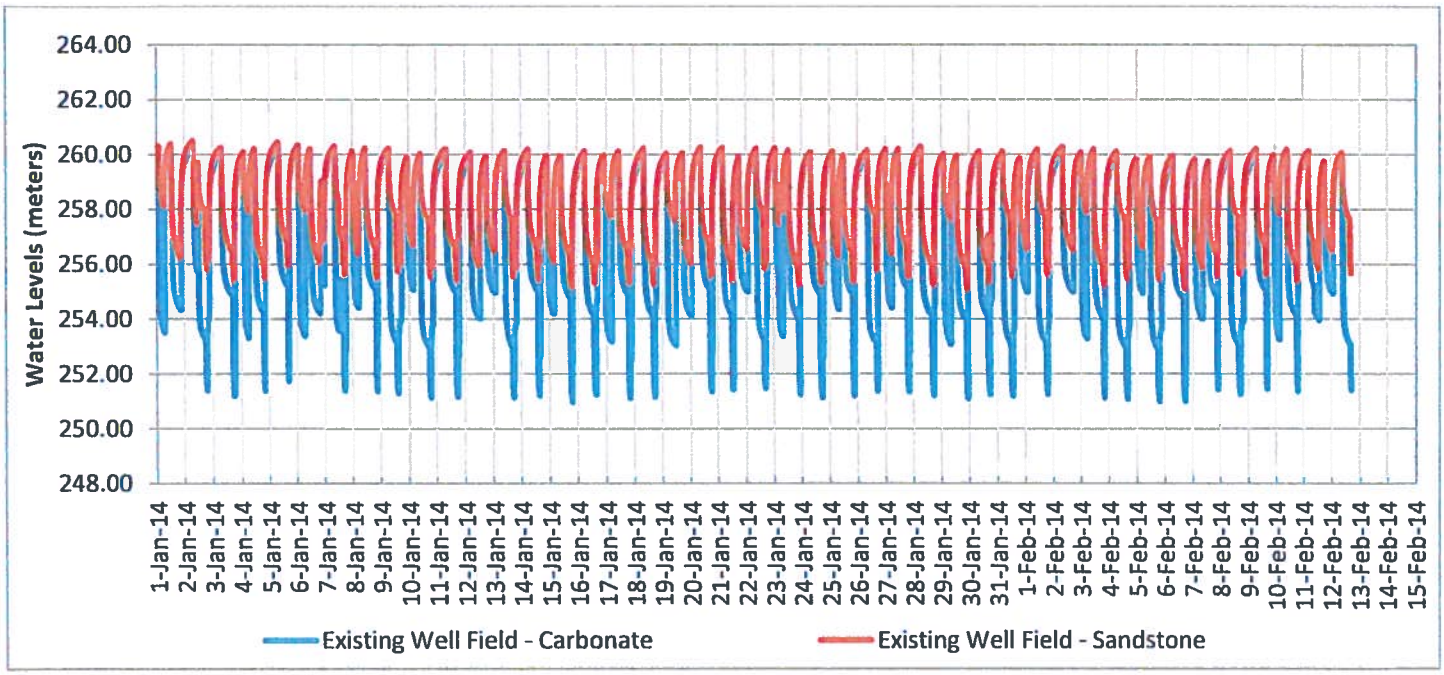

Hangar OBS - Sand and Gravel
270.00
269.50
269.00
268.50
268.00
267.50
267.00
266.50
266.00
265.50
265.00
264.50
264.00
263.50
263.00
262.50
262.00
261.50
261.00
260.50
260.00
02/12/2013
04/12/2013
06/12/2013
08/12/2013
10/12/2013
12/12/2013
14/12/2013
16/12/2013
18/12/2013
20/12/2013
22/12/2013
24/12/2013
26/12/2013
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014
16/02/2014
18/02/2014
20/02/2014
22/02/2014
24/02/2014

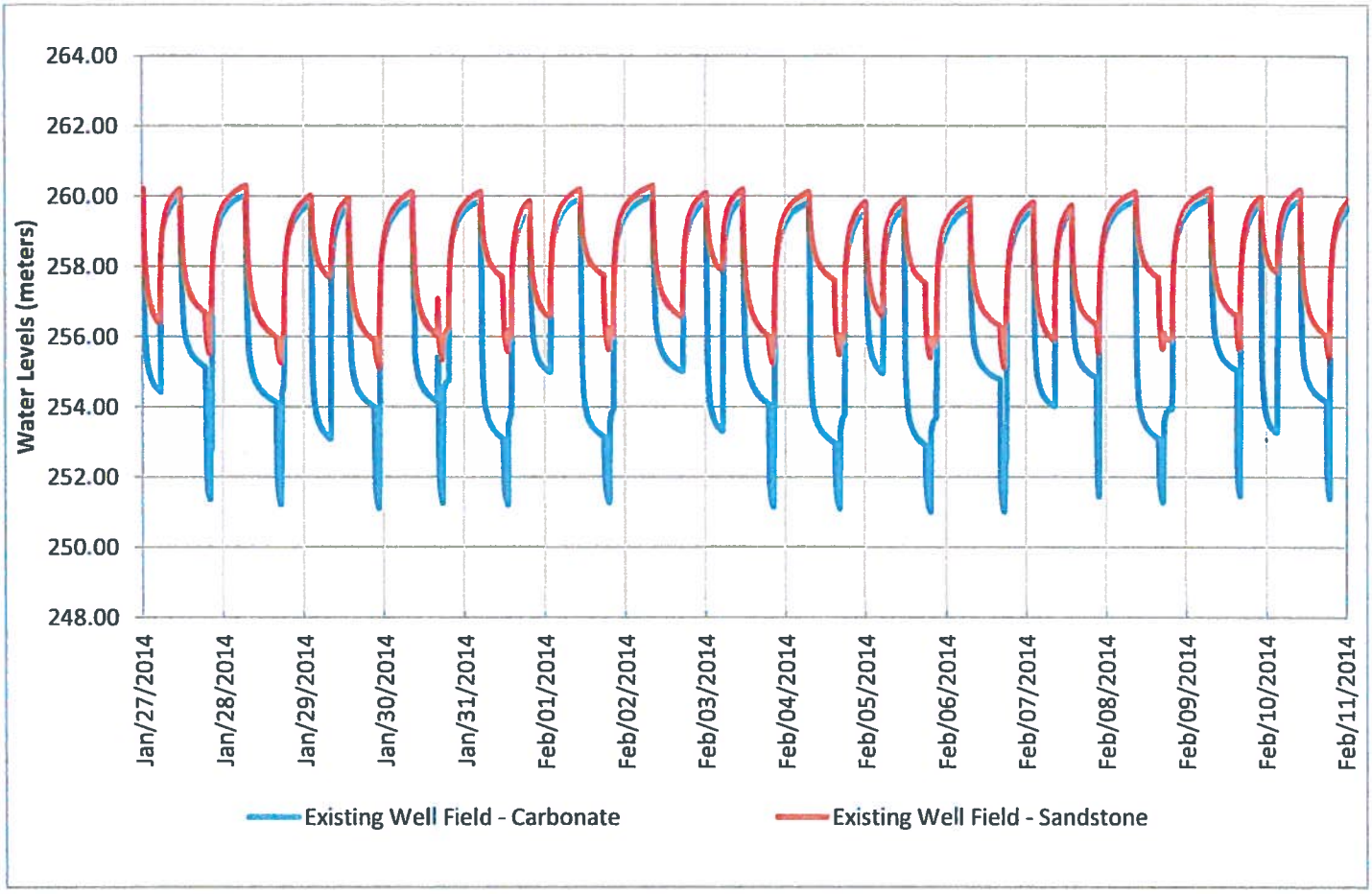

Shop Well
Groundwater Levels (Meters)
258.00
257.50
257.00
256.50
256.00
255.50
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
28/12/2013
30/12/2013
01/01/2014
03/01/2014
05/01/2014
07/01/2014
09/01/2014
11/01/2014
13/01/2014
15/01/2014
17/01/2014
19/01/2014
21/01/2014
23/01/2014
25/01/2014
27/01/2014
29/01/2014
31/01/2014
02/02/2014
04/02/2014
06/02/2014
08/02/2014
10/02/2014
12/02/2014
14/02/2014

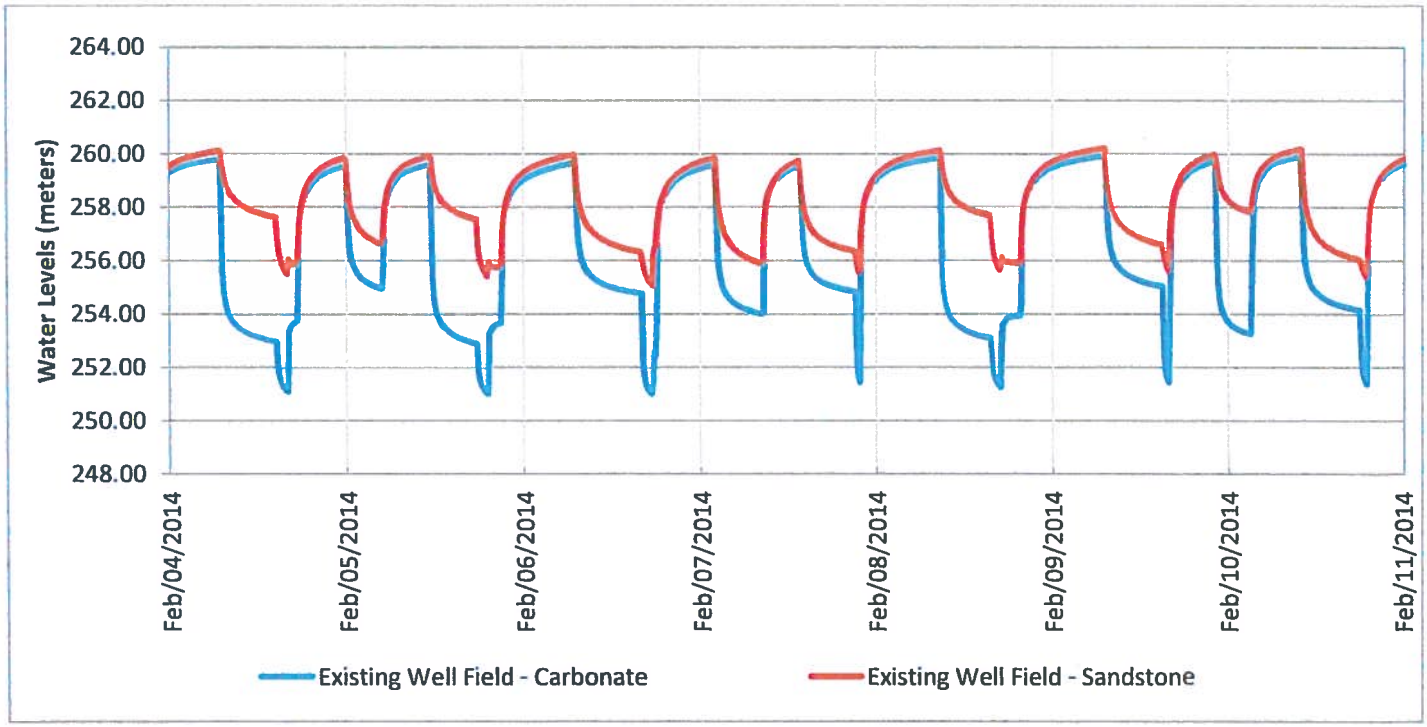

Mitchell School OBS
Groundwater Levels (Meters)
257.00
256.50
256.00
255.50
255.00
254.50
254.00
253.50
253.00
252.50
252.00
251.50
251.00
250.50
250.00
249.50
249.00
248.50
248.00
247.50
247.00
21/01/2014
22/01/2014
23/01/2014
24/01/2014
25/01/2014
26/01/2014
27/01/2014
28/01/2014
29/01/2014
30/01/2014
31/01/2014
01/02/2014
02/02/2014
03/02/2014
04/02/2014
05/02/2014
06/02/2014
07/02/2014
08/02/2014
09/02/2014
10/02/2014
11/02/2014
12/02/2014
13/02/2014
14/02/2014
15/02/2014

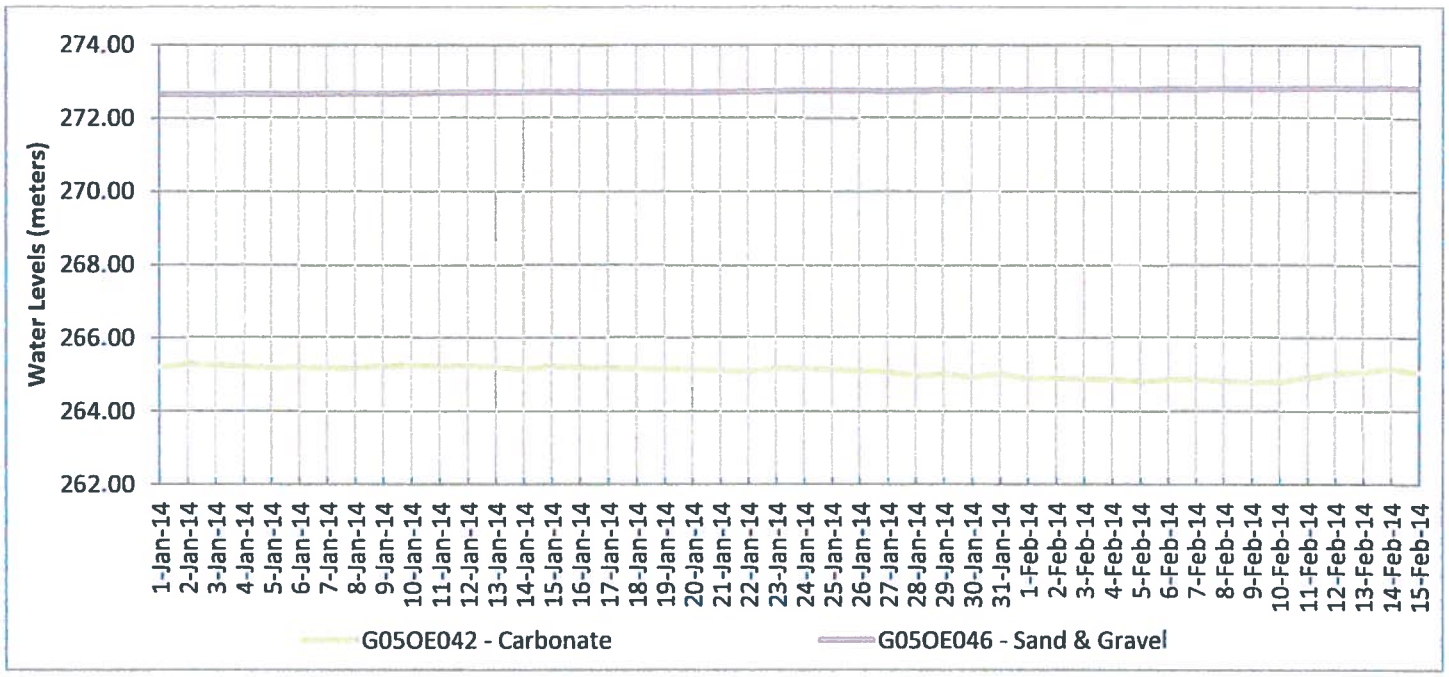

262.00
261.00
260.00
259.00
258.00
257.00
256.00
255.00
254.00
Water Levels (meters)
Jan/27/2014
Jan/28/2014
Jan/29/2014
Jan/30/2014
Jan/31/2014
Feb/01/2014
Feb/02/2014
Feb/03/2014
Feb/04/2014
Feb/05/2014
Feb/06/2014
Feb/07/2014
Feb/08/2014
Feb/09/2014
Feb/10/2014
Feb/11/2014
Lift Station - Carbonate
Lift Station - Sandstone

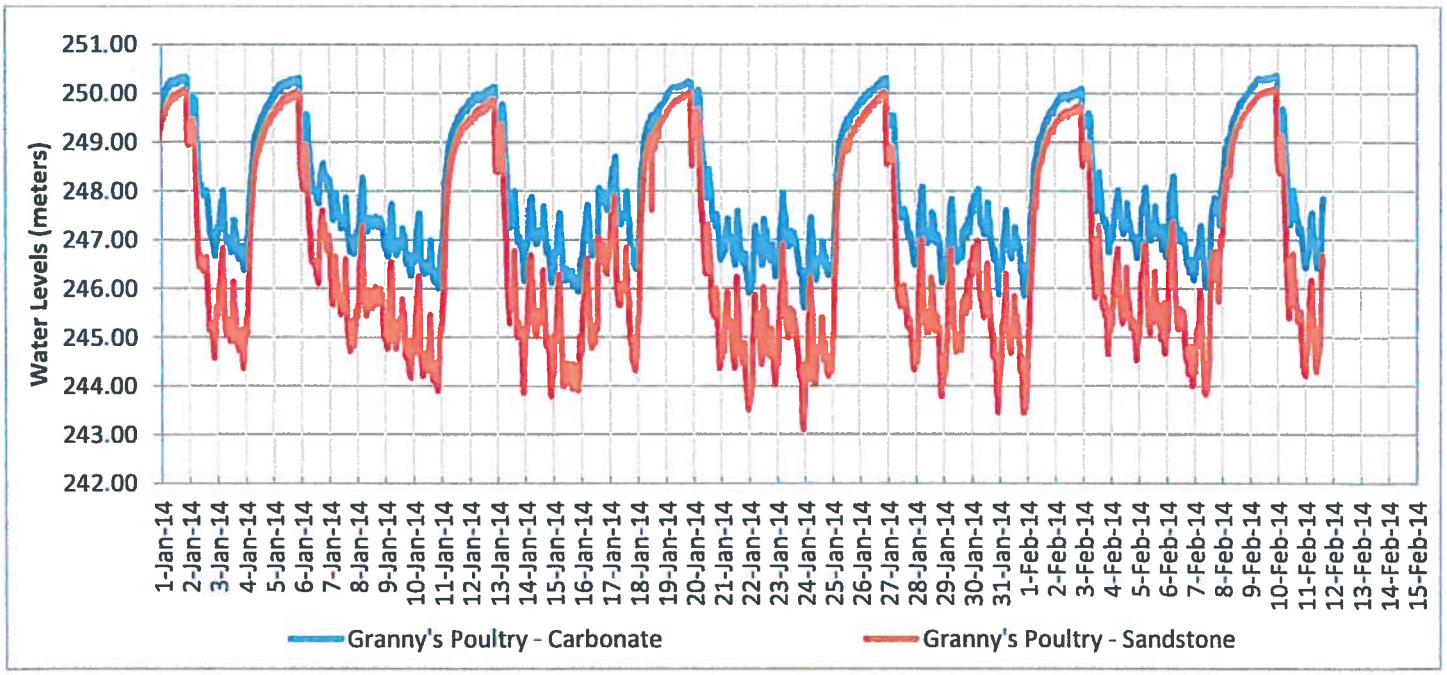

Water Levels (meters)
262.00
261.00
260.00
259.00
258.00
257.00
256.00
255.00
254.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
Lift Station - Carbonate
Lift Station - Sandstone

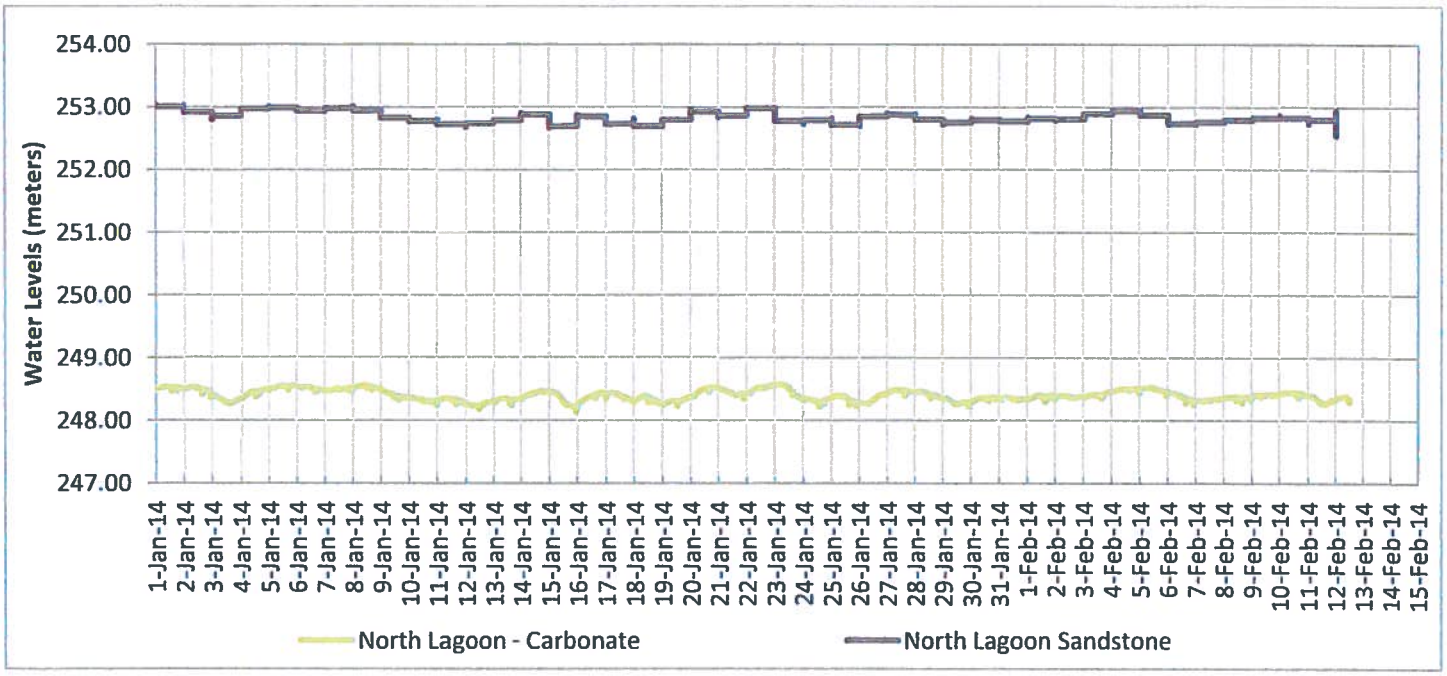

Water Levels (meters)
264.00
262.00
260.00
258.00
256.00
254.00
252.00
250.00
248.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
Existing Well Field - Carbonate
Existing Well Field - Sandstone

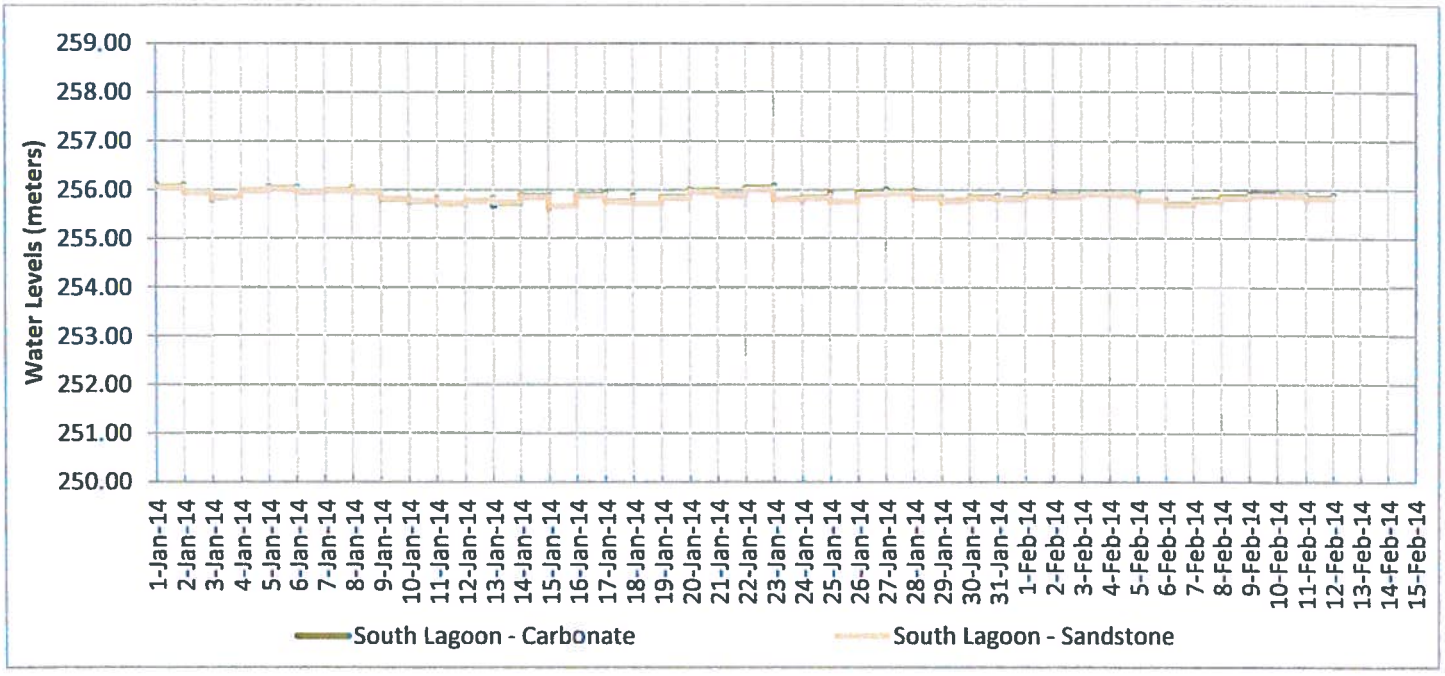

264.00
262.00
260.00
258.00
256.00
254.00
252.00
250.00
248.00
Water Levels (meters)
Jan/27/2014
Jan/28/2014
Jan/29/2014
Jan/30/2014
Jan/31/2014
Feb/01/2014
Feb/02/2014
Feb/03/2014
Feb/04/2014
Feb/05/2014
Feb/06/2014
Feb/07/2014
Feb/08/2014
Feb/09/2014
Feb/10/2014
Feb/11/2014
Existing Well Field - Carbonate
Existing Well Field - Sandstone


264.00
262.00
260.00
258.00
256.00
254.00
252.00
250.00
248.00
Water Levels (meters)
Feb/04/2014
Feb/05/2014
Feb/06/2014
Feb/07/2014
Feb/08/2014
Feb/09/2014
Feb/10/2014
Feb/11/2014
Existing Well Field - Carbonate
Existing Well Field - Sandstone


Water Levels (meters)
274.00
272.00
270.00
268.00
266.00
264.00
262.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
G05OE042 - Carbonate
G05OE046 - Sand & Gravel


Water Levels (meters)
251.00
250.00
249.00
248.00
247.00
246.00
245.00
244.00
243.00
242.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
Granny's Poultry - Carbonate
Granny's Poultry - Sandstone


Water Levels (meters)
254.00
253.00
252.00
251.00
250.00
249.00
248.00
247.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
North Lagoon - Carbonate
North Lagoon Sandstone


Water Levels (meters)
259.00
258.00
257.00
256.00
255.00
254.00
253.00
252.00
251.00
250.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
South Lagoon - Carbonate
South Lagoon - Sandstone

PROVINCE OF MANITOBA

GROUNDWATER OBSERVATION STATION HYDROGRAPH

Station Number: 6050032

Station Name: Steinbach #5

Date Chart Placed: 2013 12 18 Time: 12:05

Depth to Water Level: 2.895 m

Date Chart Removed: 2014 02 14 Time: 12:25

Depth to Water Level: 3.112 m

Gauge Scale: 5:1 Time Scale: 7D Day

Datum Elevation: m

Gauge Scale Error: Time Scale Error: Hrs.

