MUNICIPAL DISTRICT OF GREENVIEW NO. 16

REGULAR COUNCIL MEETING AGENDA

Tuesday, May 9, 2017 | 9:00 AM | Council Chambers, Administration Building

---

#1	CALL TO ORDER			
#2	ADOPTION OF AGENDA			1
#3	MINUTES		3.1 Regular Council Meeting minutes held April 25, 2017 – to be adopted.	3
			3.2 Business Arising from the Minutes	
#4	PUBLIC HEARING			
#5	DELEGATION	10:00 a.m.	5.1 Shell Canada Presentation	11
		11:00 a.m.	5.2 Geothermal Deep Dive Presentation	38
#6	BYLAWS			
#7	OLD BUSINESS			
#8	NEW BUSINESS		8.1 Policy 4001 – Security Deposits for Residential Construction to Proposed Residential Developments	137
			8.2 Valleyview & Districts Agricultural Society – Aggregate	147
			8.3 Alberta High School Rodeo Association – Funding Request	150
			8.4 Grande Prairie Stompede Association – Funding Request	154
			8.5 Grande Prairie River Rats Association – Jet Boat Race Funding Request	158

		8.6 Meeting Date for Municipal Planning Commission Meeting	171
		8.7 Grande Prairie & District Victim Services	181
		8.8 Expression of Interest Book Hiring Procedure	185
		8.9 CAO / Managers' Report	190
#9	COUNCILLORS BUSINESS & REPORTS		
#10	CORRESPONDENCE	• Alberta Wetland Policy Response Letter • Millar Western Forest Products Limited Beehive Burner • Source Water Protection Plan Committee Meeting • Valleyview Cemetery Committee Minutes • Community Readiness Report Invitation • Hillside Jr/Sr High School Commencement Ceremony • Town of Grande Cache Response Letter • Monthly Peace Officer Report	
#11	IN CAMERA	11.1 Privileged Information *(FOIPP; Section 21(1))*	
#12	ADJOURNMENT		

Minutes of a
REGULAR COUNCIL MEETING
MUNICIPAL DISTRICT OF GREENVIEW NO. 16
M.D. Administration Building,
Valleyview, Alberta, on Tuesday, April 25, 2017

 # 1: CALL TO ORDER

Reeve Dale Gervais called the meeting to order at 9:07 a.m.

PRESENT

Reeve	Dale Gervais
Deputy Reeve	Roxie Rutt
Councillors	Tom Burton
	George Delorme
	Dave Hay
	Bill Smith
	Dale Smith

ATTENDING

Chief Administrative Officer	Mike Haugen
General Manager, Corporate Services	Rosemary Offrey
General Manager, Community Services	Dennis Mueller
General Manager, Infrastructure & Planning	Grant Gyurkovits
Communications Officer	Diane Carter
Recording Secretary	Lianne Kruger

ABSENT

Councillor	Les Urness

#2: AGENDA

MOTION: 17.04.154. Moved by: COUNCILLOR DALE SMITH
That Council adopt the April 25, 2017 agenda with the addition of:

- 7.1 4th Quarter Report

CARRIED

#3.1 REGULAR COUNCIL MEETING MINUTES

MOTION: 17.04.155. Moved by: COUNCILLOR TOM BURTON
That Council adopt the Minutes of the Regular Council Meeting held on Tuesday, April 11, 2017 as amended:

- Add Policy Review Committee Meeting to Councillor Les Urness' Members Report

CARRIED

#3.2 BUSINESS ARISING FROM MINUTES

3.2 BUSINESS ARISING FROM MINUTES:

MOTION: 17.04.156. Moved by: COUNCILLOR TOM BURTON
That Council direct Administration to implement Take It or Leave It programs at all Greenview transfer stations with funding to come from Contingency Reserve.

CARRIED

#5 DELEGATIONS

5.0 DELEGATIONS

5.1 COMMUNITY FOUNDATION OF NORTHWESTERN ALBERTA

COMMUNITY FOUNDATION OF NORTHWESTERN ALBERTA

MOTION: 17.04.157. Moved by: COUNCILLOR TOM BURTON
That Council contribute $10,000.00 to the Community Foundation of Northwestern Alberta, and provide Administration staff to the Board, funds to come from the Contingency Reserve.

CARRIED

#4 PUBLIC HEARING

4.0 PUBLIC HEARING

BYLAW 17-778 ROAD CLOSURE

BYLAW 17-778 PUBLIC HEARING

Chair Dale Gervais opened the Public Hearing regarding Bylaw 17-778 at 10:03 a.m.

IN ATTENDANCE

Applicant	Gordon Vivian
Adjacent Land Owner	Corey Carty
Adjacent Land Owner	Cheryl Carty
Adjacent Land Owner	Brian Gallivan

INTRODUCTIONS

The Chair requested each Council Member and Staff member introduce themselves and asked Council Members if there were any reasons that they should be disqualified from the hearing.
Each Members' reply was no.

The Chair asked the applicants if there was any abjection or concern with any members sitting on the Board.
Applicants reply was no.

PURPOSE FOR THE HEARING

The purpose of the hearing is to hear submissions for and opposed to proposed Bylaw 17-778, being the bylaw of the MD of Greenview, is to close the existing undeveloped road allowance on the west boundary of SE 23-69-22 W5M.

REFERRAL AGENCY & ADJACENT LANDOWNER COMMENTS

General Manager, Grant Gyurkovits provided a summary of the responses from the referral agencies.

QUESTIONS FROM COUNCIL

The Chair called for any questions from Council.
Councillor Dale Smith requested that the Utilities Right-of-Way be noted.

THOSE IN FAVOUR

The Chair requested that anyone in favour of the application to come forward.
Mr. Brian Gallivan came forward and provided comments in favour of the road closure.

THOSE AGAINST

The Chair requested that anyone against the application to come forward.
Mr. Corey Carty and Mrs. Cheryl Carty came forward stating their concerns of runoff from the right-of-way running into their yard should the trees and underbrush be removed.

QUESTIONS FROM COUNCIL

The Chair called for any questions from Council.
None were heard.

QUESTIONS FROM APPLICANT

The Chair called for any questions from the Applicant or those that had spoken in favour or against the application with regards to the comments for Planning and Development, the referral agencies, or adjacent landowners.
None were heard.

FAIR & IMPARTIAL HEARING

The Chair asked the Applicant if they have had a fair and impartial hearing.
The Applicants response was yes.

BYLAW 17-778 PUBLIC HEARING ADJOURNED

Chair Dale Gervais adjourned the Public Hearing regarding Bylaw 17-778 at 10:48 a.m.

5.2 FOX CREEK RCMP PRESENTATION

FOX CREEK RCMP

MOTION: 17.04.158. Moved by: COUNCILLOR TOM BURTON
That Council accept the presentation from the Valleyview RCMP and the Fox Creek RCMP for information, as presented.

CARRIED

#6 BYLAWS

6.0 BYLAWS

6.1 BYLAW 17-778 ROAD CLOSURE SE 23-69-22 W5M

BYLAW 17-778 SECOND READING

That Council give Second Reading to Bylaw 17-778, to close a portion of the West boundary of the "original government road allowance" adjoining the East boundary of the South East Quarter of Section 23, Township 69, Range 22, West of the 5th Meridian.

MOTION: 17.04.159. Moved by: DEPUTY REEVE ROXIE RUTT
That Council table Second Reading of Bylaw 17-778 until after a response from Alberta Transportation.

CARRIED

8.2 VALLEYVIEW SEED CLEANING PLANT

VALLEYVIEW SEED CLEANING PLANT

MOTION: 17.04.160. Moved by: COUNCILLOR DALE SMITH
That Council authorize Administration to enter into an agreement with the Valleyview Seed Cleaning Cooperative Ltd. Board as to the dissolution and disbursement of assets of the Valleyview Seed Cleaning Cooperative Ltd.(VSCCL).
CARRIED

MOTION: 17.04.161. Moved by: COUNCILLOR DALE SMITH
That Council authorize Administration to transfer an upset limit of $40,000.00 to the 2017 Agriculture Services operating Budget to facilitate the VSCCL dissolution process, funds to come from the Operating Contingency Reserve Fund.
CARRIED

8.3 APPOINTMENT OF PEST INSPECTORS

PEST INSPECTORS

MOTION: 17.04.162. Moved by: COUNCILLOR BILL SMITH
That Council appoint: Dennis Haglund, Maureen Bly, Hazel Edwards, Amy Cymbaluk, Jennifer Hammel, Jesslyn Alguire, Hayden Grotkowski, and Glenn Allen as Pest inspectors for Greenview for the term of their employment.
CARRIED

8.4 APPOINTMENT OF WEED INSPECTORS

WEED INSPECTORS

MOTION: 17.04.163. Moved by: COUNCILLOR DALE SMITH
That Council appoint: Dennis Haglund, Maureen Bly, Hazel Edwards, Amy Cymbaluk, Jennifer Hammel, Jesslyn Alguire, Hayden Grotkowski, and Glenn Allen as Weed inspectors for Greenview for the term of their employment.
CARRIED

Reeve Gervais recessed the meeting at 11:51 a.m.
Reeve Gervais reconvened the meeting at 1:08 p.m.

TRANSFER FROM SURPLUS TO ECONOMIC DEVELOPMENT RESERVES

MOTION: 17.04.164. Moved by: COUNCILLOR TOM BURTON
That Council direct Administration to transfer $15,000,000.00 from Surplus to the Economic Development Reserve effective December 31, 2016.
CARRIED

8.6 2016 AUDITED FINANCIAL STATEMENTS and INFORMATION RETURNS

2016 AUDITED FINANCIAL STATEMANTS & INFORMATION RETURNS

MOTION: 17.04.165. Moved by: DEPUTY REEVE ROXIE RUTT
That Council approve the 2016 Audited Financial Statements and the 2016 Financial Information Return as amended by Hawkings EPP Dumont Chartered Accountants for submission to the Minister of Alberta Municipal Affairs.

CARRIED

Reeve Gervais recessed the meeting at 2:16 p.m.
Reeve Gervais reconvened the meeting at 2:31 p.m.

#7 OLD BUSINESS

7.0 OLD BUSINESS

7.1 FOURTH QUARTER REPORT

MOTION: 17.04.166. Moved by: COUNCILLOR BILL SMITH
That Council accept the 2016 Fourth Quarter Report verbal update as presented, for information.

CARRIED

#8 NEW BUSINESS

8.0 NEW BUSINESS

8.1 GREENVIEW CANADA 150 GRANT REQUESTS

CANADA 150 GRANT REQUEST

MOTION: 17.04.167. Moved by: COUNCILLOR TOM BURTON
That Council approve the Greenview Canada 150 Grant applications as follows:

Fox Creek Library	$4,500.00
Cranberry Lake Rodeo	$15,000.00
DeBolt & District Pioneer Museum	$30,000.00
Mountain Metis Nation Association	$13,100.00

CARRIED

8.5 GREENVIEW MASCOT

GREENVIEW MASCOT

MOTION: 17.04.168. Moved by: COUNCILLOR GEORGE DELORME
That Council authorize Administration to purchase a mascot with an upset limit of $8,000.00 with funds to come from the 2017 Communications Promotional Marketing budget.

CARRIED

8.7 MCAUSLAND DEVELOPMENT THIRD PARTY ENGINEERING REPORT

THIRD PARTY ENGINEERING REPORT

MOTION: 17.04.169. Moved by: COUNCILLOR DALE SMITH
That Council accept the third party report completed by Helix Engineering as presented.

CARRIED

8.8 EXPRESSION OF INTEREST BOOK HIRING PROCEDURE

EOI HIRING PROCEDURE

That Council provide direction regarding the guidelines for Administration to craft a policy for the hiring process in the use of the Expression of Interest book.

MOTION: 17.04.170. Moved by: COUNCILLOR BILL SMITH
That Council table the Expression of Interest Book Hiring Procedure until a future date.

CARRIED

#9 COUNCILLORS BUSINESS & REPORTS

9.1 COUNCILLORS' BUSINESS & REPORTS

9.2 MEMBERS' REPORT: Council provided an update on activities and events attended, including the following:

WARD 1

COUNCILLOR GEORGE DELORME updated Council on his recent activities, which include:
Municipal Planning Commission Meeting

WARD 4

COUNCILLOR DAVE HAY updated Council on his recent activities, which include:
Mighty Peace Watershed Alliance Meeting
FCSS Meeting
Heart River Housing Meeting
Mighty Peace Watershed Alliance Meeting

WARD 7

DEPUTY REEVE ROXIE RUTT updated Council on her recent activities, which include:
Grande Prairie Public Library Meeting
DeBolt Seniors Meeting
Municipal Planning Commission Meeting
Joint Council Meeting with Town of Fox Creek
FCSS Meeting

Greenview Regional Waste Management Commission Meeting
Mighty Peace Watershed Alliance Meeting
Northern Lakes College Committee Meeting
Crooked Creek Recreation Club Meeting

MOTION: 17.04.171. Moved by: COUNCILLOR TOM BURTON
That Council direct Administration to send a letter of support to the Mighty Peace Watershed Alliance in support of Councillor Dave Hay retaining a seat on the Alliance.

CARRIED

WARD 5 **COUNCILLOR DALE SMITH** updated Council on his recent activities, which include:
Municipal Planning Commission Meeting
Joint Council Meeting with Town of Fox Creek
2016 Financial Statement Review

WARD 6 **COUNCILLOR TOM BURTON** updated Council on his recent activities, which include:
DeBolt Seniors Residential Facilities Meeting
Municipal Planning Commission Meeting
Joint Council Meeting with Town of Fox Creek
DeBolt Library Board Meeting

WARD 8 **COUNCILLOR BILL SMITH** updated Council on his recent activities, which include:
Grande Prairie Regional Tourism Association Meeting

WARD 3 **COUNCILLOR LES URNESS**
Not in attendance.

9.1 REEVE'S REPORT:

WARD 2 **REEVE DALE GERVAIS** updated Council on his recent activities, which include:
Municipal Planning Commission Meeting
Joint Council Meeting with the Town of Fox Creek
Grande Cache Council Meeting

#10 CORRESPONDENCE **10.0 CORRESPONDENCE**

MOTION: 17.04.172. Moved by: COUNCILLOR DALE SMITH
That Council accept the correspondence as presented.

CARRIED

#11 IN CAMERA

11.0 IN CAMERA

There was no In Camera presented.

12.0 ADJOURNMENT

#12 ADJOURNMENT

MOTION: 17.04.173. Moved by: DEPUTY REEVE ROXIE RUTT
That this meeting adjourn at 4:33 p.m.

CARRIED

_____ _____

CHIEF ADMINISTRATIVE OFFICER REEVE

REQUEST FOR DECISION

SUBJECT:	**Shell Canada Presentation**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	KK
DEPARTMENT:	ECONOMIC DEVELOPMENT	GM:	DM	PRESENTER:	

RELEVANT LEGISLATION:
Provincial (cite) –N/A

Council Bylaw/Policy (cite) - N/A

RECOMMENDED ACTION:
MOTION: That Council accept the Shell Canada presentation for information, as presented.

BACKGROUND/PROPOSAL:
Shell Canada, a Member of the Fox Creek Operators Group (FCOG) will provide an update for its 2017 development activities within the Municipal District of Greenview. In addition; the presentation will highlight Shell Canada's 2017 Community engagement polices in order to find potential alignments with Greenview's future aspirations.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of accepting the presentation is to confirm reception of the update on Shell Canada activities within Greenview for the 2017 year.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantages to accepting the presentation.

ALTERNATIVES CONSIDERED:
Alternative #1: - N/A

FINANCIAL IMPLICATION:
Direct Costs: - N/A
Ongoing / Future Costs: - N/A

STAFFING IMPLICATION:
N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

INFORM - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

INFORM - We will keep you informed.

FOLLOW UP ACTIONS:

N/A

ATTACHMENT(S):

- Shell Canada provided PowerPoint presentation.

Shell in the MD of Greenview No. 16

13

Update to the MD of Greenview No. 16
May 9, 2017

Definitions and Cautionary Note

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this presentation "Shell", "Shell group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this presentation refer to companies in which Royal Dutch Shell either directly or indirectly has control, by having either a majority of the voting rights or the right to exercise a controlling influence. The companies in which Shell has significant influence but not control are referred to as "associated companies" or "associates" and companies in which Shell has joint control are referred to as "jointly controlled entities". In this presentation, associates and jointly controlled entities are also referred to as "equity-accounted investments". The term "Shell interest" is used for convenience to indicate the direct and/or indirect (for example, through our 23% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest. This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as ''anticipate'', ''believe'', ''could'', ''estimate'', ''expect'', ''intend'', ''may'', ''plan'', ''objectives'', ''outlook'', ''probably'', ''project'', ''will'', ''seek'', ''target'', ''risks'', ''goals'', ''should'' and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this presentation, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including potential litigation and regulatory measures as a result of climate changes; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional factors that may affect future results are contained in Royal Dutch Shell's 20-F for the year ended 31 December, 2016 (available at www.shell.com/investor and www.sec.gov). These factors also should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation, February 22. Neither Royal Dutch Shell nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this presentation. There can be no assurance that dividend payments will match or exceed those set out in this presentation in the future, or that they will be made at all. We use certain terms in this presentation, such as discovery potential, that the United States Securities and Exchange Commission (SEC) guidelines strictly prohibit us from including in filings with the SEC. U.S. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov. You can also obtain this form from the SEC by calling 1-800-SEC-0330.

Agenda (MD)

- Introduction to Shell's Alberta Light Tight Oil
- Shell in Fox Creek and Gold Creek
- 2016 Review
- 2017 Activities
- Water Management
- Taxation
- Local benefits and stakeholder engagement
- Q&A

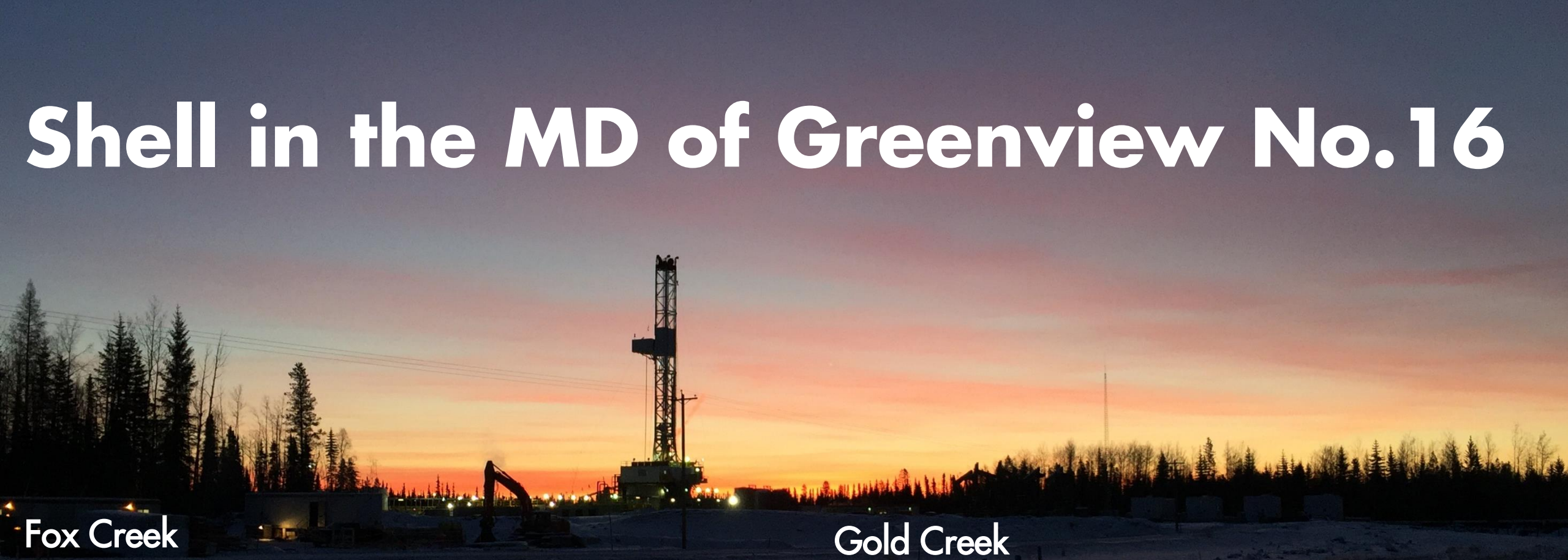
15

Alberta Light Tight Oil

On a Roller Coaster

We are surviving, not thriving, given the 'lower for longer' price scenario and intense competition for investment dollars, even within our own portfolio

Shell in the MD of Greenview No.16



Fox Creek

- Began operations in the area in 2011
- Acquired ~255k net acres around Fox Creek
- Targeting the Duvernay formation
- ~119 wells drilled to date

Gold Creek

- Acquired land in the area in 2011
- De-risking with a multi-well program
- Targeting Wet Montney formation
- ~25 wells drilled to date

Shell in Fox Creek

- Full-time Shell operators live and work in Fox Creek
- In late 2015, Shell **established an office in the town of Fox Creek,** including building an access road, opening our office and constructing a laydown yard
- Operations, Projects, Drilling and Completions staff working in the area are based here
- In 2017, during peak activity, 200 contractors (on average) per day are in Fox Creek
- ~60 Shell employees/contractors stay at the Iosegun Lake Road Camp, managed by Horizon North (security and an EMT are on-site)

19

Shell in Gold Creek

- 8 full-time Shell operators work out of our Grande Prairie office, which opened in 2008, moved in 2010 to it's current location and is now under renovation
- 30+ local contractors work at Gold Creek

20

2016 Review

Fox Creek

- 3 rigs and 2 completions crews in Fox Creek area
- Constructed a water hub
- Kicked off construction of the Kaybob 5–33 processing facility

Gold Creek

- 1 rig and 1 completion crew
- Drilled wells

2017 Activities

Fox Creek

- 3 rigs and 2 completions crews in Fox Creek area
- Ongoing project to expand pipeline infrastructure
- Construction of Kaybob 5-33 processing facility
- Drill over 50 wells in the Fox Creek area

Gold Creek

- 1 rig and 1 completion crew
- Drill up to 11 wells

Water Management

Our Approach to Water

- We are constantly looking for ways to **reduce fresh water** use through seeking alternative water sources, recycling produced water, and by using less water per well
- Our **agreement with the town** to use the Town of Fox Creek's wastewater is critical in our ability to reduce fresh water use
- When it is available, it is **used first** for hydraulic fracturing activities in the place of available fresh water from any other sources

24

Our Water Strategy

- We are constantly looking for ways to **reduce fresh water** use
- We source our water from a number of sources, including:
  - Recycled produced water;
  - Municipal waste water from the Town of Fox Creek;
  - The 5-year term license for Iosegun Lake;
  - Surface collection through borrow pits; and
  - Temporary Diversion Licenses on local rivers or lakes
- Long-term, we aim to reduce our overall water use and evaluate the use of more sustainable sources of water, including municipal wastewater, treated effluent water and produced water recycling

25

Shell's Water Hub

- Constructed to reduce the potential impact of water withdrawal on Iosegun Lake
- Licensed to store fresh water and is connected through pipelines to future well pad locations
- Enables us to withdraw water when it's abundant and store for future use when the season is drier

Water at Gold Creek

- Currently water production is 1-2 barrels of water per barrel of oil produced
- Gold Creek minimizes fresh water use by maximizing use of produced saline water
- We are currently assessing water storage options to ensure we are only withdrawing water during period of high flow
- We currently source water via temporary works; water lines and pumps are temporarily deployed within existing disturbances to minimize new footprint and new disturbance

27

Property Taxes

Bill 21: Municipal Government Act

- Shell would like to see accountability limitations attached to the subclass authority:
  - Permit up to 10% reductions in tax for non-industrial properties tax rate, but require the difference be made up through residential taxes, providing strong accountability linkage

28

Local Benefits and Stakeholder Engagement

Supporting Local and Indigenous Businesses

- Supporting local and Indigenous businesses is a priority for Shell
- We define 'local area' as the geographic area within 100km of our operations
- In addition to local contracting and employment, Shell values long-term workforce development and has funded the following:
  - 5 welding booths at the Fox Creek School
  - Indspire, including Industry in the Classroom
  - Banff Centre for Indigenous Leadership
  - Scholarships and bursaries for Indigenous students at Northern Lake Colleges

30

Stakeholder Engagement

- Our philosophy is to **engage early** and **openly** with our stakeholders
- We engage in ongoing community dialogue to **identify and minimize potential impacts** and **maximize benefits,** including:
  - FCOG annual open house, days of caring, and bi-annual newsletter
  - Annual presentations to town council and regular meetings
  - Ongoing engagement with Indigenous communities
  - 1:1 meetings with local stakeholders
  - Local advertisements
  - Fueling Kindness in Fox Creek

31

In the Community

We invest in local initiatives in the areas of **environment**, **education**, **employees** and **community**

Some of the initiatives Shell funded in 2015/2016:

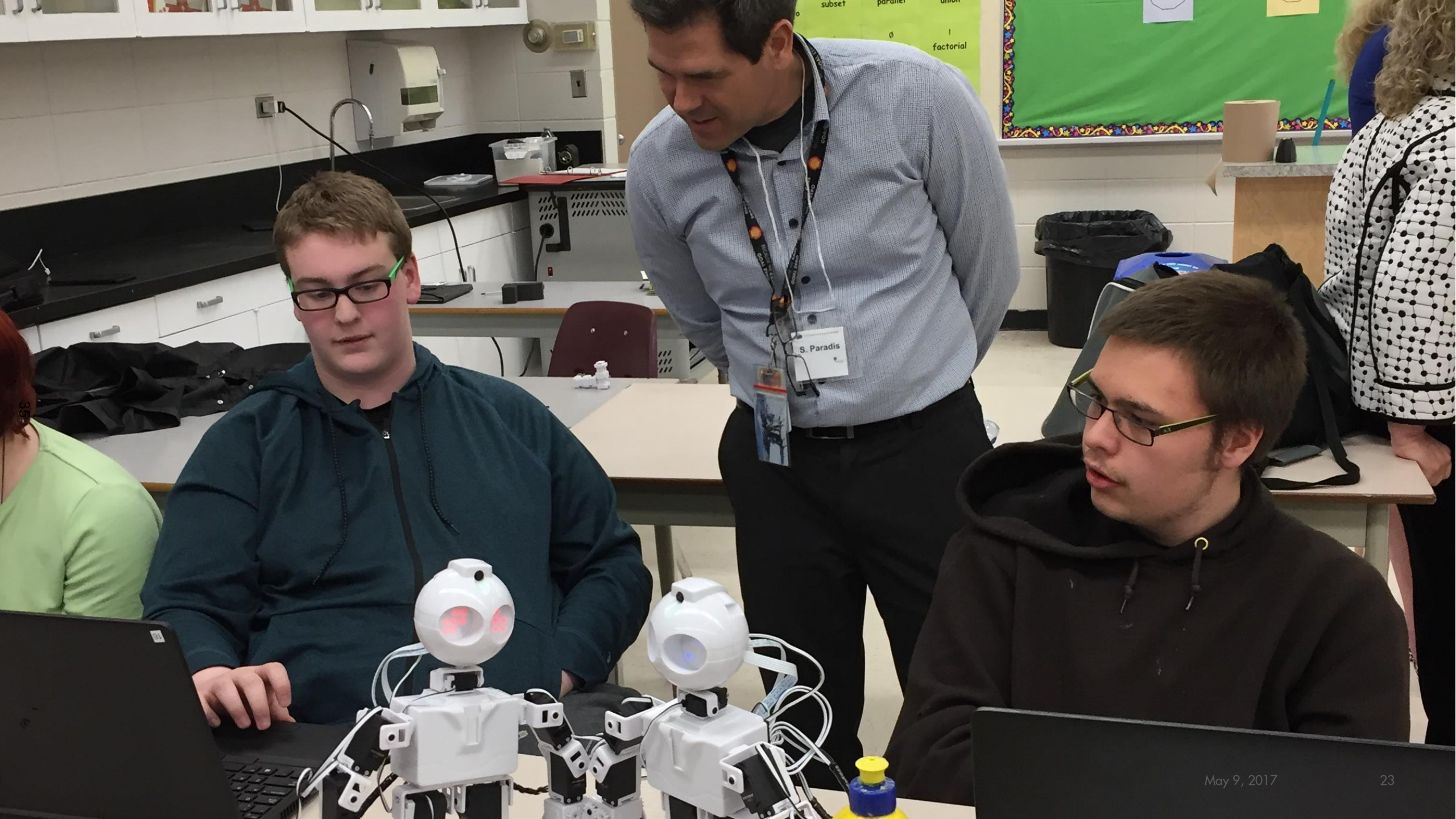
- Fox Creek Comprehensive Community Plan
- Fox Creek Volunteer Fire Department
- Fox Creek School Scholarships
- Fox Creek Municipal Library Science, Tech, Engineering, and Math (STEM) Materials
- CHAMP Mental Health Program
- New Volunteer Driver Program
- New Community Kitchen Initiative
- Peace Wapiti Academy Scholarships
- GP YMCA After School Program

STEM

Experiential Learning Week

- For Experiential Learning Week, Shell partnered with Northern Gateway public schools and Northern Lakes College to support the Fox Creek school skills exploration days
- Supporting science, technology, engineering, and mathematics education empowers future generations with the skills to prosper
- The Skills Exploration Days have succeeded in inspiring students through hands-on experiences that promote creativity, empathy, and exploration

34


subset
parallel
union
factorial
S. Paradis

Contact Us

Simon Paradis
Operations Manager
Simon.paradis@shell.com

Craig Hallden
External Relations Manager
Craig.Hallden@shell.com

Charlene Parker
Community Liaison Officer
Charlene.parker@shell.com

Bil Hetherington
External Relations Advisor
Bil.hetherington@shell.com

REQUEST FOR DECISION

SUBJECT:	**Geothermal Deep Dive Presentation**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	KK
DEPARTMENT:	ECONOMIC DEVELOPMENT	GM:	DM	PRESENTER:	

RELEVANT LEGISLATION:
Provincial (cite) –N/A

Council Bylaw/Policy (cite) - N/A

RECOMMENDED ACTION:
MOTION: That Council accept the Deep Dive Geothermal Project report for information, as presented.