CHART NO. LD F-4 -SPI

Water Level Recorder — Type F

2.800

2.900

2.895

19/01/29

13:25

changed clock to 7D day

3.112

clock back to 128 day

PROVINCE OF MANITOBA

GROUNDWATER OBSERVATION STATION HYDROGRAPH

Station Number: 6050E047

Station Name: Site 96-7

Date Chart Placed: 2013 12 18 Time: 11:45

Depth to Water Level: 4.317 m

Date Chart Removed: 2014 02 14 Time: 12:45

Depth to Water Level: 4.383 m

Gauge Scale: 5:1 Time Scale: 178 Day

Datum Elevation: m

Gauge Scale Error: Time Scale Error: Hrs.

4.300

4.383
Switched to 178 day

CHART NO 1D F-4 -8PI

Water Level Recorder — Type F

PROVINCE OF MANITOBA

GROUNDWATER OBSERVATION STATION HYDROGRAPH

Station Number: GOSOE046

Station Name: Sifa 96 6

Date Chart Placed: 2013 12 17 Time: 11:50

Depth to Water Level: 3.527 m

Date Chart Removed: 2014 02 14 Time: 12:55

Depth to Water Level: 3.777 m

Gauge Scale: 5:1 Time Scale: 128 Day

Datum Elevation: m

Gauge Scale Error: Time Scale Error: Hrs.

-SPI

CHART NO. LD F-4

Water Level Recorder — Type F

3.500

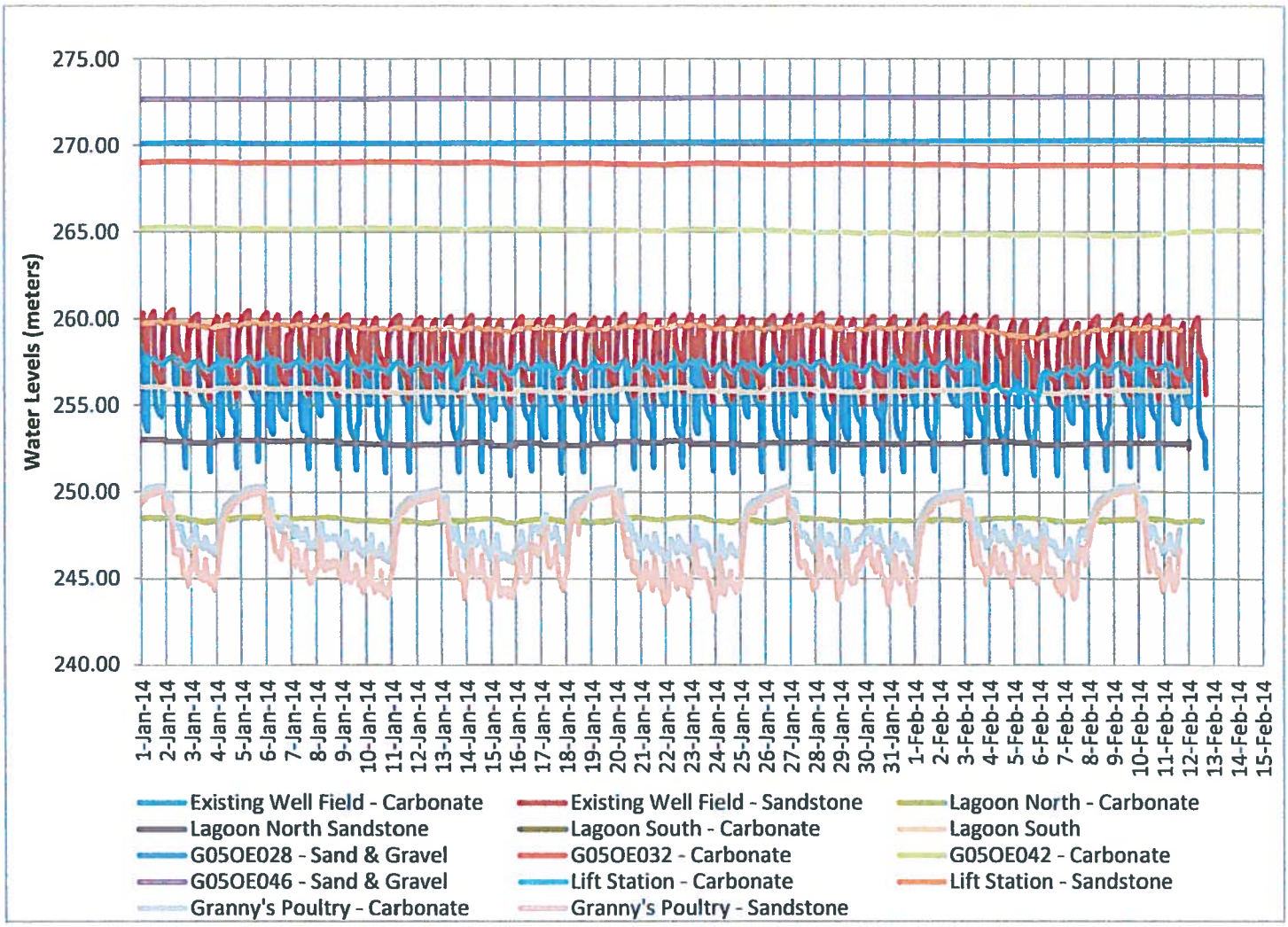
3.600

3.707A
14/01/31
13:15

Changed chart to 32 day

3.777

Switched to 128 day


Water Levels (meters)
275.00
270.00
265.00
260.00
255.00
250.00
245.00
240.00
1-Jan-14
2-Jan-14
3-Jan-14
4-Jan-14
5-Jan-14
6-Jan-14
7-Jan-14
8-Jan-14
9-Jan-14
10-Jan-14
11-Jan-14
12-Jan-14
13-Jan-14
14-Jan-14
15-Jan-14
16-Jan-14
17-Jan-14
18-Jan-14
19-Jan-14
20-Jan-14
21-Jan-14
22-Jan-14
23-Jan-14
24-Jan-14
25-Jan-14
26-Jan-14
27-Jan-14
28-Jan-14
29-Jan-14
30-Jan-14
31-Jan-14
1-Feb-14
2-Feb-14
3-Feb-14
4-Feb-14
5-Feb-14
6-Feb-14
7-Feb-14
8-Feb-14
9-Feb-14
10-Feb-14
11-Feb-14
12-Feb-14
13-Feb-14
14-Feb-14
15-Feb-14
Existing Well Field - Carbonate
Existing Well Field - Sandstone
Lagoon North - Carbonate
Lagoon North Sandstone
Lagoon South - Carbonate
Lagoon South
G05OE028 - Sand & Gravel
G05OE032 - Carbonate
G05OE042 - Carbonate
G05OE046 - Sand & Gravel
Lift Station - Carbonate
Lift Station - Sandstone
Granny's Poultry - Carbonate
Granny's Poultry - Sandstone

Appendix I

Survey Data

KEYSTONE Surveys
LAND SURVEYING & GEOMATICS
GILBERT J. LANDREVILLE – MANITOBA LAND SURVEYOR

406 Main Street
Steinbach, Manitoba
R5G 1Z5

Phone: (204) 326-2117
Fax: (204) 326-5939
info@keystonesurveys.ca

April 7, 2014

Our File No. 2014.059

Ms. Paulynn Estrella
Friesen Drillers Ltd.
307 PTH 12 North
Steinbach, MB R5G 1T8

Dear Ms. Estrella:

RE: Monitoring Well locations and elevations near Steinbach, Mitchell and Blumenort Areas

As requested, we have located and determined the elevations of the monitoring wells which are listed on the attached table.

We note that you are present with my field crew when we carried out our measurements.

If any item has not been addressed or appears to be identified incorrectly, please contact myself for clarification immediately.

A Statement of Account is enclosed. Please call if you have any questions.

Yours truly,

Gilbert J. Landreville
Manitoba Land Surveyor

GJL/nw
Encl.

Cc: Mr. Phil Kalyta, City of Steinbach

KEYSTONE Surveys
LAND SURVEYING & GEOMATICS
406 Main Street
Steinbach, Manitoba
R5G 1Z5
Phone: (204) 326-2117
Fax: (204) 326-5939
info@keystonesurveys.ca
GILBERT J. LANDREVILLE – MANITOBA LAND SURVEYOR

Well Locations near Steinbach, Mitchell and Blumenort

Friesen Drillers

File No. 2014.059

Well ID	Northing	Easting	Ground Elevation	Height of Pipe (m)	Pipe Elevation
1 Pump Well	5490433.48	665821.20			256.641
3 Second Supply Well	5490429.51	665696.32			256.678
4 Supply Well Field MW.	5490429.49	665696.36			256.174
5 c) Lift Station M.W.			256.21	0.50	256.714
s) Lift Station M.W.			256.21	0.84	257.050
7 James' House	5492343.86	666322.02	253.63	0.48	254.112
8 Shop Well			257.14	0.33	257.474
9 c) Lagoon South	5490572.03	663511.61	252.49	0.58	253.070
s) Lagoon South	5490572.06	663511.60	252.49	0.74	253.232
10 Mitchell, MB	5490071.44	661655.44	252.35	0.46	252.810
11 Old Well Field Obs.	5488119.63	668172.84	263.16	0.81	263.965
12 c) Lagoon North	5492963.48	663857.30	250.32	0.77	251.094
s) Lagoon North	5492963.49	663857.20	250.32	0.70	251.021
14 John's Hangar					
15 c) Granny's Poultry			255.29	0.59	255.882
s) Granny's Poultry			255.29	0.57	255.864

Well ID		Northing	Easting	Elevations
John's Hangar	Felt Mark on Concrete Pad	5491312.66	667609.59	257.708

Elevations are geodetic and accurate to +/- 5 cm for wells in the Steinbach & Mitchell areas.
The accuracy of the elevations for the wells in Blumenort is +/- 35 cm.

Appendix J

Pumping Test Data

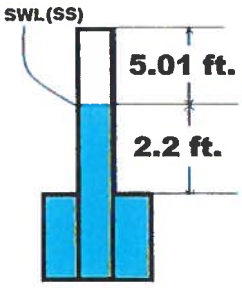
Monitoring Well on Field

City of Steinbach West Well Field

South Monitoring Well (Well Field)
Date Start: Feb. 3, 2014
Pump Well : South Well

Depth to Setting : 95'3"
Orifice: 4"
Pipe: 6"

Local Time	Elapsed Time (min)	Limestone	Sandstone	Comment/s	Rate
1:00 PM	0		-2.20	both flowing wells, SS had pipe	
1:01 PM	1	1.58	-2.20		
1:02 PM	2	3.42	-2.21		
1:03 PM	3	4.17	-2.20		
1:04 PM	4	5.00	-2.19		45"- 48" = 430-440 gpm
1:05 PM	5	5.67	-2.18		
1:06 PM	6	7.00	2.15		
1:07 PM	7	7.92	-2.18		
1:08 PM	8	8.67			
1:09 PM	9	9.00	-2.15		
1:10 PM	10	9.75	2.12		
1:13 PM	13	10.00	-1.95		48" - 440 gpm
1:14 PM	14	10.08			
1:16 PM	16	10.75	-2.25		
1:18 PM	18	11.17	-2.25		
1:20 PM	20	11.75	-2.25		47"- 48" : 434-440 gpm
2:15 PM	75	15.80	-2.10		
3:00 PM	120	17.18	-2.10	2 hrs	3:15 46" : 429 gpm, increased opening
4:00 PM	180	18.30	-2.05	3 hrs	
5:00 PM	240	18.81	-	SS frozen	5:20 46" : 429 gpm
6:00 PM	300	18.99		5 hrs	46" : 429 gpm
7:00 PM	360	19.65		6 hrs	
8:00 PM	420	20.15		7 hrs	
9:00 PM	480			can't reach wells	
1:44 PM	1484	21.85			



City of Steinbach Pump Well

City of Steinbach West Well Field

Pump Well: South Well
Date Start: Feb. 3, 2014

Depth to Setting : 95'3"
Orifice: 4"
Pipe: 6"

Local Time	Elapsed Time (min)	Pump Well (South Well)	Comment/s	Rate
1:00 PM	0	-1.05	flowing	
1:01 PM	1	29.80		
1:02 PM	2	37.30		
1:03 PM	3	41.60		
1:04 PM	4	44.40		
1:05 PM	5	46.50		45"- 48" = 430-440 gpm
1:06 PM	6	48.20		
1:07 PM	7	49.50		
1:08 PM	8	50.50		
1:09 PM	9	51.50		
1:10 PM	10	52.10		
1:13 PM	13	54.10		48" - 440 gpm
1:14 PM	14	54.50		
1:16 PM	16	55.25		
1:18 PM	18	55.90		
1:20 PM	20	56.50		47"- 48" : 434-440 gpm
1:25 PM	25	57.70		
1:30 PM	30	58.60		
1:35 PM	35	59.20		
1:40 PM	40	59.82		
1:45 PM	45	60.00		
1:50 PM	50	60.70		
1:55 PM	55	61.03		47": 434 gpm
2:00 PM	60	62.50	1 hr	
2:15 PM	75	62.40		
2:30 PM	90	63.00		
2:45 PM	105	63.53		
3:00 PM	120	64.34	2 hrs	3:15 46" : 429 gpm
3:30 PM	150	65.10		increased opening
4:00 PM	180	66.35	3 hrs	
4:30 PM	210	66.64		
5:00 PM	240	65.82	4 hrs	5:20 46" : 429 gpm
6:00 PM	300	67.11	5 hrs	46" : 429 gpm
7:00 PM	360	67.11	6 hrs	
8:00 PM	420	67.75	7 hrs	
9:00 PM	480	68.35	8 hrs	
10:00 PM	540	69.90	9 hrs	
11:00 PM	600	69.10	10 hrs	
12:00 AM	660	69.00	11 hrs	
1:00 AM	720	69.40	12 hrs	

City of Steinbach Pump Well

2:00 AM	780	69.95	13 hrs	
3:00 AM	840	69.65	14 hrs	
4:00 AM	900	69.20	15 hrs	
5:00 AM	960	69.45	16 hrs	
6:00 AM	1020	69.30	17 hrs	
7:00 AM	1080	67.10	18 hrs	
8:00 AM	1140	70.20	19 hrs	
9:00 AM	1200	70.40	20 hrs	9:20 46" : 429 gpm
10:00 AM	1260	71.45	21 hrs	increased opening
11:00 AM	1320	71.75	22 hrs	11:10 46" : 429 gpm
12:00 PM	1380	72.37	23 hrs	
1:00 PM	1440	73.15	1 day	1:25 46" : 429 gpm
2:00 PM	1500	73.56	25 hrs	increased opening
3:00 PM	1560	73.66	26 hrs	3:15 46":429 gpm
4:00 PM	1620	73.90	27 hrs	
5:00 PM	1680	73.90	28 hrs	
6:00 PM	1740	73.10	29 hrs	7:20 45.5"
7:00 PM	1800	72.80	30 hrs	44" : increased opening
8:00 PM	1860	78.00	31 hrs	7:30 47"
9:00 PM	1920	77.90	32 hrs	47.5"
10:00 PM	1980	77.25	33 hrs	47"
11:00 PM	2040	76.30	34 hrs	46.5"
12:00 AM	2100	76.50	35 hrs	
1:00 AM	2160	76.81	36 hrs	
2:00 AM	2220	77.10	37 hrs	
3:00 AM	2280	77.34	38 hrs	
4:00 AM	2340	77.80	39 hrs	
5:00 AM	2400	77.98	40 hrs	
6:00 AM	2460	78.40	41 hrs	
7:00 AM	2520	79.00	42 hrs	
8:00 AM	2580	79.10	43 hrs	46" - 47"
9:00 AM	2640	78.86	44 hrs	
10:00 AM	2700	78.53	45 hrs	47"
11:00 AM	2760	78.02	46 hrs	
12:00 PM	2820	79.17	47 hrs	46" : 429 gpm
1:00 PM	2880	79.56	2 days	
2:00 PM	2940	79.71	49 hrs	
3:00 PM	3000	79.93	50 hrs	
4:00 PM	3060	78.95	51 hrs	48 " 440 gpm
5:00 PM	3120	78.68	52 hrs	48"
6:00 PM	3180	79.20	53 hrs	48"
7:00 PM	3240	79.25	54 hrs	48"
8:00 PM	3300	78.55	55 hrs	48"
9:00 PM	3360	78.70	56 hrs	48"
10:00 PM	3420	79.30	57 hrs	48"
11:00 PM	3480	80.40	58 hrs	11:45 gen. shut off for 15min
12:10 AM	3550	74.80	59.17 hrs	

City of Steinbach Pump Well

1:00 AM	3600	78.60	60 hrs	generator shut off

North Well (Other Well)

City of Steinbach West Well Field

Pump Well: South Well
Date Start: Feb. 3, 2014

Depth to Setting : 95'3"
Orifice: 4"
Pipe: 6"

Local Time	Elapsed Time (min)	Other Well (North Well)	Comment/s	Rate
1:00 PM	0	-1.20	flowing	
1:01 PM	1	-2.10		
1:02 PM	2	-1.25		
1:03 PM	3	-0.49		
1:04 PM	4	0.19		
1:05 PM	5	0.65		45"- 48" = 430-440 gpm
1:06 PM	6	1.18		
1:07 PM	7	1.68		
1:08 PM	8	2.30		
1:09 PM	9	2.70		
1:10 PM	10	3.05		
1:13 PM	13	3.60		48" - 440 gpm
1:14 PM	14	4.10		
1:16 PM	16	4.55		
1:18 PM	18	4.96		
1:20 PM	20	5.33		47"- 48" : 434-440 gpm
1:25 PM	25	6.10		
1:30 PM	30	6.72		
1:35 PM	35	7.24		
1:40 PM	40	7.69		
1:45 PM	45	8.05		
1:50 PM	50	8.38		
1:55 PM	55	8.68		47": 434 gpm
2:00 PM	60	8.97	1 hr	
2:15 PM	75	9.70		
2:30 PM	90	10.17		
2:45 PM	105	10.59		
3:00 PM	120	11.04	2 hrs	3:15 46" : 429 gpm
4:09 PM	189	12.36		increased opening
5:11 PM	251	12.39		
6:12 PM	312	12.47		
7:00 PM	360	13.85	6 hrs	5:20 46" : 429 gpm
8:00 PM	420	14.00	7 hrs	46" : 429 gpm
9:00 PM	480	14.55	8 hrs	
10:00 PM	540	14.64	9 hrs	
11:00 PM	600	14.70	10 hrs	
12:00 AM	660	14.72	11 hrs	
1:00 AM	720	14.65	12 hrs	
2:00 AM	780	14.85	13 hrs	
3:00 AM	840	14.95	14 hrs	

North Well (Other Well)

4:00 AM	900	14.65	15 hrs	
5:00 AM	960	14.35	16 hrs	
6:00 AM	1020	14.00	17 hrs	
7:00 AM	1080	14.95	18 hrs	
8:10 AM	1150	14.60	19 hrs	
9:00 AM	1200	14.82	20 hrs	9:20 46" : 429 gpm
10:00 AM	1260	15.25	21 hrs	increased opening
11:00 AM	1320	15.46	22 hrs	11:10 46" : 429 gpm
12:00 PM	1380	15.81	23 hrs	
1:00 PM	1440	16.00	1 day	1:25 46" : 429 gpm
2:00 PM	1500	16.15	25 hrs	increased opening
3:00 PM	1560	16.25	27 hrs	3:15 46":429 gpm
5:00 PM	1680	17.55	28 hrs	
6:00 PM	1740	17.63	29 hrs	
7:00 PM	1800	17.38	30 hrs	7:20 45.5", 44" increased opening
8:00 PM	1860	17.20	31 hrs	7:30 47"
9:00 PM	1920	17.25	32 hrs	47.5"
10:00 PM	1980	16.90	33 hrs	47"
11:00 PM	2040	16.82	34 hrs	46.5"
12:00 AM	2100	16.50	35 hrs	
1:00 AM	2160	17.33	36 hrs	
2:00 AM	2220	17.90	37 hrs	
3:00 AM	2280	17.01	38 hrs	
4:00 AM	2340	16.90	39 hrs	
5:00 AM	2400	17.10	40 hrs	
6:00 AM	2460	17.90	41 hrs	
7:00 AM	2520	17.00	42 hrs	
8:00 AM	2580	17.20	43 hrs	46" - 47"
9:00 AM	2640	17.03	44 hrs	
10:00 AM	2700	16.95	45 hrs	47"
11:00 AM	2760	16.82	46 hrs	
12:00 PM	2820	16.86	47 hrs	46" : 429 gpm
1:00 PM	2880	17.03	2 days	
2:00 PM	2940	17.35	49 hrs	
3:00 PM	3000	17.40	50 hrs	
4:00 PM	3060	17.40	51 hrs	48 " 440 gpm
5:00 PM	3120	17.42	52 hrs	48"
6:00 PM	3180	17.53	53 hrs	48"
7:00 PM	3240	17.75	54 hrs	48"
8:00 PM	3300	17.82	55 hrs	48"
9:00 PM	3360	17.83	56 hrs	48"
10:00 PM	3420	17.84	57 hrs	48"
11:00 PM	3480	17.84	58 hrs	11:45 gen. shut off for 15min
12:10 AM	3550			
1:00 AM	3600			generator shut off

City of Steinbach
Water Samples and Parameters
Start of Test : Feb 3, 2014

Time	Elapsed Time (Hrs.)	Conductivity	Turbidity	TDS	PH	Sample
03/02/2014 14:00	1	401	7.37	350	8.6	
03/02/2014 15:00	2	440	5.19	350	8.2	
03/02/2014 16:00	3	423	4.73	400	8.1	
03/02/2014 17:00	4	436	4.63	400	8.2	
03/02/2014 18:00	5	381	5.44	400	8.2	
03/02/2014 19:00	6	372	5.41	400	8.3	
03/02/2014 20:00	7	425	2.99	440	8.2	
03/02/2014 21:00	8	367	2.78	450	8.2	
03/02/2014 22:00	9	443	3.78	390	8.4	
03/02/2014 23:00	10	364	3	350	8.3	
04/02/2014 0:00	11	408	3.51	400	8.3	
04/02/2014 1:00	12	388	3.62	400	8.4	*
04/02/2014 2:00	13	400	3.75	390	8.3	
04/02/2014 3:00	14	393	3.99	400	8.4	
04/02/2014 4:00	15	366	3.38	420	8.2	
04/02/2014 5:00	16	300	3.32	435	8.4	
04/02/2014 6:00	17	375	3.45	482	8.4	
04/02/2014 7:00	18	308	3.98	400	8.3	
04/02/2014 8:00	19	432	2.66	350	8.2	
04/02/2014 9:00	20	363	3.96	350	8.2	
04/02/2014 10:00	21	385	3.69	325	8	
04/02/2014 11:00	22	388	3.65	350	8	
04/02/2014 12:00	23	394	4.14	300	7.9	
04/02/2014 13:00	24	373	3.1	300	8	*
04/02/2014 14:00	25	369	2.94	310	7.9	
04/02/2014 15:00	26	391	5.61	300	8	
04/02/2014 16:00	27	377	3.81	300	8	
04/02/2014 17:00	28	383	2.74	320	8	
04/02/2014 18:00	29	426	2.1	350	8.2	
04/02/2014 19:00	30	437	2.62	350	8.2	
04/02/2014 20:00	31	455	2.46	400	8.2	
04/02/2014 21:00	32	442	2.46	350	8.2	
04/02/2014 22:00	33	368	6.97	350	8.3	
04/02/2014 23:00	34	380	5.66	350	8.3	
05/02/2014 0:00	35	427	4.18	350	8.2	
05/02/2014 1:00	36	419	4.17	300	8.3	*
05/02/2014 2:00	37	480	4.52	300		
05/02/2014 3:00	38	511	5.95	350	8.2	
05/02/2014 4:00	39	357	6.46	390	8.3	
05/02/2014 5:00	40	473	5.59	320	8.2	
05/02/2014 6:00	41	496	6.26	350	8.2	