BACKGROUND/PROPOSAL:
Dr. Jonathan Banks; with the University of Alberta has recently completed a study into the Deep Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta. Dr. Banks will give an updated presentation regarding the results of the analysis as it pertains to opportunities within Greenview. Dr. Banks will be joined by associates from Alberta Innovates and Terrapin Geothermic to provide information about potential future research and commercialization opportunities.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of accepting the presentation is to confirm receipt of the Council update on the future benefits of geothermal resources located within Greenview boundaries.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantages to accepting the presentation.

ALTERNATIVES CONSIDERED:
Alternative #1: - N/A

FINANCIAL IMPLICATION:
Direct Costs: - N/A
Ongoing / Future Costs: - N/A

STAFFING IMPLICATION:
N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

INFORM - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

INFORM - We will keep you informed.

FOLLOW UP ACTIONS:

N/A

ATTACHMENT(S):

- Dr. Banks and Terrapin Geothermic provided PowerPoint presentations.

UNIVERSITY OF ALBERTA
Earth and Atmospheric Sciences
culty of Science
1-26 Earth Sciences Building
780.492.3265
Edmonton, Alberta, Canada T6G 2E3
www.ualberta.ca/eas
eas.enquiries@ualberta.ca
Tel:
Fax: 780.492.2030

Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta: Final Report

Prepared by

Jonathan Banks
Research Scientist
University of Alberta
Earth Sciences Building 4 – 02
Edmonton, AB T6G 2E3
jbanks@ualberta.ca

with financial support from

Alberta Innovates, the City of Grande Prairie, Grande Prairie County, the Municipal District of Greenview, the Town of Hinton, the Tri - Council of Clearwater County, Rocky Mountain House and the Village of Caroline.

and in-kind support from

Terrapin Geothermics Inc., CES Power and Control, Solbird Energy and the Iceland School of Energy at the Reykjavik University

And with special thanks to

Nick Harris at the University of Alberta for providing faculty oversight, as well as Ryan Brenner and Even Renaud at the University of Alberta for assistance with data processing and literature reviews.

Executive Summary

Geotechnical and hydrogeological data taken from well bore logs and rock cores were used to identify, map, and predict the power production potential of geothermal reservoirs spread across several municipal districts in western Alberta. These districts include the City and County of Grande Prairie, the Municipal District of Greenview, the Town of Hinton and the Tri-council of Clearwater County, Village of Caroline and Town of Rocky Mountain House.

This study provides critical information to stakeholders for catalyzing the growth of an as-yet non-existent geothermal industry in Alberta. On a broader scale, this study provides a case study for quantifying regional scale geothermal resources in sedimentary basins. Although considerable amount of work remains to be done in order to bring a commercial geothermal project to fruition in Alberta, this study conclusively reveals a viable technical and potentially cost competitive geothermal resource base in the Western Canadian Sedimentary Basin.

We analyzed over 65,000 different wells in order to locate potentially water-bearing strata with temperatures ≥100 ˚C in the west-central parts of Alberta. We identified and quantified the resource potential of 22 possible mid-Devonian geothermal pools within our search area. Potential geothermal pools hosted in the Leduc formation were found in all of the municipal districts we investigated. Potential pools in the Swan Hills formation were identified in 3 of the 4 municipal districts investigated, as were potential pools in the Gilwood sandstone. Potential pools in the Granite Wash were found in two municipal districts. A summary of the technical parameters that went into the geologic modeling is found in the table below.

In addition to quantifying the thermal and electrical power potential of specific geothermal pools throughout the 4 municipal districts, this study also investigated 4 end-use scenarios:

- electricity production for a small pilot demonstration facility
- retrofitting of oil and gas wells for district heat use
- geothermal heating for greenhouses
- geothermal heating for timber drying

The major findings from this study are:

- Identification of over 6,100 MWt of thermal power capacity potential for a 30-year production period spread across the study area.
- Quantification of the scale of a geothermal system required to run both a greenhouse (~6 kg/s per hectare with a 60 °C brine) and a standard timber drying kiln (~9 kg/s with a 100 °C brine, for a standard size installation). With repurposed wells, such a system may cost $50-500/kWt. A system with new wells would cost $800-1000/kWt, and would need to be ~10x bigger to justify the expense.
- Identification of over 1,150 MWe of technically recoverable electrical power capacity potential for a 30-year production period. Indicators show that nearly 800MWe would be potentially cost competitive with today's technologies and roughly 80% of this resource is located within the 50km radius around the Town of Hinton.
- Electricity production of Alberta's geothermal resources is at a lower technology readiness level than direct use of heat production. Costs of first adoption of pilot scale binary-cycle geothermal power production in Alberta are ~$12,000-15,000/kWe. These costs are indicative of a pre-commercial technology that still requires technical and cost competitive de-risking. Some factors that may reduce these costs over time are continued exploration using existing oil and gas data, repurposing oil and gas wells as geothermal slim holes and developing and optimizing low and ultra-low temperature heat engines. As the technology matures, we expect these cost to be reduced

to $6,000-$8,000/kWe, which would make geothermal power cost competitive with wind and solar on a kilowatt-hour basis.

- Cost estimates for a 2.5 MWe demonstration plant, based on Albertan environmental conditions, using Albertan design, manufacturing and construction. With new wells, a first-of-its-kind plant of this scale may cost $25-30 million. Initial work indicates that if existing wells can be repurposed to save on drilling costs, this price decreases significantly.
- Cost estimates were developed for refurbishing an under-performing oil and gas well for geothermal heat or electrical power use and for drilling new, full-size geothermal wells in the Alberta economy. The fixed costs for retrofitting a well are ~$150,000, with an additional $40-50 per meter required for new tubing to be installed. The fixed costs for drilling new, full-size geothermal wells estimated to be $1.5 – 2 million per kilometer
- Quantification of the flow rates required to produce 1 MWe of electrical power, as a function of reservoir temperature. Three groups and three methods in this study independently confirmed the flow rates. The flow rates predicted within the study area range from ~40 kg/s to > 200 kg/s per megawatt of electrical power.

By developing our geothermal resources at home, we have the potential to position Albertan companies to be global leaders in basin-hosted geothermal production technology. Exploiting geothermal resources in sedimentary basins is a key aspect of making geothermal energy a major, rather than a niche, renewable power, globally. Due to the ubiquity of oil and gas wells in the Alberta subsurface, we have the potential to save tens of millions of dollars in the upfront costs related to geothermal energy exploration. In addition, if these well can be repurposed for geothermal energy production, the costs savings to the developer by not having to drill new wells for production could be in the tens of billions. Because of the clear technology transfer pathways between the oil and gas and geothermal industries, as well as Alberta's homegrown expertise in drilling and reservoir engineering, Alberta has a significant opportunity to be at the forefront of the development of transformative technology in the geothermal space.

Next steps required to bring geothermal energy to commercial production include building static reservoir models and reservoir production models for the top sites identified in this study, as well as expanded preliminary exploration, similar to that found in this study, for sited all across central and western Alberta. To take of advantage the widespread presence of 60 °C-100 ° water throughout the basin, we also recommend the further development and optimization of low and ultra-low temperature differential heat engines. Additionally further economic modelling is required to show the commercial viability of specific projects, or to determine term the economic variables that will make the technology commercial viable. Finally, a regulatory framework for producing and selling geothermal energy in the province is required.

Town	Reservoir	Temperature (°C)	Depth (m)	Thermal Energy (MWt)	Flow Rate per MWt (kg/s)	Electrical Energy (MWe)	Flow Rate per MWe (kg/s)
Sexsmith	*Leduc*	92±2	3300±83	109	17	15	124
	Swan Hills						
	Granite Wash	120±6	4198±488	176	11	40	48
	Gilwood						
Grande Prairie	*Leduc*	96±3	3389±70	238	16	35	106
	Swan Hills						
	Granite Wash	120±6	4198±488	71	11	16	48
	Gilwood						
Wembley	*Leduc*	112	4256±269	176	12	35	61
	Swan Hills						
	Granite Wash	120±6	4198±488	24	11	5	48
	Gilwood						
Beaverlodge	*Leduc*						
	Swan Hills						
	Granite Wash	120±6	4198±488	71	11	16	48
	Gilwood						
Hythe	*Leduc*						
	Swan Hills						
	Granite Wash	120±6	4198±488	99	11	22	48
	Gilwood						
Valleyview	*Leduc*	75±12	2675±325	597	24	51	282
	Swan Hills	83±6	2825±182	78	20	9	180
	Granite Wash	80±10	3035±175	462	22	46	214
	Gilwood	83±14	3081±367	141	20	16	175
Fox Creek	*Leduc*						
	Swan Hills	90±15	3043±17 6	349	18	46	135
	Granite Wash						
	Gilwood	93±14	3158±164	63	17	9	116
Hinton	*Leduc*	129±13	4513±627	883	10	222	38
	Swan Hills	129±12	4557±486	1558	10	393	38
	Granite Wash						
	Gilwood	119±14	4306±264	69	11	15	50
Rocky Mountain House	*Leduc*	112±11	3608±994	20	12	4	60
	Swan Hills	118±15	4200±690	112	11	24	51
	Granite Wash						
	Gilwood						
Caroline	*Leduc*	96±10	3457±150	592	16	90	102
	Swan Hills	94±10	3788±133	220	16	32	114
	Granite Wash						
	Gilwood	100±8	3861±70	79	15	13	90

UNIVERSITY OF ALBERTA
Earth and Atmospheric Sciences
culty of Science
1-26 Earth Sciences Building
780.492.3265
Edmonton, Alberta, Canada T6G 2E3
www.ualberta.ca/eas
eas.enquiries@ualberta.ca
Tel:
Fax: 780.492.2030

Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta: Final Report

Prepared by

Jonathan Banks
Research Scientist
University of Alberta
Earth Sciences Building 4 – 02
Edmonton, AB T6G 2E3
jbanks@ualberta.ca

with financial support from

Alberta Innovates, the City of Grande Prairie, Grande Prairie County, the Municipal District of Greenview, the Town of Hinton, the Tri - Council of Clearwater County, Rocky Mountain House and the Village of Caroline.

and in-kind support from

Terrapin Geothermics Inc., CES Power and Control, Solbird Energy and the Iceland School of Energy at the Reykjavik University

And with special thanks to

Nick Harris at the University of Alberta for providing faculty oversight, as well as Ryan Brenner and Even Renaud at the University of Alberta for assistance with data processing and literature reviews.

DISCLAIMER

Alberta Innovates ("AI") and Her Majesty the Queen in right of Alberta make no warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in this publication, nor that use thereof infringe on privately owned rights. The views and opinions of the author expressed herein do not necessarily reflect those of AI or Her Majesty the Queen in right of Alberta. The directors, officers, employees, agents and consultants of AI and the Government of Alberta are exempted, excluded and absolved from all liability for damage or injury, howsoever caused, to any person in connection with or arising out of the use by that person for any purpose of this publication or its contents.

The University of Alberta makes no warranty, express or implied, nor assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information contained in this publication, nor the use thereof infringes on privately owned rights. The views and opinions of the author expressed herein do not necessarily reflect those of the University of Alberta. The directors, officers, employees, agents, students and consultants of the University of Alberta are exempted, excluded and absolved from all liability for damage or injury, howsoever caused, to any person in connection with or arising out of the use by that person for any purpose of this publication or its contents.

Contents

Table of Figures

Table of Tables

Definitions

Several terms are used throughout this report that may carry various meanings, depending on the background of the reader. For the purposes of this report, the following terms are defined as follows:

Section: A stacked collection of geological formations that span a prolonged unit of time, i.e. the Cambrian section, or the middle Devonian section

Formation: An individual geological unit with a well-defined age, stratigraphic horizon and rock type, i.e. the Granite Wash formation or the Leduc formation

Brine: The fluid contained with a formation's pore space

Resource: Economically valuable material within a formation, i.e. the thermal energy contained within the brine and the rocks

Reservoir: A regional scale, resource-rich formation

Pool: A localized section of a reservoir that is being investigated for commercial development

Geothermal doublet: A basic geothermal energy production system consisting of a brine production and a brine reinjection well

List of Abbreviations and Symbols

GW	gigawatt
˚C	degrees Celsius
ΔH	change in enthalpy
ΔS	change in entropy
Cp_f	geothermal fluid heat capacity
Cp_r	reservoir rock heat capacity
EJ	exaJoule
ϕ	porosity
γ	thermal recovery factor
η	electricity conversion factor
H_0	dead state enthalpy
H_r	reservoir enthalpy
K	Kelvin
km	kilometer
m	meter
m^3	cubic meters
MJ/m^3K	mega Joules per cubic meter Kelvin; heat capacity
MWe	megawatt of electrical power
M_{wh}	fluid mass at well head
MWt	megawatt of thermal power
ORC	Organic Rankine Cycle
$Q_{r,}$	thermal energy in reservoir
Q_{wh}	thermal energy at wellhead
S_0	dead state entropy
S_r	reservoir entropy
T_0	dead state temperature
T_r	reservoir temperature
V_f	reservoir rock volume
V_r	reservoir fluid volume
W_A	exergy
WCSB	Western Canadian Sedimentary Basin
W_p	exergy available for electricity production

Executive Summary

Geotechnical and hydrogeological data taken from well bore logs and rock cores were used to identify, map, and predict the power production potential of geothermal reservoirs spread across several municipal districts in western Alberta. These districts include the City and County of Grande Prairie, the Municipal District of Greenview, the Town of Hinton and the Tri-council of Clearwater County, Village of Caroline and Town of Rocky Mountain House.

This study provides critical information to stakeholders for catalyzing the growth of an as-yet non-existent geothermal industry in Alberta. On a broader scale, this study provides a case study for quantifying regional scale geothermal resources in sedimentary basins. Although considerable amount of work remains to be done in order to bring a commercial geothermal project to fruition in Alberta, this study conclusively reveals a viable technical and potentially cost competitive geothermal resource base in the Western Canadian Sedimentary Basin.

We analyzed over 65,000 different wells in order to locate potentially water-bearing strata with temperatures ≥100 ˚C in the west-central parts of Alberta. We identified and quantified the resource potential of 22 possible mid-Devonian geothermal pools within our search area. Potential geothermal pools hosted in the Leduc formation were found in all of the municipal districts we investigated. Potential pools in the Swan Hills formation were identified in 3 of the 4 municipal districts investigated, as were potential pools in the Gilwood sandstone. Potential pools in the Granite Wash were found in two municipal districts. A summary of the technical parameters that went into the geologic modeling is found in the table below.

In addition to quantifying the thermal and electrical power potential of specific geothermal pools throughout the 4 municipal districts, this study also investigated 4 end-use scenarios:

- electricity production for a small pilot demonstration facility
- retrofitting of oil and gas wells for district heat use
- geothermal heating for greenhouses
- geothermal heating for timber drying

The major findings from this study are:

- Identification of over 6,100 MWt of thermal power capacity potential for a 30-year production period spread across the study area.
- Quantification of the scale of a geothermal system required to run both a greenhouse (~6 kg/s per hectare with a 60 °C brine) and a standard timber drying kiln (~9 kg/s with a 100 °C brine, for a standard size installation). With repurposed wells, such a system may cost $50-500/kWt. A system with new wells would cost $800-1000/kWt, and would need to be ~10x bigger to justify the expense.
- Identification of over 1,150 MWe of technically recoverable electrical power capacity potential for a 30-year production period. Indicators show that nearly 800MWe would be potentially cost competitive with today's technologies and roughly 80% of this resource is located within the 50km radius around the Town of Hinton.
- Electricity production of Alberta's geothermal resources is at a lower technology readiness level than direct use of heat production. Costs of first adoption of pilot scale binary-cycle geothermal power production in Alberta are ~$12,000-15,000/kWe. These costs are indicative of a pre-commercial technology that still requires technical and cost competitive de-risking. Some factors that may reduce these costs over time are continued exploration using existing oil and gas data, repurposing oil and gas wells as geothermal slim holes and developing and optimizing low and ultra-low temperature heat engines. As the technology matures, we expect these cost to be reduced

to $6,000-$8,000/kWe, which would make geothermal power cost competitive with wind and solar on a kilowatt-hour basis.

- Cost estimates for a 2.5 MWe demonstration plant, based on Albertan environmental conditions, using Albertan design, manufacturing and construction. With new wells, a first-of-its-kind plant of this scale may cost $25-30 million. Initial work indicates that if existing wells can be repurposed to save on drilling costs, this price decreases significantly.
- Cost estimates were developed for refurbishing an under-performing oil and gas well for geothermal heat or electrical power use and for drilling new, full-size geothermal wells in the Alberta economy. The fixed costs for retrofitting a well are ~$150,000, with an additional $40-50 per meter required for new tubing to be installed. The fixed costs for drilling new, full-size geothermal wells estimated to be $1.5 – 2 million per kilometer
- Quantification of the flow rates required to produce 1 MWe of electrical power, as a function of reservoir temperature. Three groups and three methods in this study independently confirmed the flow rates. The flow rates predicted within the study area range from ~40 kg/s to > 200 kg/s per megawatt of electrical power.

By developing our geothermal resources at home, we have the potential to position Albertan companies to be global leaders in basin-hosted geothermal production technology. Exploiting geothermal resources in sedimentary basins is a key aspect of making geothermal energy a major, rather than a niche, renewable power, globally. Due to the ubiquity of oil and gas wells in the Alberta subsurface, we have the potential to save tens of millions of dollars in the upfront costs related to geothermal energy exploration. In addition, if these well can be repurposed for geothermal energy production, the costs savings to the developer by not having to drill new wells for production could be in the tens of billions. Because of the clear technology transfer pathways between the oil and gas and geothermal industries, as well as Alberta's homegrown expertise in drilling and reservoir engineering, Alberta has a significant opportunity to be at the forefront of the development of transformative technology in the geothermal space.

Next steps required to bring geothermal energy to commercial production include building static reservoir models and reservoir production models for the top sites identified in this study, as well as expanded preliminary exploration, similar to that found in this study, for sited all across central and western Alberta. To take of advantage the widespread presence of 60 °C-100 ° water throughout the basin, we also recommend the further development and optimization of low and ultra-low temperature differential heat engines. Additionally further economic modelling is required to show the commercial viability of specific projects, or to determine term the economic variables that will make the technology commercial viable. Finally, a regulatory framework for producing and selling geothermal energy in the province is required.

Town	Reservoir	Temperature (°C)	Depth (m)	Thermal Energy (MWt)	Flow Rate per MWt (kg/s)	Electrical Energy (MWe)	Flow Rate per MWe (kg/s)
Sexsmith	*Leduc*	92±2	3300±83	109	17	15	124
	Swan Hills						
	Granite Wash	120±6	4198±488	176	11	40	48
	Gilwood						
Grande Prairie	*Leduc*	96±3	3389±70	238	16	35	106
	Swan Hills						
	Granite Wash	120±6	4198±488	71	11	16	48
	Gilwood						
Wembley	*Leduc*	112	4256±269	176	12	35	61
	Swan Hills						
	Granite Wash	120±6	4198±488	24	11	5	48
	Gilwood						
Beaverlodge	*Leduc*						
	Swan Hills						
	Granite Wash	120±6	4198±488	71	11	16	48
	Gilwood						
Hythe	*Leduc*						
	Swan Hills						
	Granite Wash	120±6	4198±488	99	11	22	48
	Gilwood						
Valleyview	*Leduc*	75±12	2675±325	597	24	51	282
	Swan Hills	83±6	2825±182	78	20	9	180
	Granite Wash	80±10	3035±175	462	22	46	214
	Gilwood	83±14	3081±367	141	20	16	175
Fox Creek	*Leduc*						
	Swan Hills	90±15	3043±17 6	349	18	46	135
	Granite Wash						
	Gilwood	93±14	3158±164	63	17	9	116
Hinton	*Leduc*	129±13	4513±627	883	10	222	38
	Swan Hills	129±12	4557±486	1558	10	393	38
	Granite Wash						
	Gilwood	119±14	4306±264	69	11	15	50
Rocky Mountain House	*Leduc*	112±11	3608±994	20	12	4	60
	Swan Hills	118±15	4200±690	112	11	24	51
	Granite Wash						
	Gilwood						
Caroline	*Leduc*	96±10	3457±150	592	16	90	102
	Swan Hills	94±10	3788±133	220	16	32	114
	Granite Wash						
	Gilwood	100±8	3861±70	79	15	13	90

1 Introduction

1.1 Project Background and Overview

Geothermal energy production refers to harnessing the latent heat of the earth to provide fuel for human activity. Geothermal energy is a baseload, renewable resource that has the potential to play a role in a global transformation away from fossil fuel based resources. Historically, the development of utility scale geothermal power projects has been restricted to tectonically active areas where high surface heat flow and extensive subsurface fracture networks allow for relatively easy access to hot fluids. These areas are often far away from human activities that require the thermal and electrical power that geothermal energy may provide.

Recent growth in the global geothermal industry has focused on sedimentary basins, many of which contain geothermal resources that are closer to suitable geothermal energy end users. The Western Canadian Sedimentary Basin (WCSB) is a continental scale, alpine foreland basin that underlies many population centers and possesses a large geothermal resource base. The WCSB, which covers most of the Province of Alberta, is best known for its hydrocarbon reservoirs, which include the Athabasca oils sands, as well as over a quadrillion of cubic feet of natural gas and coalbed methane. Prolific development of these hydrocarbon resources has created a robust set of thermodynamic and hydrogeologic subsurface data that can potentially be used to locate and map geothermal resources, as well as quantify the power production capabilities of these resources throughout the basin.

The Department of Earth and Atmospheric Sciences at the University of Alberta undertook this Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta in order to catalyze commercial geothermal energy development in the province. We used data from the oil and gas industry to assess the geothermal resource potential of several hot sedimentary aquifers in Alberta, which overlay some of the deepest parts of the WCSB. Five regional municipal governments with high potential for being impacted by exploitation of the WCSB's geothermal resources participated in this project as funding partners. From north to south, these governments are:

1. The County of Grande Prairie
2. The City of Grande Prairie
3. The Municipal District of Greenview
4. The Town of Hinton
5. The Tri-council of Clearwater County, Village of Caroline, Town of Rocky Mountain House

In-kind support for this project in the form of cost estimates, power needs, process flow diagrams were provided by Terrapin Geothermics, Solbird Energy, CES Power and Control and the Iceland School of Energy at Reykjavik University.

The purpose of this study is to provide the participating municipal districts the requisite information for long-term strategic planning towards developing their geothermal resources and to begin the process of commercial development. This information fell into 3 basic categories:

1. The precise location of geothermal reservoirs at depth
2. The thermal and electrical power production capacity of these reservoirs
3. Local options for geothermal power utilization, including cost estimates for various applications

The goal of the study was to incubate a geothermal energy industry in Alberta, leading to commercial production of this resource by 2020.

We began the study by accessing well data for every well in these municipalities that is deeper than 1500 m, as shown in Figure 1.