Water Samples and Parameters

05/02/2014 7:00	42	436	6.9	400	8.2	
05/02/2014 8:00	43	380	6.88	488	8.2	
05/02/2014 9:00	44	386	4.27	350	8.2	
05/02/2014 10:00	45	353	7.16	350	8.2	
05/02/2014 11:00	46	383	5.39	325	8.1	
05/02/2014 12:00	47	386	5.98	350	8	
05/02/2014 13:00	48	391	7.8	350	7.9	*
05/02/2014 14:00	49	400	5.89	350	8	
05/02/2014 15:00	50	397	6.1	320	8.2	
05/02/2014 16:00	51	369	4.27	350	8.2	
05/02/2014 17:00	52	304	3.15	360	8.1	
05/02/2014 18:00	53	380	3.27	400	8.4	
05/02/2014 19:00	54	332	3.19	350	8.1	
05/02/2014 20:00	55	556	3.22	350	8.2	
05/02/2014 21:00	56	428	3.21	350	8.3	
05/02/2014 22:00	57	384	4.62	350	8.1	
05/02/2014 23:00	58	392	4.62	350	8.1	
06/02/2014 0:00	59	381	2.57	350	8.3	
06/02/2014 1:00	60	350	3.52	340	8.2	*
06/02/2014 2:00	61					
06/02/2014 3:00	62					
06/02/2014 4:00	63					
06/02/2014 5:00	64					
06/02/2014 6:00	65					
06/02/2014 7:00	66					
06/02/2014 8:00	67					
06/02/2014 9:00	68					
06/02/2014 10:00	69					
06/02/2014 11:00	70					
06/02/2014 12:00	71					
06/02/2014 13:00	72					

CD CONTAINING PUMP TEST TRANSDUCER DATA - STEINBACH

Appendix K

Analytical Laboratory Data (L1420128)

FRIESEN DRILLERS LTD
ATTN: JEFF BELL
307 PTH 12 N
STEINBACH MB R5G 1L9

Date Received: 07-FEB-14
Report Date: 16-APR-14 10:38 (MT)
Version: FINAL

Client Phone: 204-326-2485

Certificate of Analysis

Lab Work Order #: L1420128
Project P.O. #: Steinbach West
Job Reference: SOUTHWELL - CITY OF STEINBACH
C of C Numbers:
Legal Site Desc:

Craig Riddell
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1420128-1 12 HRS							
Sampled By: CLIENT on 04-FEB-14 @ 01:00							
Matrix: Water							
ROU4W total							
Alkalinity							
Alkalinity, Total (as CaCO3)	288		20	mg/L		08-FEB-14	R2788542
Bicarbonate (HCO3)	351		24	mg/L		08-FEB-14	R2788542
Carbonate (CO3)	<12		12	mg/L		08-FEB-14	R2788542
Hydroxide (OH)	<6.8		6.8	mg/L		08-FEB-14	R2788542
Chloride by Ion Chromatography							
Chloride	14.5		0.50	mg/L		08-FEB-14	R2789416
Conductivity							
Conductivity	520		20	umhos/cm		08-FEB-14	R2788542
Fluoride by Ion Chromatography							
Fluoride	0.42		0.10	mg/L		08-FEB-14	R2789416
Hardness Calculated							
Hardness (as CaCO3)	227		0.30	mg/L		12-FEB-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		11-FEB-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Sulfate by Ion Chromatography							
Sulfate	1.85		0.50	mg/L		08-FEB-14	R2789416
TDS calculated							
TDS (Calculated)	302		5.0	mg/L		12-FEB-14	
Total Metals by ICP-MS							
Calcium (Ca)-Total	48.1		0.20	mg/L	11-FEB-14	11-FEB-14	R2789756
Iron (Fe)-Total	0.60		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Magnesium (Mg)-Total	26.0		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Manganese (Mn)-Total	0.0067		0.0010	mg/L	11-FEB-14	11-FEB-14	R2789756
Potassium (K)-Total	5.34		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Sodium (Na)-Total	33.7		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Turbidity							
Turbidity	9.60		0.10	NTU		11-FEB-14	R2789787
pH							
pH	7.69		0.10	pH units		08-FEB-14	R2788542
L1420128-2 24 HRS							
Sampled By: CLIENT on 04-FEB-14 @ 13:00							
Matrix: Water							
ROU4W total							
Alkalinity							
Alkalinity, Total (as CaCO3)	266		20	mg/L		08-FEB-14	R2788542
Bicarbonate (HCO3)	325		24	mg/L		08-FEB-14	R2788542
Carbonate (CO3)	<12		12	mg/L		08-FEB-14	R2788542
Hydroxide (OH)	<6.8		6.8	mg/L		08-FEB-14	R2788542
Chloride by Ion Chromatography							
Chloride	14.6		0.50	mg/L		08-FEB-14	R2789416
Conductivity							
Conductivity	524		20	umhos/cm		08-FEB-14	R2788542
Fluoride by Ion Chromatography							
Fluoride	0.41		0.10	mg/L		08-FEB-14	R2789416
Hardness Calculated							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1420128-2 24 HRS							
Sampled By: CLIENT on 04-FEB-14 @ 13:00							
Matrix: Water							
Hardness Calculated							
Hardness (as CaCO3)	219		0.30	mg/L		12-FEB-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		11-FEB-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Sulfate by Ion Chromatography							
Sulfate	1.77		0.50	mg/L		08-FEB-14	R2789416
TDS calculated							
TDS (Calculated)	285		5.0	mg/L		12-FEB-14	
Total Metals by ICP-MS							
Calcium (Ca)-Total	46.1		0.20	mg/L	11-FEB-14	11-FEB-14	R2789756
Iron (Fe)-Total	0.58		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Magnesium (Mg)-Total	25.2		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Manganese (Mn)-Total	0.0061		0.0010	mg/L	11-FEB-14	11-FEB-14	R2789756
Potassium (K)-Total	4.99		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Sodium (Na)-Total	32.7		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Turbidity							
Turbidity	8.07		0.10	NTU		11-FEB-14	R2789787
pH							
pH	7.68		0.10	pH units		08-FEB-14	R2788542
L1420128-3 36 HRS							
Sampled By: CLIENT on 05-FEB-14 @ 01:00							
Matrix: Water							
Miscellaneous Parameters							
Special Request	See Attached					16-APR-14	R2822640
ROU4W total							
Alkalinity							
Alkalinity, Total (as CaCO3)	267		20	mg/L		08-FEB-14	R2788542
Bicarbonate (HCO3)	325		24	mg/L		08-FEB-14	R2788542
Carbonate (CO3)	<12		12	mg/L		08-FEB-14	R2788542
Hydroxide (OH)	<6.8		6.8	mg/L		08-FEB-14	R2788542
Chloride by Ion Chromatography							
Chloride	14.8		0.50	mg/L		08-FEB-14	R2789416
Conductivity							
Conductivity	529		20	umhos/cm		08-FEB-14	R2788542
Fluoride by Ion Chromatography							
Fluoride	0.40		0.10	mg/L		08-FEB-14	R2789416
Hardness Calculated							
Hardness (as CaCO3)	232		0.30	mg/L		12-FEB-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		11-FEB-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Sulfate by Ion Chromatography							
Sulfate	1.74		0.50	mg/L		08-FEB-14	R2789416
TDS calculated							
TDS (Calculated)	292		5.0	mg/L		12-FEB-14	
Total Metals by ICP-MS							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1420128-3 36 HRS							
Sampled By: CLIENT on 05-FEB-14 @ 01:00							
Matrix: Water							
Total Metals by ICP-MS							
Calcium (Ca)-Total	49.4		0.20	mg/L	11-FEB-14	11-FEB-14	R2789756
Iron (Fe)-Total	0.55		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Magnesium (Mg)-Total	26.4		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Manganese (Mn)-Total	0.0067		0.0010	mg/L	11-FEB-14	11-FEB-14	R2789756
Potassium (K)-Total	5.29		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Sodium (Na)-Total	34.4		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Turbidity							
Turbidity	9.95		0.10	NTU		11-FEB-14	R2789787
pH							
pH	7.72		0.10	pH units		08-FEB-14	R2788542
L1420128-4 48 HRS							
Sampled By: CLIENT on 05-FEB-14 @ 13:00							
Matrix: Water							
Miscellaneous Parameters							
Special Request	See Attached					16-APR-14	R2822640
ROU4W total							
Alkalinity							
Alkalinity, Total (as CaCO3)	267		20	mg/L		08-FEB-14	R2788542
Bicarbonate (HCO3)	325		24	mg/L		08-FEB-14	R2788542
Carbonate (CO3)	<12		12	mg/L		08-FEB-14	R2788542
Hydroxide (OH)	<6.8		6.8	mg/L		08-FEB-14	R2788542
Chloride by Ion Chromatography							
Chloride	14.8		0.50	mg/L		08-FEB-14	R2789416
Conductivity							
Conductivity	526		20	umhos/cm		08-FEB-14	R2788542
Fluoride by Ion Chromatography							
Fluoride	0.40		0.10	mg/L		08-FEB-14	R2789416
Hardness Calculated							
Hardness (as CaCO3)	219		0.30	mg/L		12-FEB-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		11-FEB-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Sulfate by Ion Chromatography							
Sulfate	1.72		0.50	mg/L		08-FEB-14	R2789416
TDS calculated							
TDS (Calculated)	286		5.0	mg/L		12-FEB-14	
Total Metals by ICP-MS							
Calcium (Ca)-Total	46.8		0.20	mg/L	11-FEB-14	11-FEB-14	R2789756
Iron (Fe)-Total	0.88		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Magnesium (Mg)-Total	24.9		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Manganese (Mn)-Total	0.0074		0.0010	mg/L	11-FEB-14	11-FEB-14	R2789756
Potassium (K)-Total	5.08		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Sodium (Na)-Total	32.5		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Turbidity							
Turbidity	11.0		0.10	NTU		11-FEB-14	R2789787
pH							
pH	7.70		0.10	pH units		08-FEB-14	R2788542

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1420128-5 60 HRS							
Sampled By: CLIENT on 06-FEB-14 @ 01:00							
Matrix: Water							
Miscellaneous Parameters							
Special Request	See Attached					16-APR-14	R2822640
ROU4W total							
Alkalinity							
Alkalinity, Total (as CaCO3)	269		20	mg/L		08-FEB-14	R2788542
Bicarbonate (HCO3)	328		24	mg/L		08-FEB-14	R2788542
Carbonate (CO3)	<12		12	mg/L		08-FEB-14	R2788542
Hydroxide (OH)	<6.8		6.8	mg/L		08-FEB-14	R2788542
Chloride by Ion Chromatography							
Chloride	15.0		0.50	mg/L		08-FEB-14	R2789416
Conductivity							
Conductivity	525		20	umhos/cm		08-FEB-14	R2788542
Fluoride by Ion Chromatography							
Fluoride	0.40		0.10	mg/L		08-FEB-14	R2789416
Hardness Calculated							
Hardness (as CaCO3)	220		0.30	mg/L		12-FEB-14	
Nitrate as N by Ion Chromatography							
Nitrate-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Nitrate+Nitrite							
Nitrate and Nitrite as N	<0.071		0.071	mg/L		11-FEB-14	
Nitrite as N by Ion Chromatography							
Nitrite-N	<0.050		0.050	mg/L		08-FEB-14	R2789416
Sulfate by Ion Chromatography							
Sulfate	1.64		0.50	mg/L		08-FEB-14	R2789416
TDS calculated							
TDS (Calculated)	286		5.0	mg/L		12-FEB-14	
Total Metals by ICP-MS							
Calcium (Ca)-Total	46.2		0.20	mg/L	11-FEB-14	11-FEB-14	R2789756
Iron (Fe)-Total	1.07		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Magnesium (Mg)-Total	25.3		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Manganese (Mn)-Total	0.0096		0.0010	mg/L	11-FEB-14	11-FEB-14	R2789756
Potassium (K)-Total	5.05		0.10	mg/L	11-FEB-14	11-FEB-14	R2789756
Sodium (Na)-Total	31.8		0.050	mg/L	11-FEB-14	11-FEB-14	R2789756
Turbidity							
Turbidity	20.6		0.10	NTU		11-FEB-14	R2789787
pH							
pH	7.68		0.10	pH units		08-FEB-14	R2788542

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-WP	Water	Alkalinity	APHA 2320B
Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. It is determined by titration with a standard solution of strong mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.			
CL-IC-WP	Water	Chloride by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
ETL-HARDNESS-TOT-WP	Water	Hardness Calculated	HARDNESS CALCULATED
ETL-SOLIDS-CALC-WP	Water	TDS calculated	CALCULATION
F-IC-WP	Water	Fluoride by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E
MET-T-MS-WP	Water	Total Metals by ICP-MS	APHA 3030E/EPA 6020A-T
This analysis involves preliminary sample treatment by hotblock acid digestion (APHA 3030E). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).			
NO2+NO3-CALC-WP	Water	Nitrate+Nitrite	CALCULATION
NO2-IC-WP	Water	Nitrite as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
NO3-IC-WP	Water	Nitrate as N by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
PH-WP	Water	pH	APHA 4500H
The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.			
SO4-IC-WP	Water	Sulfate by Ion Chromatography	EPA 300.1 (modified)
Anions in aqueous matrices are analyzed using ion chromatography with conductivity and/or UV absorbance detectors.			
SPECIAL REQUEST-UW	Misc.	Special Request University of Waterloo	SEE SUBLET LAB RESULTS
TURBIDITY-WP	Water	Turbidity	APHA 2130B (modified)
Turbidity in aqueous matrices is determined by the nephelometric method.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
UW	UNIVERSITY OF WATERLOO
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Analytical Request Form
800 668 9878
...il.com

L1420128-COFC

10-023933

L1420128

Page ___ of ___

Report To			**Service Requested:** (Rush subject to availability)
Company: Friesen Drillers Ltd.			Regular (Standard Turnaround Times)) X
Contact: Jeff Bell, P.Eng.	Select: PDF ✓ Excel ✓ Digital	Fax	Priority, Date Req'd: _____ (Surcharges apply)
Address: 307 PTH 12 N	Email 1: jeff@friesendrillers.com		Emergency (1 Business Day) - 100% Surcharge
Steinbach MB R5G 1T8	Email 2: paulynn@friesendrillers.com		For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: (204) 326-2485	Fax: (204) 326-2483		**Analysis Request**
Invoice To Same as Report ? (circle) Yes or No (If No, provide details)	**Client / Project Information**		(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No	Job #: South Well - City of Steinbach		
Company:	PO / AFE: (Steinbach West)		
Contact:	LSD:		
Address:			
Phone: Fax:	Quote #:		
Lab Work Order # (lab use only) [redacted]	**ALS Contact:** Judy	**Sampler:**	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Routine	Tritium Enriched	Oxygen 18	Deuterium	Carbon 14								Number of Containers
[redacted] 1	12 HRS	04-Feb-14	1:00	water	X												
[redacted] 2	24 HRS	04-Feb-14	13:00	water	X												
[redacted] 3	36 HRS	05-Feb-14	1:00	water	X	X	X	X									
[redacted] 4	48 HRS	05-Feb-14	13:00	water	X	X	X	X									
[redacted] 5	60 HRS	06-Feb-14	1:00	water	X	X	X	X	X								
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	
[redacted]																	

Special Instructions / Regulations / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			MB	Feb 7/14	8 AM	3.8 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

Client: Dalmaijer
ALS Environmental
Work Order #: L1420128

ISO# 2014091
Location:
3 for 18O, 2H, E3H,
1 for 13C,DIC/14C,AMS - Direct

#	Sample	Lab#	$\delta^{18}O$	Result	Repeat	$\delta^{2}H$	Result	Repeat	E3H	Result	± 1σ	Repeat	± 1σ	δ13C/14C	Result	Repeat
			H_2O	VSMOW		H_2O	VSMOW							DIC/AMS	PDB	
1	L1420128-3 36HRS	321745	X	-13.82	-13.89	X	-103.27	-103.68	X	<0.8	0.4					
2	L1420128-4 48HRS	321746	X	-13.83		X	-103.58		X	<0.8	0.4					
3	L1420128-5 60HRS	321747	X	-13.69	-13.68	X	-103.52	-103.90	X	<0.8	0.4			X	-10.62	

DirectAMS	14C		RCAge		14C		RCAge	
Code	pmC	1σ error	BP	1σ error	pmC	1σ error	BP	1σ error
D-AMS 005888	33.08	0.15	8885	36	32.60	0.14	9003	36

uncorrected values	renormalized to -25 permil using provided d13C values

18O/2H Results from LGR Laser

Tritium is reported in Tritium Units.
1TU = 3.221 Picocurries/L per IAEA, 2000 Report.
1TU = 0.11919 Becquerels/L per IAEA, 2000 Report.

Note April 16, 2014: Corrected sample names for #2 and #3:
#2. L1420128-4 48 HRS from L1420128-3 48 HRS
#3. L1420128-5 60 HRS from L1420138-4 60HRS

To Contact uwEILAB:
519 888 4732

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

Appendix L

Sediment Sample Analysis Results
(University of Manitoba)

Analysis of sediment sludge from the Red River Formation at Steinbach, Manitoba (NTS 62H)

by Arthur Vanjecek

Submitted in partial fulfillment of the requirements of GEOL 4920 Technical Report

Department of Geological Sciences

University of Manitoba

February 21, 2014

Abstract

Extracting water from aquifers requires specific source rock conditions to ensure clean, potable drinking water. During a water well drilling project, an unexpected sediment sludge was encountered within the fractures of the Red River Formation limestone, which underlie the City of Steinbach, Manitoba. A sample was recovered from a depth of 176 ft. (53.65 m) and analyzed to determine the viability of the site. Sample analysis was conducted through macroscopic examination and X-ray diffraction and Scanning electron microscopy techniques. The sludge was found to contain high concentrations of calcite and quartz, along with minor constituents of K-feldspar, rutile, pyrite and rare earth minerals. The colour of the sludge was suspicious, as the main mineralogical components generally do not form dark brown hues. The presence of a clay mineral, such as kaolinite or illite, could explain this colour variation. Two scenarios hypothesized to explain the presence of the sediment sludge are as follows. (1) The sludge may represent a lens or pod formed in a depression that allowed the material to settle. (2) Water may have transported the sludge through fractures in the limestone from another source area outside the region.

Table of Contents

List of Tables

List of Figures

Introduction

Many southern Manitoba towns and cities supply water from aquifers to their residents, businesses and industry. The water must be of high quality and in sufficient amounts to meet these requirements. Demand for this water is increasing rapidly, and requires more water to be drawn out from the aquifer. It is crucial then, to ensure the aquifer can sustain the increased load.

The City of Steinbach (Fig. 1), located in southeastern Manitoba (NTS 62H), has a population of over 13,000 residents (Statistics Canada, 2012). Rate of growth for Steinbach from 2006 to 2011 was 22.2% (Statistics Canada, 2012).

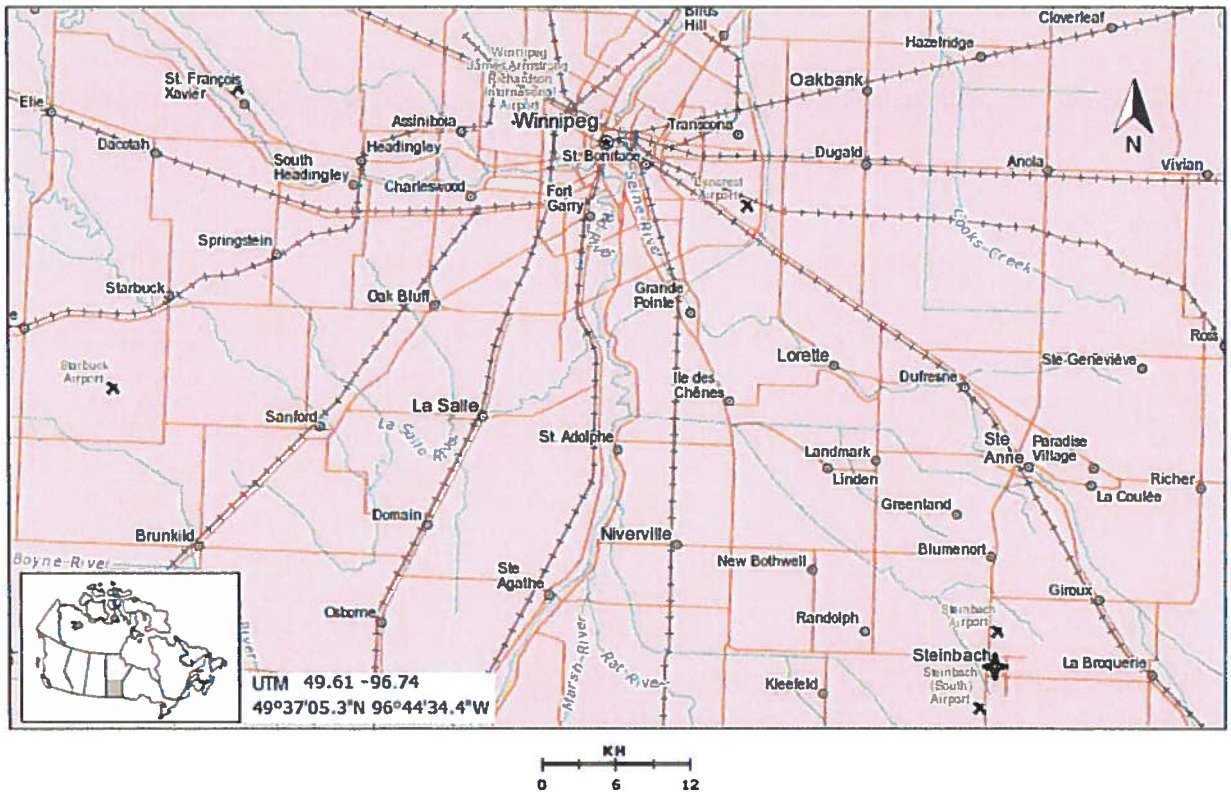


Figure 1. Location of the project area, indicated by the star, at City of Steinbach, Manitoba (NTS 62H) (Modified from Natural Resources Canada, 2013).

Water for the city is currently drawn from three wells in the carbonate aquifer of the Red River formation. Steinbach stores water from the aquifer in four reservoirs: two for raw water and two for treated water. The total capacity of the combined reservoirs equals 2-3 days' storage. Water in the reservoirs is in constant circulation in order to prevent it from going stale (City of Steinbach Waterworks Department, 2012).

The high growth rate has prompted the city to apply for additional water resources under the Environment Act to meet the additional demand for water. The Environment Act requires well pump tests and aquifer response measurements to be completed in order to obtain approval. Specifically, ensuring pump rates will be sufficient to deliver the needed water while preventing over extraction, safeguarding the aquifer from significant drawdown.

Access to the new well field is on municipal land via Park Road on the west side of the city (Fig. 2). This area was selected by the city because several municipal utilities are located there already. Friesen Drillers Ltd. was contracted to drill the wells and conduct the pump tests and measure aquifer response. They recently drilled two wells to a depth of 223 ft. (68 m) into the Red River Formation, which contains the carbonate aquifer that is currently exploited by Steinbach for their drinking water. During drilling, an unexpected sediment sludge was recovered from the well that was to serve as the pumping well. The sludge, which is the focus of this report, lowered water quality below acceptable standards.

Figure 2. Location of the wells, 1.6 km west of the City of Steinbach (Modified from Google Earth, 2014).

Regional Geology

Much of southeastern Manitoba is underlain by thin Quaternary sediments that cover Precambrian bedrock and Phanerozoic rocks of the Williston Basin. The Williston Basin, part of the Western Canada Sedimentary Basin (WCSB), extends to southwest and south-central Manitoba which forms the eastern edge of the basin (Fig. 3, Table 1). Sedimentary rocks vary in age from Cambrian to Tertiary; however most were deposited in the Ordovician and Devonian (McCabe, 1971). Sedimentation during the Ordovician produced two formations, the Red River Formation and the Winnipeg Formation. These formations are of particular significance due to their water-bearing properties.

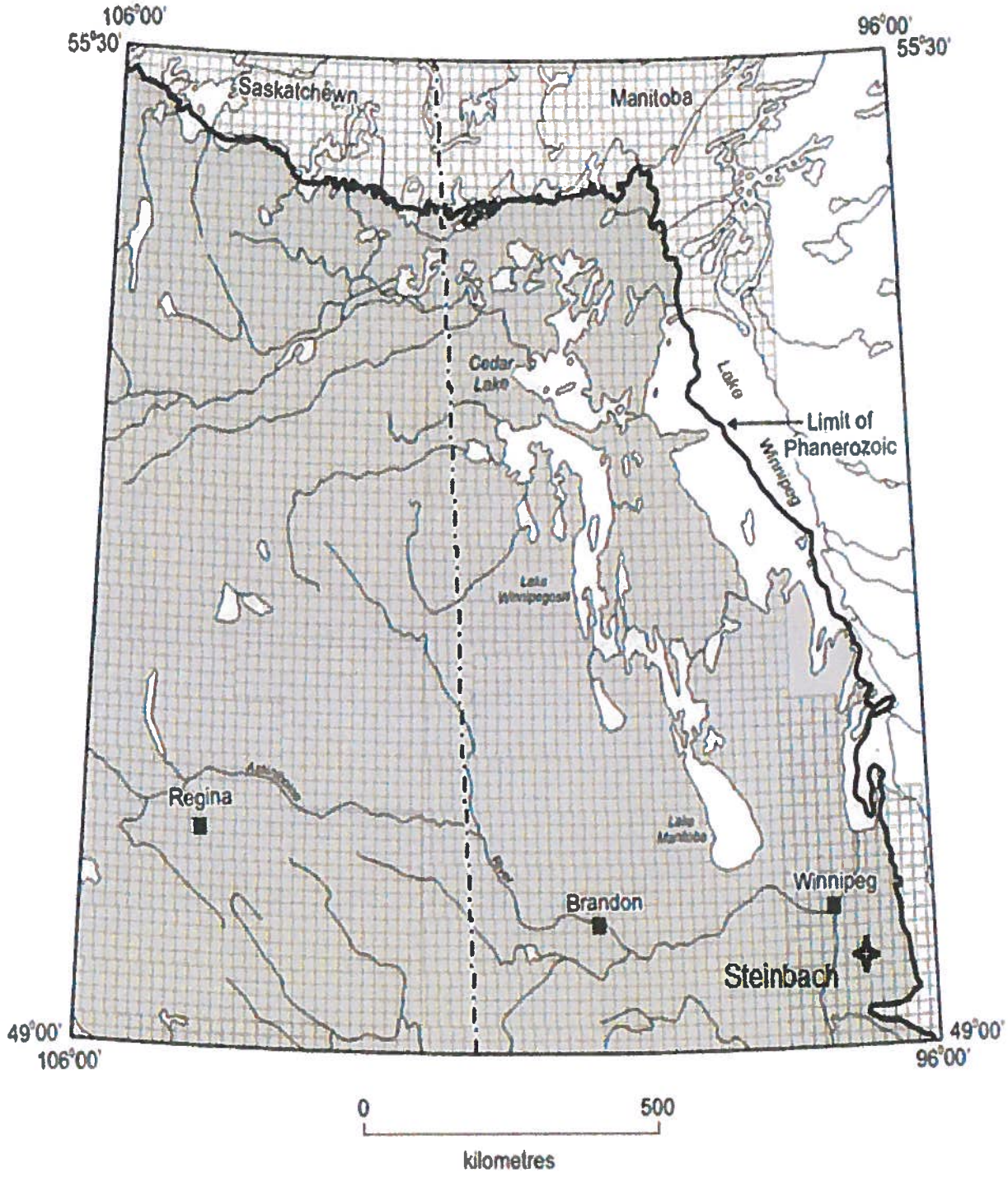


Figure 3. Extent of the Williston Basin in Manitoba (Nicolas, 2008).