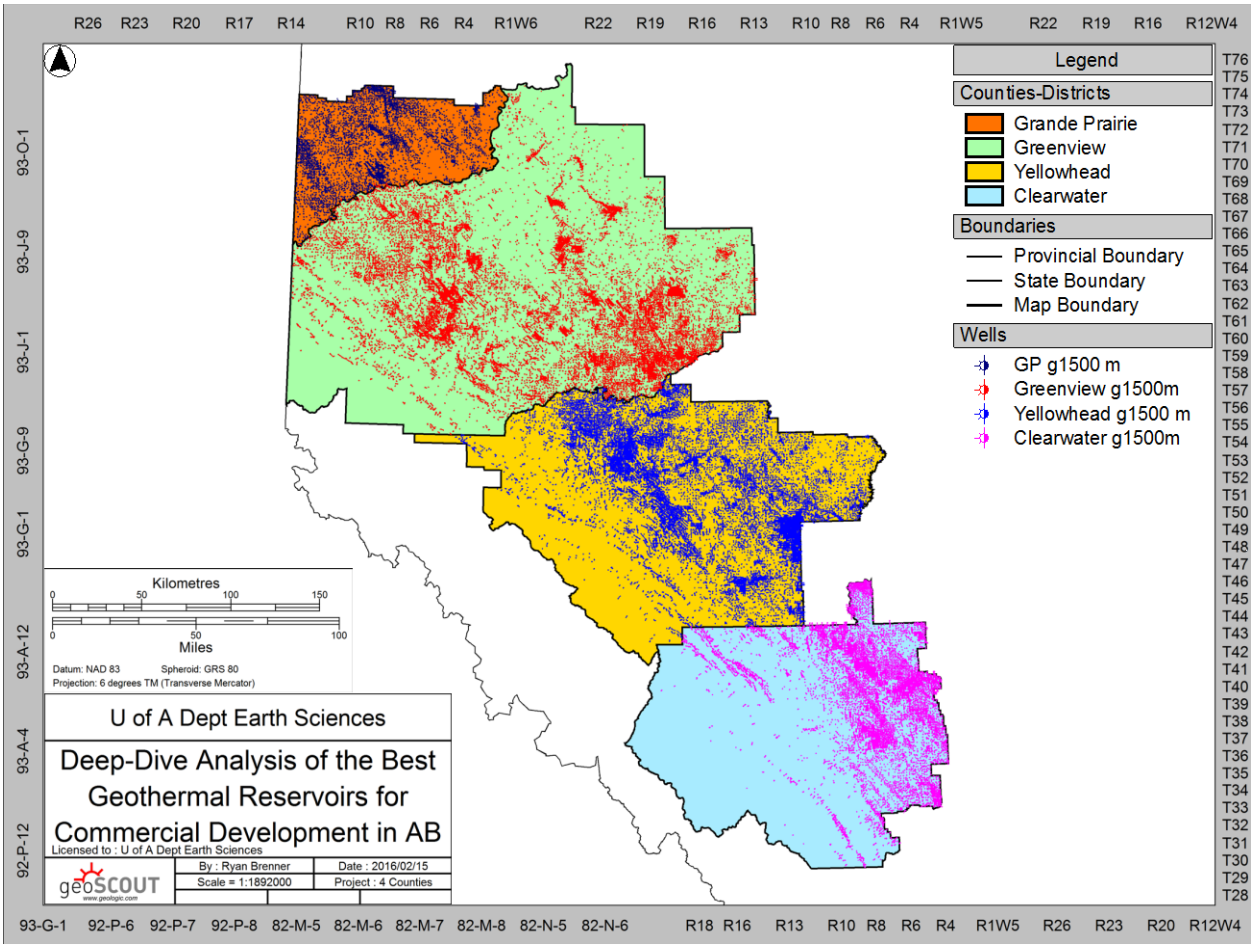


Figure 1 Map of the municipal districts participating in this study, together with every well data point that was used for building the models and developing the volumetric energy assessments

Table 1 shows the breakdown of these wells by depth. Altogether, over 65,000 data points were used to identify the reservoirs most suitable for commercial development.

Table 1 Distribution of wells used in this study by municipal district and well depth

	Number Wells by Municipal District			
Well Depth	*Grande Prairie*	*Greenview*	*Yellowhead*	*Clearwater*
> 1500	5,877	21,354	21,300	12,213
> 2000	4,693	17,395	18,300	10,243
> 2500	1,772	12,528	13,244	5,808
> 3000	253	7,063	7,442	2,449
> 3500	69	1,648	1,737	999
> 4000	19	332	607	401
> 4500	6	108	303	140
> 5000	1	43	30	40
> 5500	0	12	8	8

Temperature is the primary concern in evaluating the technical and commercial viability of a geothermal resource. Commercial use of geothermal energy directly as heat can begin with resource temperatures as low as 50 °C. In Alberta, where average annual air temperatures hover at a balmy 0 °C, utility-scale electricity may be produced from resources with temperatures ≥100 °C. Our search for the most viable resources began by determining the temperature distribution of gas pools throughout the study region. The assumption here is that gas pools lie directly above the water pools, and thus the gas pools provide a window into the conditions found in the underlying aquifers. Figure 2 shows a histogram of all the potential geothermal pools in our study area, categorized by temperature.

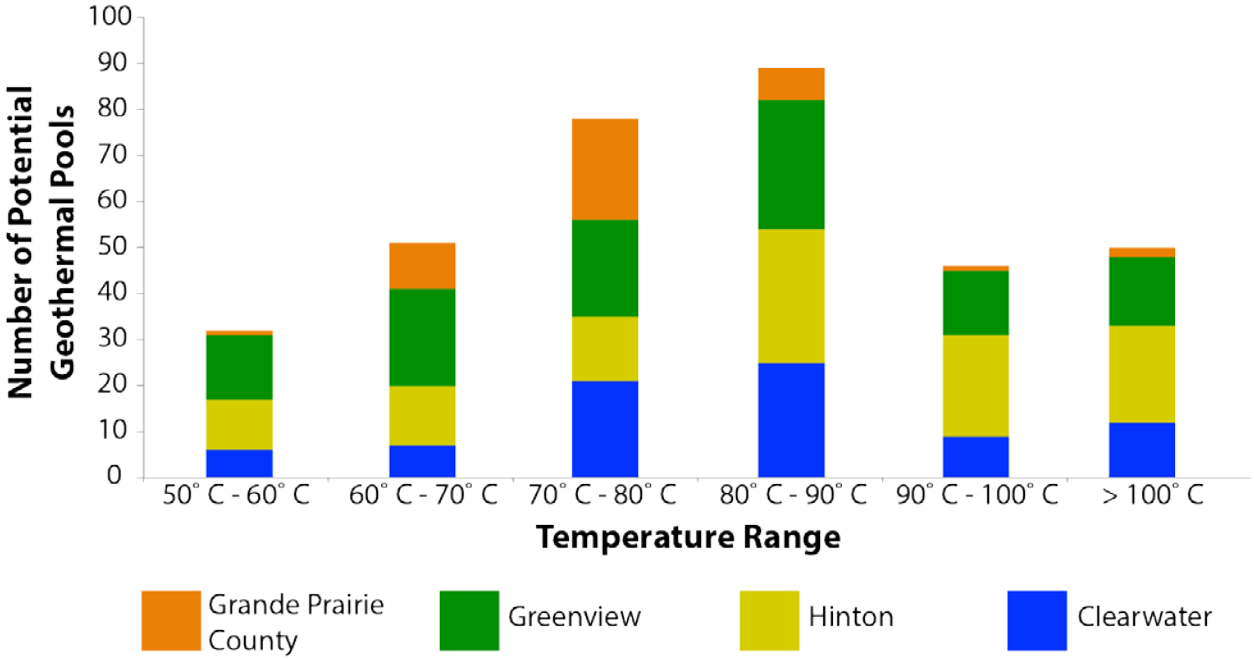


Figure 2 Histogram of identified potential geothermal pools as a function of temperature and municipal location

In the proposal stage of this project, we anticipated identifying 10 geothermal pools that may have the temperatures required for producing electricity. The data revealed that there might be as many as 50 pools in the study area that meet this criterion. Furthermore, an additional 296 pools were identified with temperatures > 50 ˚C. These pools, which contain the majority of Alberta's basin - hosted geothermal resources, are appropriate for direct use of geothermal heat.

In order to maintain the focus of diving deeply, we needed to narrow down the number of ≥100 ˚C pools to choose from for comprehensive evaluation. We chose to start at the bottom of the basin and focus only on Devonian) formations, i.e. formations from 419.2 million years old to 358.2 million years old. Specifically, we looked at all formations below the Ireton as possible geothermal reservoirs. This was a strategic decision made to reduce the total volume of data we needed to manage within the timeframe of this study. Starting at the bottom of the section was a way to insure we targeted the highest temperature reservoirs first. Capping the search below the Ireton formation was an arbitrary decision geared towards keeping the number of pools we investigated close to the expected number identified in the initial project proposal. In the end, we focused on 4 geologic formations that, based on known lithologies and hydrogeologic properties, were deemed to be the most likely water bearing strata. These formations, from the youngest to oldest are:

1. Leduc (carbonate reef)
2. Swan Hills (carbonate reef)
3. Granite Wash (fluvial deltaic sandstone)
4. Gilwood (arkosic sandstone)

Other formations in the study region may also be suitable geothermal reservoirs on a more local basis, but these formations were not investigated in this study. For example, in the interim report, we also briefly discussed several Cambrian formations in the Municipal District of Greenview and Clearwater County. Upon further investigation, however, it became clear that there were not enough data to reliably determine the potential of these formations. Therefore, they are not included in this final report.

The formations mentioned above are the most widespread potential deep aquifers in the study region, and therefore, they have the greatest potential as geothermal reservoirs. Table 3 summarizes the extent of their presence beneath population centers throughout the study region.

Table 2 Locations of the 4 investigated formations beneath 10 population centers within our study area

Municipal District	Population center	Gilwood	Granite Wash	Swan Hills	Leduc
Grande Prairie County	Sexsmith		X		X
	Grande Prairie		X		X
	Wembley		X		X
	Beaverlodge		X		
	Hythe		X		
Municipal District of Greenview	Valleyview	X	X	X	X
	Foxcreek	X		X	
Yellowhead County	Hinton	X		X	X
Clearwater County	Rocky Mountain House			X	X
	Caroline	X		X	X

In total, we identified, mapped and calculated the thermal and electrical power production capacity for 22 potential geothermal pools situated beneath 10 population centers throughout the study region.

A detailed description of the Devonian section of the WCSB underlying western Alberta is found in section 1.2, below. A summary of previous geothermal energy research in the WCSB, found in section 1.3, completes this introductory chapter. Chapter 2 of this report details the methods we used in completing the geotechnical elements of the study, including both the mapping and modeling methods, as well as the volumetric methods used for calculating the bulk thermal and electrical power potential of the reservoirs. Chapter 3 summarizes the results of the geotechnical section of the study, and Chapter 4 details specific options available to the participating municipalities. In Chapter 5, we provide preliminary process flow diagrams, thermodynamic assessments and cost estimates for direct use and electricity generation opportunities available to the participating municipalities. Chapter 6 presents a review of royalty and regulatory issues facing Alberta. The study concludes in Chapter 7 with a summary of the major results and recommendations for further action.

1.2 Devonion Strata beneath the Alberta Foothills

Devonian strata in the Alberta foothills and plains are represented by, from oldest to youngest, the Lower Devonian strata, the Elk Point Group, the Beaverhill Lake Group, the Woodbend Group, the Winterburn Group and the Wabamun Group. Devonian strata make up some of the thickest accumulations of rock in

the WCSB and contain world–class hydrocarbon resources. A stratigraphic section of Devonian formations in the Alberta foothills is shown in Figure 3.

The Lower Devonian has been almost entirely eroded away, save for within the Williston Basin (Saskatchewan and Manitoba) and outcrops exposed within the Rocky Mountains (Glass, 1990; Meijer, 1994). These strata were deposited as a result of the second major North American transgression, the Tippecanoe Sequence. The Tippecanoe transgression ended a period of early–Appalachian erosion that deposited siliclastic and carbonate sediments across the North American Craton during the middle Ordovician to the early Devonian (Glass, 1990; Meijer, 1994). This event was followed by a period of erosion during which most of the Lower Devonian in Alberta strata were destroyed. Remnants of the Lower Devonian are nonetheless found in various regions of our study, most notably in the north, in the form of the Granite Wash sandstones (Rottenfusser and Oliver 1977; Meijer, 1994; Dec et al., 1996)

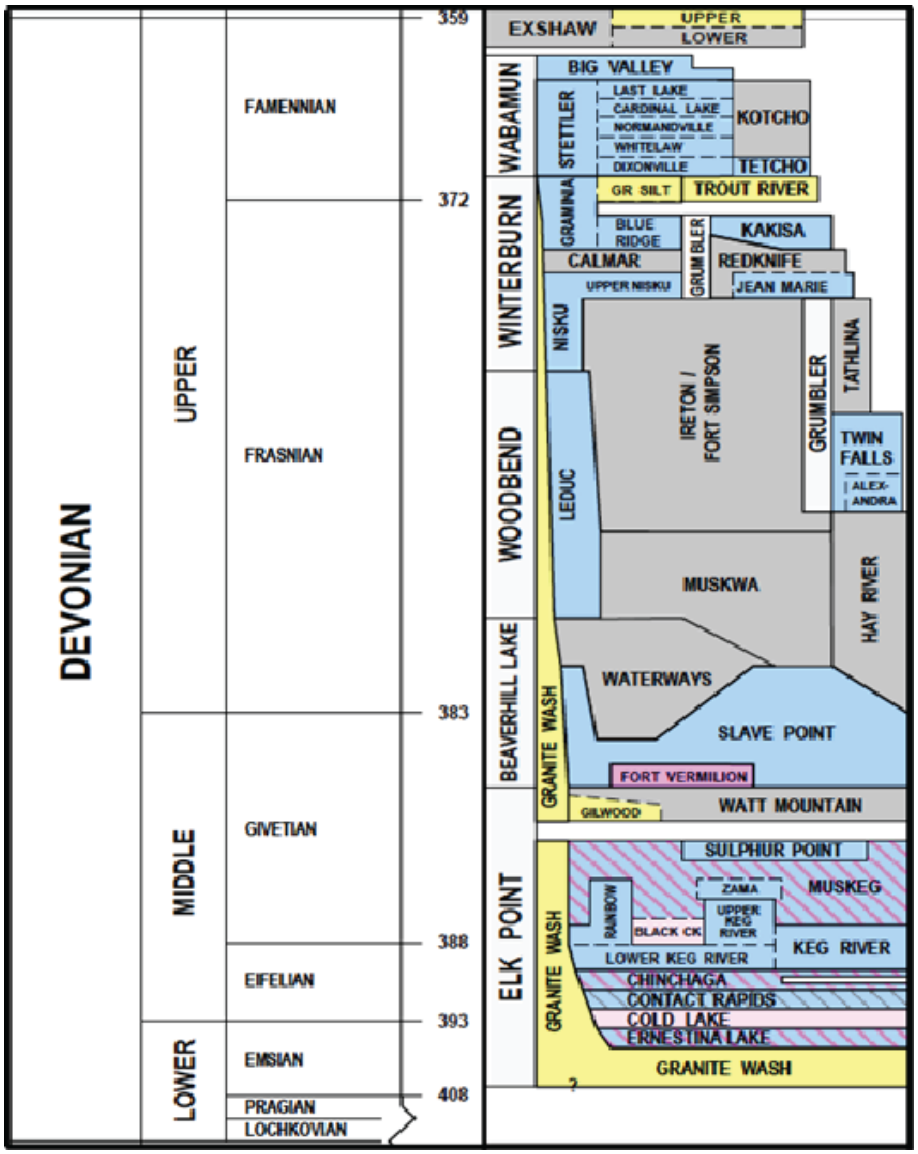


Figure 3 Idealized Devonian stratigraphic columns for our study area in the Alberta foothills (adapted from: Alberta Geological Survey, 2015)

Due to an erosional period at the end of the lower Devonian, the Elk Point Group was deposited on an irregular surface of considerable relief. The Elk Point Group variously overlies Ordovician and Silurian carbonates, Precambrian igneous and metamorphic rocks, and Cambrian clastics and carbonates (James and Leckie, 1988; Glass, 1990.) The initial Elk Point deposit consists of the green shales of the Watt Mountain Formation and the red to green dolomitic mudstones of the Second Red Bed member (Kramers and Lerbekmo, 1967; Rottenfusser and Oliver 1977; Meijer, 1994). Arkosic sandstones of the Gilwood Member (part of the Watt Mountain) were deposited in a fluvial-deltaic complex along the Peace River Arch (Rottenfusser and Oliver 1977). The Gilwood is a promising sandstone reservoir in the southern parts of our study area. The Muskeg, Keg River, Prairie Evaporites and Sulphur Point are all prominent members of the Elk Point Group, although they do not play important roles in this study, either due to their absence from the study area, or their lack of appropriate reservoir properties (Kramers and Lerbekmo, 1967; Meijer, 1994).

A rise in relative sea level initiated the beginning of the Beaverhill Lake Group (Glass, 1990). The Fort Vermillion Formation at the base of this group consists of restricted coastal marine carbonates and evaporites. A further increase in relative sea level deposited widespread open-marine carbonates of the Slave Point Formation, which in turn gave a suitable substrate for the reefs of the Swan Hills Formation (Hemphill et al., 1970; Oldale and Munday, 1994). The Swan Hills Formation contains one of Alberta's most abundant geothermal resources and is found in 3 of the 4 municipal districts in this study. Following the formation of the Swan Hills reefs, the sea again regressed, allowing the shales and argillaceous carbonates of the Waterways Formation to fill in the space between the reefs (Hemphill et al., 1970; Oldale and Munday, 1994).

The Woodbend Group, which overlies the Beaverhill Lake Group, represents a period of relative sea level rise upward from the Cooking Lake, through the Majeau Lake, Leduc and Duvernay formations (Glass, 1990; Switzer et al., 1994). The Cooking Lake Formation is composed of extensive sheet-like shelf carbonates and a deeper – basin filling shale. Majeau Lake contains similar lithofacies, but also contains isolated reef complexes and reefal margins (Andrichuk, 1958; Switzer et al, 1994; Wendte; 1994). The growth of the Leduc Reefs represents the culmination of sea level rise during the deposition of the Beaverhill Lake Group. Leduc reefs are found throughout our study area and, with the Swan Hill reefs, are among Albert's most promising geothermal resources (Jansa and Fischbuch, 1974; Kaufman et al., 1990; Atchley et al., 2006)

Contemporaneously with the formation of the Leduc Reefs, the Duvernay formation was deposited as basin in-filling, dark brown bituminous shale and limestone (Dunn et al., 2012). Similar to the Waterways Formation, the Duvernay basinal sediments were deposited extensively across the entire basin. Eventually an end to the sequence of deepening (and the conclusion of the Woodbend Group) occurred with the deposition of the Ireton Formation consisting of cyclic successions of basin – filling shale (Switzer et al, 1994; Dunn et al., 2012)

The remaining Devonian sequences, i.e. the Winterburn and the Wabamum Groups, were not investigated in this study.

The sedimentary rocks which comprise Alberta's Devonian Strata are of two types: siliclastics and carbonates. Siliclastic formations are formed predominantly from silicate minerals (i.e. quartz, feldspar, micas, clays) that have been physically eroded, transported, re – deposited and lithified. Sandstones and shales are the most common siliclastic rocks. Reservoir quality in siliclastic rocks is defined by the nature of their inter – granular contacts and in – filling cement. Sandstones are generally good reservoirs because their physical composition (i.e. individual sand grains) makes them resistant to compaction. Thus, their primary porosity is often preserved, even when they are found at great depth. We assume that this porosity is water saturated. The relationship between porosity and permeability in sandstones is also fairly well understood in sandstones via the "Klinkenberg" correlation. Therefore, predicting fluid flow behaviour based only on porosity data is reliable over a large area.

Carbonates can form from the chemical precipitation of carbonate – bearing minerals (i.e. limestone) from a body of water, or the accumulation of organically – derived carbonate material (e.g. dead microorganisms; shells) on a substrate. The properties of carbonate rocks vary depending on the environment of their deposition. They can also display significant amounts of secondary porosity, caused either through dolomitization (i.e. calcite changing to dolomite), or karstification (i.e. chemical dissolution in contact with a fluid.) Of the various types of carbonates, reef facies are deemed most favourable for geothermal energy production. Carbonate reefs contain high degrees of both primary and secondary porosity, whereas open marine, shelf and bank carbonates may be severely hydrogeologically restricted. Carbonate reef reservoirs, like sandstones, are generally believed to be water saturated.

Of the formations within these investigated groups, the Leduc (carbonate), Swan Hills (carbonate), Granite Wash (sandstone), and Gilwood (sandstone) are the most widespread and promising geothermal resources. As shown in Table 2, we have identified 22 potential geothermal pools within these formations underlying the population centers underlying our study are. Thus, we studied more than twice the number of pools we sought to investigate during the initial proposal stage of this project.

1.3 Geothermal Research in the Western Canadian Sedimentary Basin

Geothermal research in Canada dates back to Garland and Lennox (1962), who studied heat flow throughout the western Canadian provinces and territories. Majorowicz and Jessop (1981) first studied regional heat flow patterns in the WCSB, specifically. Subsequently, this research has expanded to include thermal conductivity studies throughout the basin (Lam et al., 1985), radiogenic heat production and heat flow from the Precambrian basement underlying the WCSB (Jones and Majorowicz, 1987; Bachu, 1993) and temperature distribution along the Precambrian and various Paleozoic surfaces in WCSB (Jones et al., 1985). Much of this early research was plagued by inconsistencies with the temperature data. Thus, extensive work has been done to correct temperature data for hydrodynamic influences (e.g. Majorowicz et al., 1999), paleoclimatic effects (Majorowicz et al., 2012a) and other biases (Gray et al., 2012). Nieuwenhuis et al, (2015) released a database at the 2015 World Geothermal Congress that is the culmination of the efforts to correct temperature measurements throughout the WCSB.

In addition to the emphasis on temperature corrections, recent geothermal research in the WCBS has focused on exploitation of the basin's geothermal energy for heating and electricity. On behalf of the Geological Survey of Canada, Grasby et al. (2012) performed a country-wide geothermal resource base estimate. Majorowicz et al. (2012b) investigated the possibility of using geothermal energy as heat source for oil-sands upgrading. Weides et al. (2013) looked for potential geothermal resources in Paleozoic strata in the Edmonton, AB metropolitan area (population ~1.16 million). This research led to a further interest in using the basal Cambrian sandstones as a potential electricity producing resource (Weides et al, 2014a). Weides et al, (2014b) also investigated the siliciclastic Granite Wash unit in the Peace River area of Alberta. Heat and electricity from a geothermal source could be used to offset the environmental footprint of in-situ hydrocarbon production in this region. Restricted largely by temperature, both of these formations have marginal electricity producing capabilities in these areas, but are able to provide ample heat for direct use.

This present study is predominantly inspired by the work done by Weides and Majorowicz (2014) that looked at spatial variability in heat flow throughout the entire WCSB. They overlaid the areal extent of known deep basin aquifers with temperature profiles from the surfaces of various geologic periods throughout the Paleo- and Mesozoic. The level of detail in Weides and Majorowicz's (2014) study allowed us to identify specific formations to investigate that have the potential to be exploited for electricity production and are close to either population centers, or areas where there is high industrial power demand. While other studies (e.g. Majorowicz and Grasby, 2010 Grasby et al., 2011, Majorowicz et al., 2012b; Majorowicz and Moore, 2014) have looked at Alberta's geothermal resource base as a diffuse, province-wide commodity. This is the first study that quantifies the power production potential of specific pools within exploitable proximity of possible end users.

2 Methods & Materials

2.1 Regional Reservoir Properties

Using data acquired from GeoSCOUT and the Alberta Energy Regulator and processed with Petrel, Surfer and Voxler, we made geologic models of the Devonian (Woodburn and below) stratigraphic sections underlying our study area. Within this section, we focus on 4 formations that we hypothesized are the most suitable geothermal reservoirs. From youngest to oldest, these formations are:

1. Leduc
2. Swan Hills
3. Granite Wash
4. Gilwood

On a regional basis, we produced a number of contour maps, including depths from the ground surface to the top of the formation, formation isopachs (thicknesses), bottom hole temperatures, potentiometric surfaces and porosity. Table 3 shows the number of data points used to make these maps.

Table 3 Number of data points used for contour mapping of geothermal reservoir properties in the Alberta Foothills.

	Parameter Data Points						
	Total Wells	*Total Vertical Depth*	*Total Vertical Depth to Formation Top*	*Corrected Bottom Hole Temperature*	*Pressure*	*Permeability*	*Porosity*
Leduc	1322	557	557	557	357	402	402
Swan Hills	1708	1708	1695	991	346	736	736
Gilwood	954	936	948	799	80	44	44
Granite Wash	308	308	308	176	63	53	53

Formation tops were identified predominantly by using the GeoSCOUT well tickets. For quality control, we cross-referenced the formation top depths in the GeoSCOUT well tickets with tops identified in the well logs themselves. To assist in this quality control, type-logs for each of the formations in question were obtained from the Alberta Energy Regulator. Temperature contours were made using Nieuwenhuis' (2015; used with permission) data, which contains ~127,000 corrected thermal gradient measurements from wells throughout the entire WCSB. We used the (Horner corrected) bottom hole temperature measurements from wells that terminated in our four potential reservoirs.

Potentiometric surfaces were mapped using drill stem pressure tests. Reservoirs are assumed to be unconfined, and the potentiometric surface is calculated as the difference between the well's total vertical depth and the hydrostatic head of the formation fluid at the given pressure. A brine density of 1150 kg/m^3 was assumed in the hydraulic head calculations. This takes into account changes in water density caused by both elevated salinity and elevated temperature (e.g. Dittman, 1977). This values may be taken as a basin wide average. Potentiometric surfaces are indicator of how much pumping power is required to bring geothermal brine to the surface in a given region.

Porosity measurements were taken from drill cores from the given formations. For situations where more than one measurement was available for a give sequence of core, the value from the deepest part of the core was used. All of the porosity values available to us in this study were made within a gas or oil pool and are not truly representative of the brine saturated parts of the formation. We used the deepest depth porosity values because this is the section of core that is closest to the hydrocarbon/water contact.

2.2 Stratigraphic grids and formation volumes

We used the formation tops (and associated structural elevations) described in Section 2.1 to make maps of the surfaces of each formation at depth. We mapped not only the 4 potential geothermal reservoirs, but all formations between the Ireton and the base of the Devonian. Formation layers were stacked to create a 3-D model of the lower to mid-Devonian section underlying the Alberta foothills.

Once this model was made, we zoomed in on areas within a reasonable distance of a potential geothermal power end-user, i.e. a village, town or city. Table 4 shows the towns that we focused on, along with their populations and the radii around the towns that we modeled. These radii were selected to maximize coverage around a town, while minimizing overlapping, which would lead to redundancies in the volumetric calculations. Thus, areas with towns that are more closely spaced together have smaller search radii accompanying them. The search radii were used to establish the area associated with volumetric energy and power production calculations described in Section 2.3. Formations volumes were calculated by multiplying by the formation thicknesses in these search areas.

Table 4 List of population centers in each municipal district for targeted geothermal reservoir modeling

Municipal District	Town	Population	Modeled Radii (km)
Grande Prairie	Beaverlodge	2,365	10
	Grande Prairie	55,032	10
	Hythe	820	10
	Sexsmith	2,418	10
	Wembley	1,383	10
Greenview	Fox Creek	1,969	25
	Valley View	1,761	37.5
Yellowhead	Hinton	9,640	50
Clearwater	Caroline	501	17.5
	Rocky Mountain House	6,933	17.5

2.3 Volumetric Energy Assessment Equations & Constants

The amount of thermal energy contained in a geothermal pool is a function of the pool's bulk volume (V_b), the pool's porosity (ϕ) the volumetric heat capacities of the pool rock and pore fluid (Cp_r, Cp_f) and the gradient between the pool's temperature (T_r) and an ambient "rejection" temperature (T_0). The values used to define these variables in this study are as shown in Table 5.

The total thermal energy available in a reservoir (Q_r) is defined as:

eqn 1 $$(Q_r) = [(V_n * Cp_{(lm,ss)}) + (V_f * Cp_f)]*(T_r - T_0)$$

A recovery factor (γ) is then applied to the results of eqn 1, to estimate the percentage of the total Q_r that can be recovered at the well head. Many factors go into determining a recovery factor. Williams (2007), offers a detail discussion of this issue and gives a range of 0.1 – 0.25, with higher values being associated with basin-hosted geothermal systems. Nonetheless, we used the conservative value of 0.10 when dealing with localized regions around our population centers.

Table 5 Values and simple equations used for volumetric energy assessment variables.

Variable	Symbol	Unit	Values
Bulk reservoir volume	V_b	m^3	Calculated directly in Petrel models
Porosity	ϕ	factor	Average ± 1 standard deviation from reported core measurements
Net reservoir volume	V_n	m^3	$V_b * (1 - \phi)$
Fluid volume	V_f	m^3	$V_b * \phi$
Sandstone volumetric heat capacity	Cp_{ss}	MJ/m^3K	2.1
Limestone volumetric heat capacity	Cp_{lm}	MJ/m^3K	2.3
Fluid volumetric heat capacity	Cp_f	MJ/m^3K	4.2
Reservoir Temperature	T_r	K	Averages ± 1 standard deviation from drill stem tests and corrected logged bottom hole temperature measurements
Rejection Temperature	T_0	K	273.15

Values for the volumetric heat capacities of sandstones (Cp_{ss}; Gilwood, Granite Wash) and limestones (Cp_{lm}; Swan Hills, Leduc) were taken as average values from the literature (e.g. Robinson, 1988). The volumetric heat capacity of brine was taken from the National Institute of Standards and Technology (NIST; webbook.nist.gov).

Multiplying the total thermal energy Q_r, by the recovery factor, γ, yields the total thermal energy available for production (wellhead thermal energy; Q_{wh}), as shown in equation 2:

eqn 2 $$(Q_{wh}) = \gamma Q_r$$

The mass of fluid required to bring this thermal energy to a wellhead (M_{wh}) is then calculated as the quotient of the wellhead's thermal energy and the fluid's change in enthalpy (ΔH; $H_r - H_0$) across the temperature gradient, as shown in equations 3 and 4:

eqn 3 $$(H_r; H_0) = (4.2477 * T_{(r,0)}) - 1{,}163.5735$$

This equation is a linear regression (r^2=.99) of vapour-saturated liquid water enthalpy values plotted versus temperature taken from a standard steam table. Many steam tables are available online that vary slightly from one to another. We used a free steam table taken from Peace Software, a German engineering firm (http://www.peacesoftware.de/einigewerte/wasser_dampf_e.html)

eqn 4 $$(M_{wh}) = Q_{wh}/\Delta H$$

The wellhead mass is an important variable because it allows us to both quantify thermodynamic losses and parasitic loads, as well as estimate required fluid flow rates per unit power.

By taking entropy loses into account, we arrive at the variable of exergy (W_a), which is a measure of how much energy is present in a geothermal system that can perform thermodynamic work:

eqn 5 $$(W_A) = M_{wh} * (\Delta H - T_0 \Delta S)$$

where ΔS; $(S_r - S_0)$ is the change in entropy between the reservoir temperature and the rejection temperature, as defined by:

eqn 6 $(S_r; S_0) = 3.521E\text{-}08\ T_{(r,0)}^3 - 2.461E\text{-}05T_{(r,0)}^2 + 1.516E\text{-}02T_{(r,0)} + 2.504E\text{-}03$

This equation is a 3rd order polynomial regression (r^2=.99) of vapour-saturated liquid water entropy values plotted versus temperature taken from a standard steam table. Similar to eqn. 3, we used a free steam table taken from Peace Software, a German engineering firm (http://www.peacesoftware.de/einigewerte/wasser_dampf_e.html).

When the exergy (W_A) is multiplied by an electrical utilization factor (η), one arrives at the total amount of energy available for the production of electrical power (W_p)

eqn 7 $(W_p) = \eta W_A$

The results considers electrical utilization factors described by Augustine et al, (2009), which range from ~17 – 40% in our study area, depending on reservoir temperature. Augustine et al. (2009) show sublinear relationship between temperature and utilization factor, with the utilization factor being defined (r^2=0.98) as

eqn 8 $\eta = [(0.3083*T_r)-98.794]/100$

Utilization factors were calculated for each reservoir as a function of their mean measured temperature +/- 1 standard deviation.

Finally, amortizing W_p out over the desired timeframe of power production yields the gross electrical power production (MWe) capacity of the reservoir during the production period.

eqn 9 (MWe)= Wp/years of desired power production

We solved all of these equations as a function of variable temperature and porosity (average ± 1 standard deviation) for each of the four potential geothermal reservoirs identified in this study, as they are found below the municipalities described in Table 2. This study considers the gross thermal and electrical power capacity that a given reservoir may provide over a 30 – year period.

3 Results

3.1 Maps and Models

3.1.1 Regional overview

Wells that were used to identify the top surface depths for the Leduc, Swan Hills, Gilwood and Granite Wash formations are show in Figure 4. Figure 4 also shows the counties and municipal districts covered by the study area. Towns and cities within these municipalities, along with circles representing the areas (Table 2) for the volumetric assessments are also shown.

Wells that were used to identify the top surfaces of the Leduc, Swan Hills, Gilwood and Granite Wash formations are shown in light blue, purple, green and orange, respectively. In some cases, tops for more than one formation are present in the same well. In these cases, only the well from the uppermost formation is visible, as the lower formations are obscured.

The Leduc is the most widespread formation, being present in all four of the municipal districts within the study area. The Swan Hills is also prominent, being present in all but the most northern municipal district (County of Grande Prairie). The Gilwood and Granite Wash sandstones are more locally present, with the Gilwood being found mostly in the central part of the study area and some traces within Clearwater County, and the Granite Wash located only in the far north.

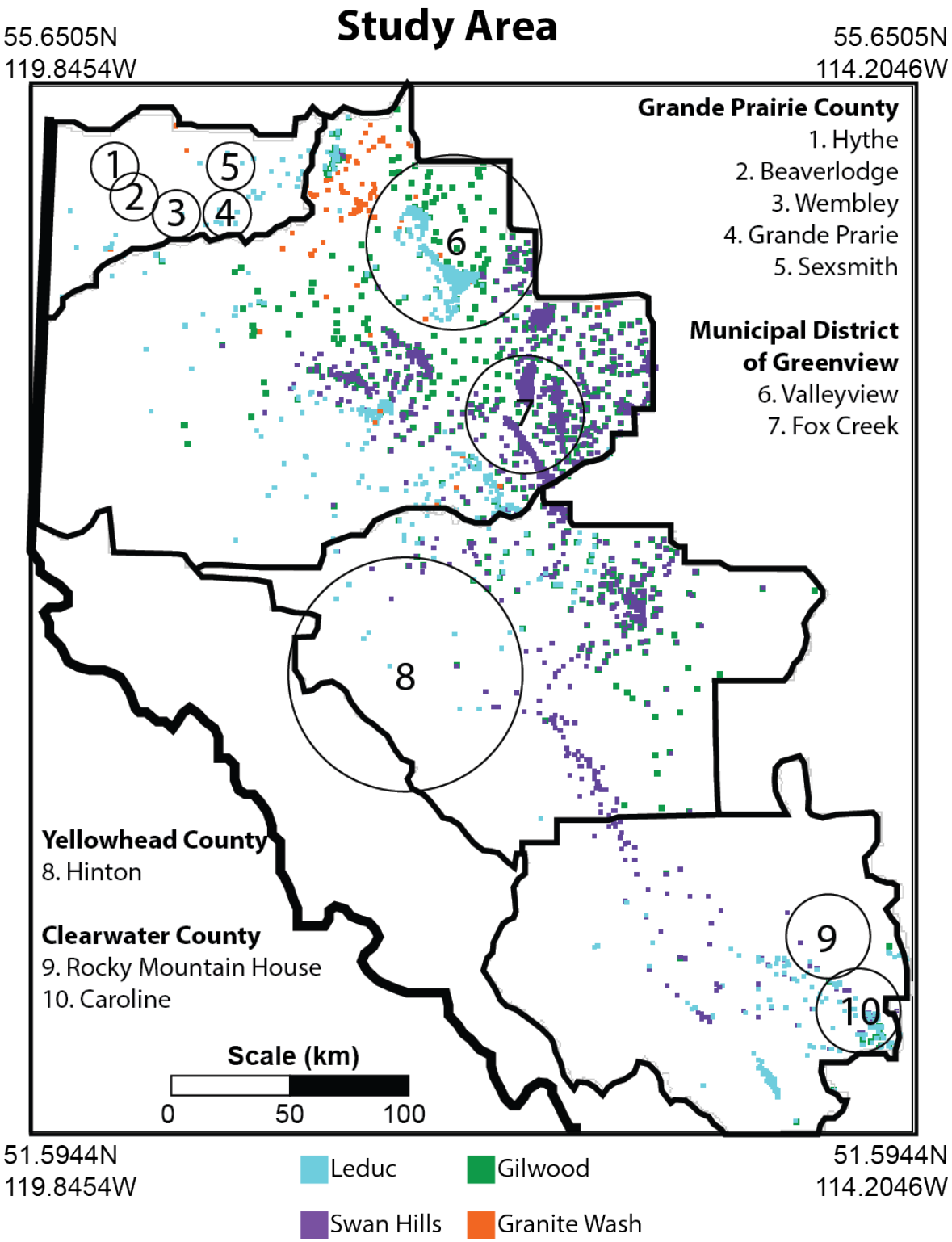


Figure 4 Map of study area showing wells used to identify formation tops, municipal districts contained within the study area, population centers within these districts and the search areas around these centers used in the volumetric assessments

3.1.2 Depth to formation tops

Figure 5 shows the depth to top of each of the 4 formations identified as potential geothermal reservoirs in the study region. Generally speaking, formations deepen to the west-southwest. An exception to this is seen in the far southwest (Clearwater County), where the Leduc, Swan Hills and Gilwood formations abruptly shallow from east to west. This contrast is due to the Rocky Mountain fold and thrust deformation belt extending eastward in the subsurface from the Canadian front ranges. Within the deformation belt, the top of the sequence is reached at as little as ~1000 m. The deformation belt continues northward to the west of the Town of Hinton (8) and does not affect the study area outside of Clearwater County.

In the undeformed basin, the sequence is shallowest in the far northeast of the study area, where the top of the Leduc is reached at ~2000 m. In some places, the Gilwood and the Granite Wash are shallower than the Leduc and Swan Hills due to their extended and intermittent depositional history. The Granite Wash, in particular, was deposited in various locations for most of the early and mid-Devonian and is reached at < 1500 m in the northeast corner of the Municipal District of Greenview. The Leduc, Swan Hills and Gilwood formations are deepest in the area around Hinton (8), where they are reached at depths >4000 m, and in some cases >5000 m. Near Rocky Mountain House (9) and Caroline (10), the Leduc and Swan Hills are reached at depths of 3000-4000 m. Whereas the Gilwood is only sporadically present in Yellowhead and Clearwater counties, the Granite Wash is completely absent from these districts.

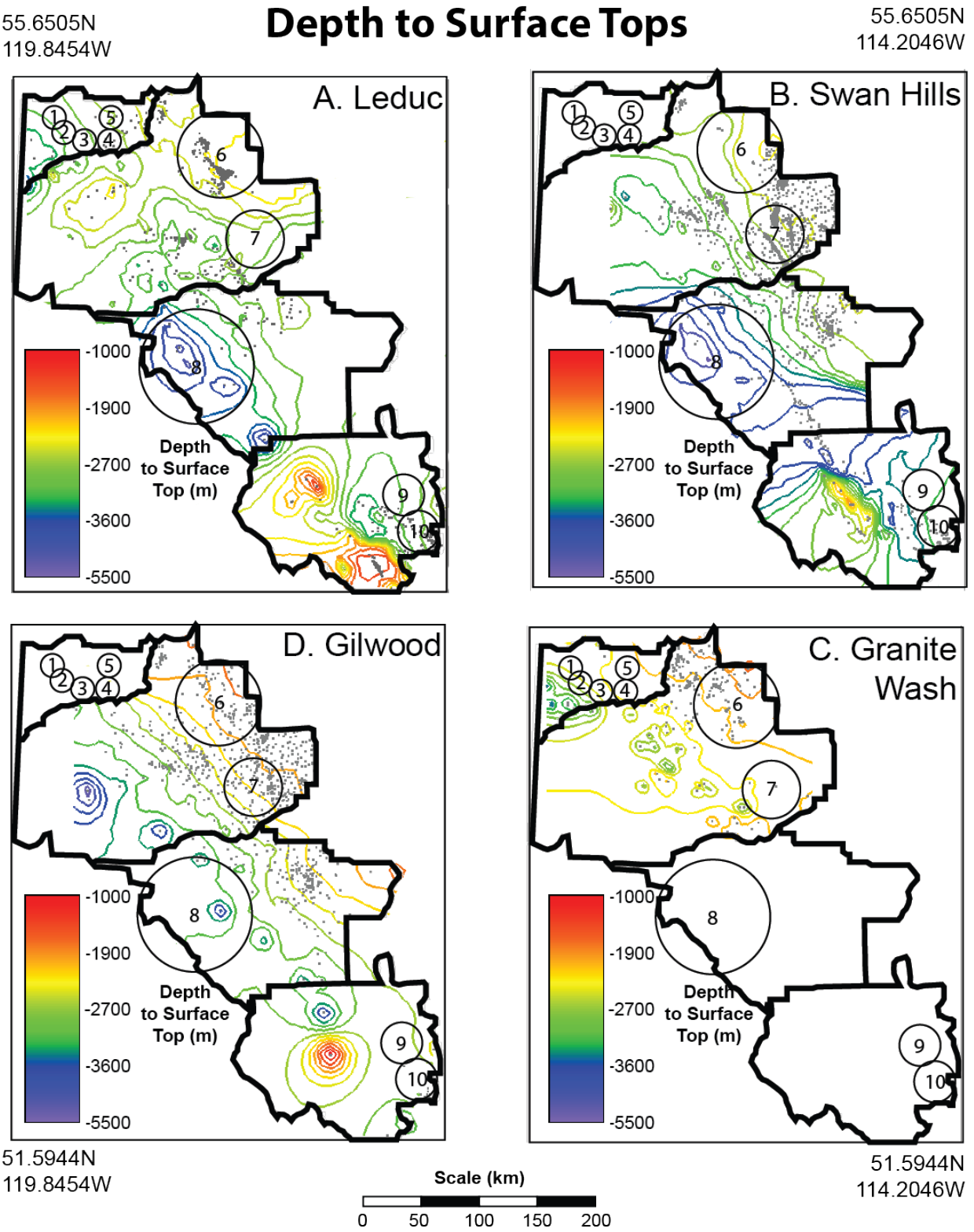


Figure 5 Depth to the top surface of major geothermal reservoirs in Alberta. Clockwise from upper left: A. Leduc, B. Swan Hills, C. Granite Wash and D. Gilwood.

3.1.3 Isopachs

Isopach (formation thickness) maps are shown in Figure 6. Progressively thicker formations are represented by progressively cooler colors (green to violet). A 175 m-300 m NE-SW trending block of the Leduc formation underlies most of the southeast section of Grande Prairie County, including Wembley (3), the City of Grande Prairie (4) and Sexsmith (5). A > 300 m thick section of Leduc fills most of the southwest quadrant of the Valleyview (6) search area. The Leduc does not underlie Fox Creek (7). Near Hinton (8), the Leduc appears as small, isolated deposits, with thicknesses ranging from 100-350 m. A 250-300 m section the Leduc underlies most of Caroline (10). This section skirts the southern margins of the Rocky Mountain House (9) search area.

The thickest section of the Swan Hills reefs runs along the southeast margins of the Valleyview (6) search area, where it is nearly 400 m thick. This section occurs throughout most of the eastern part of the Municipal District of Greenview and underlies the northeast quadrant of the Fox Creek (7) search area, where it thins to < 300 m throughout most of the rest of the search area. A ~ 250 m thick dome of the Swan Hills fills most of the northeast quadrant of the Hinton (8) search area. This dome thins slightly to the northeast and pinches out entirely to the southwest, on the border of the town itself. A 50-100 m section of the Swan Hills underlies most of central Clearwater County, including much of both the Rocky Mountain House (9) and Caroline (10) search areas.

The Granite Wash formation is found exclusively in the northernmost part of the search area. A nearly 200 m thick dome of the Granite Wash is found beneath the Grande Prairie City-Sexsmith corridor, which thins to ~100 m across most of the western part of the Grande Prairie County, all the way to Hythe. The section pinches out to the way west to Hythe, but tapers off to the north and south, nonetheless underlying all of the population centers in the county. The Granite Wash covers to northern and central parts of the Municipal District of Greenview with a 10-50 m thick layer. A 10-20 km wide NE-SW trending slice, ~100-200m thick, runs directly across the center of the Valleyview search area. Another thick, approaching 300 m, section of the Granite Wash is also found in a ~5-10 km dome directly in the center of the Municipal District of Greenview.

The Gilwood sandstone is distributed as a thin (< 50 m) layer throughout the north, east and central sections of the study area. This thin layer completely underlies Valleyview (6), Fox Creek (7) and Caroline (10). In the far east of the Caroline search area, the Gilwood is nearly 100 m thick. A NE-SW wedge of the Gilwood appears in the northeast quadrant of the Hinton (8) search areas, where it thickens to a ~70 m on the north and northeast edges of the town. The Gilwood is not found in Grande Prairie County, although a thick (>100 m) dome of it occurs to the south in a relatively uninhabited section of the Municipal District of Greenview.

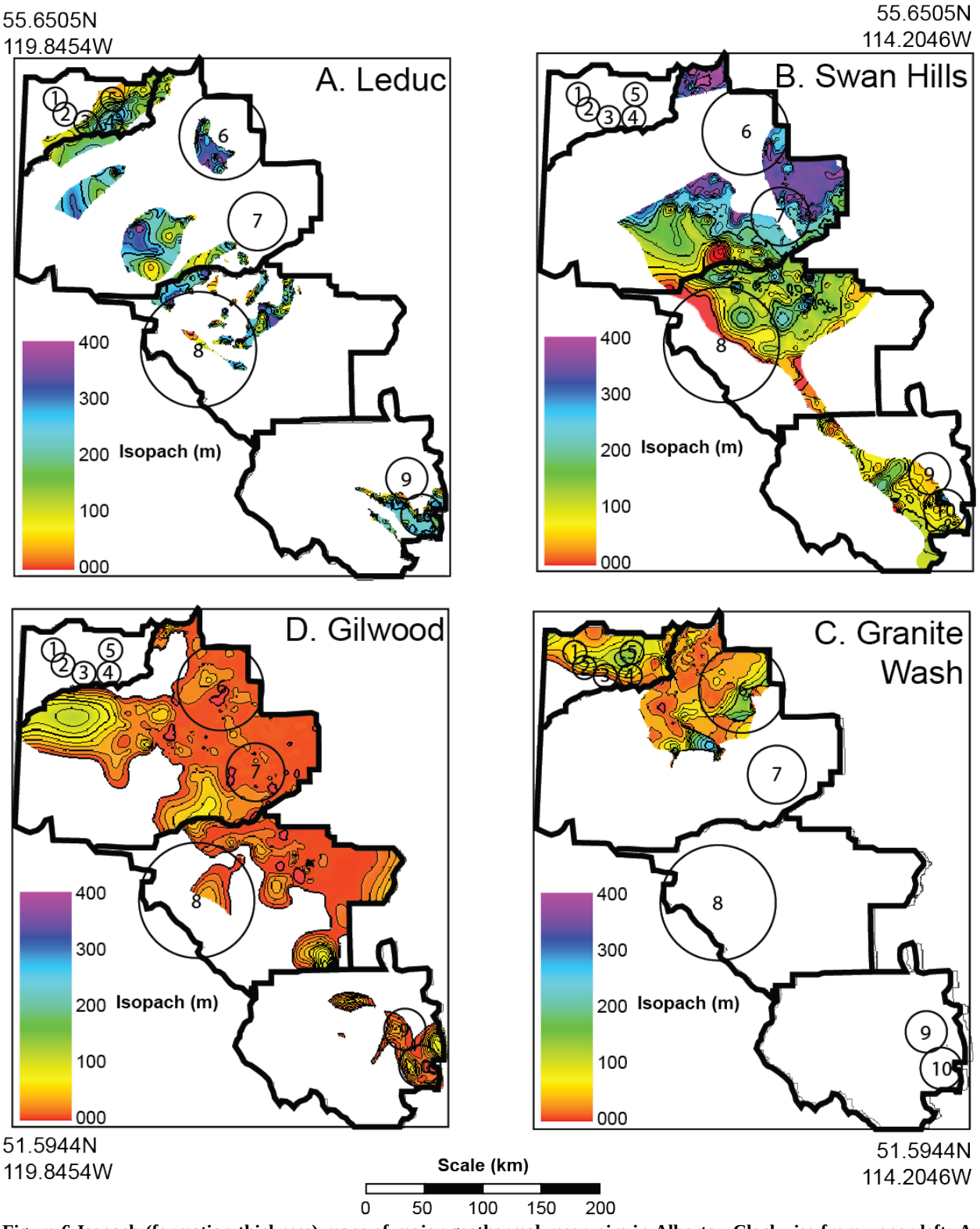


Figure 6 Isopach (formation thickness) maps of major geothermal reservoirs in Alberta. Clockwise from upper left: A. Leduc, B. Swan Hills, C. Granite Wash and D. Gilwood.

3.1.4 Temperature

Contour maps of the temperature distributions within the four formations involved in this study is shown in Figure 7. Temperatures increase sub-linearly with depth, which is indicative of a fairly constant regional geothermal gradient. A thermal inversion can be seen at the base of the stratigraphic section near Hinton (8), where the Gilwood is 10-20 °C cooler than the overlying Swan Hills and Leduc formations. Similarly, the Leduc is slightly warmer than the Swan Hills in this location, despite its situation above the Swan Hills. In the far southwest of the study area (Clearwater County), the influence of the deformation front can again be seen. Here, temperatures in the Leduc and Swan Hills abruptly drop as one moves from east to west out of the undeformed basin. This is due to the stratigraphic section's shallower depth in the deformed belt, as shown in Figure 4.

The coolest temperatures in the study areas are found in the far northeast, where temperatures in the Leduc and Granite Wash are < 70 °C. In this location, the Gilwood and Swan Hills range from 80 °C to just below 100 °C. Temperatures increase to the West and south as the basin deepens towards the mountain front. Temperatures > 100 °C can be in all formations underlying Fox Creek (7), Hinton (8), Rocky Mountain House (9) and Caroline (10). Beneath Valleyview (6), > 100 °C temperatures are reached in the southwest sections of the search area in the Gilwood and Granite Wash. In Grande Prairie County, > 100 °C temperature are reached in the Leduc below Wembley (3) and the western edge of Grande Prairie City (4), as well as in the Granite Wash underlying Hythe (1), Beaverlodge (2) and Wembley (3).