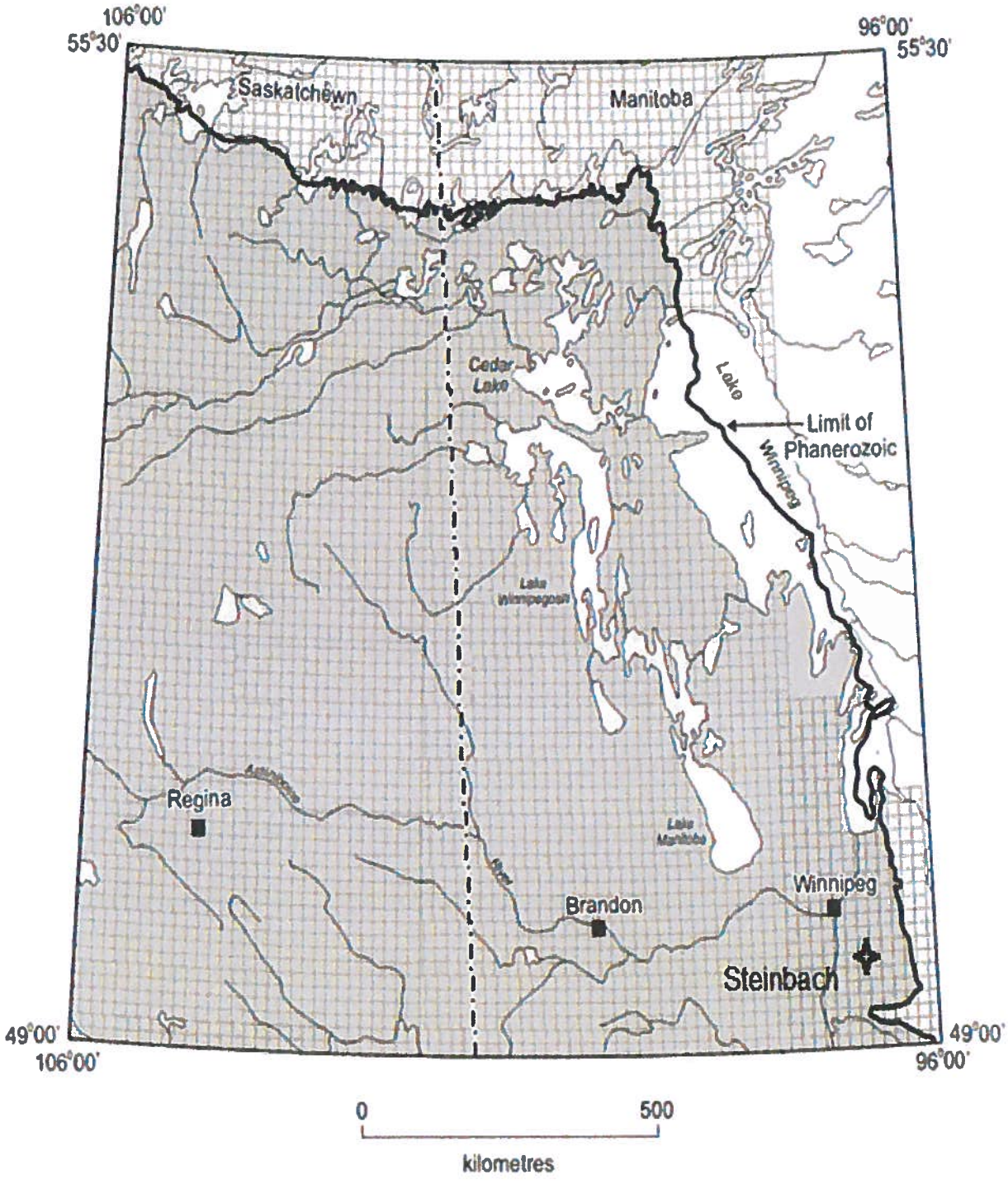


Figure 3. Extent of the Williston Basin in Manitoba (Nicolas, 2008).

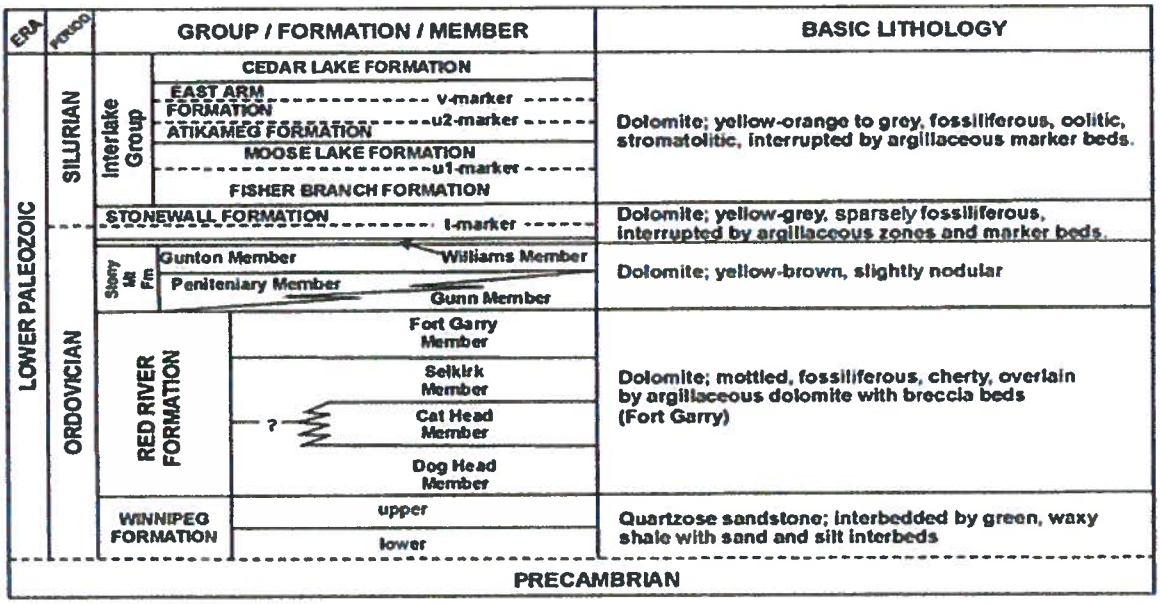


Table 1. Stratigraphy of the Western Canada Sedimentary Basin in Manitoba. The Red River Formation and Winnipeg Formation are divided into members, however each formation is treated as a hydrogeologic unit. Therefore additional information will not be presented here. (Bezys and Bamburak, 2004).

The lowermost formation is the Ordovician Winnipeg Formation, which occurs at a depth of 230 to 243 ft. (70 to 74 m) below grade (Bell, 2009) and a thickness of ~197 ft. (60 m) (Bezys and Conley, 1998). It comprises a complex sequence of interbedded sands and shales. The formation unconformably overlies Precambrian basement rocks and is conformably overlain by limestone and dolomite of the Ordovician Red River Formation (Bezys and Conley, 1998) at depths of 91 to 94 ft. (28 to 29 m) with a thickness of ~129 ft. (39 m) at the well site. The transition between the two formations is characterized by argillaceous interbeds of shales of varying thickness that represent the basal portion of the Red River Formation (McCabe, 1978). This shale thus becomes an effective aquitard due to its low permeability. The shale hydrologically isolates the two formations. However, some wells completed into the Winnipeg Formation have

interconnected the formations, resulting in an exchange of fluids that has degraded groundwater abundance from the Winnipeg Formation (Betcher *et al.*, 1995).

Lastly, Quaternary sediments consisting of glacial tills, proglacial lacustrine sediments, and shallow marine deposits of variable thickness were deposited unconformably over the Phanerozoic bedrock (Betcher *et al.*, 1995). On average, 16 ft. (5 m) of till was draped over the bedrock formations in southern Manitoba (Render, 1970). Specifically near the project area, offshore glaciolacustrine sediments comprising silt and clay 10 ft. (3 m) thick (Matile and Keller, 2004) are underlain by grey clay till ~108 ft. (33 m) thick (Bell, 2009). At the terminus of Wisconsinan glaciation, numerous glaciofluvial complexes were established proximal to the boundary between the Canadian Shield and the Williston Basin. This includes the Sandilands Interlobe Moraine (Fig. 4), which serves as a major groundwater recharge area (Cherry, 2000).

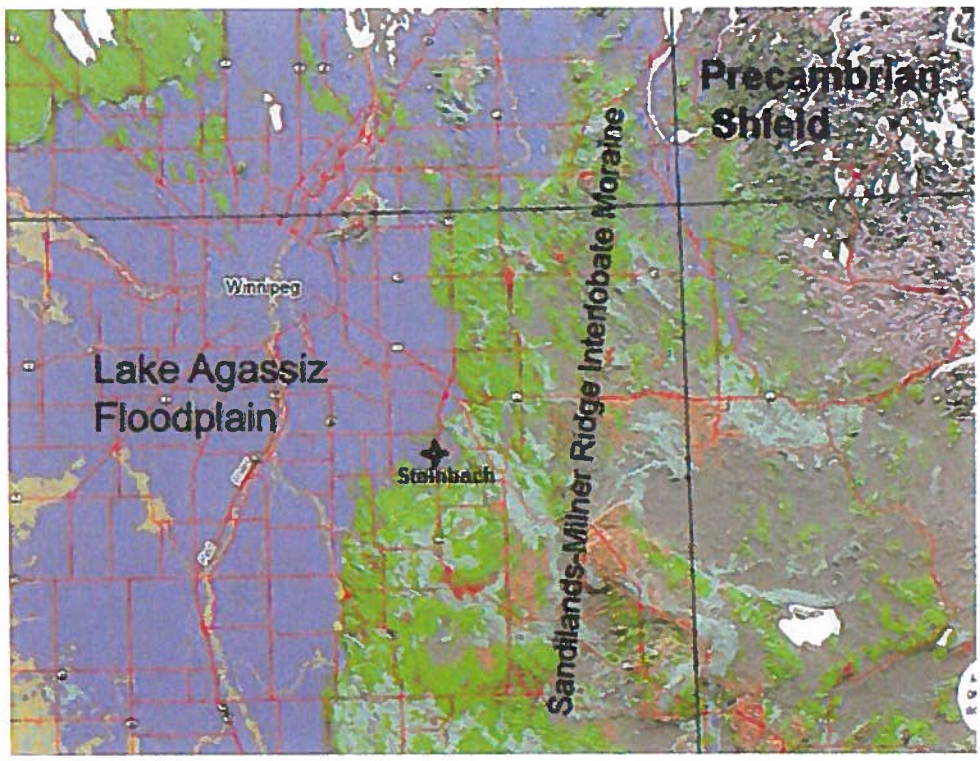


Figure 4. Sandilands Interlobe Moraine relative to the City of Steinbach (Modified from Bamburak, 2010).

Regional Hydrogeology

The Red River and Winnipeg Formations dip gently toward the southwest at 2 to 10 m/km, increasing toward the southwest (Fig. 5; McCabe, 1971). The Winnipeg

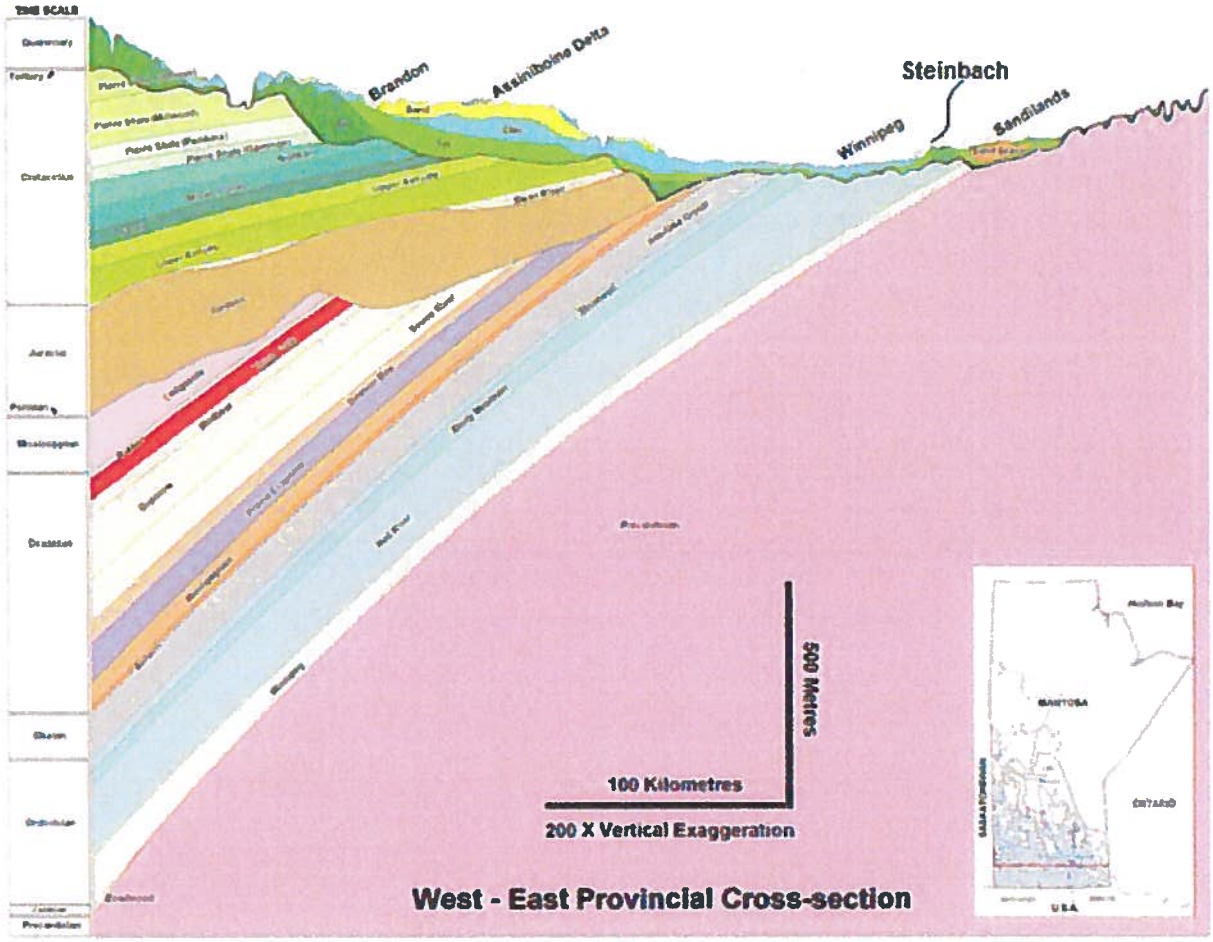


Figure 5. Cross section of westerly dipping formations of the Paleozoic across south Manitoba (Modified from Manitoba Resources Division, 2010).

Formation, in the middle to upper part of the basal clastic hydrostratigraphic unit contains an aquifer with transmissivities from 3.6×10^{-2} to 5.2×10^{-5} m^2/s. Hydraulic conductivities range from 1.1×10^{-3} m/s to 3.2×10^{-6} (Betcher *et al.*, 1995). An interface, 70 km west of the subcrop belt, between saline and freshwater exists in the unit, and is marked by an increase in sodium and chloride levels. The saline and brackish

groundwater flows updip from the Williston Basin while recharge to the aquifer occurs from outcrop areas such as the Sandilands Interlobe Moraine (Fig. 6a; Betcher *et al.*, 1995).

The carbonate-evaporite hydrogeologic unit of the Red River Formation is the largest aquifer system to provide potable water (Betcher *et al.*, 1995). Transmissivities in the Winnipeg area range from 100 m^2/d to over 2500 m^2/d (Baracos *et al.*, 1983). Figure 6b shows the direction of groundwater flow within the aquifer.

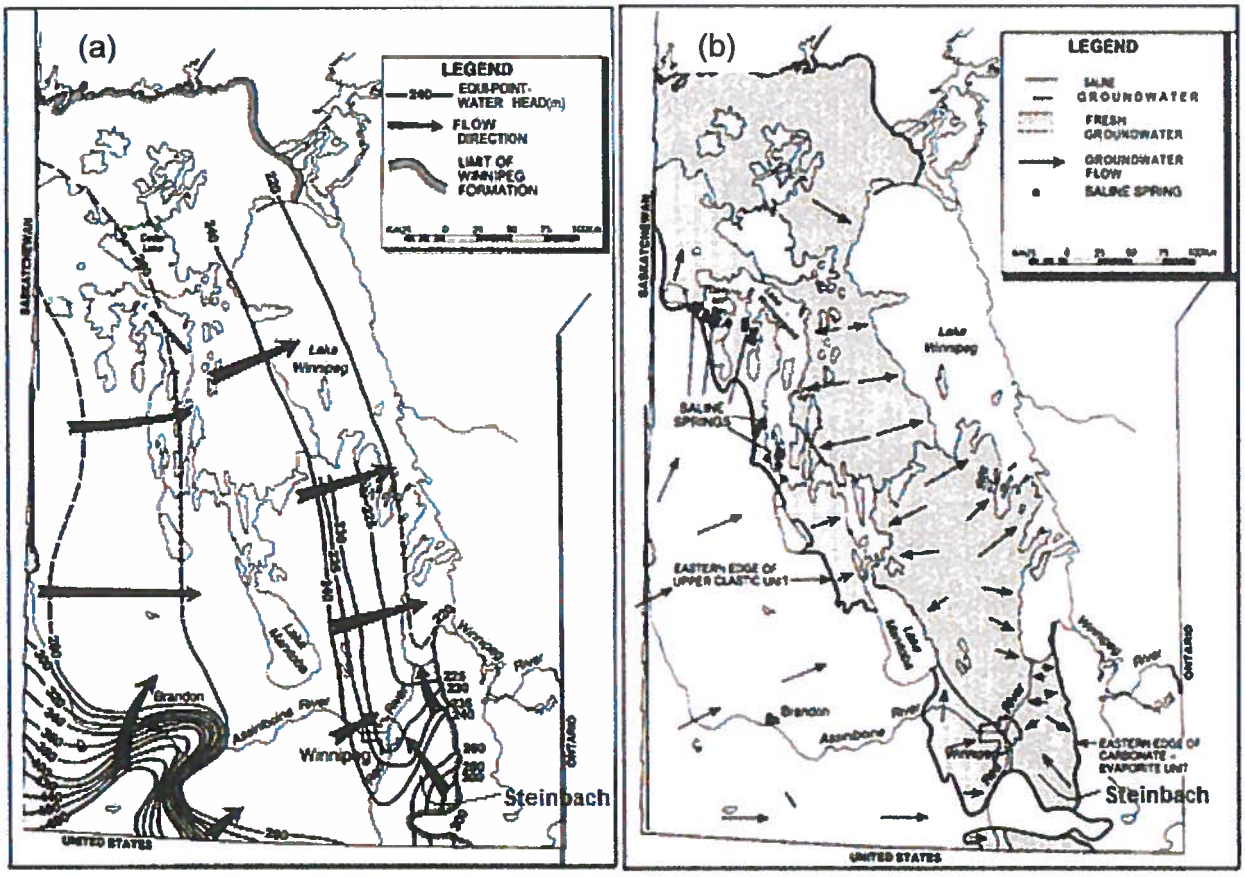


Figure 6. Regional groundwater flow within (a) Winnipeg Formation and (b) Red River Formation (Modified from Betcher *et al.*, 1995).

Lithification of limestones and dolomites by compaction and cementation has reduced intergranular porosity to 5-7% (Bannatyne, 1988). Joints, fractures and bedding planes serve as conduits for groundwater movement. In the upper part of the formation, fractures are abundant. The upper few feet to 33 ft. (10 m) depth are significantly fractured and permeable. Fracture abundance decreases with depth in the formation. Fracture width is generally small, on the order of 1 to 2 feet (0.3 to 0.6 m). This fracturing can be attributed to glacial stresses or enhancement of joint networks (Betcher *et al.*, 1995). Chen *et al.* (2004) indicated that dissolution processes can also enhance the permeability of certain fractures. A transition from saline to fresh water coincides approximately along the Red River in a north-south direction and is apparently at equilibrium (Betcher *et al.*, 1995). Saline waters from the west result from updip flow in the Williston Basin (Grasby and Betcher, 2002). Principle recharge occurs from the Sandilands moraine with minor recharge occurring from the overlying glacial sediments from the north and east of Winnipeg. The City of Steinbach currently draws its water from the lower portion of the carbonate aquifer in the Red River Formation. Wells at one time extended into the Winnipeg Formation aquifer, but were sealed after sand pumping caused mechanical problems (Bell, 2009). Water quality is generally good, with treatment only to remove iron and calcium carbonate (City of Steinbach Waterworks Department, 2012).

Methodology

Two wells were drilled at the project site: well #1 in the northwest, and well #2 in the southeast on November 7th, 2013 and November 13th, 2013 respectively (Friesen Drillers Ltd., 2013a, 2013b; Fig. 2).

In these holes, two repeating cycles of clay and till are overlie the limestone of the Red River Formation, which occurs at a depth of approximately 91 ft. (28 m) (Fig. 7, 8).

Driller's Report

Well Location	QTR	SEC	TWP	RGE	E		W		GPS Reading				
	R. Lot	Parish							Lat. N° 49.54501				
	Remarks								Long W° 096.70939				
Well Owner	Name	Steinbach Town Well							Location Sketch of Well				
	Address						Phone						
							Cell Phone						
Well Identification	Well No. 1/ North Well												
Well Use	Production	X	Test Well		Recharge		Observation						
Water Use	Domestic		Livestock		Industrial		Irrigation						
	Air-condition		Other	X	Specify		Municipal						
Date well completed	November 7, 2013												

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	16 ft.	Clay	
16	43 ft.	Till	
43	86 ft.	Blue Clay	
86	91 ft.	Brown Till	
91	222 ft.	Limestone	

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	92 ft.	x						12"	12 3/4 "	Weld	Black Steel	
96	162 ft.		x					12"				
162	222 ft.		x					11"				
0	35 ft.					x				Cement		

Top of Casing 2 Feet above X Below

REMARKS:
Far northwest corner of property.
Well #1
Water table down 3' below ground when drilling Well #2

PUMPING TEST		CONTRACTOR	
Date of Test:		License Number	607 13
Pumping	Flowing X Rate I.G.P.M.		
Water level before pumping	7 ft. Above X Below	Name	Friesen Drillers Ltd.
Pumping level at end of test	Above Below	Address	307 PTH 12 N Steinbach, MB. R5G 1T8
Duration of test	HRS Minutes	Drill Operator	Peter Friesen
Recommended pumping rate	I.G.P.M.		
With pump intake at	Feet below ground level		

Figure 7. Well #1 driller's report (Friesen Drillers Ltd., 2013a).

Driller's Report

Well Location	QTR SEC TWP RGE E W R. Lot Parish Remarks	GPS Reading Lat. N° 49.5438 Long W° 096.70776
Well Owner	Name Steinbach Town Well Address Phone Cell Phone	Location Sketch of Well
Well Identification	Well No. 2/ South Well	
Well Use	Production X Test Well Recharge Observation	
Water Use	Domestic Livestock Industrial Irrigation Air-condition Other X Specify Municipal	
Date well completed	November 12, 2013	

Depth Below Ground in Feet		DESCRIPTION WELL LOG	Water Record
0	22 ft.	Clay	
22	43 ft.	Till	
43	87 ft.	Blue Clay	
87	94 ft.	Brown Till	
94	223 ft.	Limestone	

DRAFT CONFIDENTIAL

WELL CONSTRUCTION

Depth Below Ground Level		Casing	Open Hole	Perforations	Gravel Pack	Casing Grout	Inside Diameter	Outside Diameter	Screen Slot size	TYPE	MATERIAL	MAKE
0	92 ft.	x						12"	12 3/4 "	Weld	Black Steel	
96	223 ft.		x					11"				
0	30 ft.					X				Cement		

Top of Casing 2 Feet above X Below

REMARKS: Fractures at 170, 180, 210, 218 ft.
Far southeast corner of property.
Well #2

PUMPING TEST

Date of Test:
Pumping Flowing X Rate I.G.P.M.
Water level before pumping 7 ft. Above X Below
Pumping level at end of test Above Below
Duration of test HRS Minutes
Recommended pumping rate I.G.P.M.
With pump intake at Feet below ground level

CONTRACTOR

License Number 607 13
Name Friesen Drillers Ltd.
Address 307 PTH 12 N
Steinbach, MB. R5G 1T8
Drill Operator Peter Friesen

Figure 8. Well #2 drillers report (Friesen Drillers Ltd., 2013b).

The limestone is fractured at depths of 170, 180, 210 and 218 ft. (52, 55, 64 and 66 m), which is a key characteristic of the limestone aquifer in the region.

The sediment sludge was recovered from well #2 at a depth of ~176 ft. (54 m), which places the sample within the Red River Formation carbonate unit (Fig. 9). It was collected from water flowing though the fractures at that depth. The well was drilled to a depth of 223 ft. (68 m) to determine proximity to the Winnipeg Formation, which is thought to be present at a depth of 230 to 243 ft. (70 to 74 m) (Bell, pers. comm., 2013).