The warmest temperatures in the study region are found in the Hinton (8) search area. Here, temperatures in the Gilwood are > 120 °C, and temperatures in the Leduc and Swan Hills exceed 140 °C. On the northern edge of the town of Hinton, temperatures > 150 °C can be found in the Leduc formation. Other areas with high temperatures (i.e. > 120 °C) can be found in the western parts of the Municipal District of Greenview, which is largely uninhabited. The Granite Wash formation in the western part of Grande Prairie County may also approach 120 °C

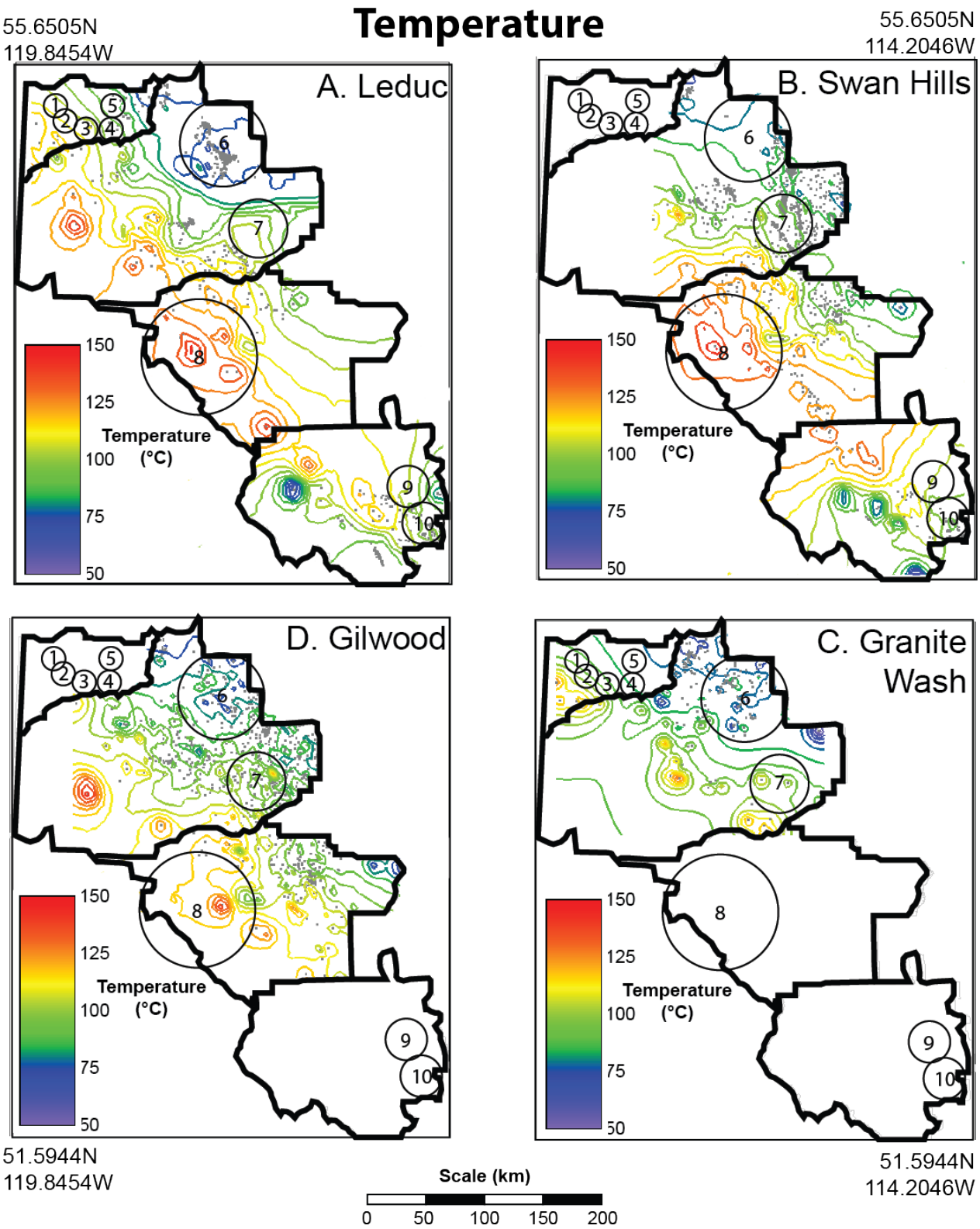


Figure 7 Temperature distribution maps of major geothermal reservoirs in Alberta. Clockwise from upper left: A. Leduc, B. Swan Hills, C. Granite Wash and D. Gilwood.

3.1.5 Potentiometric Surfaces

Contour map of potentiometric surfaces throughout the study area are shown in Figure 8. In the image, warm colors (green to red) represent over-pressured formations, where pore pressure is high enough to bring formation fluid to the surface without additional pumping power. Cool colors (violet to green) represent under-pressured formations, where pumping will be required to bring fluid to the surface. Drill stem pressure data are less abundant than temperature or depth data, and thus the potentiometric surface maps involve substantially more interpolation than the previous figures. Further investigation of reservoir pressures, and by extension, potentiometric surfaces, are required to accurately predict the flow rates reservoirs may be able to sustain, as well as the pumping power required to achieve the necessary brine flow rates.

Pressure in the Leduc and Swan Hills formations tend to drop from north to south across the study area. Near Wembley (3), Grande Prairie City (4) and Sexsmith, the potentiometric surface in the Leduc is ~ 100 m above ground level. The pressure increases to > 300 m underneath the Valleyview (6) search area. Here, the potentiometric surface of Swan Hills formation fluids is ~ 100 m above ground level. Further to the south, underneath Fox Creek (7), the Swan Hills' potentiometric surface approaches 400 m above the surface. North of Hinton (8), the Swan Hills is highly over pressured, with one measurement showing a potentiometric surface of > 1000 m above ground level. In contrast, the Leduc formation in the Hinton (8) area is strongly under pressured, with the potential metric surface falling > 500 m below the ground surface. Similar conditions can be found in the Leduc and Swan Hills in the southern most portions of the study area. i.e. Rocky Mountain (9) and Caroline (10).

Both the Gilwood and the Granite Wash are over pressured throughout the study area, where data are available. Beneath Valleyview, both of these formations have potentiometric surfaces > 200 m above the ground level. In some locations around Fox Creek (7), the Gilwood's potentiometric surface is > 750 m above the ground level. No pressure data are available for either of the sandstone formations in Grande Prairie County.

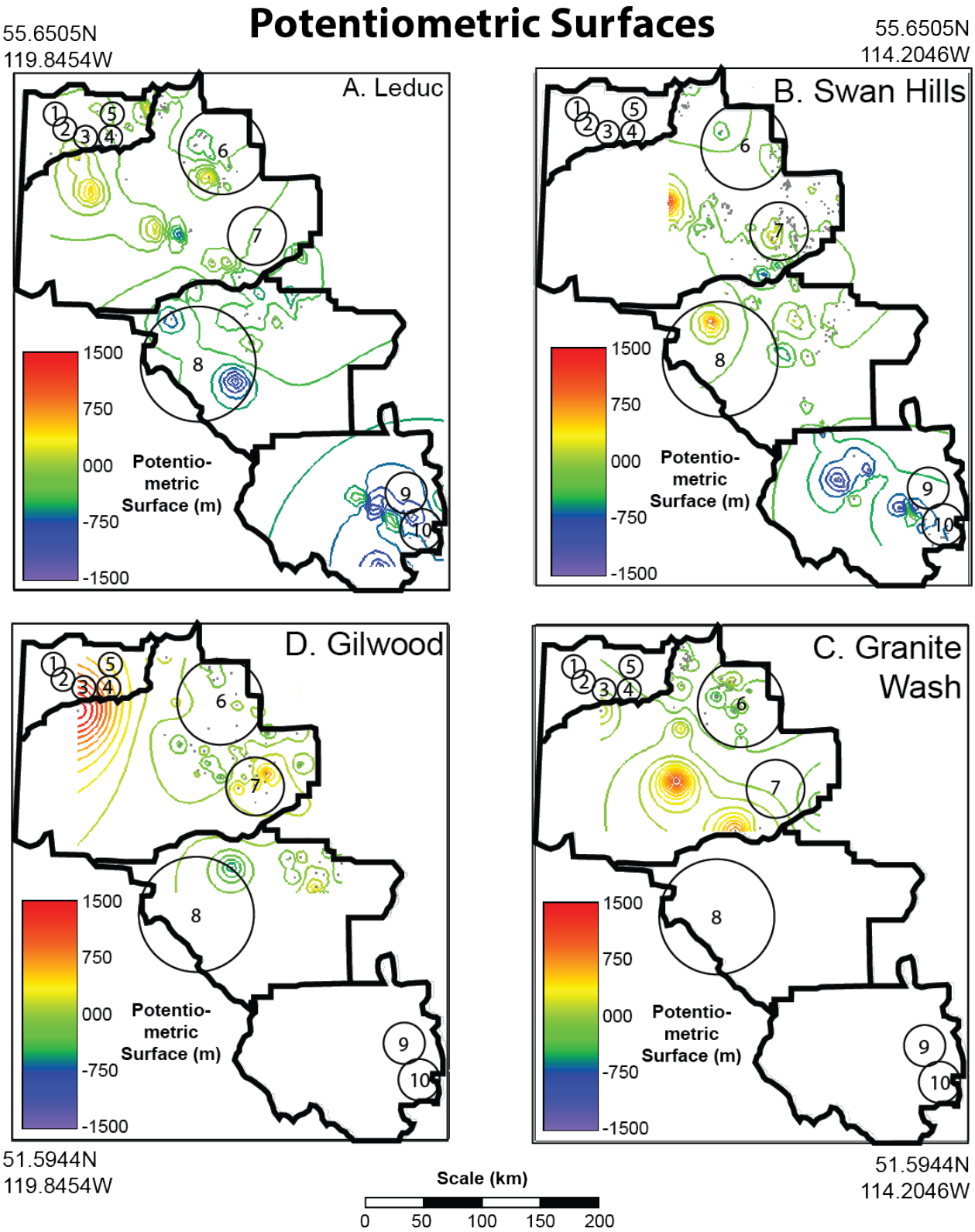


Figure 8 Potentiometric surfaces of major geothermal reservoirs in Alberta. Clockwise from upper left: A. Leduc, B. Swan Hills, C. Granite Wash and D. Gilwood.

3.1.6 Porosity

Figure 9 shows a contour map of regional porosity distribution within the four formations under investigation. Porosity is an important variable in volumetric calculations, which require both a net reservoir volume and brine volume. Porosity is an indicator of the presence of an aquifer. Because the heat capacity of brine is approximately twice that of the reservoir rock, increased pore space, which is presumably saturated with brine, increases the over all thermal energy content of the reservoir. High porosity is also generally correlated with high permeability, which is essential for maintaining brine circulation during plant operations. A rigorous study of reservoir permeabilities was beyond the scope of this study.

Porosity values from the study area are sparse. The highest porosities are found in the Gilwood formation underlying Valleyview (6). Here, several cores have porosities approaching 25 %. The Granite Wash also has a well with a similar porosity measurement just outside the northeast corner of the Valleyview search area. The rest of the sandstone (Gilwood and Granite Wash) porosity measurements fell in the 5-8 % range. The carbonates (Leduc and Swan Hills) have similar porosity values (i.e 5-8 %). Some exceptions to this are seen in uninhabited areas of the Municipal District of Greenview and the Yellohead County, where the porosity is 10–20 %.

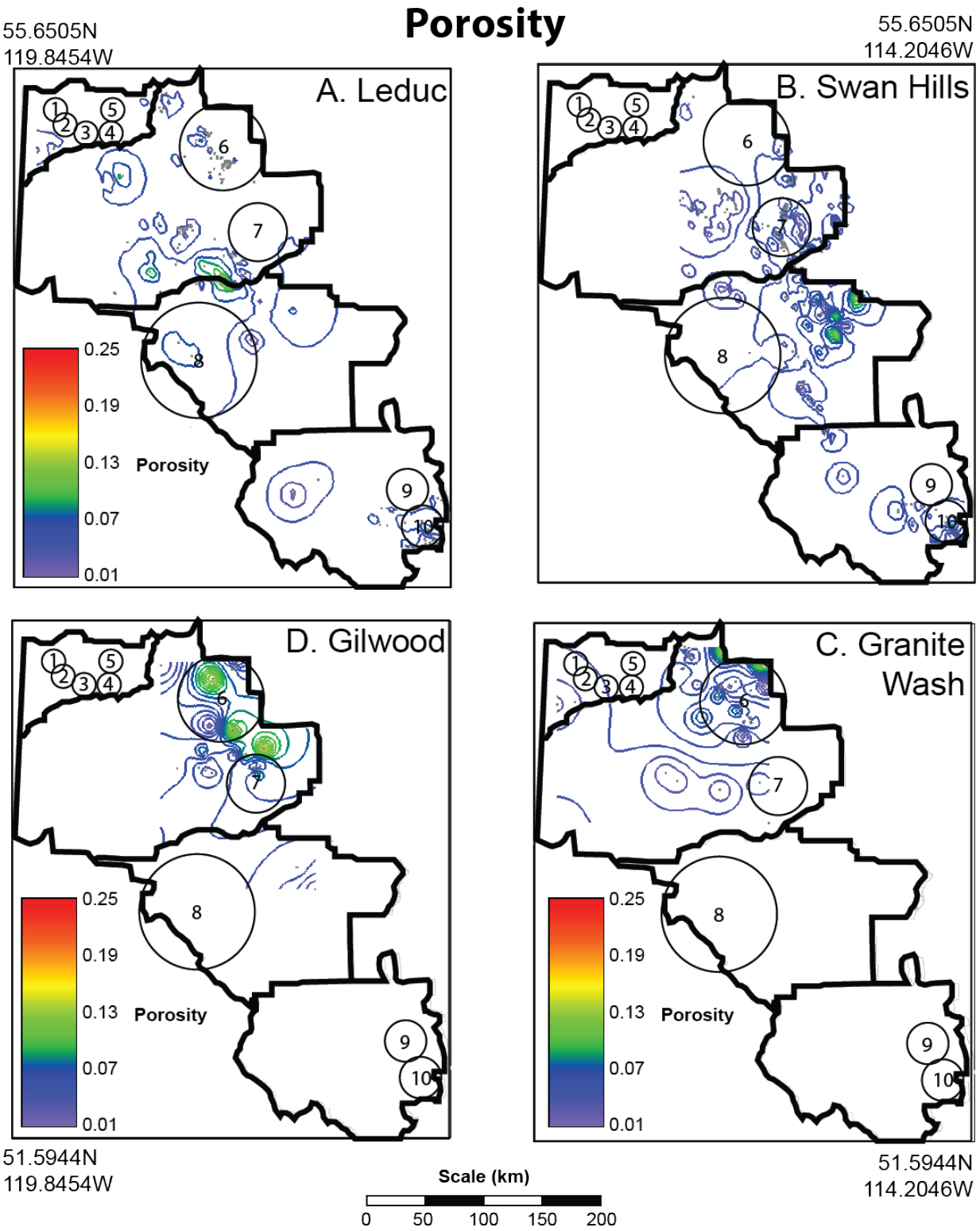


Figure 9 Porosity distribution of major geothermal reservoirs in Alberta. Clockwise from upper left: A. Leduc, B. Swan Hills, C. Granite Wash and D. Gilwood.

3.2 Volumetric Power Potential Calculations

The isopachs shown in Figure 6 were multiplied by the search areas shown in Table 2 to obtain the bulk formation volumes underlying the investigated population centers. The bulk formations volumes, along with the mean (+/- 1 standard deviation) formation temperature and porosity, were used to perform the volumetric method described in Section 2. In order to provide a more accurate volumetric assessment, only data from wells contained within the targeted municipal boundaries were used. Figure 10 shows the mean gross thermal and electricity power production potential for a 30-year operating period in each of the municipal districts involved in this study.

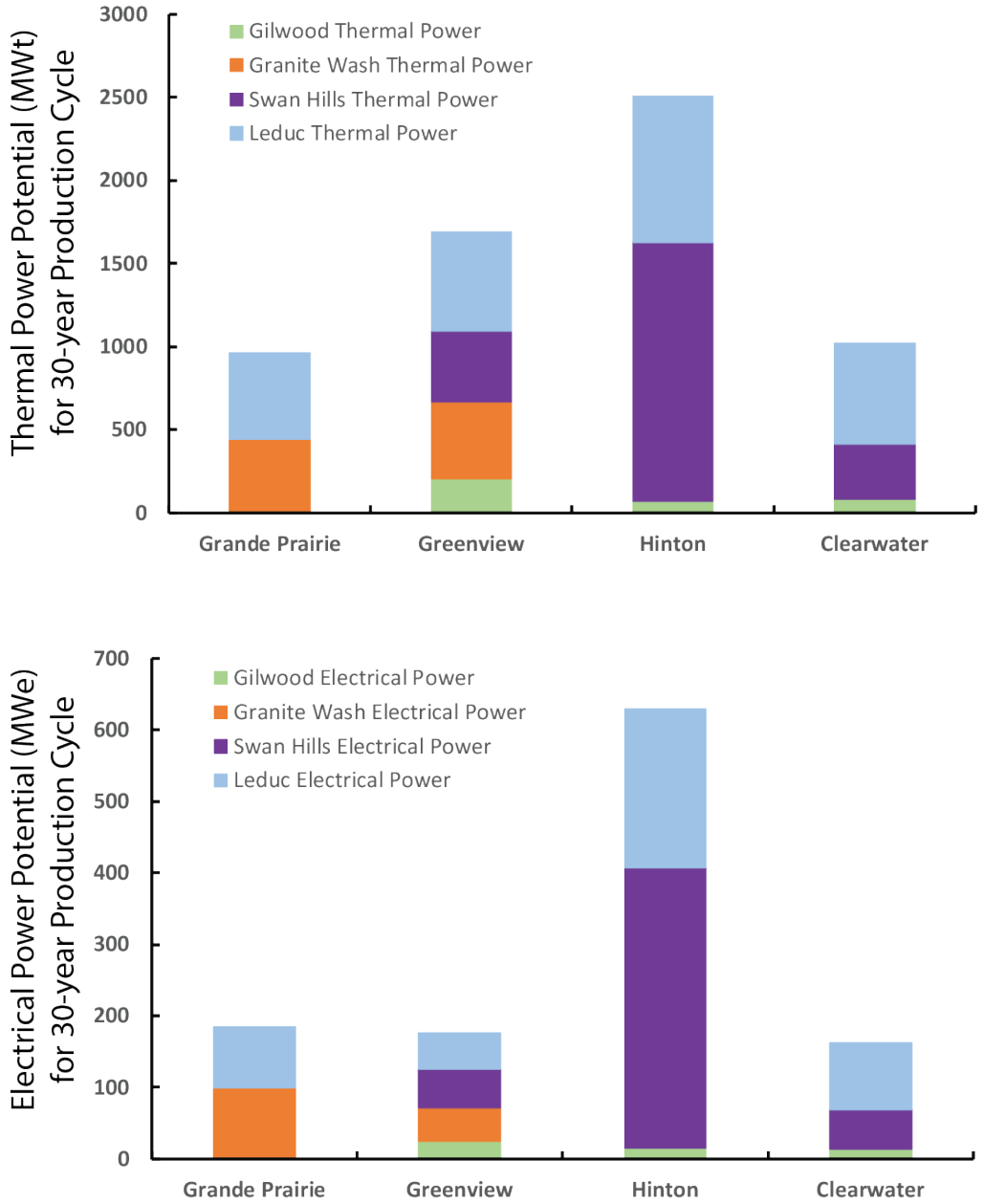


Figure 10 Column charts showing the total thermal power capacity (A.) and total electrical power capacity (B.) for the different formations and municipalities targeted in this study.

Nearly 6,200 MWt of potential thermal power for a 30-year production period was identified within the search areas. Over ¾ of this potential capacity is found in the Leduc and Swan Hills formations. The Swan Hills formation in the vicinity of Hinton alone contains over 1,500 MWt of potential capacity. The Granite Wash formation has a thermal power potential of ~900 MWt for a 30-year production period, and the Gilwood may contain ~350 MWt. These are mean values from a range that considers the mean +/- one standard deviation of temperature and porosity found within the individual search areas.

Using the range of utilization factors described by Augustine et al. (2009; eqn. 8), the electrical power potential was calculated as a function of the reservoirs' temperature and exergy. The thermal energy contained in these reservoirs has a mean electrical power production potential of ~1,150 MWe for a 30-year production period. Over 80% of this potential is found in the Leduc and Swan Hills formations, and over 50% of that is found in the area around Hinton. The Granite Wash and the Gilwood formations contribute ~15 MWe and ~53 MWe, respectively, to the overall electrical power production potential during a 30-year production period.

3.3 Flow Rates per Megawatt of Thermal and Electrical Power

The final metric we analysed was the flow rate required to produce 1 megawatt of gross thermal (MWt) and electrical (MWe) power from any given reservoir and location. This number was derived by dividing the mass-at-well head calculated in the volumetric method (eqn. 4) by the total power production potential (eqn. 9). To convert back to thermal power production potential, we multiplied the results of eqn. 9 by the utilization factor (eqn. 8). Figure 11 shows a scatterplot of calculated flow rates per megawatt of power production for each of the formations and localities in the study area.

In Hinton, the Swan Hills flow rate (purple) is slightly obscured by the Leduc plot (light blue). Flow rates required to produce 1 MWt of power range from <10 kg/s in the Swan Hills and Leduc formations near Hinton to >20 kg/s in the Leduc formation by Valleyview. All of the formations by Valleyview require flow rates > 20 kg/s to produce 1 MWt of gross thermal power. The Leduc formation in the northeast part of Grande Prairie County, as well as the Leduc and Swan Hills near Fox Creek and the Leduc, Swan Hills and Gilwood near Caroline have required flow rates ranging from 10 kg/s to 20 kg/s. Only one value (~11 kg/s) was calculated for the Granite Wash sandstone in Grande Prairie County, because only one porosity value (0.028 +/- 0.008) was available for this formation throughout the county.

Flow rates required for producing 1 MWe of gross electrical power range from ~38 kg/s in the Swan Hills and Leduc formations to nearly 300 kg/s in the Leduc formation beneath Valleyview. All of the formations beneath Valleyview require flow rates > 175 kg/s to produce 1 MWe of gross electrical power. It is likely that these flow rates will make electricity production in this area economically unrealistic, as too many wells would be required. The Leduc formation in Sexsmith, Grande Prairie and Caroline, as well as the Gilwood and Swan Hills beneath Fox Creek and the Swan Hills beneath Caroline all require flow rates of 100-150 kg/s for 1 MWe of gross electrical power. These flow rates may be attainable with few enough wells to make a project economically viable. Areas where required flow rates for 1 MWe of gross electrical power are <100 kg/s are considered good targets for commercial electricity production. These areas include all of the reservoirs beneath Hinton, the Granite Wash formation throughout Grande Prairie County, the Swan Hill formation beneath Rocky Mountain House, and the Leduc formation beneath Rocky Mountain House and Wembley.

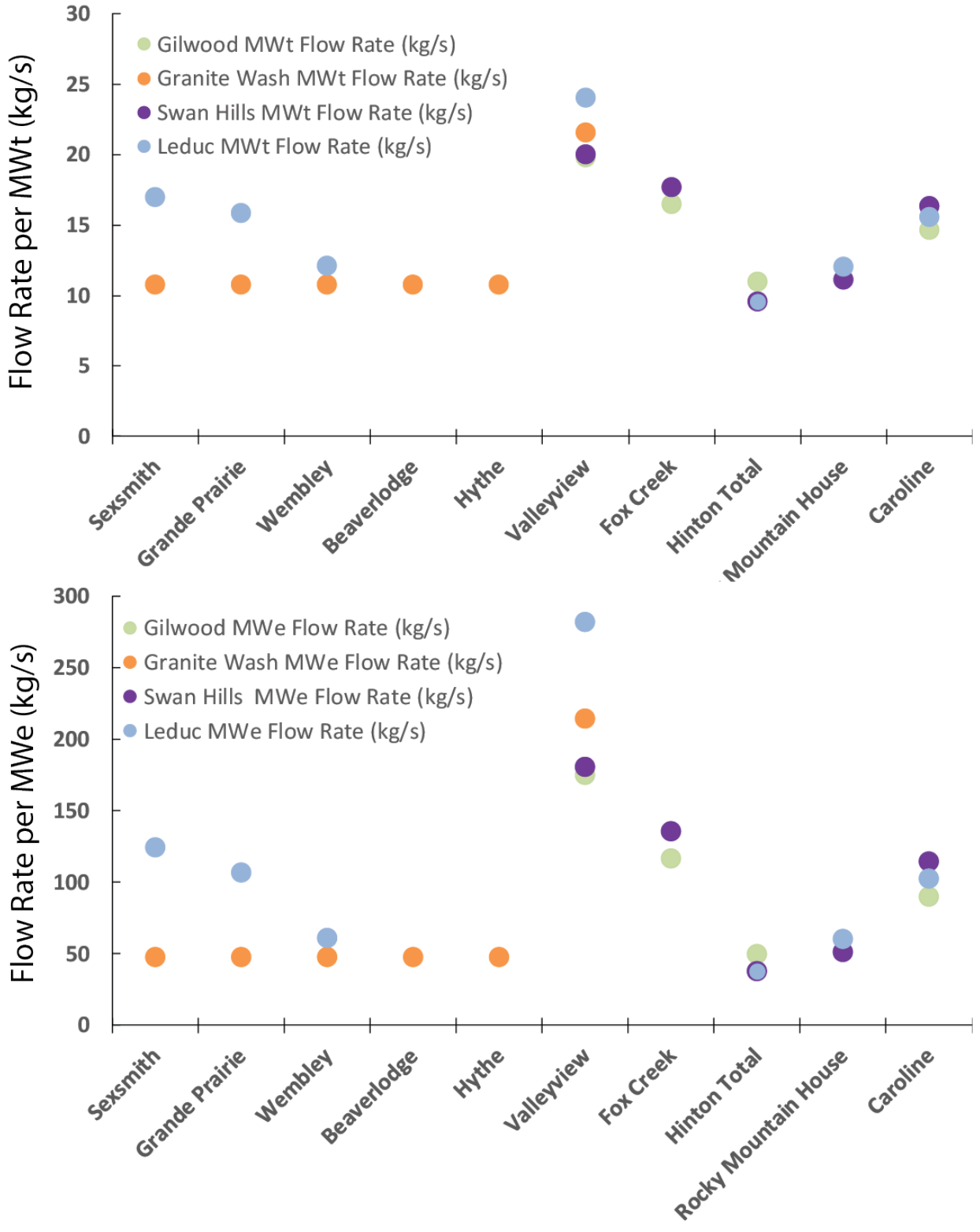


Figure 11 Flow rate (kg/s) required to produce 1 MW of gross thermal and electrical power

3.4 Discussion

We identified over 6,100 MWt of thermal power available to domestic, commercial and industrial end-users throughout the study region for a 30-year production period. This equates to an electrical power potential of ~1,150 MWe. This is enough to meet more than 20% of Alberta's mandate of ~5,000 MWe of renewable power being brought online by 2030.

This estimate must be tempered with practical concerns. The first concern is the quality of the resource. In some places, for example Valleyview, none of the reservoir temperatures are hot enough to reliably produce electricity with existing binary cycle technology. Even if such an ultra-low temperature differential engine was available, the flow rates needed to produce any meaningful power (i.e. >175 kg/s) would require too many wells, making any electricity generation economically untenable. Areas that require flow rates of 100 – 150 kg/s to produce 1 MWe of electrical power present a more promising case for electricity production. Here, technology may be available to convert the thermal energy to electrical power, but local electricity markets and specific projects will determine whether or not commercial development is viable. Areas with flow rates < 100 kg/s required to produce 1 MWe of gross electrical power are considered good targets for commercial development. Using these guidelines, ~800 MWe of economically recoverable electrical power potential was identified, more than 75% of which was found near Hinton. An additional ~225 MWe of electrical power potential may also be available in the areas around Sexsmith, Grande Prairie City, Fox Creek and Caroline. The resource in Valleyview, while not hot enough for electricity production, may still provide ample thermal energy for direct heating. Thus, the first order estimate of 6,100 MWt of gross thermal power potential does not require much revision.