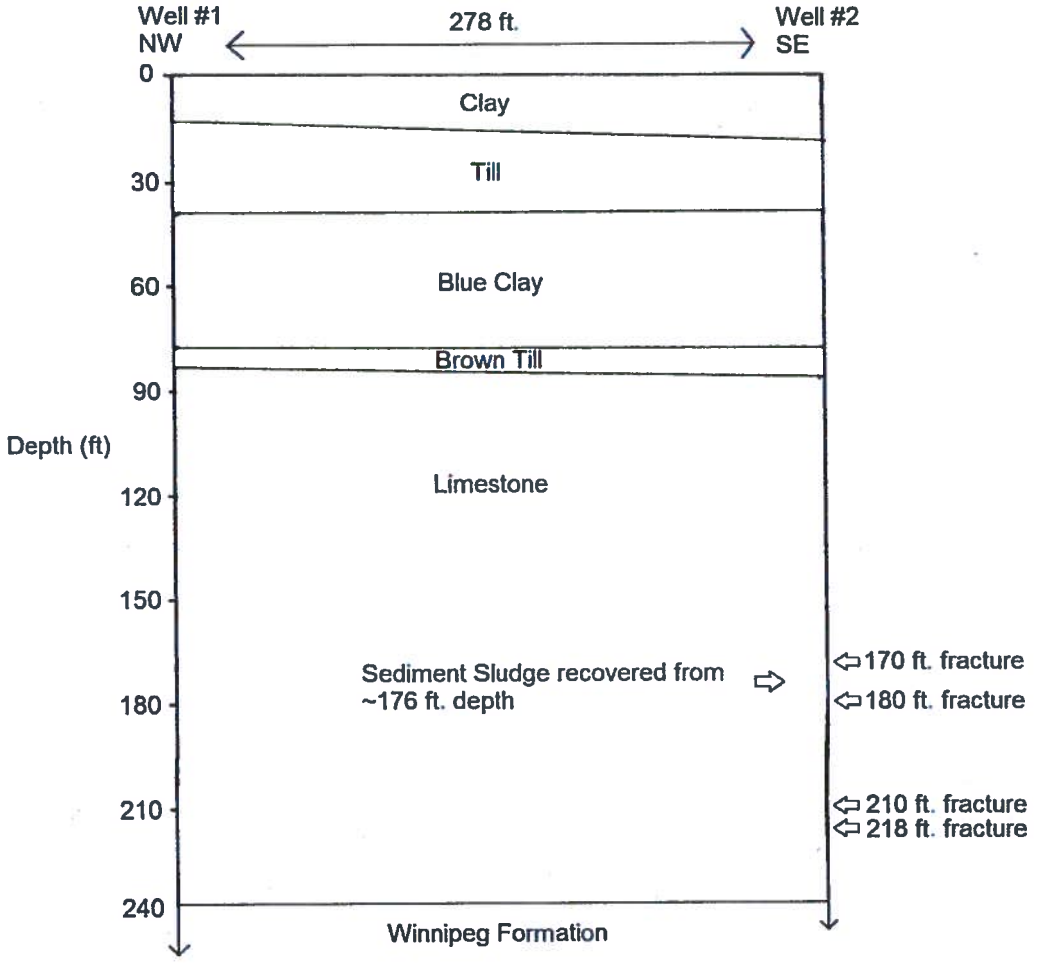


Figure 9. Cross section between well #1 and well #2.

Geophysical logging was completed for the two boreholes on December 20, 2013 by Robertson Geologging Technology and returned caliper, electric and natural gamma logs (Fig. 10, 11, 12, 13 and 14).

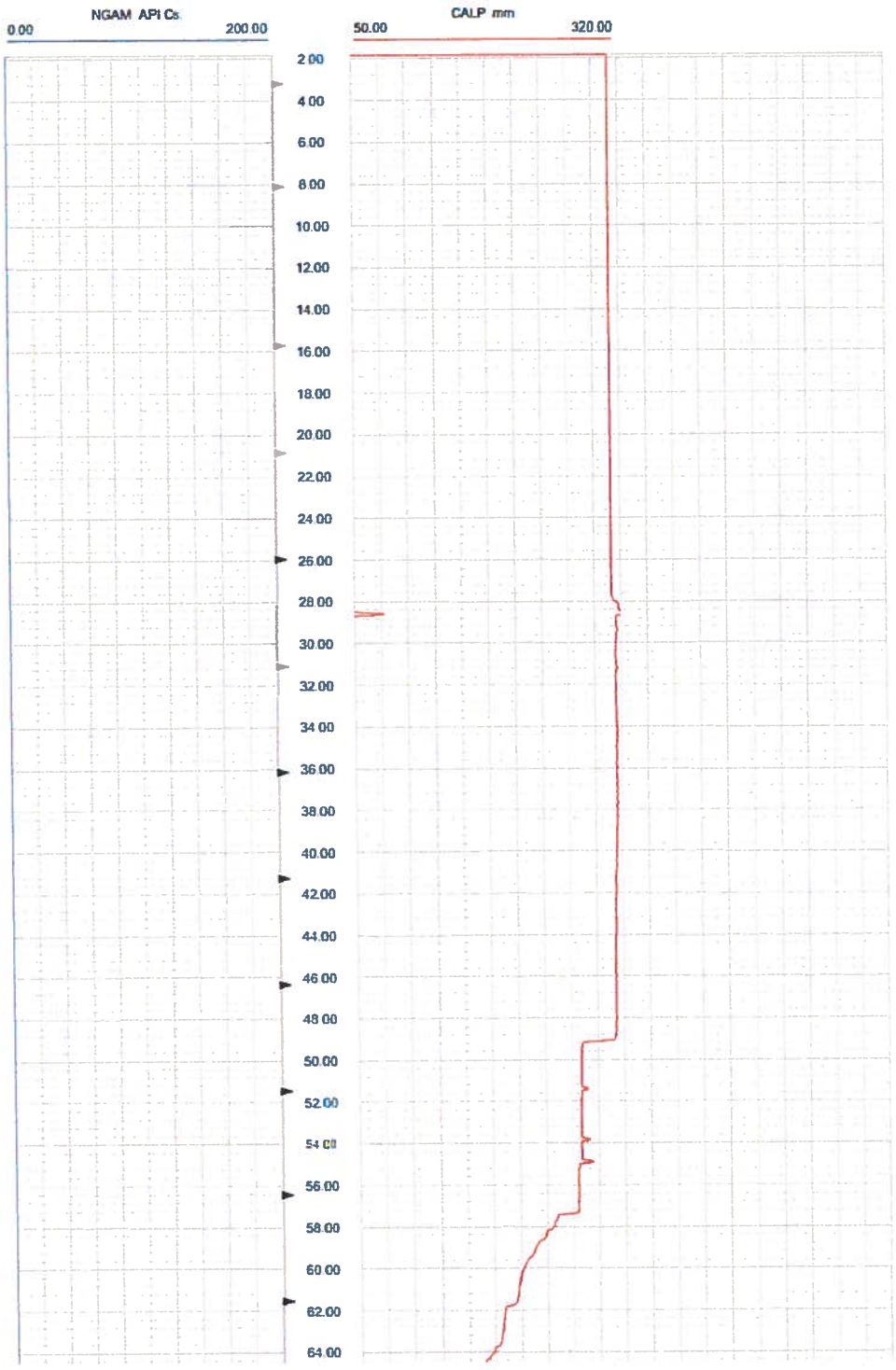


Figure 10. Well #1 caliper log (Robertson Geologging Technology, 2013a).

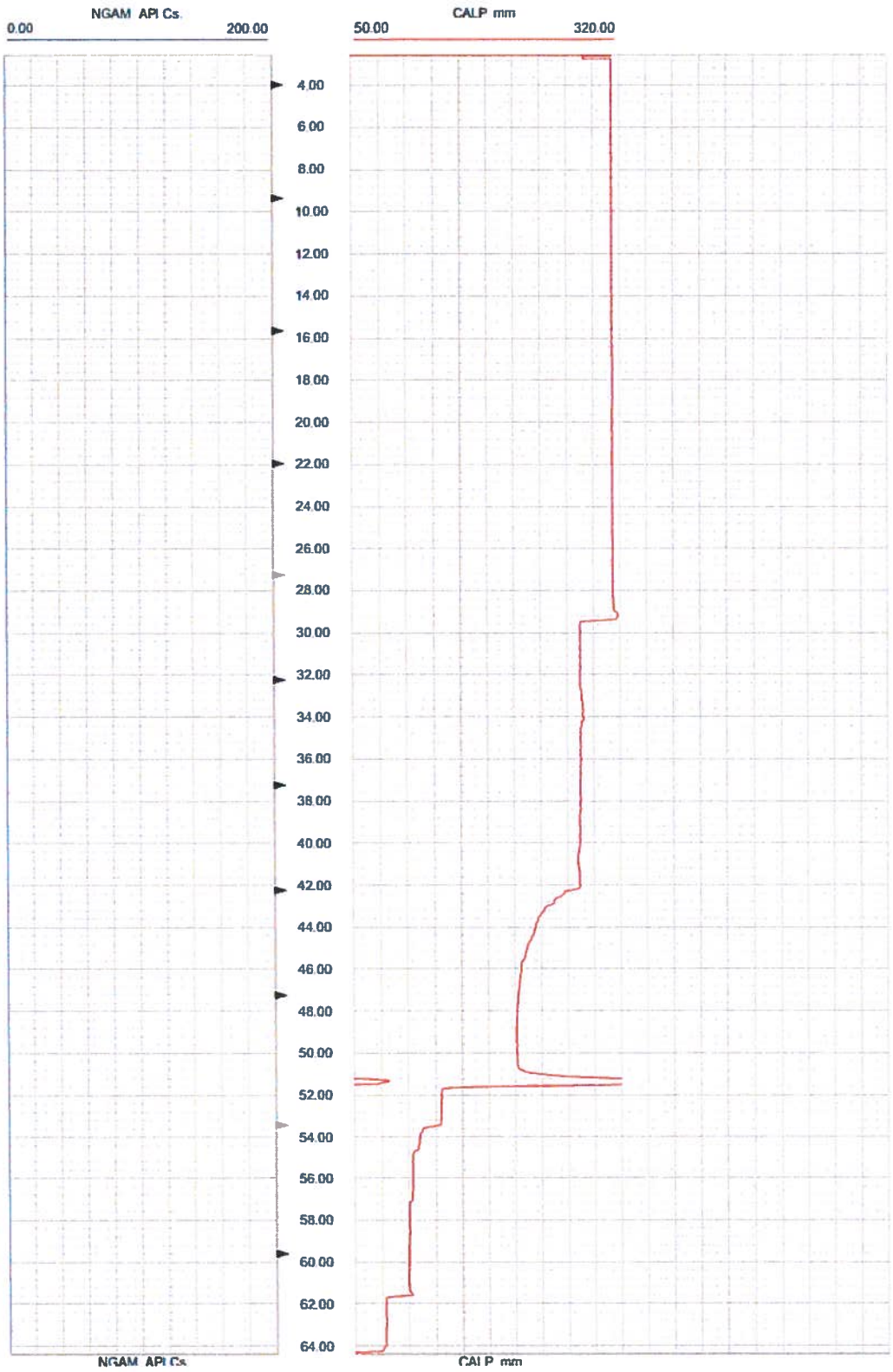


Figure 11. Well #2 caliper log (Robertson Geologging Technology, 2013b).

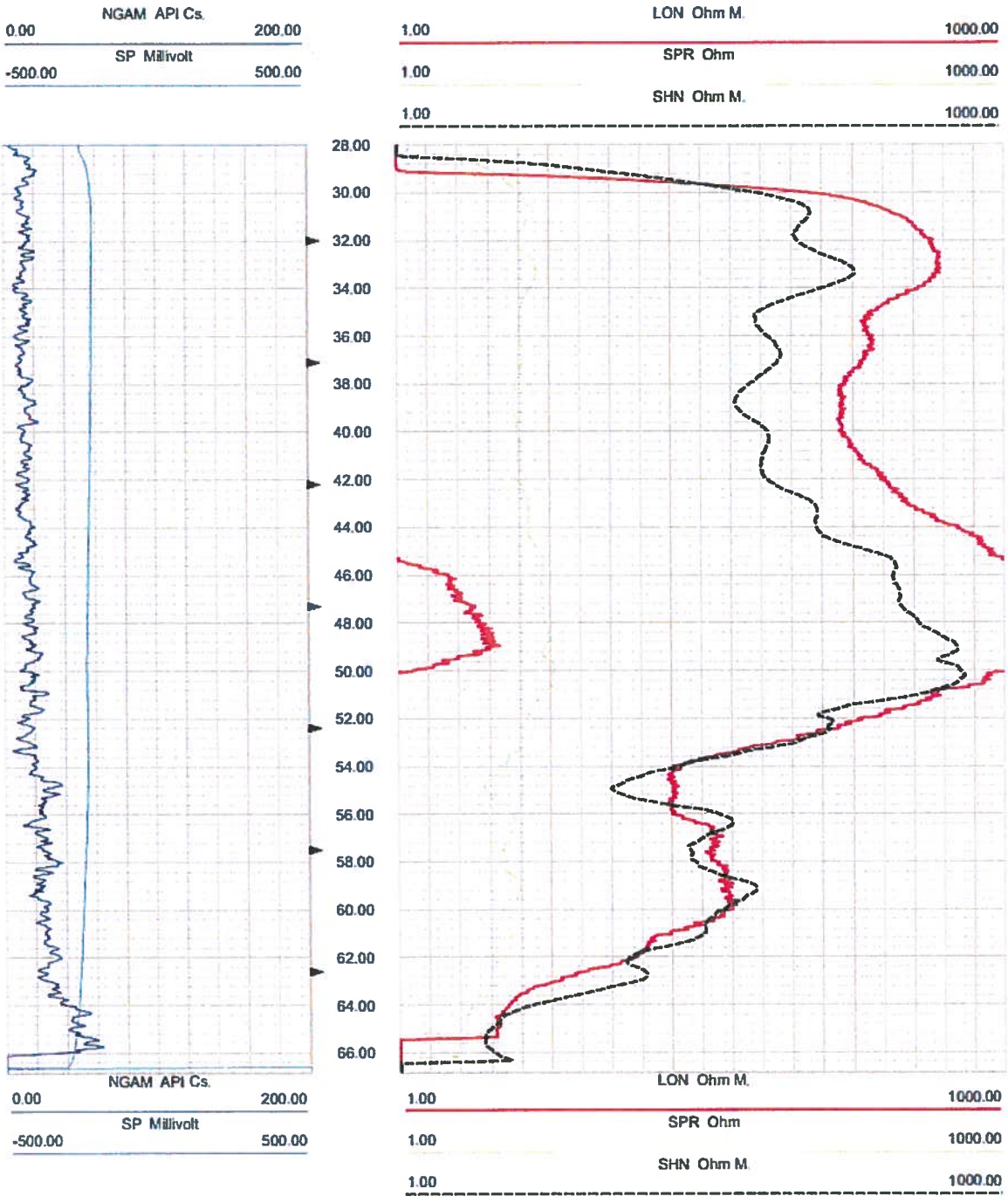


Figure 12. Well #1 electric log (Robertson Geologging Technology, 2013c).

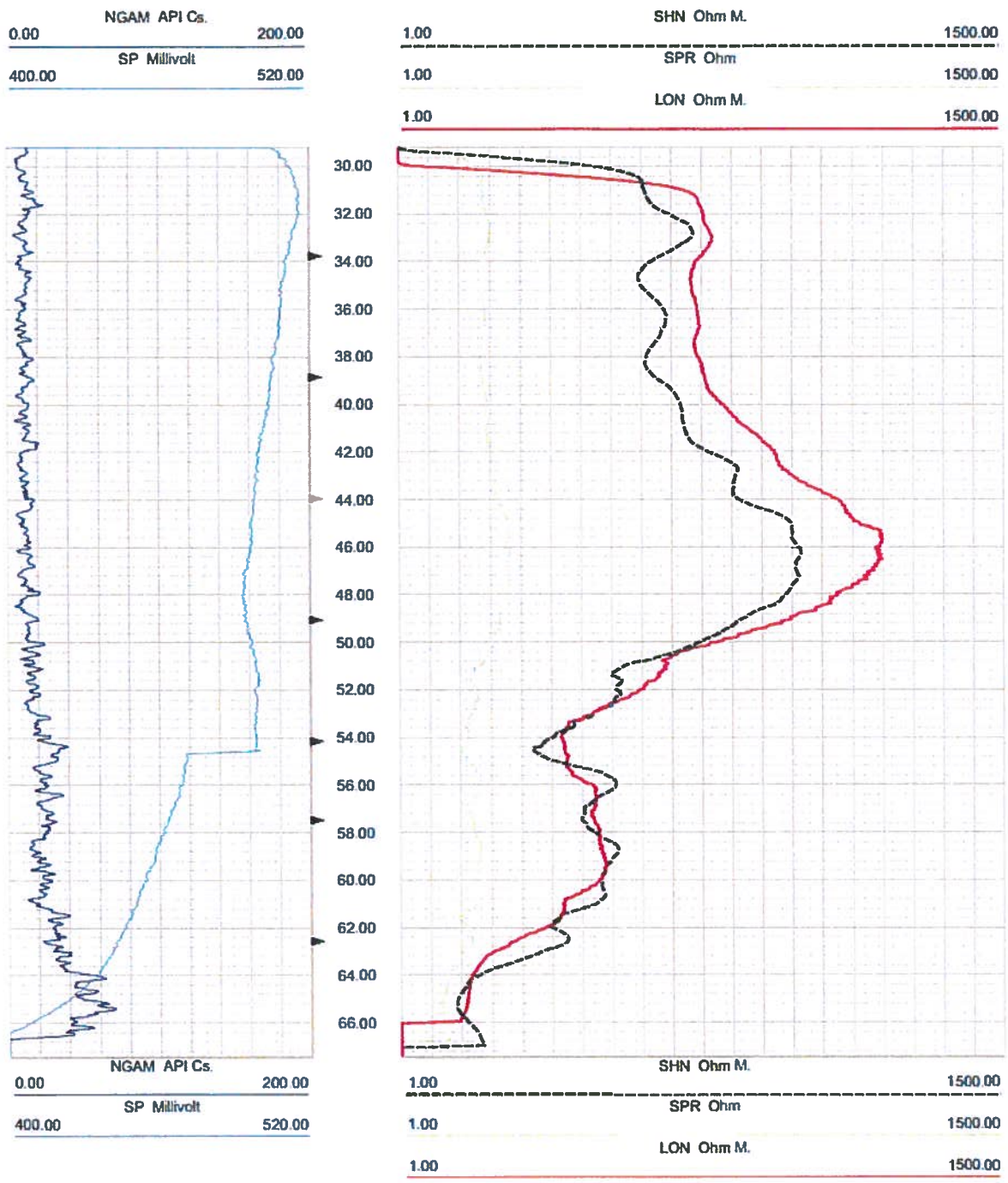


Figure 13. Well #2 electric log (Robertson Geologging Technology, 2013d).

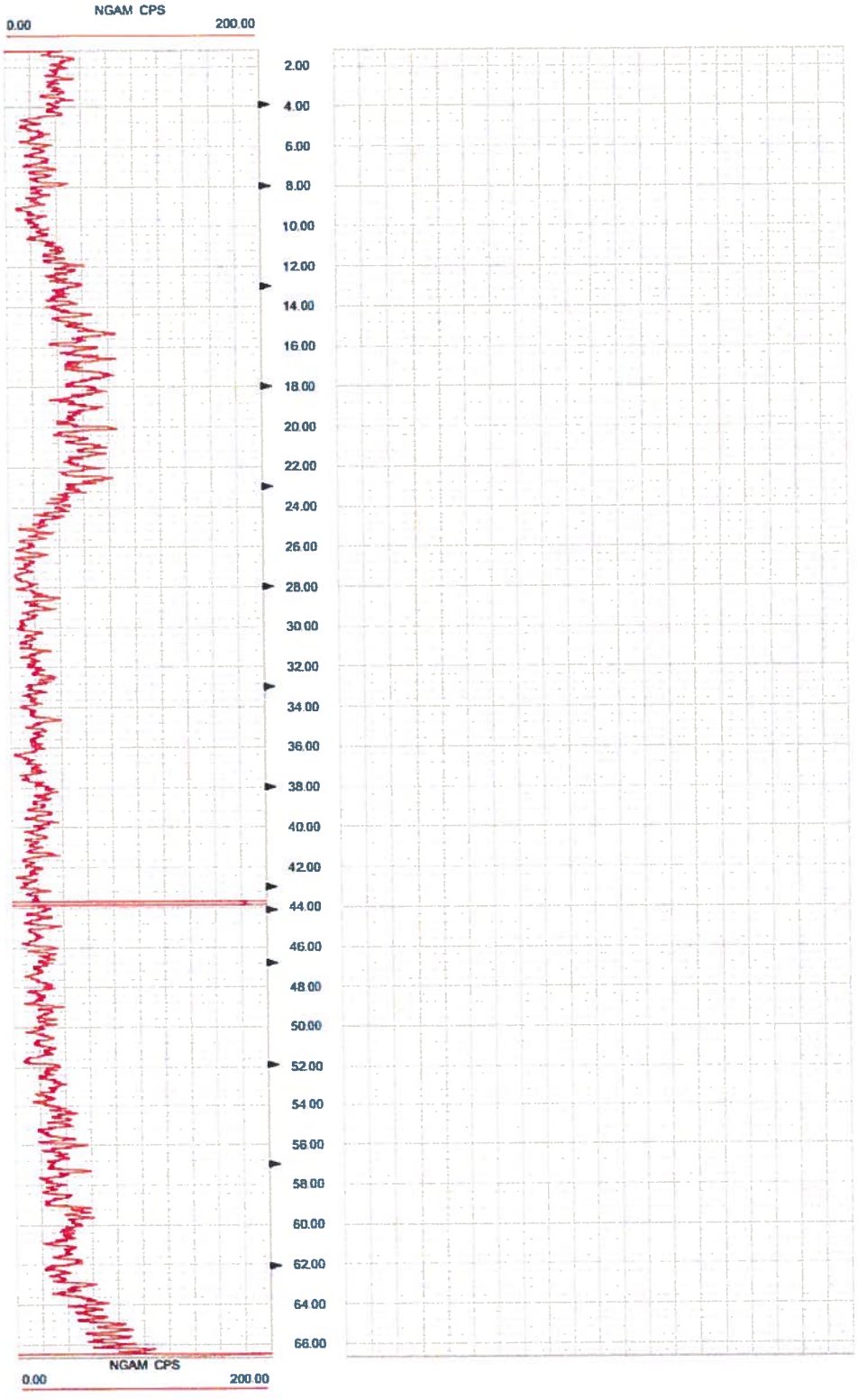


Figure 14. Well #1 natural gamma log (Robertson Geologging Technology, 2013e).

Four samples, three of which represent what is typically found underlying Steinbach, were submitted for analysis. This included unconsolidated sand from the Winnipeg Formation and two shales, which were analyzed by petrographic microscopy and X-ray diffraction (XRD). These pieces were sampled to provide a comparative analysis to the sludge. The fourth sample was the sediment sludge, which was examined through hand sample, smear slide and oil immersion analysis. Standard techniques were employed to accomplish this. Further analysis was completed by XRD and Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM w/ EDS) at the Geological Sciences building at the University of Manitoba.

X-ray diffraction relied on a Siemens (Bruker) D5000 powder diffractometer. The D5000 system uses a K710H 2.7kW sealed-tube type X-ray generator with the vertical goniometer housed in a fully-enclosed radiation cabinet. The goniometer is in Bragg-Brentano (θ to 2θ) geometry and uses CuKα radiation. The system is equipped with computer-controlled divergence and receiving slits, a rotating sample holder, diffractedbeam graphite monochromator and a scintillation detector. Sample preparation involved forming a powder using a mortar and pestle for each specimen and transferring it to a glass slide forming a thin layer. Data were collected using Bruker's DIFFRACplus software and processed with MDI Jade+ software. Step scan data for all samples were collected from 3 to 70° 2θ, step width of 0.02° 2θ, a dwell time of 1s/step, and divergence and anti-scatter slits of 1°.

Scanning electron microscopy with energy dispersive X-ray spectroscopy was completed using a smear sample slide mounted in the machine. Copper strips were

affixed to the slide, in order to prevent specimen charging which can lead to image distortion. The SEM machine used was a JEOL model JSM-5900LV. Important components to this machine are the electron gun, condenser lens, scanning coil, objective lens, sample stage, secondary electron detector and back-scattered electron detector. Upon completion of scanning using JSM 5000 software, the images were then analysed with the INCA EDS software. The specific settings required to reproduce the obtained results are a vacuum mode, 20kV accelerating velocity, 30 s acquisition times, <30% dead time and a line scan dwell time of 2000 µm.

Results

The unconsolidated brown sludge was acquired as a sediment sample, wet from water in the borehole. It comprises sediments ranging in size from very fine to very coarse sand. It displays moderate to poor sorting, and the clasts are predominantly subangular. Application of dilute HCl caused a vigorous reaction suggesting significant carbonate content. The sludge appears to be covered in a mixture consisting of the very fine particulate matrix and water, which in combination limits further hand sample analysis. Potential solution to this problem was twofold. Analysis by smear sample and oil immersion was attempted. Both methods indicated the presence of quartz and calcite, grain size of which is approximately 0.004 to 0.03 mm. Grains are subangular to subrounded and moderately sorted.

X-ray diffraction analysis determined that calcite, quartz and microcline are present in the sediment sludge (Appendix I). Scanning electron microscopy imaging of a dried brown sample of sludge was attempted; however, due to the film coating the

sludge, the results were inconclusive (Fig. 15). A second run using SEM was attempted to collect bulk composition using a thin smear of the sludge. The bulk composition

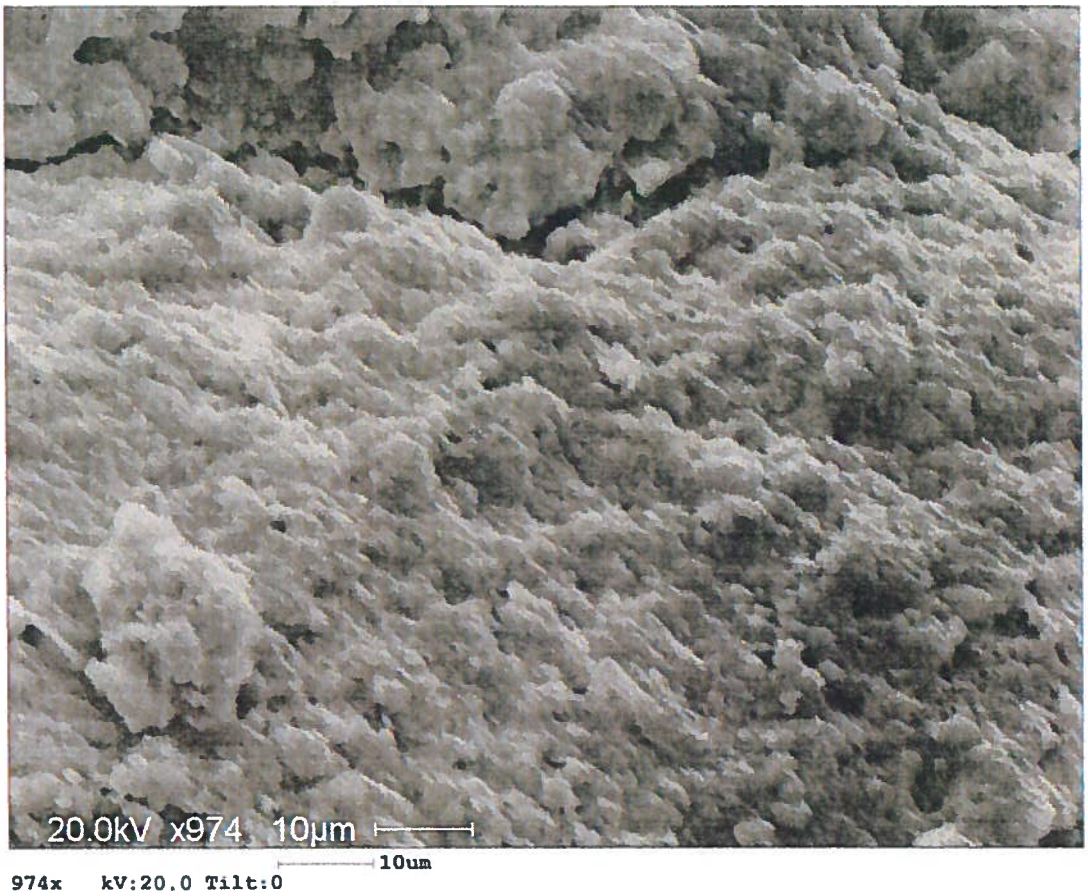


Figure 15. SEM image of a dried sample of sediment sludge. Fine particulate residue mantles minerals and other clasts.

(Appendix II) suggest the clasts and matrix consist of quartz, calcite, microcline and dolomite. Rutile and pyrite are also present (Fig. 16a, b). Rare earth elements are evident in the sample, which could be attributed to minor concentrations of monazite or bastnäsite. Although not in the XRD data, there may be trace amounts of clay minerals such as kaolinite or illite within the sediment sludge, explaining its colour.

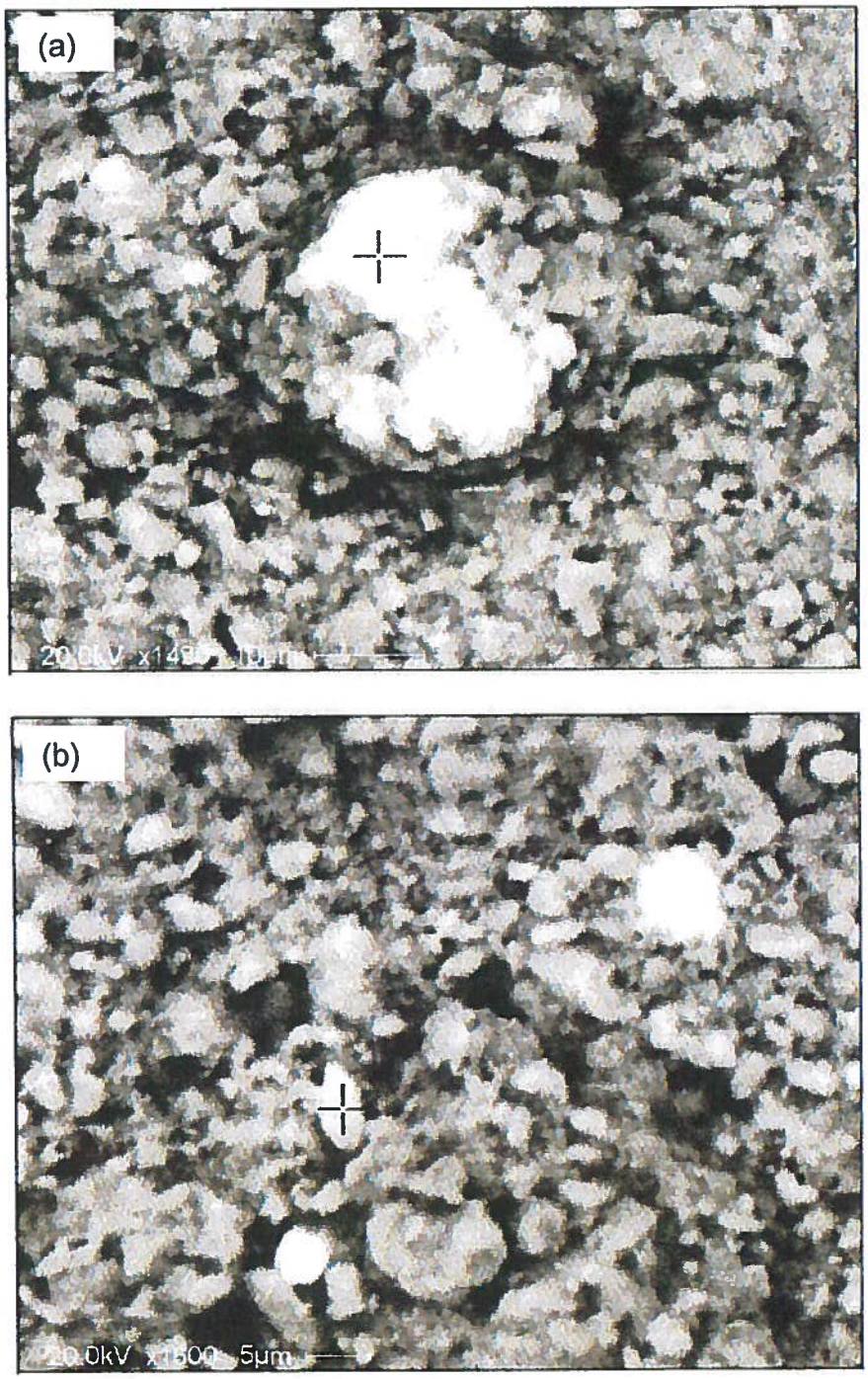


Figure 16. Scanning electron microscopy imaging of a thin smear of sediment sludge. (a) Pyrite is shown at the crosshairs, surrounded by aggregate material with a darker mantle or residue coating. Bulk analysis indicated high Fe and S oxides. Note the angular shapes of the smaller grains, signifying low transport conditions. (b) Rutile at the crosshair, displays typical elongate form and has high amounts of Ti. Bulk analysis also returned high concentrations of Fe-Al silicates, potentially explained by pyroxene or almandine in the matrix.

The sand is an unconsolidated white sample that comprises subangular to subrounded, medium sand-size quartz. X-ray diffraction confirmed composition to be 100% quartz (Appendix I).

The two shales, green and purple in colour respectively, are from the interbeds separating the Red River Formation from the Winnipeg Formation. Both are massive, and comprises fine grained clay sized glauconite and kaolinite with minor quartz and sanidine (Appendix I). Quartz grains in the green shale are medium sand to fine sand sized, subangular to subrounded, and are poorly sorted. The purple shale contains quartz grains that are very fine sand sized, subangular to subrounded and are moderately sorted. Colour was the significant differentiating factor between the two shales.

The caliper log (Fig. 10, 11) indicates a decrease in borehole size with depth, notably at ~160 and 187 to 210 ft. (49 and 57 to 64 m) for well #1. Well #2 yields a decrease in borehole size at depths of ~95, 138 and 170 ft. (29, 42 and 52 m). Spontaneous potential (SP) from the electric log reads low SP for well #1 while having high SP for well #2 from ~98 to 177 ft. (30 to 54 m) then sharply decreasing from 177 to 217 ft. (54 to 66 m). The electric logs indicate increasing resistivity for well #1 between 92 and 164 ft. (28 and 50 m). Resistivity stabilizes at its higher values until a depth of 197 ft. (60 m), then decreases substantially to depth. Well #2 shows a similar trend, except it increases between 98 and 157 ft. (30 and 48 m). Resistivity values then decreases at depth of 177 ft. (54 m), stabilize down to 197 ft. (60 m), then decrease again towards the bottom of the well. The natural gamma log (Fig. 14) shows generally

low gamma readings, with a few minor fluctuations in the upper part of the carbonate unit.

Discussion

The results indicate wide-ranging potential origins of the sediment sludge. The variable mineralogical composition of the sediment sludge likely represents influence from the Red River Formation carbonate and the overlying cycles of till and clay. The mineralogical constituents included quartz, calcite, microcline, dolomite, rutile, pyrite, monazite, bastnäsite, and potentially kaolinite and illite.

In analyzing the geophysical logs, the narrowing of a borehole below ~190 ft. (58 m) would suggest mudcake buildup, however since the well was drilled with water not mud, this doesn't work. It could also have been caused by mud caving in from above. Yet the well was cased to ~98 ft. (30 m), which would have prevented any caving in. The spontaneous potential is interpreted that deflections on the log towards positive values indicate low permeability while negative deflections indicate high permeability. This is based on the assumption that the resistivity of the drilling fluid is greater than the resistivity of the formation water. The logs then show that the upper part of the carbonate unit at a depth of 95 to 177 ft. (29 to 54 m) is tight (low porosity) as indicated by high SP. The lower part of the carbonate unit at a depth below 177 ft. (54 m), yields increasing porosity (increasing SP). The aforementioned sequence of low porosity/low permeability in the upper part of the carbonate unit is also indicated by the electric logs. Furthermore, the electric logs show a different response in the lower carbonate unit, which could be due to higher porosity where the pores are filled with saline water.

The natural gamma log is useful as it reveals low shale content for the non-cased section of the well.

Since the Red River Formation in this region is predominantly dolomitic limestone (Bezys and Conley, 1998), it can be inferred that the carbonate in the sludge likely comes from the Red River Formation. However it is interesting that specifically in this area, there is a lack of substantial dolomite. This feature could be explained simply by this part of the Red River Formation not being well dolomitized.

The sludge was collected from water flowing through the fractures within the carbonate aquifer at depth. This raises questions regarding the lateral extent of the fractures within the aquifer as this pertains to possible transportation of the sludge from a source area within the aquifer. The aquifer in the region is recharged mainly through infiltration of water in the Sandilands area (Cherry, 2000). If the fractures in the aquifer were to extend far laterally through an interconnected system, combined with high transmissivities of the groundwater, these features could be used to interpret a distal source for the sludge. The sludge contained quartz and feldspars, which are not consistent with the Red River Formation. They do occur in the Winnipeg Formation, where vertical or lateral water movement from recharge areas may have provided these minerals. However, if significant transport were to have occurred, augmented roundness alteration of individual grains would be expected. Since the grains were subangular to subrounded, it is unlikely that lengthy transport took place.

Drilling of well #2 may have encountered a discrete pod or a lens of the sediment sludge that is laterally discontinuous, as this sludge has not been found in other wells in

the area (Bell, pers. comm., 2013). Joints and fractures, along with dissolution features such as karsting created by glacial processes could have created flow paths in the limestone, potentially explaining the high carbonate content in the sludge. A constraining mechanism would be required, due to the isolated occurrence of the sludge. Also, the angular nature of the calcite supports minimal transport of the clasts. Further, the sludge is poorly sorted which is a principal criterion in the identification of glacial tills and would explain the high silica content and associated minor mineral constituents. It is possible then that glacial till infiltrated into the limestone through the fractures and joints during melting of the overlying ice sheets. In order to investigate this as a possibility, geochemical analysis of the tills in the region could be conducted and the results compared to the sediment sludge. Similar results would strengthen this interpretation.

It is difficult to hypothesize as to the origin of the sediment sludge with a single sample from only one well. Without further examination, inclusive of drilling and geochemical work such as XRD and SEM, determination of the source of the sludge may not be possible. The extent of the sludge is important as it may impact water quality in the region if it extensive and not isolated. The City of Steinbach is growing at above-average rates and multiple industries utilize the aquifer for processing (Bell, 2009). Furthermore, the aquifer is also tapped by other municipalities for their drinking water needs (Bell, pers. comm., 2013). In order to ensure all these people and businesses are not affected, the exact nature and extent of the sludge should be determined.

Conclusion

The conclusions of this report are:

1. The sediment sludge consists of quartz, calcite, microcline, trace minerals in monazite and bastnäsite, Fe-Ti oxides, pyrite, Fe-Al silicates, kaolinite and illite.
2. Potential explanations for the sediment sludge include infiltration of sediment derived from the overlying glacial tills and clay that permeated into the carbonate aquifer through joints and fractures.
3. Vertical and lateral groundwater movement through interconnected fracture systems could have transported the sediment sludge from the Winnipeg Formation or from a source area within the Red River Formation.
4. Further examination of the area is required to determine the source of the sediment sludge.

Acknowledgments

I would like to thank Jeff Young for being my project advisor and providing excellent analytical support, Jeff Bell and Friesen Drillers Ltd. for providing the project, samples, data and site visitation, Bill Last for the geophysical log interpretations and Karen Ferreira for providing guidance and support throughout the duration of the project. I would also like to thank Neil Ball and Ravi Sidhufor their assistance with collecting data in XRD and SEM labs.

References

Bamburak, J.D. (2010): Roadside geology of Manitoba – a user's guide to the province's unique geological features unique geological features; Manitoba Mining and Minerals Convention, November 20, 2010.

Bannatyne, B.B. (1988): Dolomite resources of southern Manitoba; Manitoba Energy and Mines, Geological Services, Economic Geology Report ER85-1.

Baracos, A., Shields, D.H. and Kjartanson, B. (1983): Geological engineering report for urban development of Winnipeg; *Department of Geological Engineering*, University of Manitoba.

Bell, J.J. (2009): Environmental act proposal, proposed increase in municipal water usage, the City of Steinbach municipal well field, SE35-6-6 EPM, City of Steinbach, Manitoba; Friesen Drillers Ltd., for the City of Steinbach, unpublished report.

Betcher, R.N., Grove, G. and Pupp, C. (1995): Groundwater in Manitoba: hydrogeology, quality concerns, management; Environment Canada, National Hydrology Research Institute, NHRI Contribution No. CS-93017, URL <http://www.gov.mb.ca/waterstewardship/reports/groundwater/hg_of_manitoba.pdf> [Accessed September 20, 2013].

Bezys, R.K. and Bamburak, J.D. (2004): Lower to middle Paleozoic stratigraphy of southwestern Manitoba; Manitoba Industry, Economic Development and Mines, WCSB/TGI II Field Trip Guidebook, May 25–28, 2004, 72 pages.

Bezys, R.K. and Conley, G.G. (1998): Geology of the Ordovician Winnipeg Formation in Manitoba; Manitoba Energy and Mines, Stratigraphic Map Series, Ow-1, 1:2000000.

Chen, Z., Grasby, S.E. and Osadetz, K.G. (2004): Relation between climate variability and groundwater levels in the upper carbonate aquifer, southern Manitoba, Canada; *Journal of Hydrology*, Volume 290, issues 1-2, pages 43-62.

Cherry, A.J. (2000): A multi-tracer estimation of groundwater recharge in a glaciofluvial aquifer in southeastern Manitoba; M.Sc. Thesis, *Department of Earth Sciences*, University of Ottawa.

City of Steinbach Waterworks Department (2012): Annual report on Steinbach's drinking water quality; pages 1-7, URL <http://www.steinbach.ca/resource/File/Waterworks/2012_Annual_Drinking_Water_Final_Report_full_package.pdf> [Accessed on September 9, 2013].

Friesen Drillers Ltd. (2013a): Driller's Report, Steinbach town well, well no. 1; Unpublished drill log.

Friesen Drillers Ltd. (2013b): Driller's Report, Steinbach town well, well no. 2; Unpublished drill log.

Google Earth (2014): Site location of the City of Steinbach, Manitoba, Canada.

Grasby, S.E. and Betcher, R.N. (2002): Regional hydrogeochemistry of the carbonate rock aquifer, southern Manitoba; *Canadian Journal of Earth Sciences*, Volume 39, no 7, pages 1053-1063.

Matile, G.L.D. and Keller, G.R. (2004): Shaded relief topography of Manitoba; Manitoba Industry, Economic Development and Mines, Manitoba Geological Survey, Geoscientific map 2004-4, 1 map. Scale 1:1 000 000.

McCabe, H.R. (1971): Stratigraphy of Manitoba, an introduction and review; Geoscience studies in Manitoba, Geological Association of Canada, Special Publication no 9, pages 167-187.

McCabe, H.R. (1978): Reservoir potential of the Winnipeg and Deadwood formations, southwestern Manitoba; Manitoba Minerals Resources Division, Volume 78, no 3, 54 pages.

Manitoba Mineral Resources Division (2010): Three-dimensional (3-D) geological model of Manitoba, East-West Provincial Cross Section, URL <http://www.gov.mb.ca/iem/mrd/geo/3dmodel/cross_section_large.html> [Accessed September 30, 2013].

Natural Resources Canada (2013): The atlas of Canada – toporama, URL <http://atlas.gc.ca/site/english/toporama/index.html#> [Accessed September 9, 2013].

Nicolas, M.P.B. (2008): Summary report on petroleum and stratigraphic investigations, southwestern Manitoba; in Report of Activities 2008, Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, pages 171–179.

Render, R.W. (1970): Geohydrology of the metropolitan Winnipeg area as related to groundwater supply and construction; *Canadian Geotechnical Journal*, Volume 7, pages 243-27.

Robertson Geologging Technology (2013a): City of Steinbach well 13-1 caliper log; Unpublished data.

Robertson Geologging Technology (2013b): City of Steinbach well 13-2 caliper log; Unpublished data.

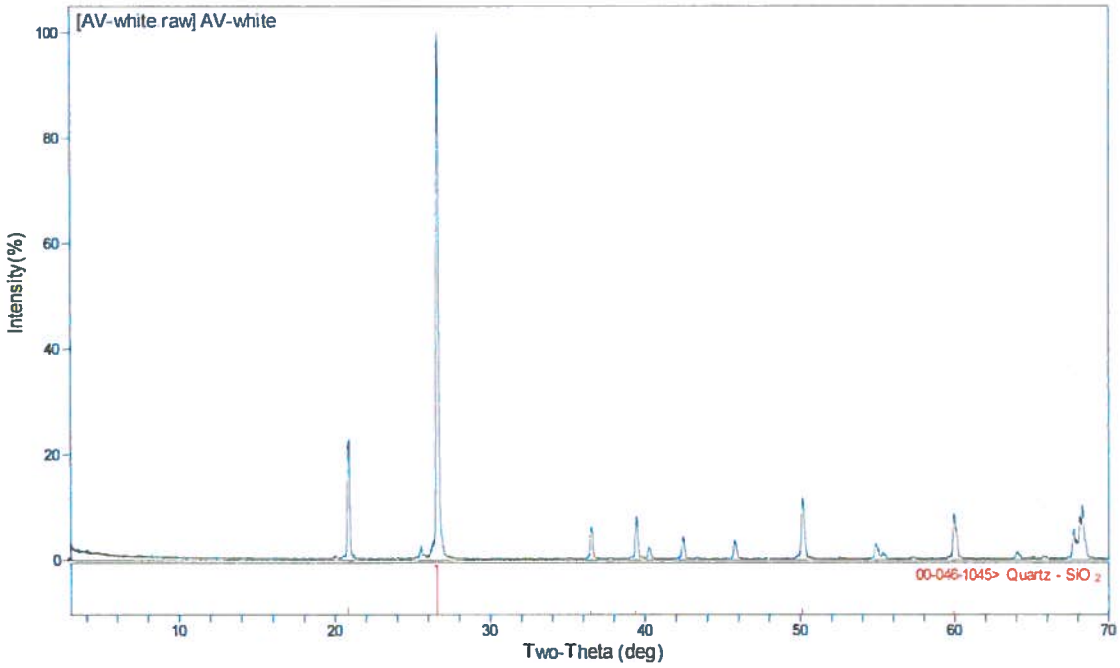
Robertson Geologging Technology (2013c): City of Steinbach well 13-1 electric log; Unpublished data.

Robertson Geologging Technology (2013d): City of Steinbach well 13-1 electric log; Unpublished data.

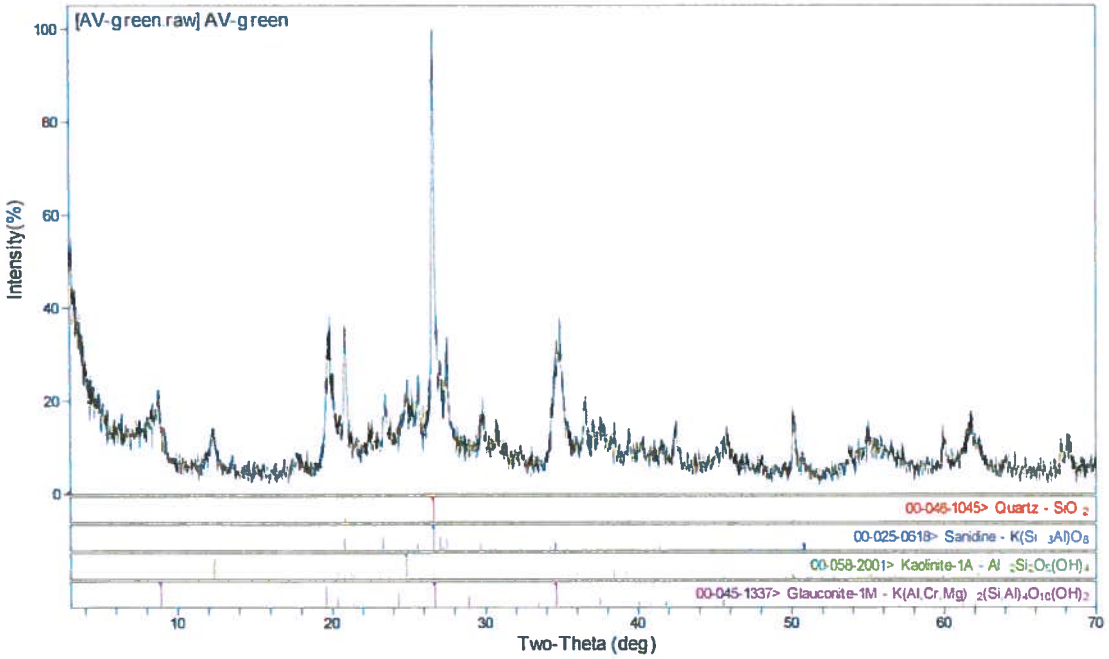
Robertson Geologging Technology (2013e): City of Steinbach well 13-1 natural gamma log; Unpublished data.

Statistics Canada (2012): Focus of geography series, 2011 Census; Statistics Canada Catalogue no. 98-310-XWE2011004, Ottawa, Ontario, Analytical products, 2011 Census, URL <https://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-cma-eng.cfm?LANG=Eng&GK=CMA&GC=605> [Accessed September 9, 2013].