Along with the temperature of the resource, and by proxy the flow rates required per unit power, another major concern is the reservoirs' hydrogeologic properties. This study only investigated porosity as a means to understand the volumetric properties of the formations. We gleaned little information regarding the reservoirs' abilities to sustain the required flow rates for electricity production. What information we were able to attain was taken from gas pools, not water pools, which, for the sake of this study, were assumed to directly underlie the gas pools.

Another salient hydrogeologic consideration is the thickness of the producing unit. Both of the carbonate units investigated in this study (i.e Leduc and Swan Hills) have ample thickness for producing from vertical wells. Production from the Gilwood or Granite wash formations, where thickness is generally <100m, will require deviated wells. A full investigation of the hydrogeologic properties necessary to model flow in these reservoirs was beyond the scope of this study. For the moment it remains unclear which well paths, completions and reservoir stimulations may be necessary to generate the required flow rates.

Finally, further study of the hydrodynamic properties of the brine, in concert with refining the data regarding the brine's hydraulic head, is required for calculating the net power potential. We identified both under-pressured and over-pressured reservoirs throughout the study region. Both situations contain unique pumping challenges that will affect the net power output. The area around Hinton, where most of the high potential resource is located, had sparse pressure data. A well in the Swan Hills ~45 km north of Hinton is over-pressured, potentially by several hundred meters of head. Two wells on a NW-SE trend on either side of Hinton show the Leduc being under-pressured by the same amount. Understanding the pumping power required to circulate the geothermal fluid is essential to determining the net power, and thus the commercial viability, of a project.

4 Regional Reports

4.1 Grande Prairie City and County

Grande Prairie was the northern – most municipal district we investigated, with sponsorship from both the city and county of Grande Prairie. The city of Grande Prairie covers ~72.8 km^2 of land area and has ~55,000 residents. The entire county covers ~5,863 km^2 of land area and contains an additional ~20,500 residents. Beyond the city itself, population centers investigated in the county include Sexsmith (pop. ~2,500), Hythe (pop. ~850), Beaverlodge (pop. ~2,800) and Wembley (pop. ~1,400). A three dimensional projection of Grande Prairie's geothermal reservoirs underlying these population centers is shown in Figure 12. Please note that the z-axis of Figure 12 represents structural elevation in meters below sea level, not the total vertical depths of the formations. Structural elevations are required for the 3D mapping because they normalize the depth below the surface to a constant datum, in this case, sea level. For total vertical depth maps of these formations, please see Figure 5 in Chapter 3.

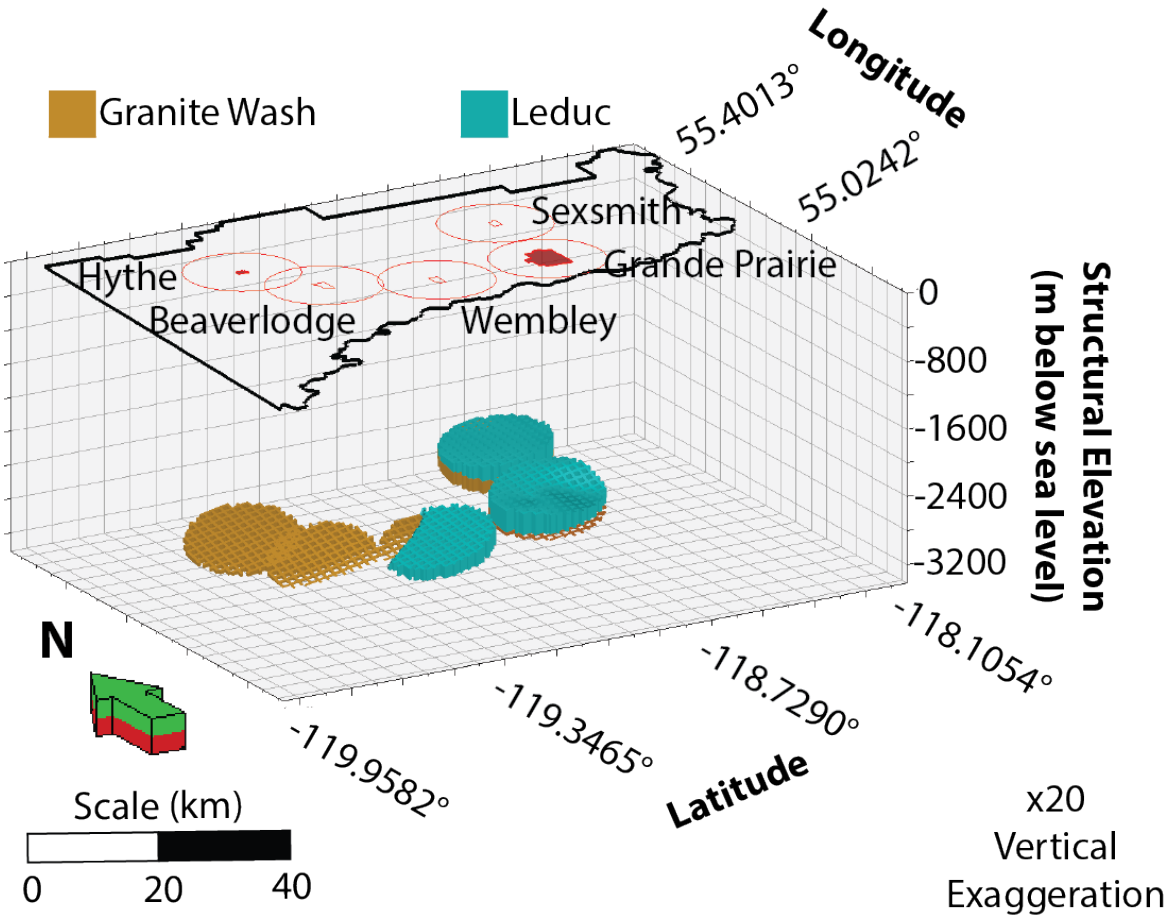


Figure 12 3D Stratigraphic grids of potential geothermal reservoirs underlying population centers in Grande Prairie County. Note that the z-axis (depth) represents structural elevation (meters below sea level) and not total vertical depth.

The two most prominent geothermal reservoirs found in this region are the Leduc carbonate reef and the Granite Wash sandstones.

As shown in Chapter 3, Figure 6a, the Leduc cuts across the county in a SW – NE (bottom left to top right) trend. The formation is more extensive in the northeast, where it underlies practically the whole county. To the southwest, the Leduc becomes laterally far less extensive and only underlies the southern margins of the county. Neither Hythe nor Beaverlodge appear to overlie the Leduc Formation. Figure 6c, shows the Granite Wash Formation underlying approximately 2/3rds of Grande Prairie County. This formation was not identified in the south-western section of the county. The Granite Wash appears to completely underlie the city of Grande Prairie, Hythe and Beaverlodge. It skirts the only northern edge of Wembley, limiting its volume near this town. Table 6 shows the values that were used in the volumetric power potential calculations for each of the population centers in Grande Prairie County.

Table 6 Values used in volumetric power potential assessments for population centers in Grande Prairie County

		Sexsmith	Grande Prairie	Wembley	Beaverlodge	Hythe
Volume (m^3)	*Leduc*	3.11E+10	6.35E+10	3.58E+10		
	Granite Wash	3.51E+10	1.42E+10	4.77E+09	1.41E+10	1.97E+10
Depth (m)	*Leduc*	3300±83	3389±70	4256±269		
	Granite Wash	4198±488	4198±488	4198±488	4198±488	4198±488
Temperature (°C)	*Leduc*	91.7±2.3	95.56±3.41	112		
	Granite Wash	120.2±5.7	120.2±5.7	120.2±5.7	120.2±5.7	120.2±5.7
Porosity	*Leduc*	0.028±0.008	0.028±0.008	0.028±0.008	0.028±0.008	0.028±0.008
	Granite Wash	0.044±0.023	0.044±0.023	0.044±0.023		

Only one reliable temperature and porosity datum was found for the Granite Wash formation in Grande Prairie County. Thus, their values are constant throughout the table. The top of the Granite Wash is reached at ~3500 m in the northeast part of the county near Sexsmith and is at least 4700 m deep in the southwest of the county by Beaverlodge. The Leduc is reached at less than3500 m near both Sexsmith and Grande Prairie City. In the area around Wembley, the top of the Leduc is generally deeper than 4000 m.

Figure 13 shows the mean thermal and electrical power production potentials for each of the population centers in Grande Prairie County, calculated using the range of values shown in Table 6. In total, we identified nearly ~960 MWt of thermal power production potential in the county, roughly 1/3rd of which is found in the Grande Prairie City search area. The towns of Wembley and Sexsmith both also contain over 200 MWt of thermal power potential. Beaverlodge and Hythe, which are underlain only by the Granite Wash formation, each contain less than 100 MWt of thermal power production potential.

This thermal power equates to roughly 185 MWe of electrical power potential across the county. Temperatures in the Leduc formation beneath Sexsmith and Grande Prairie city, however, may not be high enough to reliably produce electricity with existing technology. Removing these reservoirs from the calculation yields an electrical power potential of ~135 MWe. The largest single reservoir is the Granite Wash beneath Sexsmith, which potentially could produce ~40 MWe of electrical power during a 30-year production period. The next largest reservoir, with a potential of ~35 MWe, is the Leduc underlying Wembley. As is the case for all of the areas described herein, the capacity would be achieved through several small plants, rather than one central facility.

Given Grande Prairie County's population of < 100,000, there is enough electricity power potential in the Granite Wash formation to provide for all of the domestic needs the county's residents. Producing this power, especially in the western part of the county, may be challenging, because the Granite Wash

formation is thin. Beneath Sexsmith and Grande Prairie City, however, the Granite Wash is likely thick enough to be exploited with vertical wells. Among these two cities alone, the Granite Wash has an electrical power production potential of ~57 MWe

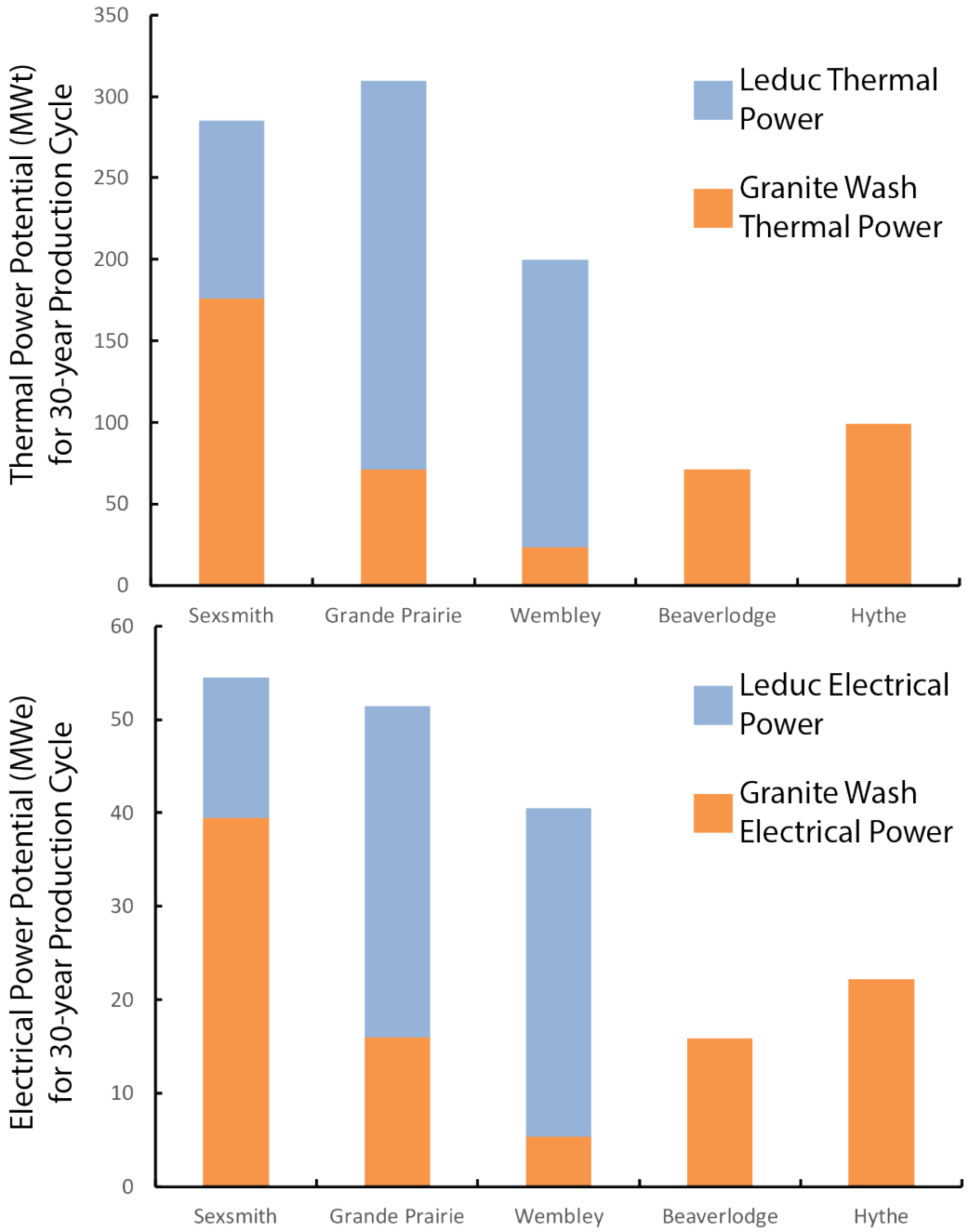


Figure 13 Mean thermal and electrical power production potential for the Granite Wash and Leduc formations underlying population centers in Grande Prairie County

Although the Leduc formation beneath Sexsmith and Grande Prairie City may not be hot enough to produce electricity, they contain ample thermal energy for direct heating applications. This heat can be used for residential and commercial district heating, industrial process heat, agriculture development, snow melting and recreation (e.g. swimming pools).

4.2 Municipal District of Greenview #16

The Municipal District of Greenview covers a land area of ~33,000 km^2, with a population of ~13,500. About 45% of this population (~4,300) lives in Grande Cache. Due to its location west of the deformation belt, however, we were unable to investigate the area immediately surrounding Grande Cache. We did investigate a 75 km diameter around Valleyview (population ~1,750) and a 50 km diameter around Fox Creek (population ~2,000). A three dimensional projection of the geothermal reservoirs underlying these population centers is shown in Figure 14. Please note that the z-axis of Figure 14 represents structural elevation in meters below sea level, not the total vertical depths of the formations. Structural elevations are required for the 3D mapping because they normalize the depth below the surface to a constant datum, in this case, sea level. For total vertical depth maps of these formations, please see Figure 5 in Chapter 3.

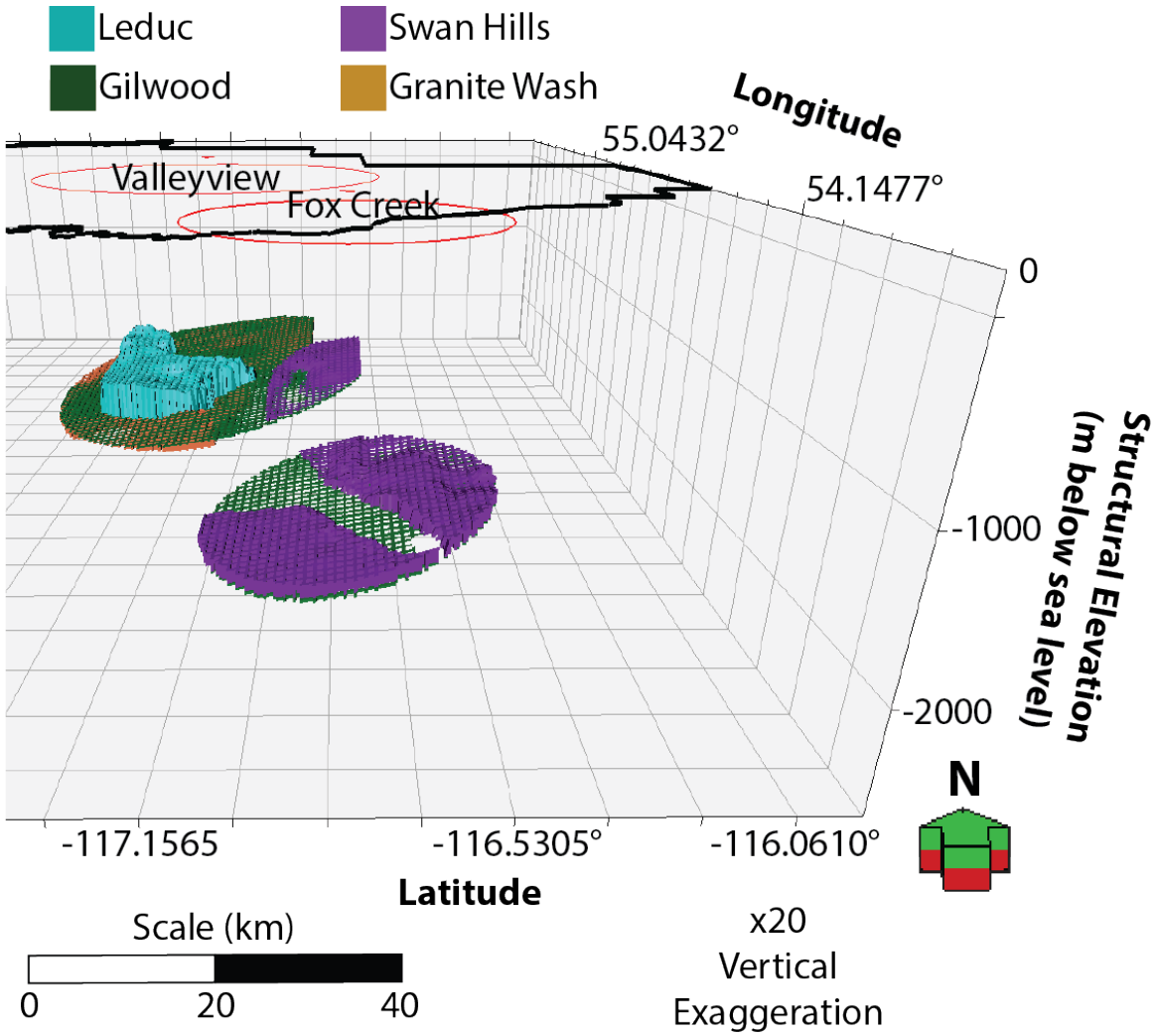


Figure 14 Stratigraphic grids of potential geothermal reservoirs underlying population centers in the Municipal District of Greenview. Note that the z-axis (depth) represents structural elevation (meters below sea level) and not total vertical depth.

All 4 of the formations investigated in this study underlie Valleyview. The Gilwood and Granite Wash form thin layers that basically cover the entire search area. The Swan Hills appears as a 275-375 m reef margin on the southeast section of the search areas. A less than 300 m thick section of the Leduc underlies practically the entire southwest quadrant of the Valleyview search area. Only the Swan Hills and the Gilwood are found beneath Fox Creek. Here, the Gilwood forms a thin layer, 10s of meters thick,

underlying the entire area. The Swan Hills appears as two 200-300 m thick shelves to the northeast and southwest of the town, but does not appear to underlie the town itself.

Table 7 shows the values that were used in the volumetric power potential calculations for each of the population centers in the Municipal District Greenview.

Table 7 Values used in volumetric power potential assessments for population centers in the Municipal District of Greenview

	Town	Valleyview	Fox Creek
Volume (m^3)	*Leduc*	2.4E+11	
	Swan Hills	2.62E+10	1.04E+11
	Granite Wash	1.80E+11	
	Gilwood	5.01E+10	1.87E+10
Depth (m)	*Leduc*	2675±325	
	Swan Hills	2825±182	3043±17 6
	Granite Wash	3035±175	
	Gilwood	3081±367	3158±164
Temperature (°C)	*Leduc*	75±12	
	Swan Hills	83±6	90±15
	Granite Wash	80±10	
	Gilwood	83±14	93±14
Porosity	*Leduc*	0.05±0.03	
	Swan Hills	0.05±0.05	0.05±0.04
	Granite Wash	0.06±0.03	
	Gilwood	0.06±0.05	0.06±0.02

Within our study area, the investigated formations are shallowest in the Municipal District of Greenview. Beneath Valleyview, the Leduc and the Swan Hills are both reached at depths of <3000m. Both of the sandstone units (Granite Wash and Gilwood) are reached at depths of ~3000 m. Beneath Fox Creek, the Gilwood and the Swan Hills are reached at depths of ~3050 m and ~3150 m, respectively. These are the only two formations present in this area. In the interim report, Cambrian formations were also discussed. Due to a lack of reliable data, however, we were unable to confirm the stratigraphy of the Cambrian section in this area. While the Cambrian section is potentially up to 500 m thick to the southeast of Fox Creek, we do no know of where the potential water-bearing strata are. Therefore, a more detailed analysis of Cambrian geothermal resources beneath Fox Creek would require additional exploration.

Due to the shallow depths of the investigated formations in the Municipal District of Greenview, the temperatures in the formations may not be high enough for reliably producing electricity. This case is especially true around Valleyview, where the mean temperatures in the formations are not much higher than 80 °C. Both formations beneath Fox Creek have mean temperatures ~90 °C, which, given Alberta's cold climate, may be considered a marginal electricity producing resource. In both cases, one standard deviation of the mean higher would put the resource above 100 °C. These hotter wells are found to the southwest of the town of Fox Creek.

Figure 15 shows the mean thermal and electrical power production potentials for each of the population centers in the Municipal District of Greenview, calculated using the range of values shown in Table 7. In

total, we identified nearly 1,700 MWt of thermal power production potential in the municipal district. Over 75% of this thermal resource is situated beneath Valleyview. This phenomenon is partially due to the fact that the Valleyview search diameter was 25 km larger than the Fox Creek area.

This thermal power equates to roughly 175 MWe of electrical power potential across the municipal district. Due to the lower temperature of the resource near Valleyview, however, it is unlikely that electricity can be reliably produced from the thermal energy. In the area around Fox Creek, ~50 MWe of electrical power may be available. Even in this area, however, the electricity producing capabilities of the resource are marginal, albeit improving to the southwest.

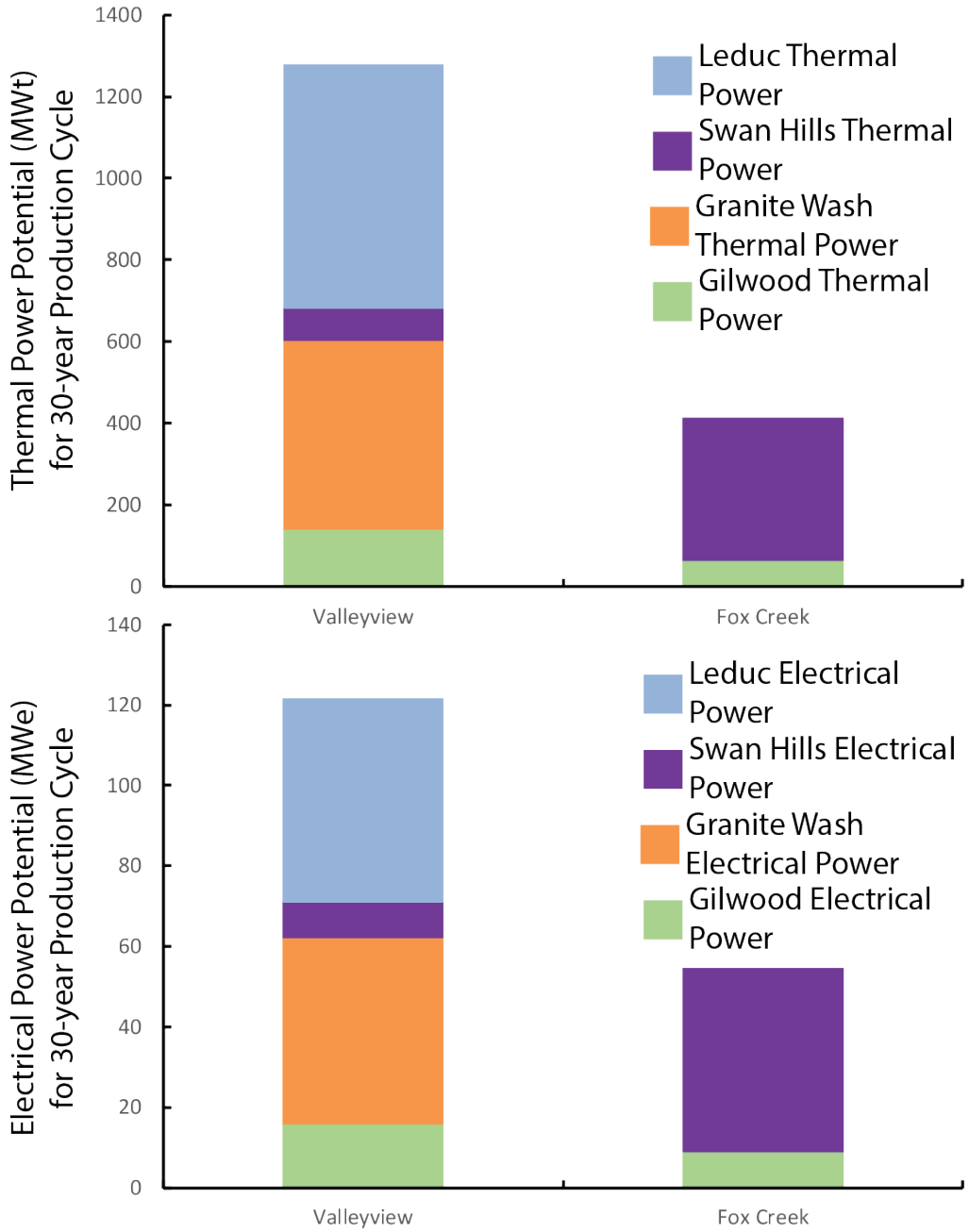


Figure 15 Mean thermal and electrical power production potential for potential geothermal reservoirs underlying population centers in the Municipal District of Greenview

Despite the lack of temperatures required for producing electricity beneath Fox Creek and Valleyview, ample thermal energy is available for various residential, commercial and industrial purposes. New residential developments and work camps in the area could benefit from a constant, non-combustion based source of heat. Producing geothermal brine from the area around Fox Creek may have the added benefit of reducing induced seismicity in the area.

While not investigated in this study, the area around Grande Cache most likely possesses a large, high grade geothermal resource base. The basin is deep in this area, perhaps > 6000 m in places. Additionally, the town's situation over deformed strata, coupled with it is proximity to the mountain front, mean that hot fluid from the mid-crust have ample flow conduits to reach shallow depths. This process would elevate the local geothermal gradient, potentially creating formation fluids hot enough to power a traditional steam turbine, as opposed to a binary cycle turbine. Further exploration to determine the geothermal resource potential in this area is recommended.