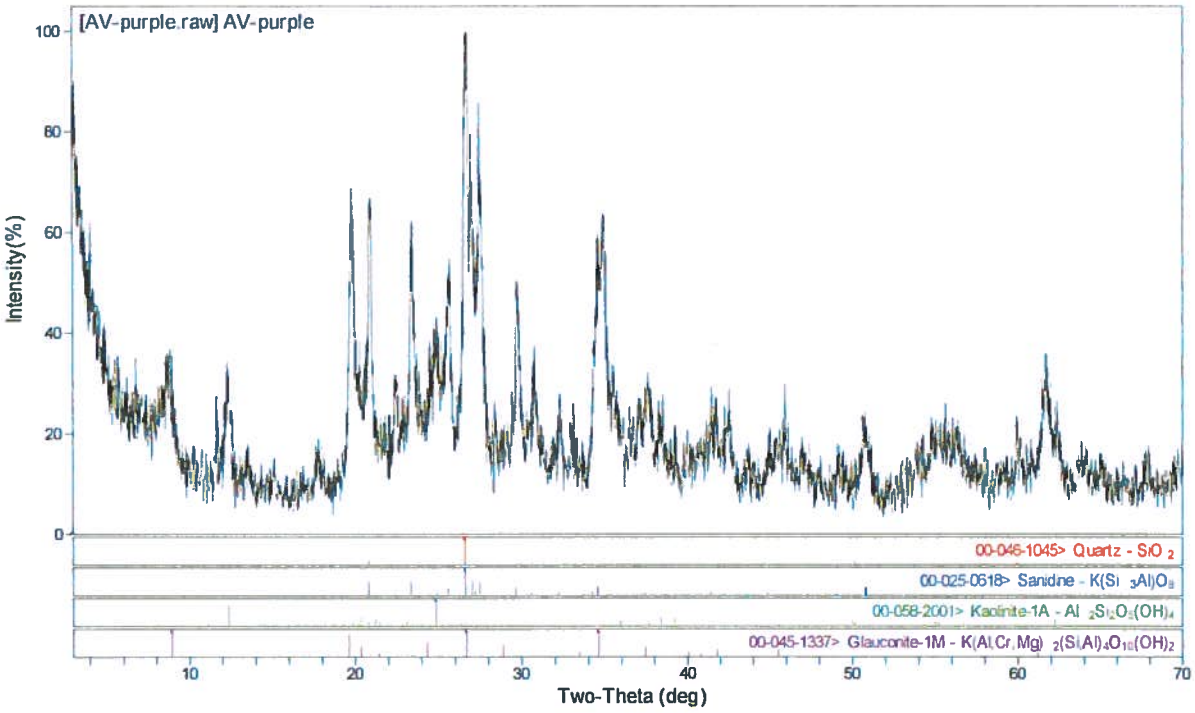
Appendix I: XRD Data



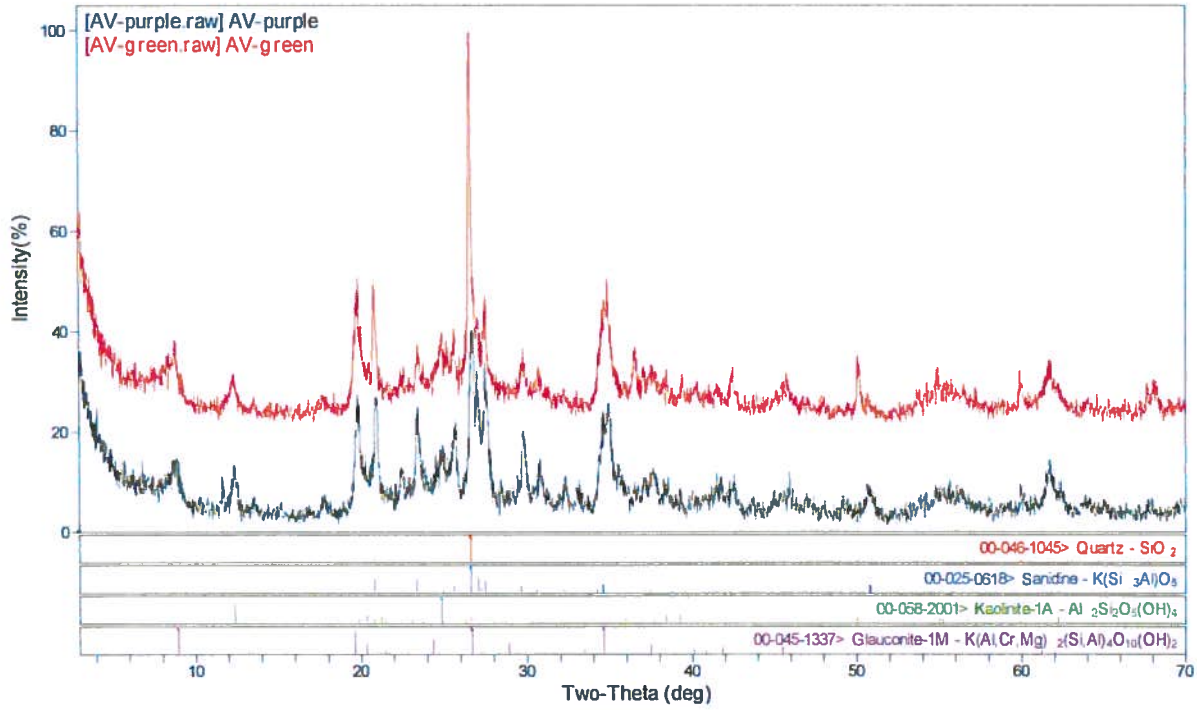
X-ray diffraction data of the unconsolidated white sample.



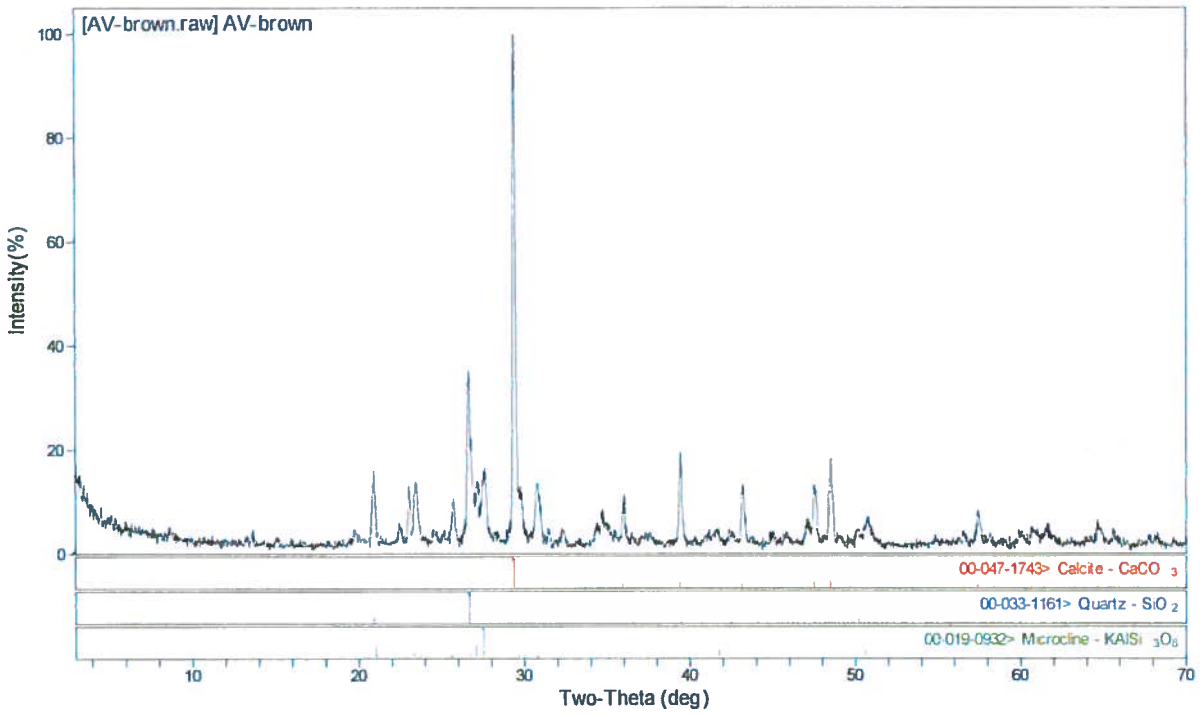
X-ray diffraction data of the massive green shale.



X-ray diffraction data of the massive purple shale.

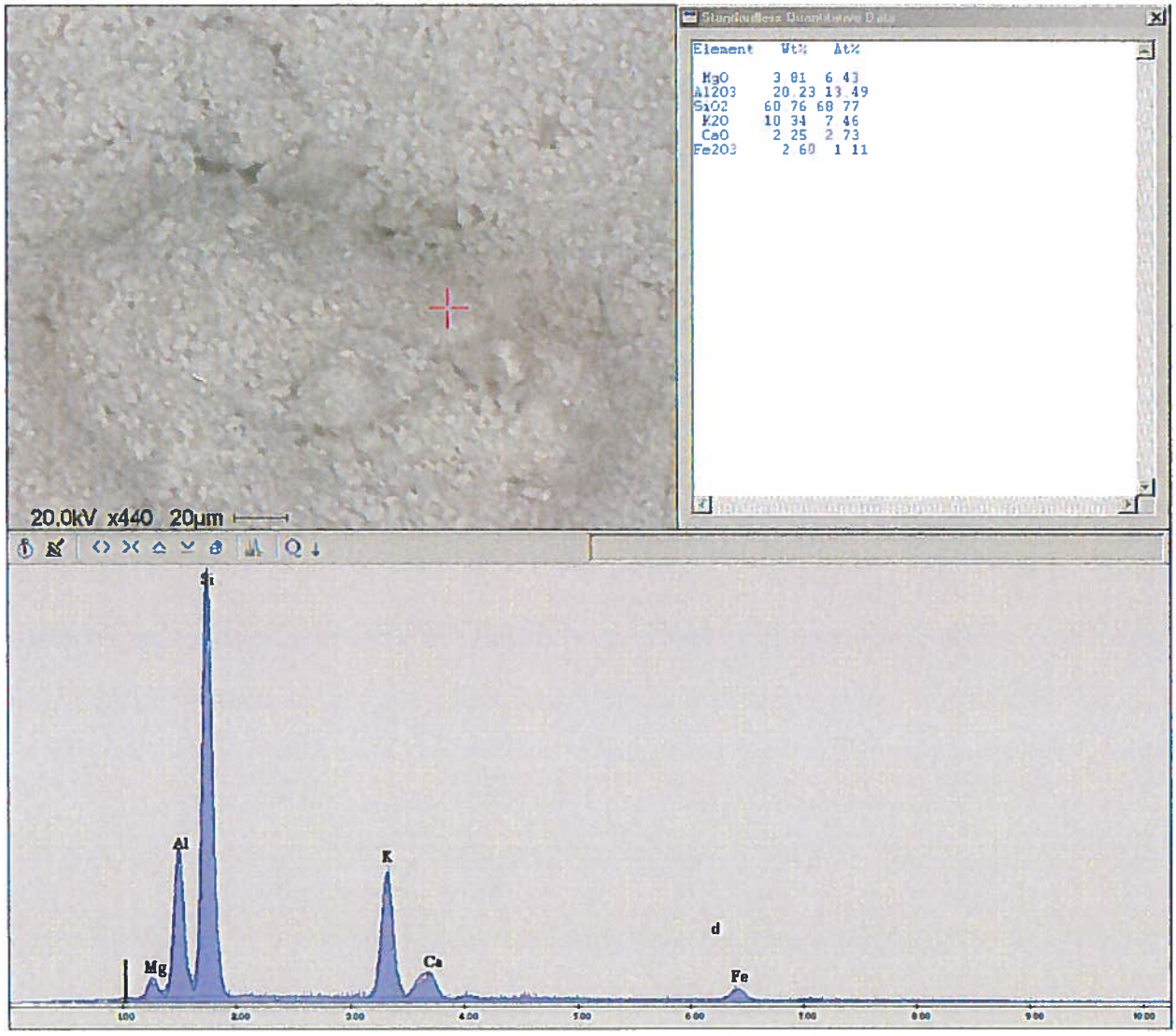


X-ray diffraction data comparison of the two shales.

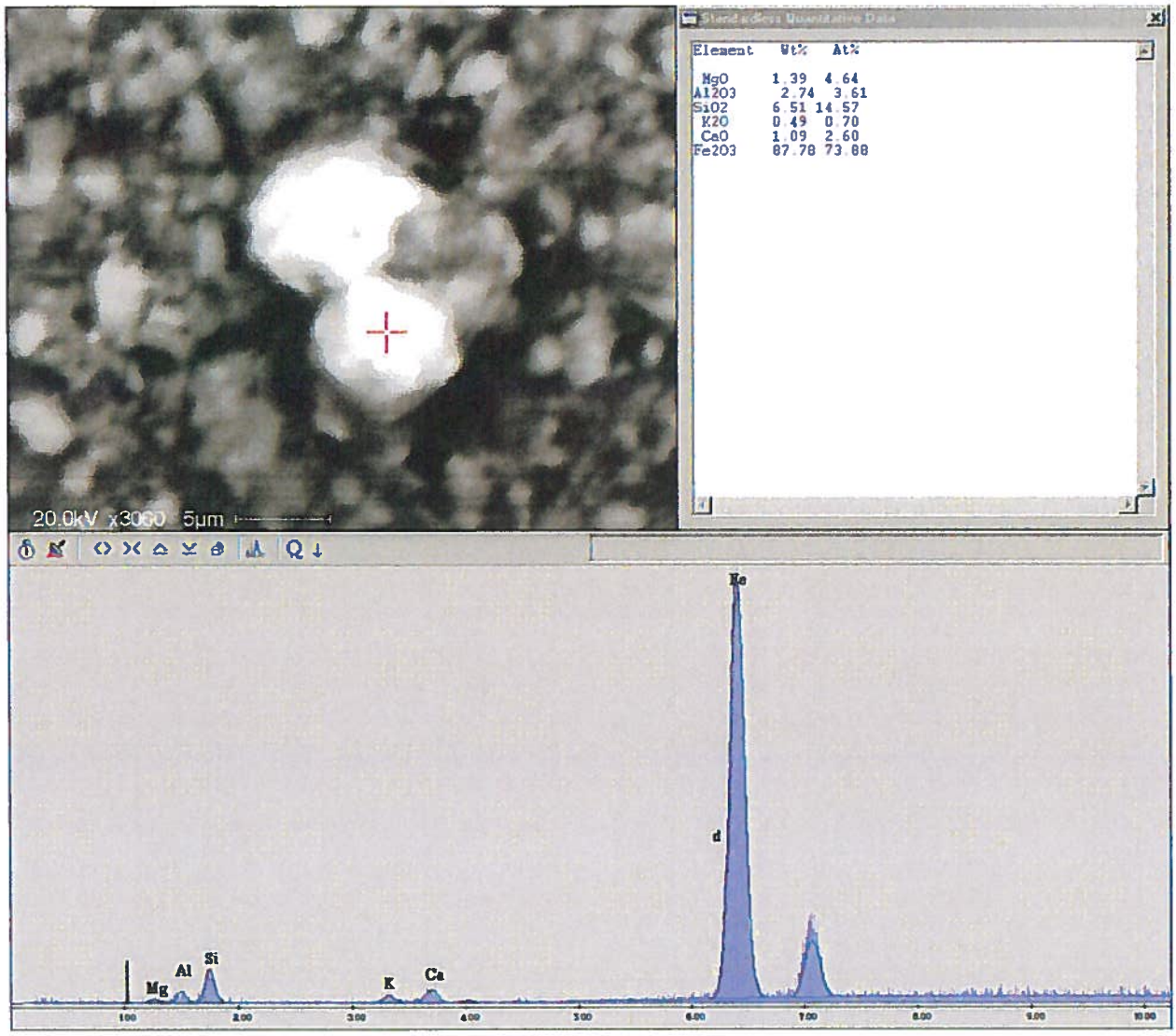


X-ray diffraction data of the sediment sludge.

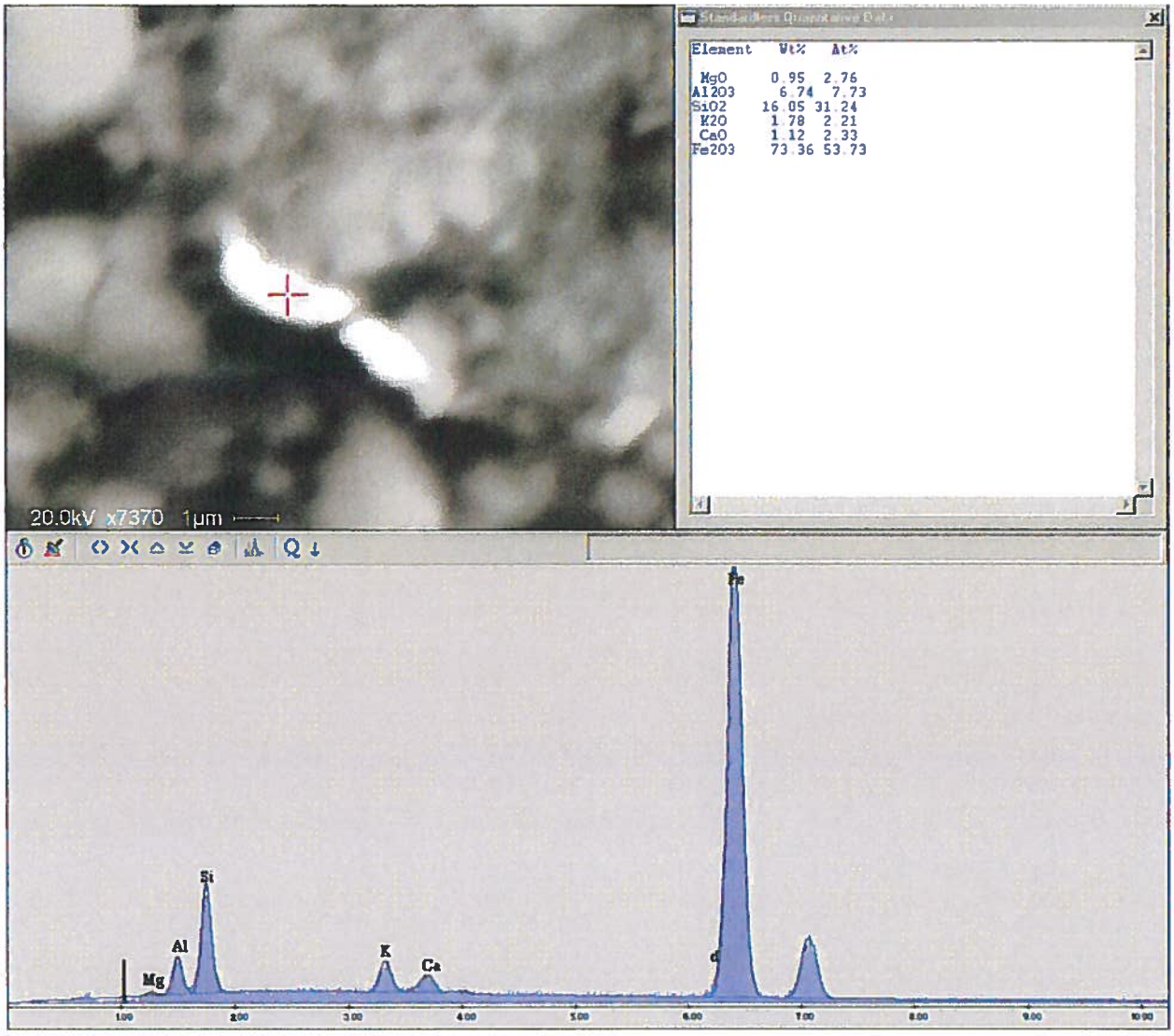
Appendix II: SEM Data



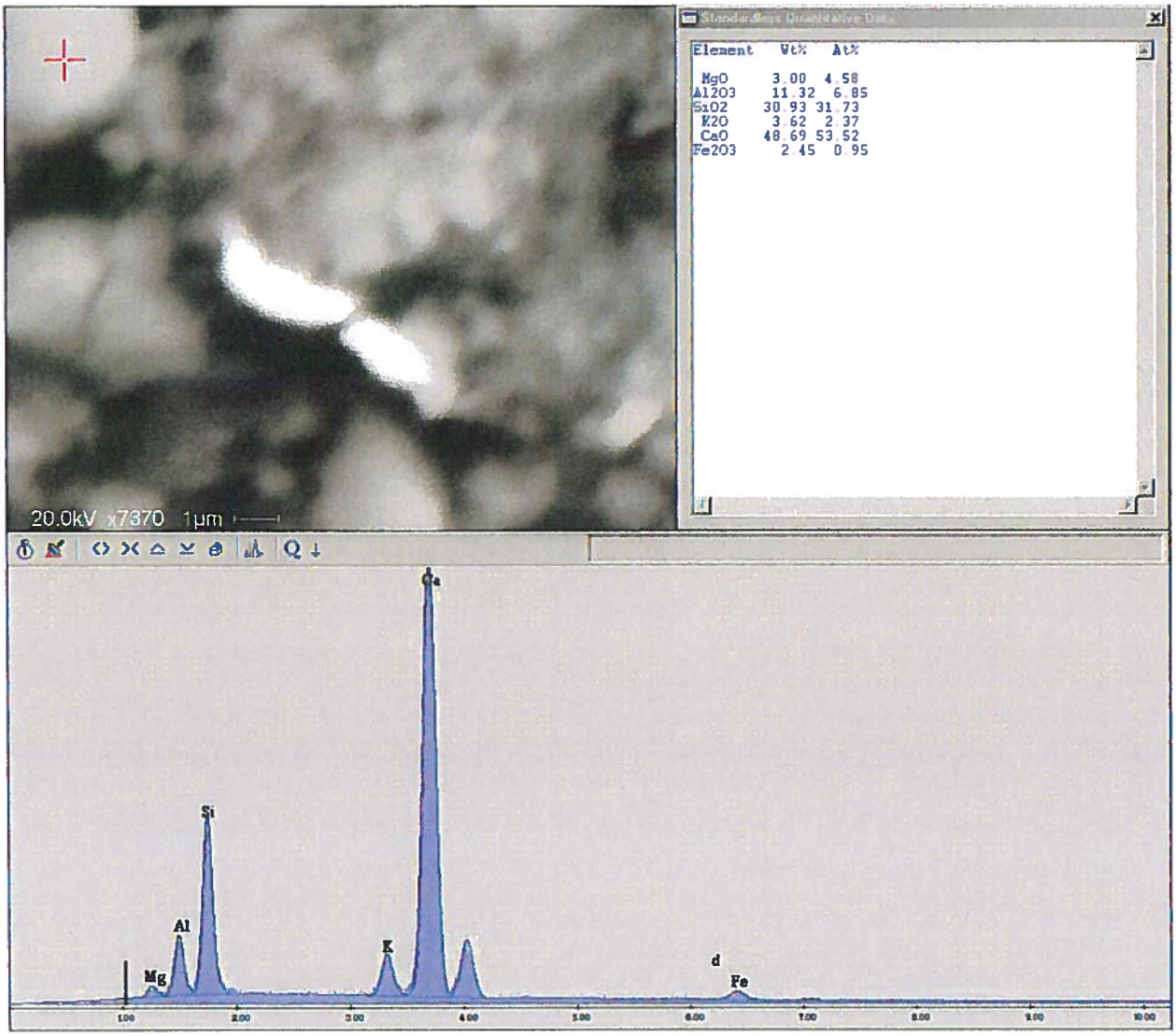
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating quartz and microcline.



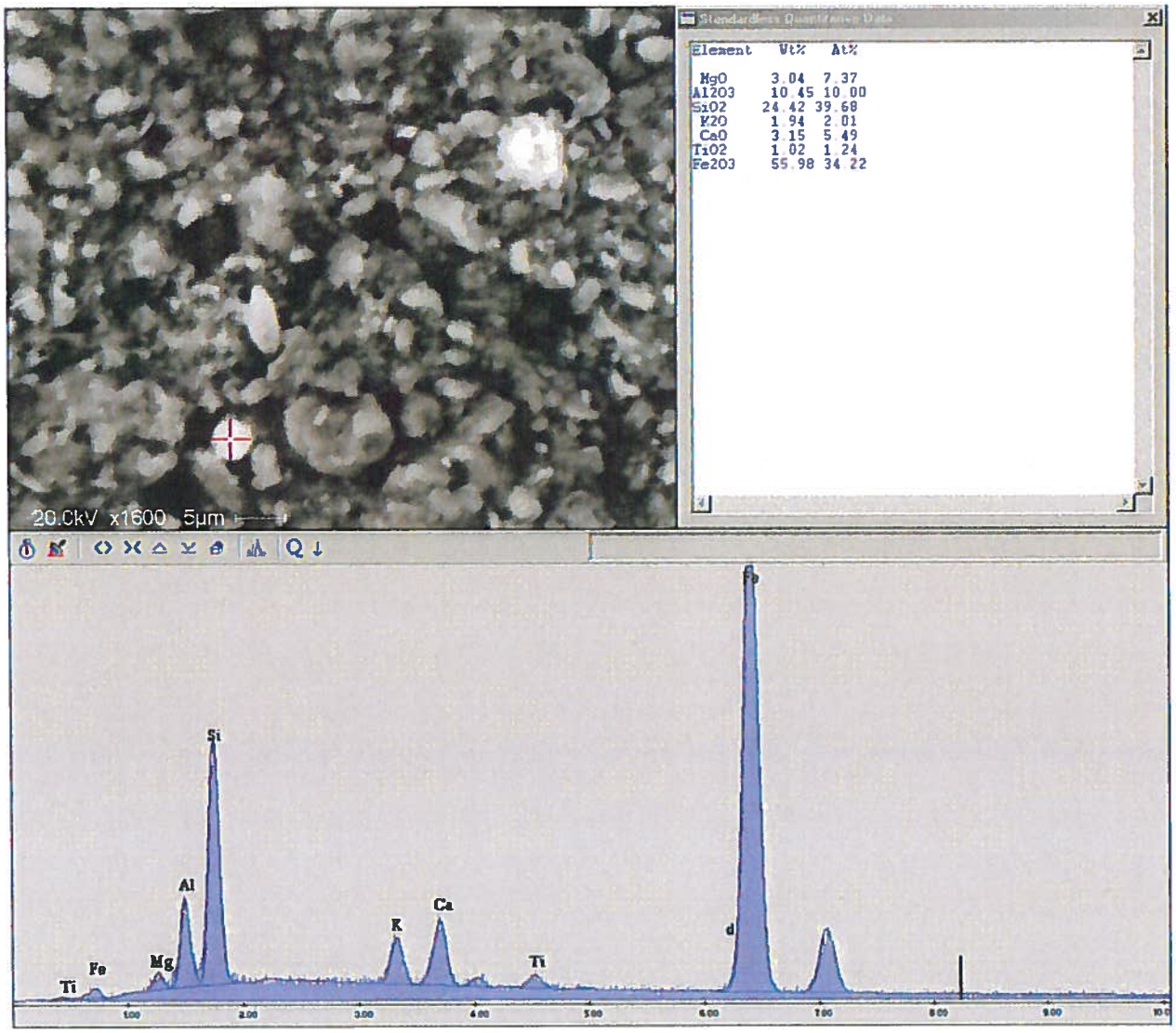
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating Fe oxide mineral. Note the angular grains towards the top of the image.