4.3 Hinton & Western Yellowhead County

Geothermal exploration in Yellowhead County was funded entirely by the Town of Hinton, population ~10,000. We focused on a 50 km radius around the town. This radius was selected because it included the area around Obed, where an electrical tie in station was recently constructed. Data in the immediate vicinity of Hinton was sparse, which also led to the increased search radius. Due to the issues associated with mapping within the deformation belt (sparse data; tenuous correlations), we were not able to map beneath the west side of the town. Figure 16 shows a stratigraphic grid of potential geothermal reservoirs found within 50 km of Hinton. Please note that the z-axis of Figure 16 represents structural elevation in meters below sea level, not the total vertical depths of the formations. Structural elevations are required for the 3D mapping because they normalize the depth below the surface to a constant datum, in this case, sea level. For total vertical depth maps of these formations, please see Figure 5 in Chapter 3.

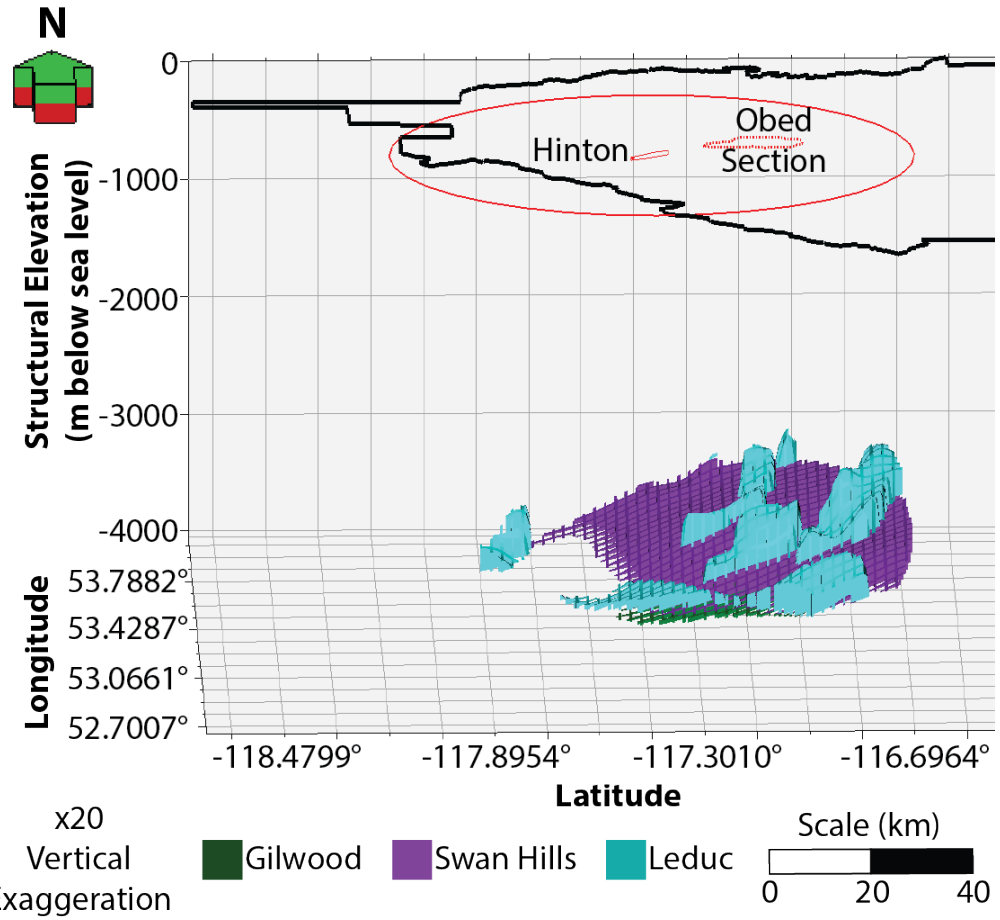


Figure 16 Stratigraphic grids of potential geothermal reservoirs underlying the Town of Hinton in Yellowhead County. Note that the z-axis (depth) represents structural elevation (meters below sea level) and not total vertical depth.

Three potential geothermal reservoirs were found in Yellowhead County's Devonian strata: the Gilwood, the Swan Hills and the Leduc. The Gilwood appears as 30-40 km wide tongue that is ~50 m thick on the northeast edge of the city and gradually tapers out over a distance of 40-50 km to the northeast. The Swan Hills is present as a sharply southwest dipping reef margin that fills most of the eastern half of the Hinton search area as a broad dome. The center of the dome, which is in the immediate vicinity of the Yellowhead highway about 20-25 km Northeast of Hinton, is nearly 300 m thick at its center. The Leduc formation forms isolated pods of reef deposits, often directly overlying the Swan Hills. One such reef appears to sit directly on top of the center of the Swan Hills dome. Here, the Leduc formations is also approaching 300

m thick. Another significant Leduc deposit occurs in a thin sliver running parallel to the deformation front (NW-SE) just along the northeast edge of the city. The section of the Leduc is thickest (>300 m) about 45 km southeast of the Town of Hinton. It tapers to about 100 m thick beneath the city and pinches out about 20 km to the northwest.

In Hinton, we made a volumetric assessment for the entire area, as we did for the other municipal districts, and we did a separate calculation for the section where the Leduc is deposited directly on top of the thick part of the Swan Hills dome. Due it its proximity to the coal mine, we deemed this area the "Obed Section." Table 8 shows the values that were used in the volumetric power potential calculations for both the Obed section and the entire Hinton search area.

Table 8 Values used in volumetric power potential assessments for the Obed section and the entire Hinton search area

	Town	Obed Section	Hinton Total
Volume (m^3)	*Leduc*	2.1E+10	1.39E+11
	Swan Hills	9.7E+09	2.50E+11
	Gilwood		1.39E+10
Depth (m)	*Leduc*	4240±459	4513±627
	Swan Hills	4484±440	4557±486
	Gilwood		4306±264
Temperature (°C)	*Leduc*	134±6	129±13
	Swan Hills	138±8	129±12
	Gilwood		119±14
Porosity	*Leduc*	0.068±0.046	0.068±0.046
	Swan Hills	0.046	0.046
	Gilwood		0.034±0.018

The formations found in the area around Hinton are both the hottest and the deepest reservoirs in the entire study region. All of the formations are reached at an average depth between 4200 and 4500 m. Mean temperatures throughout the area at least 120 °C. Temperatures in the Obed section, where the Leduc is reached at ~4240 depth, are >135 °C. In addition to high temperatures, the Leduc formation also has the highest mean porosity of any of the reservoirs investigated in this study. Only one porosity value for the Swan Hills formation, which is the average for the entire study region, was available. The Gilwood formation, which is found as a relatively thin (<50M) wedge trending from the outskirts of Hinton to the northeast is slightly cooler, shallower and less porous than either the Leduc or the Swan Hills formations in the area.

Figure 17 shows the mean thermal and electrical power production potentials for both the Obed section and the entire 50 km search diameter around Hinton, calculated using the range of values shown in Table 8. In total, we identified ~2,500 MWt of thermal power production potential within 50 km of the Town of Hinton. Over 60% of this thermal resource is contained in the Swan Hills formation. The Obed section alone contains just over 200 MWt of thermal power production potential, with nearly 70% of it contained in the Leduc formation. These values equate to an electrical power production capacity of ~57 MWe for the Obed Section and ~630 MWe for the entire Hinton area. Again, about 60% of the electrical power potential is found within the Swan Hills formation. The Gilwood, which only has significant thickness on the northeast border of the city, has a thermal and electrical power production capacities of ~69 MWt and 15 MWe, respectively.

The area around Hinton is clearly the best target for large-scale geothermal electricity production in Alberta. For comparison purposes, the Keephills 3 coal power plan has a capacity of 450MW. The electrical power potential identified in this area would be enough to replace this capacity through the development of multiple distributed geothermal facilities. The Obed section alone contains enough electrical power potential to fuel the residential and commercial needs of a city three times the size of Hinton. Geothermal power developed from these resources can supply clean, baseload electricity to provincial and national parks in the region. In addition, thermal power from these resources can be used to support the already existing timber industry in the area, as well as fueling a year-round agriculture industry through geothermal heated greenhouses.

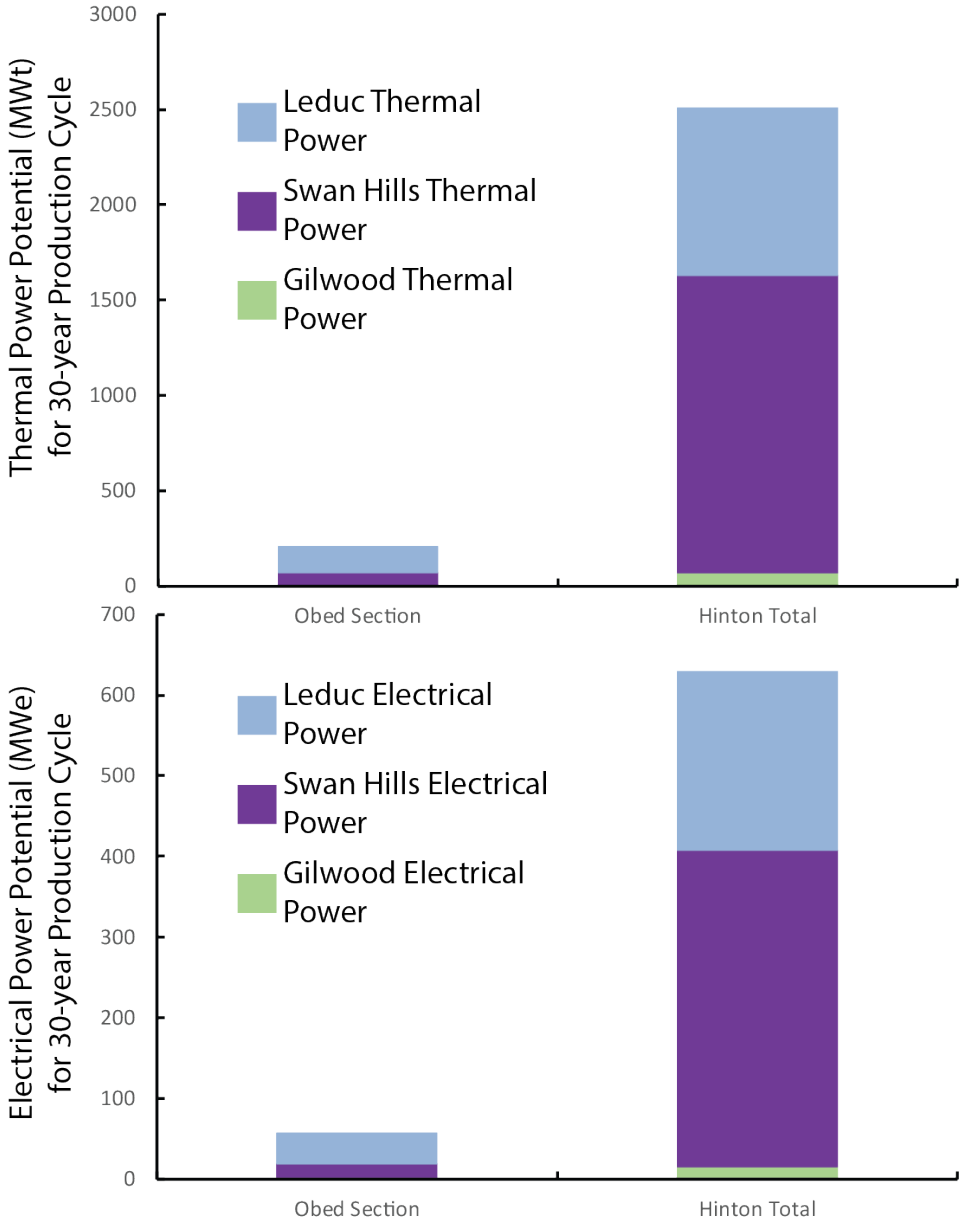


Figure 17 Mean thermal and electrical power production potential for potential geothermal reservoirs underlying the Town of Hinton, including the Obed section to the northeast of the city

4.4 Clearwater County

Clearwater County was the southern – most municipal district we investigated, with sponsorship from the Tri – Council of Clearwater County, Village of Caroline and the Town of Rocky Mountain House. Altogether, this represents about 12,300 residents, more than half of whom live in Rocky Mountain House. We investigated areas around Rocky Mountain House (35 km search diameter) and Caroline (35 km diameter). Figure 18 shows a stratigraphic grids of potential geothermal reservoirs found within 17.5 km of both of these localities. Please note that the z-axis of Figure 18 represents structural elevation in meters below sea level, not the total vertical depths of the formations. Structural elevations are required for the 3D mapping because they normalize the depth below the surface to a constant datum, in this case, sea level. For total vertical depth maps of these formations, please see Figure 5 in Chapter 3.

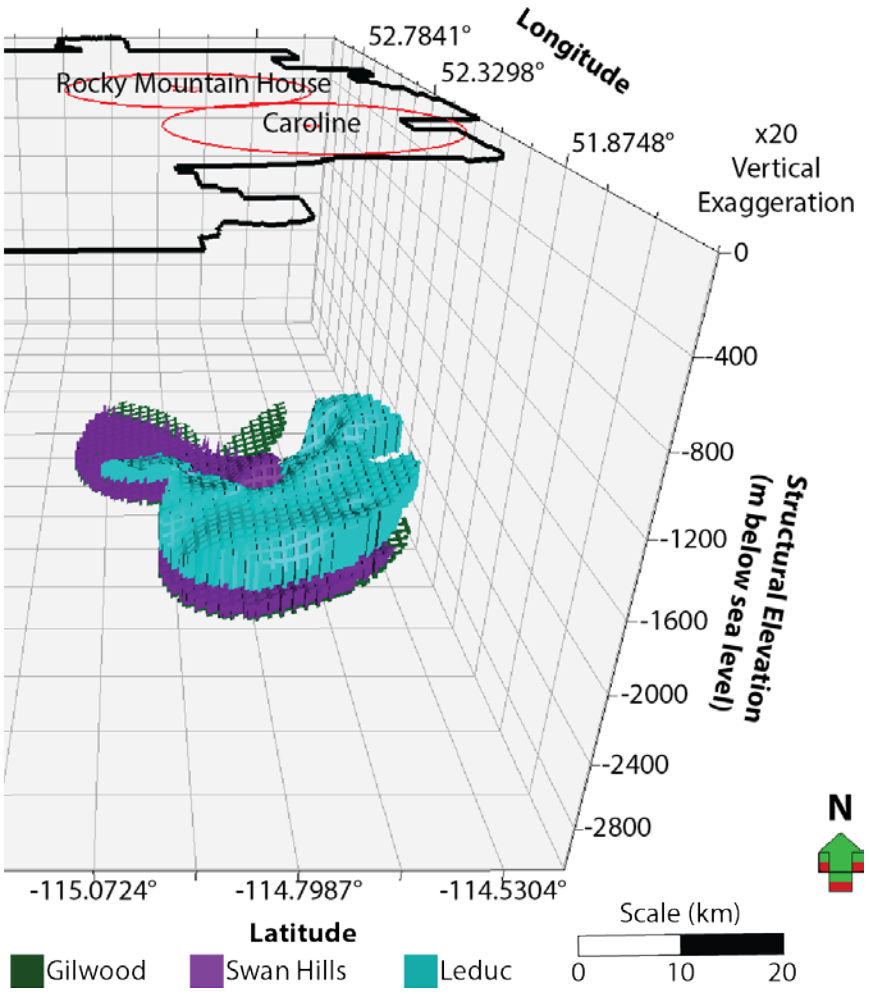


Figure 18 Stratigraphic grids of potential geothermal reservoirs underlying population centers in the Clearwater County. Note that the z-axis (depth) represents structural elevation (meters below sea level) and not total vertical depth.

The Gilwood, Swan Hills and Leduc were all identified as potential geothermal reservoirs in Clearwater County. While it appears as though all three formations underlie both population centers, only one well in the Rocky Mountain House area penetrates the Gilwood, at depth of ~1950m. There was no temperature or porosity measurement associated with this well. Therefore, the presences of the Gilwood beneath Rocky Mountain House is mostly inferred, and a volumetric assessment for this formation beneath Rocky Mountain House was not performed. Beneath Caroline, the Gilwood forms two distinct domes, one to the

west and one to the northeast of the village. Both domes have a maximum thickness of ~100 m, and they taper towards each other to a thickness of ~25 m beneath the Village. The Swan Hills in the region appears as a 75-125 m thick deposit that underlies both population centers. The Leduc appears as a thick (~275 m) deposit throughout most the Caroline search area, with the exception of the area directly north of the village. The Leduc only skirts the southwest margins of the Rocky Mountain House search area, where it appears to be <50 m thick. Table 9 shows the values that were used in the volumetric power potential calculations for the population centers in Clearwater County.

Table 9 Values used in volumetric power potential assessments for population centers in Clearwater County

	Town	Rocky Mountain House	Caroline
Volume (m^3)	*Leduc*	4.17E+9	1.52E+11
	Swan Hills	2.09E+09	5.99E+10
	Gilwood		2.06E+10
Depth (m)	*Leduc*	3608±994	3457±150
	Swan Hills	4200±690	3788±133
	Gilwood		3861±70
Temperature (°C)	*Leduc*	112±11	96.5±10
	Swan Hills	118±15	94±10
	Gilwood		100±8
Porosity	*Leduc*	0.05±0.024	0.066±0.054
	Swan Hills	0.042±0.022	0.062±0.05
	Gilwood		0.068±0.1

Both the Swan Hills and the Leduc formations beneath Rocky Mountain House have sufficient temperatures for electricity production. The mean temperature in the Gilwood beneath Caroline is also just over 100 °C, the minimum temperature we consider sufficient for electricity generation. Both the Swan Hills and Leduc formation beneath Caroline have mean temperatures in the upper 90s, placing them just on the boundary between marginal and sufficient temperature for electricity production. In all cases, porosities found throughout Clearwater County were generally higher than those found elsewhere. Porosity measurements from the Gilwood, however, varied considerably, with the standard deviation being greater than the mean. This effect results from one porosity measurement being > 20% and the remainder (3) being < 1%. With the exception of the Swan Hills formation beneath Rocky Mountain House, which is reached at a depth of ~4200 m, all the potential geothermal reservoirs we investigated in Clearwater County are reached at depths <4000 m.

As shown in Figure 19, we identified just over 1,000 MWt of thermal power production potential underlying the two investigated population centers in Clearwater County. A little more than half of this potential is found in the Leduc formation underlying Caroline. The Gilwood contributes less than 10% of this total, with the rest being supplied by the Swan Hills, predominantly beneath Caroline.

This thermal power potential equates to a mean electrical power potential of ~160 MWe. While most of this potential is found in the Leduc beneath Caroline, the temperature of the resource in that location is marginal for electricity production. The higher grade resources beneath Rocky Mountain House contain nearly 30 MWe of electrical power potential, which is enough to fuel the domestic and commercial needs of the entire county. An additional high grade resource may be found in the Gilwood beneath Caroline. Within the search area, the Gilwood's mean electrical power production potential is ~13 MWe. This is mostly contained in the dome to the southwest of Caroline. The dome to the east of Caroline, lies largely

outside of the search area and straddles the boundary with Red Deer County. This particular section of the Gilwood is a promising area for future exploration.

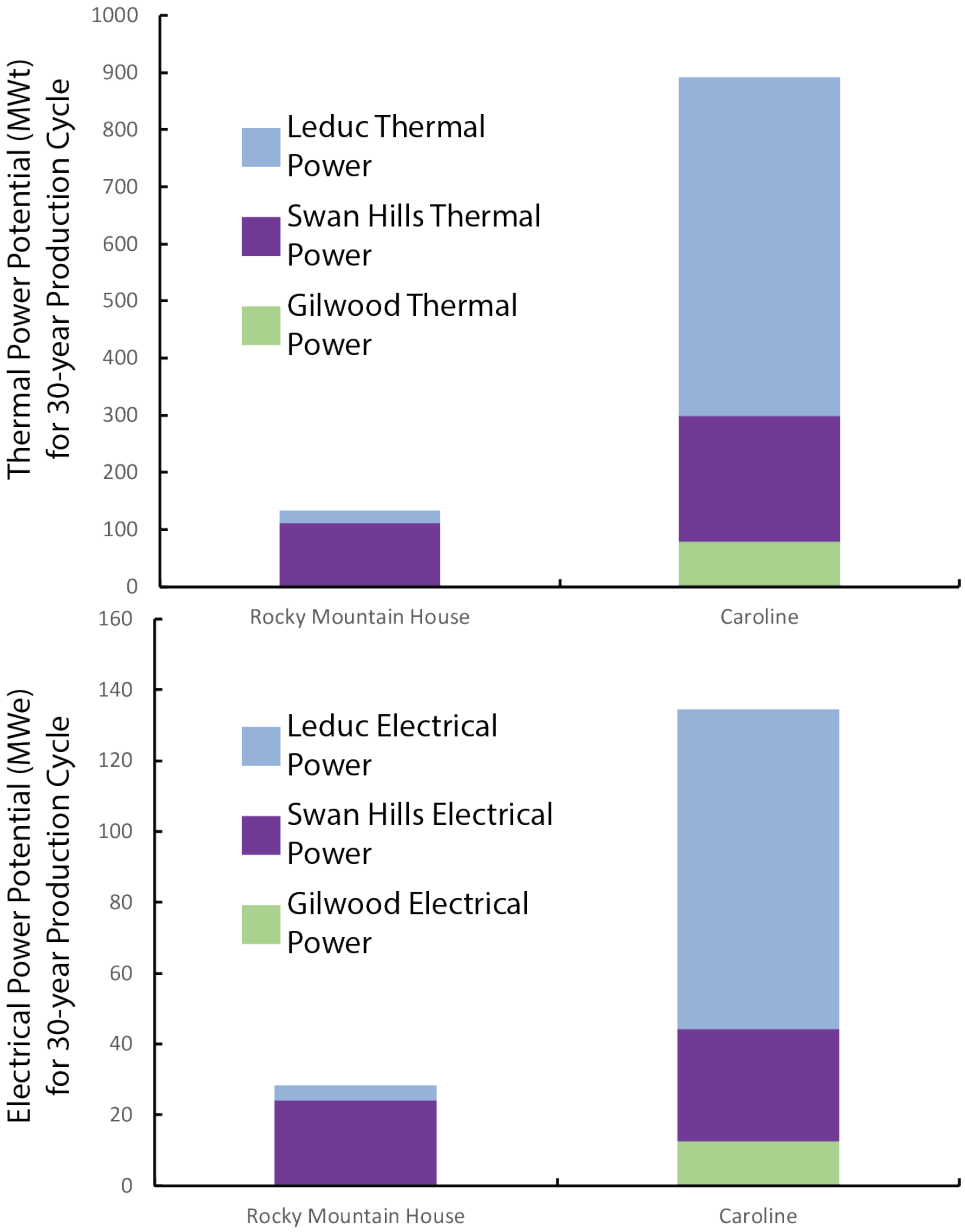


Figure 19 Mean thermal and electrical power production potential for potential geothermal reservoirs underlying the Rocky Mountain House and the Village of Caroline in Clearwater County

Clearwater County has the same standard set of opportunities (i.e. traditional electricity generation, various direct heating uses) for geothermal energy development that are available to all of the communities participating in this study. Additionally, the Caroline gas field in Clearwater County provides a unique opportunity to convert a diminishing gas field into a productive geothermal field. Many of the wells in this field are in the process of being shut in due to high water cuts in the gas flow. This water flow could be maximized by retrofitting these wells. The flow could then be used to potentially produce electricity through the development of low-temperature geothermal engines or through direct use options discussed in greater detail below.

5 Pathways to Commercialization

5.1 Overview

Previous chapters in this report detailed our geothermal resource base assessment for the Alberta foothills. The Deep Dive also compiled information concerning geothermal technology and commercial development relevant to moving projects forward. The areas we investigated were:

1. Cost estimates for major geothermal power plant components
2. Geothermal energy end-use options
3. Royalty structures in successful geothermal energy producing nations

This section of the report was performed by a consortium of industry and academic partners, external to the University of Alberta, as in-kind contributions to the Deep Dive. A list of the contributors and the areas they investigated are found in Table 10.

Table 10 List of project in-kind partners and their thematic contributions

Contributor	Topic
Terrapin Geothermics Inc.	Royality review; drilling costs; timber industry information
CES Power and Control	Organic Rankine Cycle (ORC) Modeling; 2.5 MWe ORC price quote
Iceland School of Energy; Reykjavik University	Organic Rankine Cycle (ORC) Modeling; global ORC cost review
Solbird Energy Inc.	Geothermal greenhouse thermodynamic and economic models; Greenhouse and timber kiln heating schematics

This chapter summarizes the findings and key points of each of these individual reports. The reports themselves are found in their entirety in the appendix. The reports contributed by these partners should provide guidance to the participating municipalities in support of their strategic planning activities. They are meant to inform public officials and provide frameworks for moving conversations forward on a community level. They are not meant to function as comprehensive technological or economic pre-feasibility studies.

5.2 Costs of major geothermal power plant components

5.2.1 Drilling Costs

Geothermal power plants consist of 5 major pieces of infrastructure:

1. Wells
2. Pumps
3. Heat exchangers & piping
4. Turbines
5. Electrical transmission equipment

The riskiest investment is in the wells, without which there is no direct confirmation of a reservoir's viability. The wells are required to circulate geothermal fluids from the deep subsurface. The wells are primarily what distinguishes a geothermal power station from any other type turbine-using power plant.

It is common practice for geothermal developers to drill "slim hole" test wells to prove a resource before proceeding to full scale geothermal well drilling. A geothermal slim hole is broadly similar to a conventional gas well in terms of diameter and completions. Practically speaking, any gas well in our study area could be retrofitted to serve as a geothermal slim hole. The requirements for serving this purpose are

significantly lower than the requirements for repurposing a gas well for full-time brine circulation as a geothermal producer or an injector.