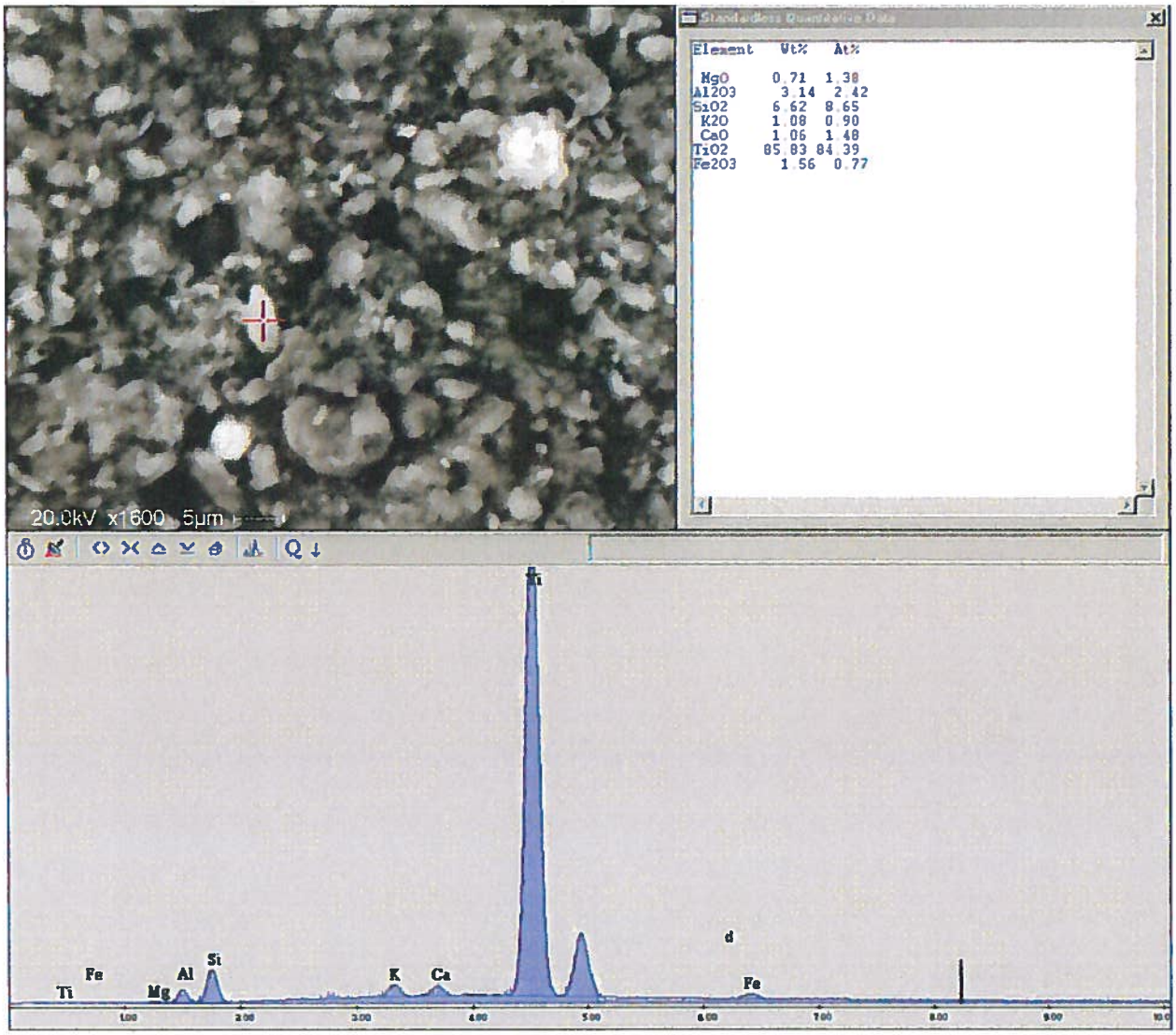
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating Fe oxide mineral, quartz and trace amounts of microcline.



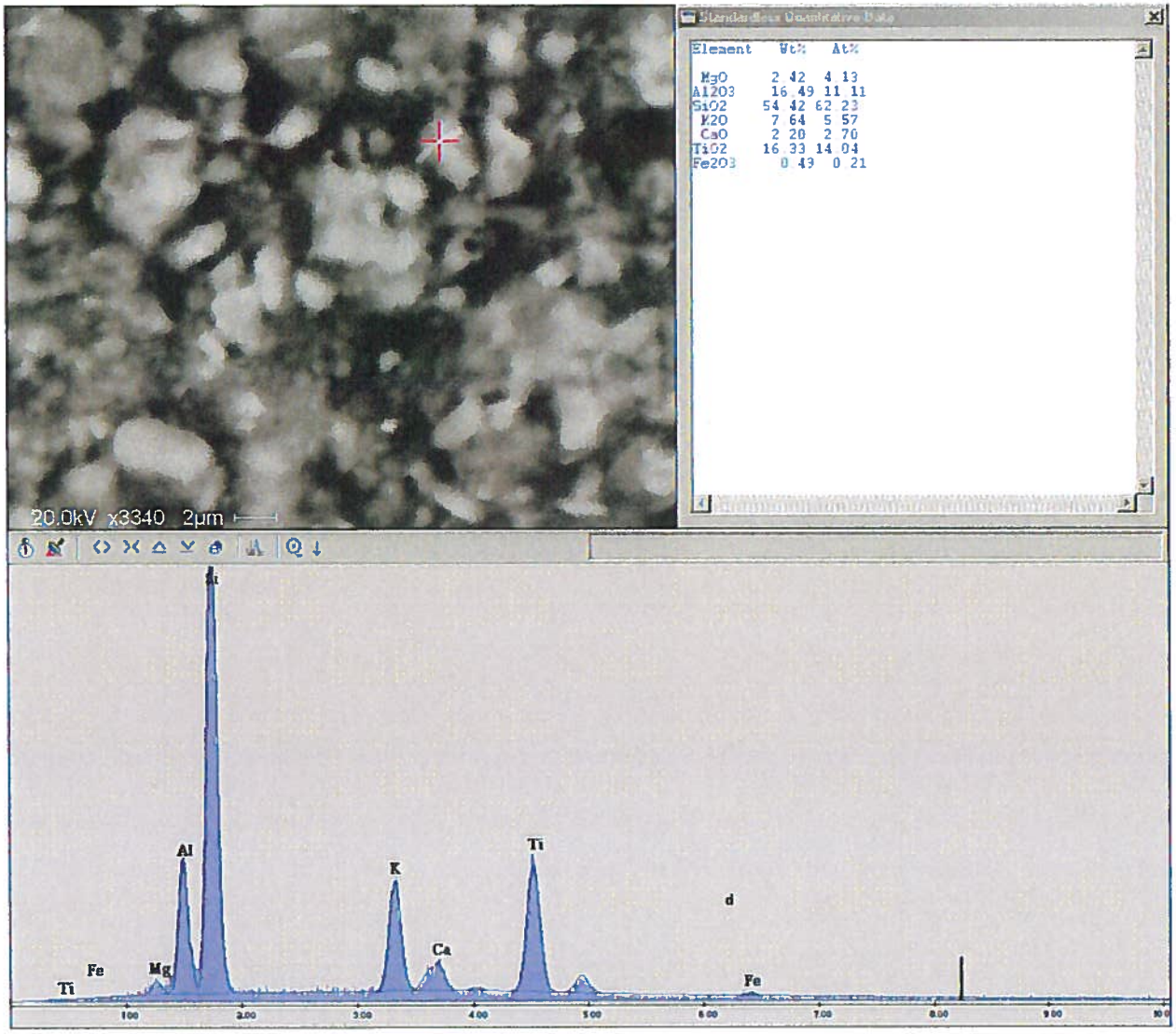
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating anorthite.



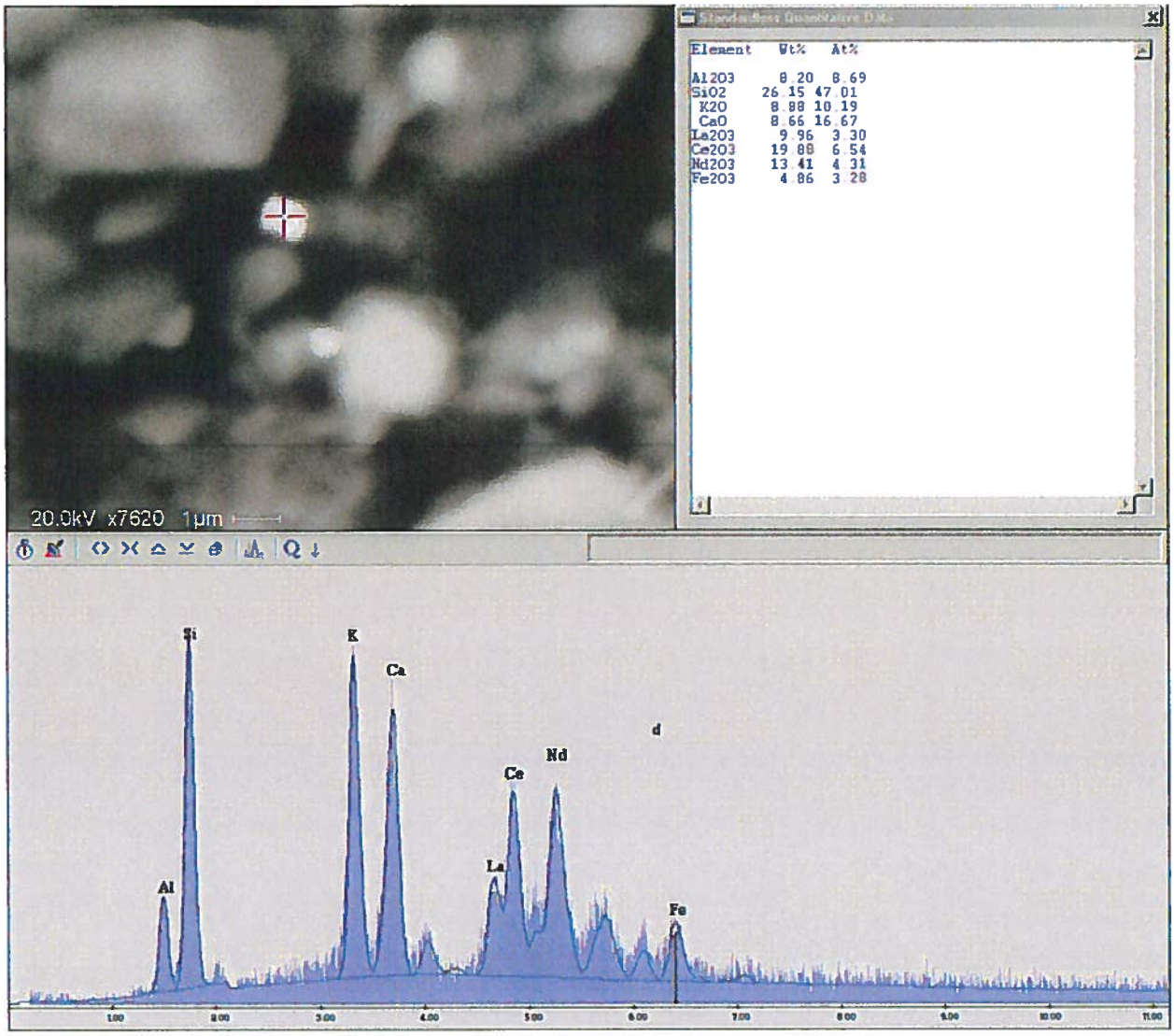
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating a Fe-Al silicate, possibly corundum.



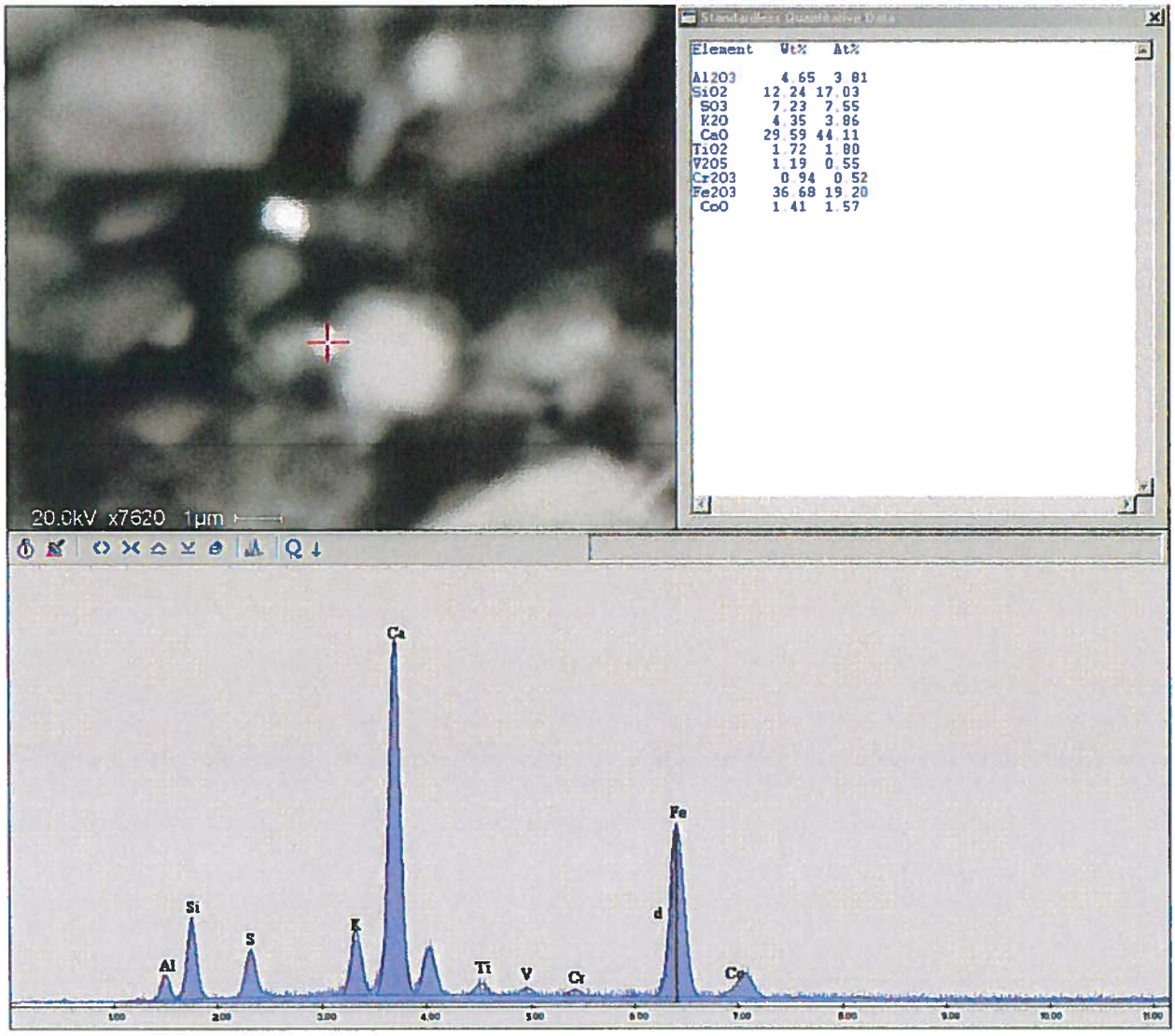
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating rutile.



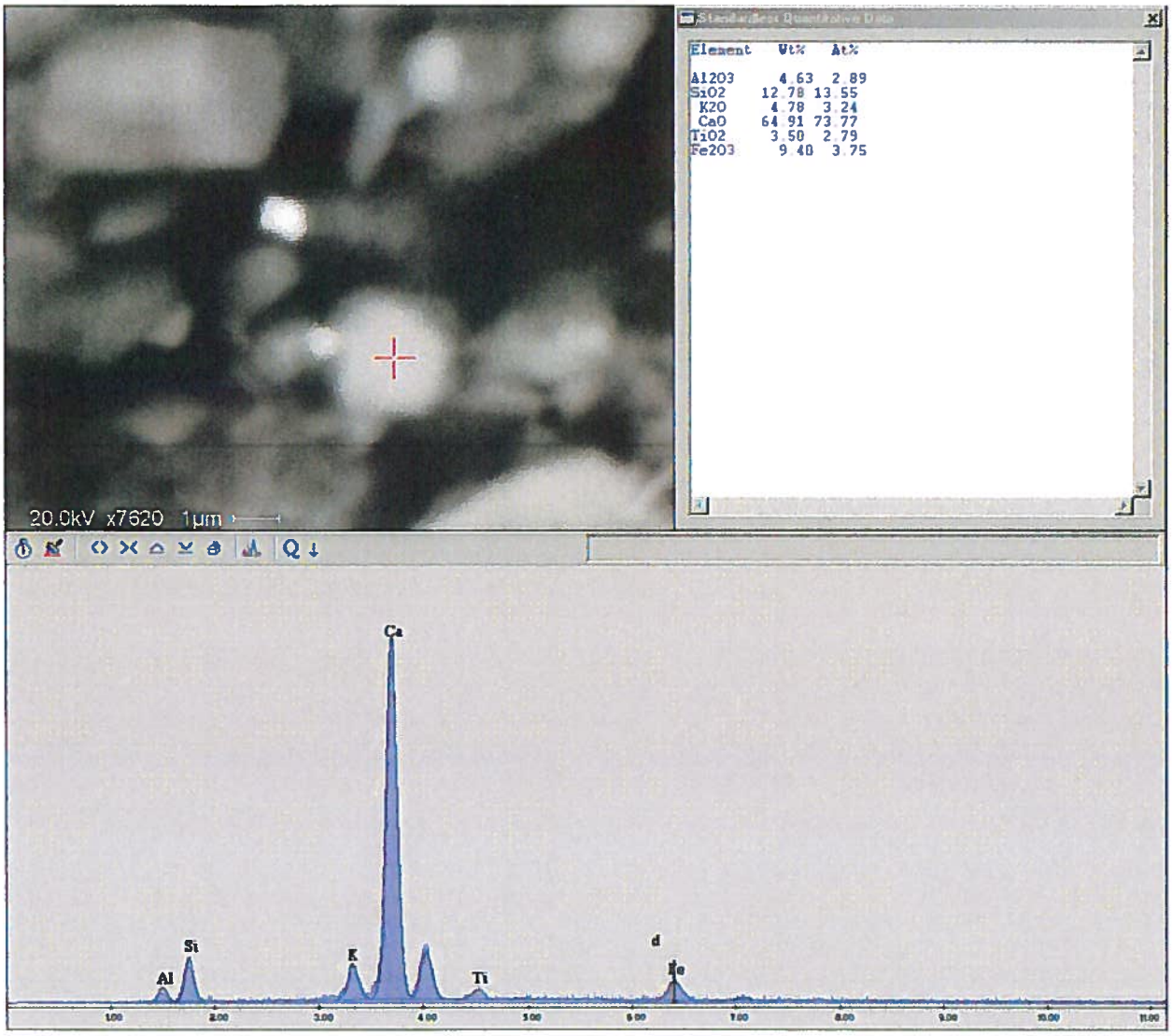
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating rutile and K-feldspar.



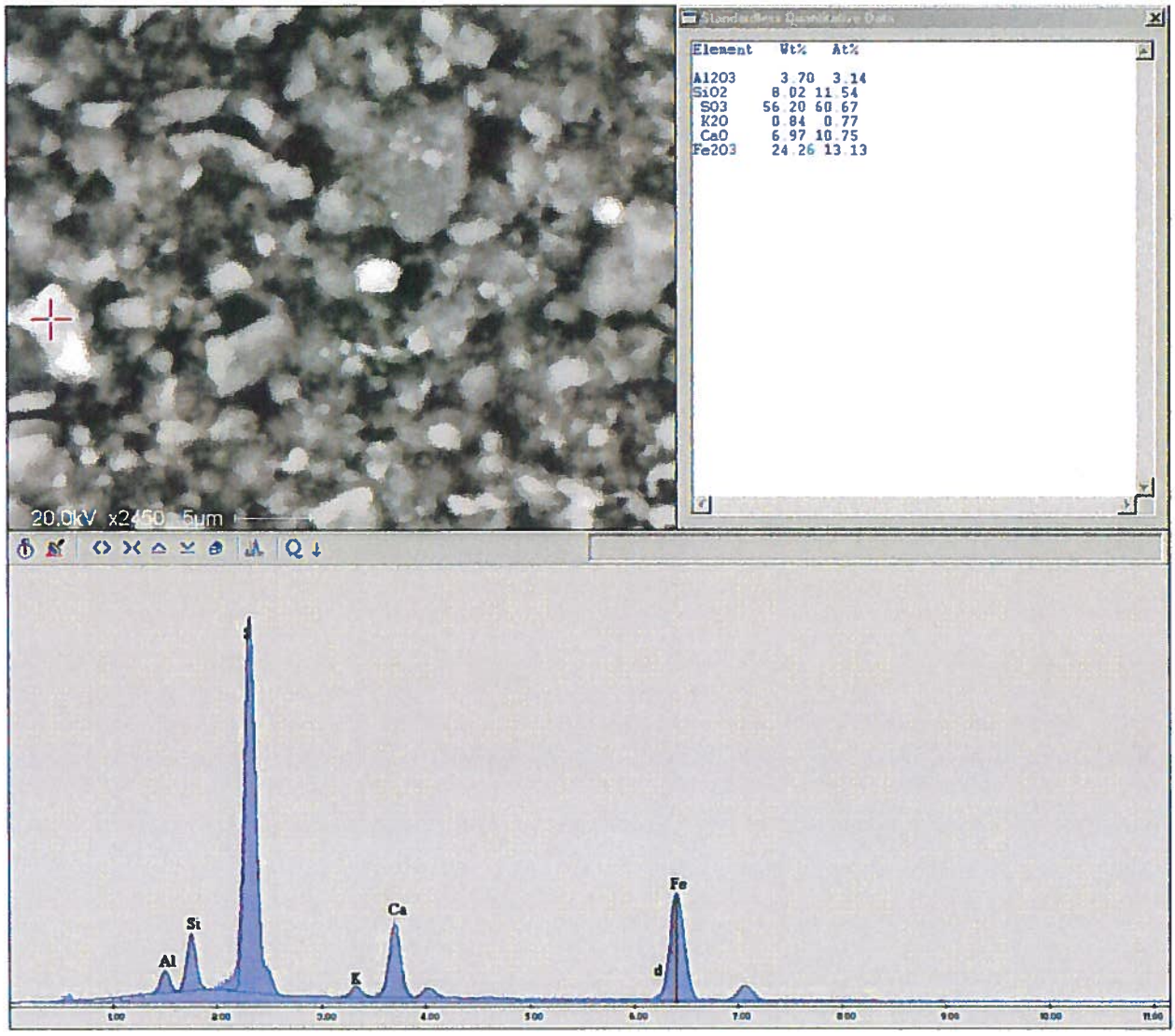
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating quartz, K-feldspar and rare earth elements (REE).



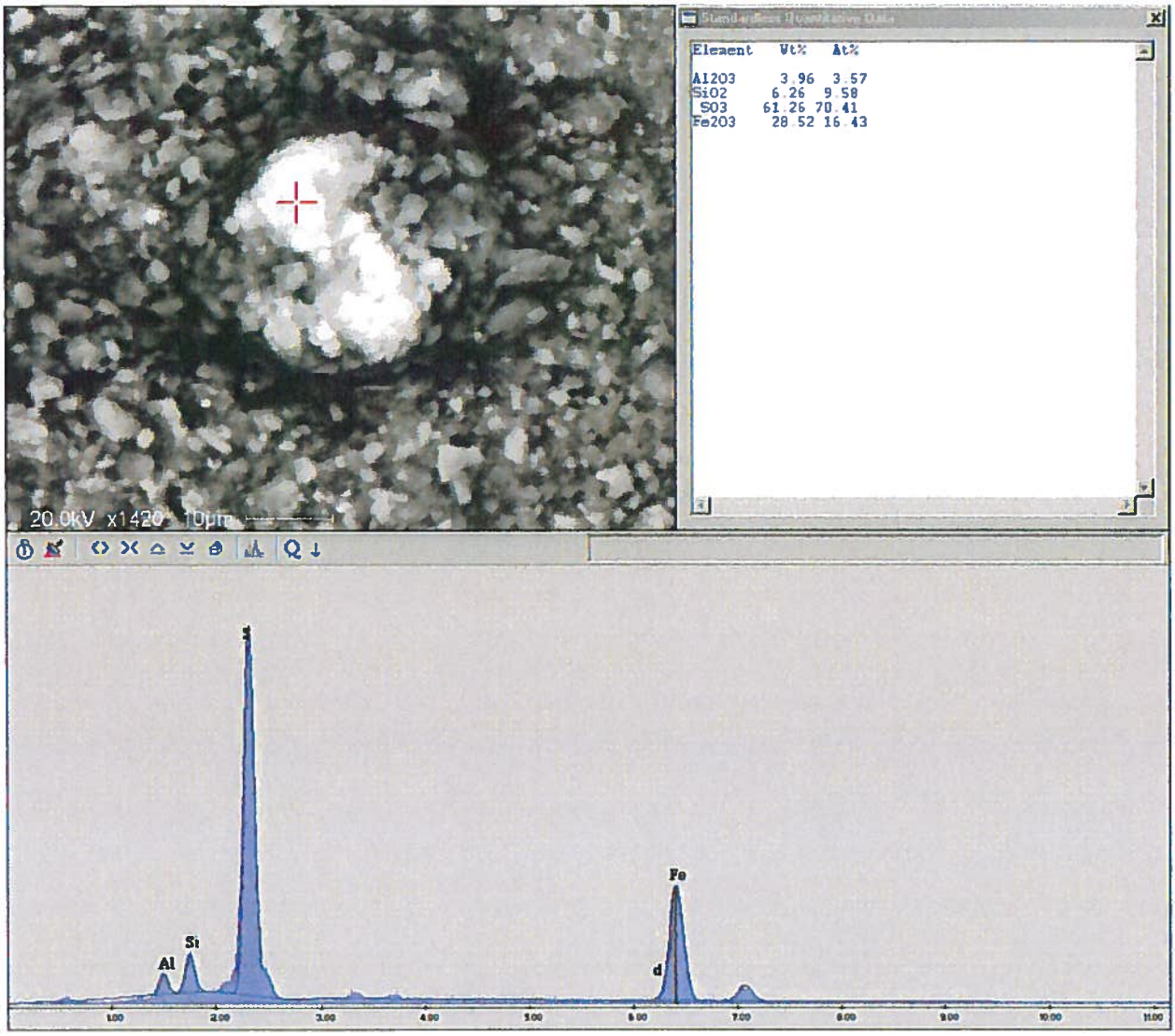
Semi-quantitative SEM analysis of the sediment sludge smear sample indicating Fe oxide and calcite.



Semi-quantitative SEM analysis of the sediment sludge smear sample indicating calcite, quartz and kaolinite.



Semi-quantitative SEM analysis of the sediment sludge smear sample indicating pyrite and kaolinite.



Semi-quantitative SEM analysis of the sediment sludge smear sample indicating pyrite.