Based on costs taken from the PSAC 2017 Well Cost Study (PSAC, 2016), we estimate the fixed costs of retrofitting a gas well for use as a geothermal slim hole to be ~$75,000 per well. This includes the costs of installing new wellhead equipment, adding a packer to seal off the current producing zone and perforating an area for a new production zone in the geothermal pool. Table 11 summarizes these fixed costs. In additional to these fixed costs, a new liner would need to be installed in the well. The PSAC study estimates $37/m for well lining. Thus, a 4,500 m well retrofit would require an additional ~$166,500 in new lining. Retrofitting a 4,500 m gas well as a geothermal slim hole is nearly an order of magnitude cheaper than drilling a new one

Table 11 Estimated material costs for repurposing a 4,500 m gas well as a geothermal slim hole

Item	Unit Cost	Units	Cost
Overhead well-retrofit	$6,000/per well	1	$6,000
Well head equipment	$18,000/per well	1	$18,000
Packer	$10,200	1	$10,200
Perforation	$34,000	1	$34,000
Well liner	37/meter	4500	$166,500
Subtotal			$234,700
Contingency	20%		$46,940
TOTAL			$281,640

Costs for drilling a full size geothermal well will vary with specific local conditions. Through Terrapin Geothermics Inc., we obtained a rule-of-thumb price quote for a full size geothermal well from Cougar Drilling. Cougar Drilling is both active locally in oil and gas drilling and globally as a geothermal driller. They estimate a cost of $5-6,000,000 for a 3,000 m geothermal well with a 20” surfacing casing that telescopes down to a 7” production casing. These costs may not increase linearly per meter past 3,000 m. A 4,000 m well may cost closer to $9,000,000 than $8,000,000, depending on local conditions.

5.2.2 Surface infrastructure

Surface infrastructure for a geothermal power plant includes pumps, heat exchangers, turbines and power distribution equipment. Pumps include brine production and injection pumps, ORC working fluid pumps, coolant pumps and district heating fluid distribution pumps. Power distribution equipment means thermal piping in the case of a direct-use geothermal system and electricity generation and transmission equipment in the case of an electricity producing geothermal plant.

The costs for a 2.5 MWe ORC, which could be run on a simple doublet, were provided by CES Power and Control, an Edmonton based company that builds small scale generation facilities for a variety of industrial purposes. A summary of these costs are provided in Table 12. The full class-C cost estimate may be found in Appendix A. For the modular designed surface plant, they estimate a cost of ~$12,000,000. Coupled with two $9,000,000 wells, the total cost of a 2.5 MWe pilot plant may be ~$30,000,000, or $12,000/kWe. This is considerably higher than the ~$3,000/kWe global average, a figure provided to us by the Iceland School of Energy (Appendix C2). The global average, however, considers mature technology and not a first-of-its-kind adoption. Nominal public subsidies could make geothermal cost competitive with solar and wind in Alberta, due to its baseload capacity factor. While the capital cost of solar capacity may cost 7-10 times less than the capital cost of geothermal capacity (e.g. Lazard, 2016), a geothermal system has 4-5 times the capacity factor.

Table 12 Estimated costs for a 2.5 MWe Organic Rankine Cycle geothermal power plant

TASK DESCRIPTION	Total
Project Management	$349,200.00
Engineering Design	$852,000.00
Site Construction Equipment	$21,600.00
Civil and Site Preparation	$444,000.00
Concrete	$21,600.00
Structural Steel	$60,000.00
Buildings	$46,800.00
ORC Equipment	$6,155,600.00
Piping	$784,800.00
Electrical	$2,619,350.80
Instrumentation	$420,000.00
Startup / Commissioning	$109,200.00
Special / Other	$118,800.00
Grand Total:	**$12,002,950.80**

A direct use geothermal plant would be significantly cheaper than an electrical power plant. The cost of the electricity generation and transmission equipment in the above scenario is ~$8,700,000. The construction and heat exchange infrastructure is ~$3,300,000. In addition to this equipment, a heating fluid pump and pipes are required. Costs for the pump are estimated to be ~$115,000 (Appendix A2). Costs for the thermal piping are taken from the PSAC well cost report and are estimated to be $22/m. An 11 km district heating network, such as the one serving the Munich-suburb of Unterhaching, would cost $242,000. The thermal power required for district heating system is dependent on application. In section 5.3, below, we describe the thermal requirements for tomato greenhouses and timber kilns, as examples.

5.3 Geothermal end-use options

5.3.1 Direct Use

Geothermal energy can be used directly as heat or converted to electrical power. Geothermal resources as cool as 40 °C can be exploited for thermal power. Direct-use applications for geothermal heat are available throughout our entire study region. Common end-uses for geothermal heat include:

1. Domestic and commercial space heating
2. Industrial process heat
3. Greenhouse and nursery heating
4. Timber and grain drying
5. Snow melting
6. Balynology (spas and public baths)

For this report, we looked closely at opportunities for geothermal applications in the agriculture and timber industries. Solbird Inc., an Edmonton based micro-renewable and ground source heat pump installation company, reviewed the economics and thermodynamics of a geothermal heated tomato greenhouse facility. Terrapin Geothermics Inc. networked with the forestry and timber industries on our behalf. They provided us with dimensions and operating conditions of a typical timber kiln, as well as the thermal load such a facility requires.

As of 2013, Alberta had ~127,000 m^2 of greenhouses, representing 5.5% of Canada's greenhouse market. A 1 hectare tomato greenhouse operation would require 45,000 GJ/year of heating. This equates to a constant thermal power requirement of ~1.5 MWt/hct. Considering an average annual air temperature of 0

°C in Alberta, this requirement would be met with a flow rate of ~6 kg/s for a 60 °C brine flow. An 80 °C brine would meet this requirement with a 4.5 kg/s flow rate. These flow rates are low; a one hectare tomato greenhouse may be undersized even for a simple doublet (production and injection well) system. These flow rates are low enough to seriously consider the use of refurbished gas wells for long term production and injection, given the typical spacing of the wells and the land requirements of the greenhouses. Furthermore, these temperatures are available as a low-grade geothermal resource throughout the Western Canadian Sedimentary Basin. In fact, it is likely that any agricultural land west of the Edmonton-Calgary corridor has access to a greenhouse-grade geothermal resource in least one geologic horizon.

Currently, over 80% of greenhouses in Alberta are heated with natural gas. Due to natural gas price fluctuations, the cost of heating a hectare size tomato greenhouse with natural gas has fluctuated from below $80,000 year in 2016 to nearly $180,000 in 2014, as shown in Figure 20. With the implementation of Alberta's new carbon tax, higher heating costs maybe expected.

Figure 20 Price fluctuations in greenhouse heating costs as function of natural gas prices from 2-13-2018

A single hectare tomato greenhouse would take decades to pay back the investment of a geothermal doublet, and the doublet would likely be far oversized for the greenhouse. The economics of a new doublet specifically for greenhouses make sense at ~5 hectares. Retrofitting existing wells for brine circulation, however, appears to be an excellent investment, where feasible. Greenhouse heat may also be provided by using the waste heat from a geothermal power plant, which is often still > 80 °C. This would essentially be free heat for the greenhouses, with practically no capital expense. Furthermore, this would add a diversified income stream for the power plant operator, making the economics of the whole project more favourable.

A qualitative process flow diagram for a geothermal-fueled greenhouse installation is found in Figure 21.

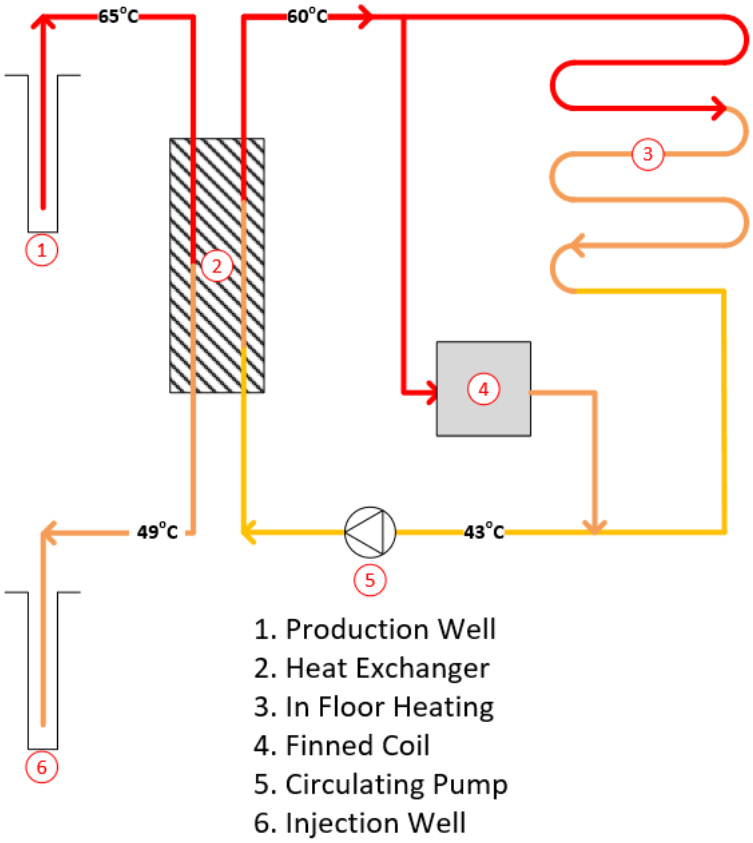
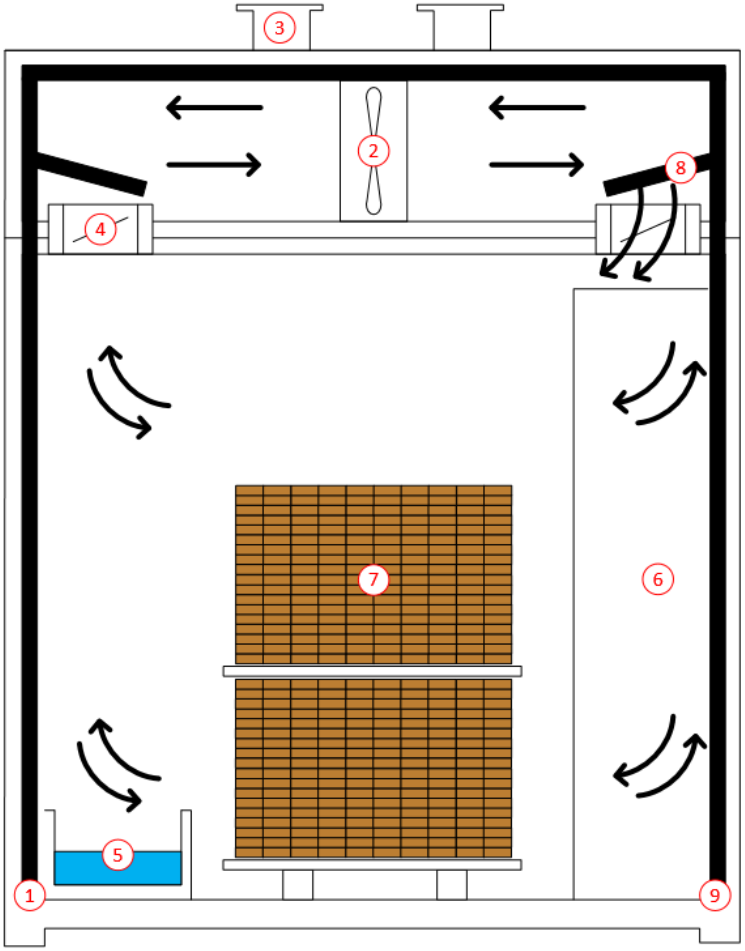


Figure 21 (adapted from Boyd, 2008) Schematic diagram for a geothermal-fueled greenhouse installation. Thermal energy from a produced brine (1) is transferred to a working fluid at the surface (2), which is then circulated through heating coils in the floor of the greenhouses (3). The working fluid is circulated throughout the system, including through a regenerator (4) with a pump (5) in a closed loop. Cooled brine is then reinjected into the subsurface (6).

Another significant direct use geothermal opportunity in Alberta are timber drying kilns. A typical drying kiln is an enormous box where 100 °C air constantly circulated. A typical kiln may be ~97,000 m^3 and require 11 million btu/hour of heat. This equates to a constant thermal power load of ~3.3 MWt. Considering the volatility of the natural case market and the coming impacts of Alberta's carbon tax using a geothermal source, rather than natural gas, for timber drying may be economically sensible, especially if coupled with power generation and/or retrofitted oil and gas wells.

A qualitative process flow diagram for a geothermal heated timber kiln is shown in Figure 22.



1. Production Well
2. Adjustable Fan
3. Aluminum Ventilator
4. Aluminum Side Air Baffle
5. Water Trough
6. Adjustable Aluminum Vertical End Air Baffle
7. Wood
8. Finned Heat Exchange
9. Injection Well

Figure 22 (adapted from Scott and Lund, 1998) Schematic diagram for a geothermal-fueled timber kiln. The kiln is essentially a large hall, where thermal energy from produced brine (1) heats ambient air (3) that is circulated through the hall with a large, adjustable fan (2). Even air flow throughout the facility is maintained with a series of baffles and fins (4, 6). Heat is transferred from the brine to the air with finned heat exchangers (7) near the air intake, and the humidity is maintained with a water tank (5). The cooled brine is reinjected into the subsurface (9).

Existing timber drying facilities in Alberta can be evaluated on a case by case basis for the feasibility of retrofitting them with a geothermal source. New timber drying facilities may be strategically located to take advantage of available geothermal resources.

5.3.2 Electricity production.

Electricity production from geothermal resources in the Western Canadian Sedimentary Basin will be employ binary cycle technology. In a binary cycle geothermal plant, the heat content from the geothermal resource is transferred to a low boiling point "working fluid," whose vapour subsequently drives a turbine as water steam would drive a steam turbine. The working fluid is then re-condensed through a chiller before going through the cycle again. The working fluid stays in a closed loop in the surface plant, and the geothermal brine stays in a semi-closed loop between the surface plant and the reservoir. The most common type of binary cycle engine employed in the geothermal industry is the Organic Rankine Cycle (ORC) engine, a schematic diagram of which is shown in Figure 23.

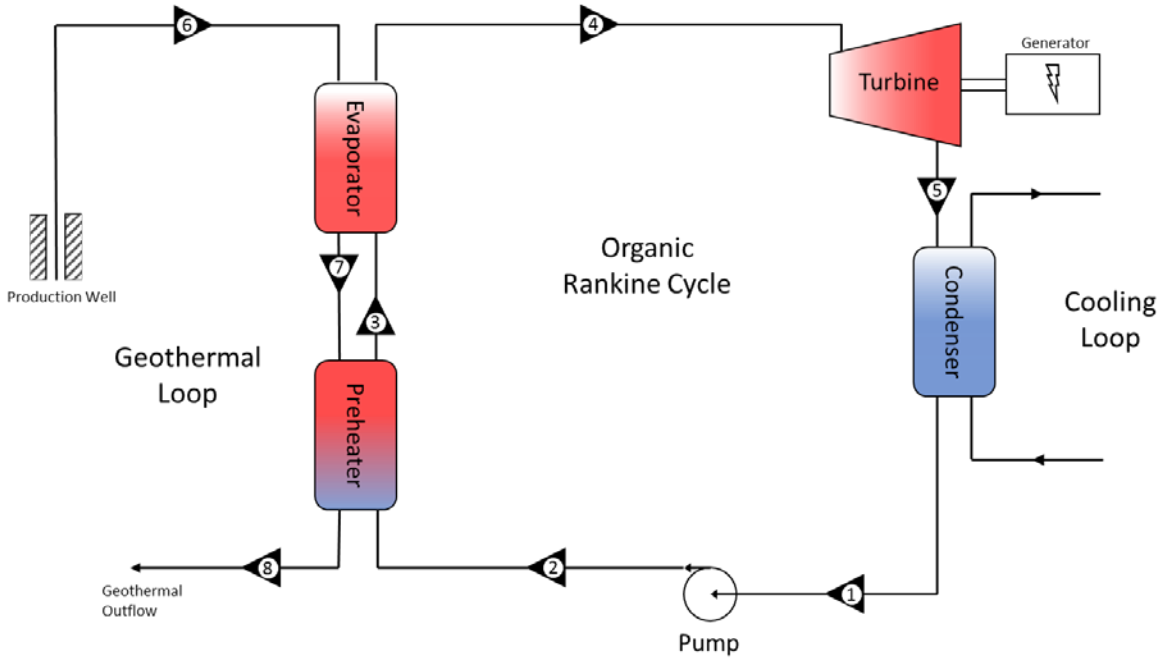


Figure 23 Process flow diagram of an Organic Rankine Cycle power plant, showing the working fluid loop (1-5) and the geothermal brine loop (6-8.) The working fluid loop begins with cool refrigerant (1) that is pumped from the condenser to the preheater (2). The pre-warmed working fluid (3) is then moved to the evaporator, where it boils (4), driving a turbine. After volume expansion within the turbine, the working fluid is then returned to the condenser (6), where the cycle begins again. In the geothermal brine loop, formation fluid is pumped from depth to the evaporator (6), where it boils the working fluid. Residual heat from the brine (7) is used to preheat the working fluid coming into the evaporator. The cooled brine is then injected back into the subsurface (8).

A team of engineers from CES Power and Control and an engineer from Iceland School of Engineering (Reykjavik University) both submitted thermodynamic models of ORCs under various operating conditions. These reports are found in Appendix C. CES Power and Control analyzed the performance of air-cooled ORCs with brine inlet temperatures of 140 °C and 120 °C and flow rates of 50 kg/s and 30 kg/s. A summary of their results are shown in Table 13, below. With a 140 °C inlet temperature, a flow rate of ~37 kg/s is required to achieve 1 MWe of net electrical production. With a 120 °C inlet temperature, a flow rate of 69-71 kg/s is required. This calculated flow rates are in good agreement with the flow rates calculated in the volumetric assessments discussed in Chapter 3 (Section 3.3; Figure 11).

Table 13 Performance summary of Organic Rankine Cycle engines at two different brine inlet temperatures and flow rates.

Brine Temp. [°C]	Flow Rate of Brine [kg/s]	Gross Electrical Work Output [kW]	Flow Rate of Working Fluid [kg/s]	Pump Power Required [kW]	Fan Motor Power [kW]	Net Electrical Work Output [kW]	Overall Eff. [%]	Flow Rate for 1 MWe (kg/s)
140	50	1798	60.37	164	140	1345	9.04	37
140	30	1079	36.22	98	83	803	9.00	37
120	50	1063	40.28	109	93	724	7.41	69
120	30	638	24.17	66	56	423	7.21	71

In addition to the models created by CES Power and Control, a master's engineering student at the Iceland School of Engineering (Reykjavik University) studied various working fluids in ORCs with both 135 °C and 105 °C brine inlet temperatures. He studied efficiency of the working fluids under different degrees of brine cooling. Figure 24 shows the optimal results for the different inlet and outlet brine conditions.

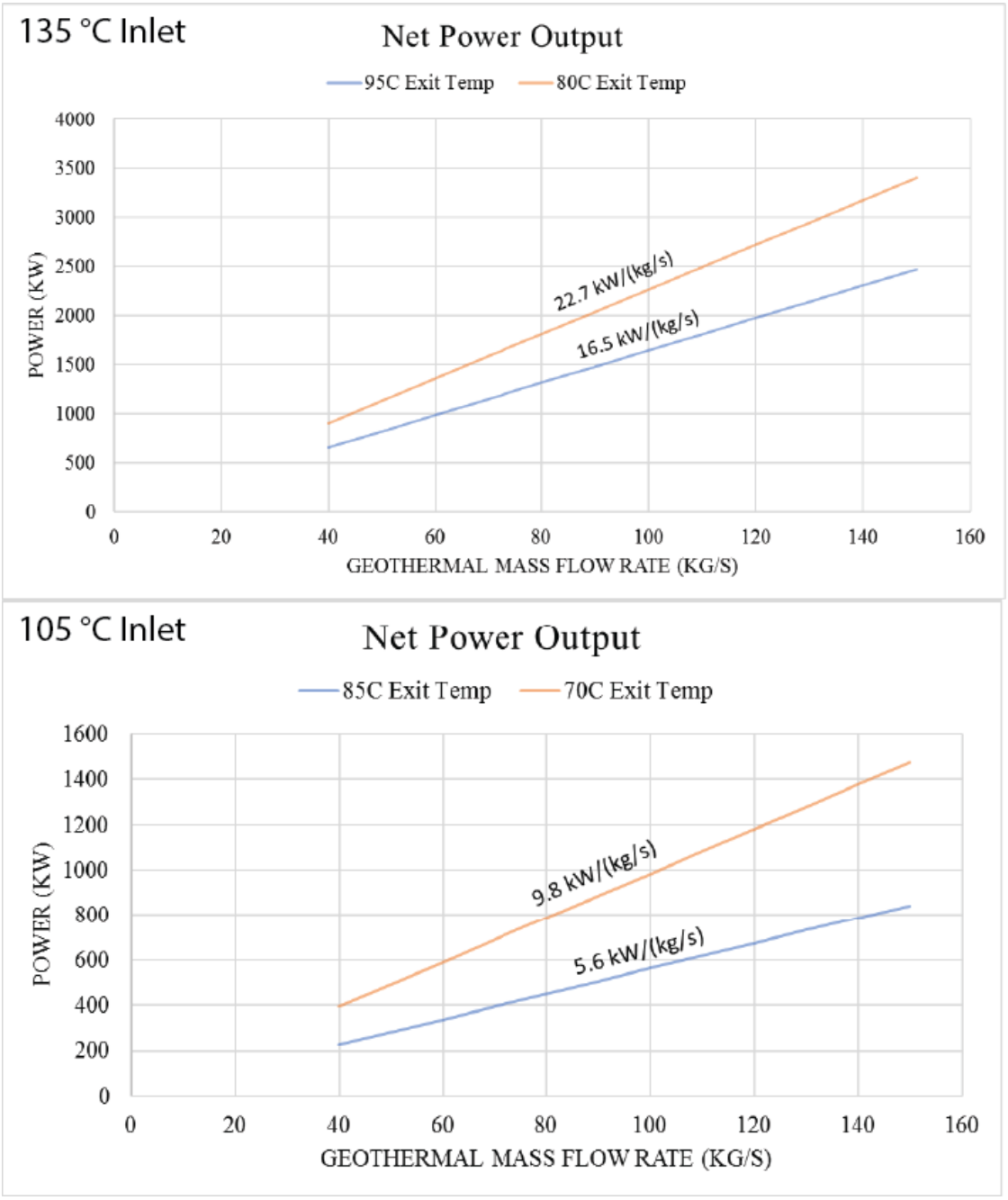


Figure 24 Net power output for an ORC with a 135 °C (top) and 105 °C (bottom) inlet temperature at 2 different brine temperature gradients

These results are also in good agreement with both the model from CES Power and Control and the volumetric calculations described in Chapter 3 (Section 3.3; Figure 11). Based on the results from these three different calculations, we expect simple doublets throughout our study area to be able to produce 1-2 MWe of net electrical power.

5.4 Geothermal Regulations in Alberta

Alberta currently has no regulatory framework in place for developing geothermal resources.

British Columbia is the only Canadian province with explicit geothermal legislation. For reference, the Geothermal Resource Act for British Columbia may be found here:

http://www.bclaws.ca/civix/document/id/complete/statreg/96171_01

In addition to work being done in Alberta on this issue, geothermal development regulations are also being contemplated in Saskatchewan, as well as the Yukon and Northwest Territories

Geothermal regulatory frameworks focus on answering several key questions, including:

- What is the definition of geothermal resource in Alberta?
- Who owns Alberta's geothermal resources?
- Can geothermal resources be regulated in a manner similar to mineral resources, water resources, or hydrocarbon resources, or does a new category of resource need to be developed?
- What are the processes for obtaining geothermal exploration and production leases?
- What environmental protections need to be in place for allowing geothermal drilling and production?

Since this study began in February 2016, the Government of Alberta has assigned a task force through the Ministry of Energy to look into these issues. A rigorous jurisdictional review of geothermal regulations around the world is not necessary in this report, as it will be undertaken by the Ministry of Energy task force. Researchers at the University of Alberta will continue assist the Government of Alberta in this process. Developing a regulatory framework for geothermal energy development in Alberta will take years and will involve deliberation by provincial officials in consultation with industry, municipal and residential stakeholders.

5.5 Environmental Impacts

While geothermal energy is classified as a renewable resource in Alberta and Canada, it is not without its environmental impacts. Most of geothermal energy development's carbon footprint is in the plant construction, including drilling and infrastructure manufacturing. Environmental impacts during geothermal power production include noise pollution, trace gas emissions, water consumption and mineral precipitant management.

While detailed environmental impact assessments must be performed on a case-by-case basis. The Geothermal Energy Association (geo-energy.org, 2017) keeps statics on the performance geothermal plants compared to other renewable and non-renewable power sources in regards to several key environmental metrics, including emissions per MWh of generated energy, land use footprint and water consumption.

No statistics are available for emissions from binary cycle geothermal plants. In theory, a binary cycle plant should have no emissions, because the working fluid is in a closed loop, and the geothermal brine is reinjected into the subsurface. The brine flow, however, will include some reservoir gas, including CO_2, methane, nitrogen, NO_x and SO_x. Gas may also be exolved as the brine depressurizes at the surface. Typically, these gases would be separated at the well head and vented to the atmosphere. Because gas entrained in the brine flow reduces the overall heat capacity of the fluid, developers would seek to have

<10% by volume gas in the brine. Thus, gas emissions from binary cycle power plant would still be negligible.

Geothermal power plants use approximately three times less land per GWh (404 acres/GWh) of produced energy than wind turbines (~1300 acres/GWh) and nearly eight times less land area than solar photovoltaic (~320 acres/GWh). During its entire life cycle, a binary cycle geothermal power plant may use anywhere from 0.32-1.08 liters of water per kWh of energy produced. This compares unfavourably to wind (~0.04 l/kWh) and solar (0.28-0.76 l/kWh). Most of water consumed by binary cycle geothermal power plant is cooling water. Alberta's low annual ambient air temperature, however, make the use of air-cooled plants more feasible here than in many other locations around the globe. The use of air-cooled plant would place geothermal energy's water use footprint on par with that of wind and solar energy.

All statistics cited above may be found at: http://geo-energy.org/geo_basics_environment.aspx

6 Conclusions

6.1 Technical Development

From the technical perspective, we have now identified the top sites in west-central Alberta for geothermal energy development. Detailed reservoir and production models for these sites, along with slim hole wells drilled into the reservoirs will be required to move this research out of a computer and into the field for a pilot and demonstration-scale technology demonstration.

Commercial opportunities for direct-use exploitation of the resources identified in this study exist throughout the study area. Although, commercially proven technology currently exists that would allow for electricity production from the hotter reservoirs identified in this study, the lack of local expertise and knowledge means that electricity production of Alberta's geothermal resources is at a lower technology readiness level than in other jurisdictions. Resources at the lower temperature end (80-100 °C) of what we identified in this study require the development and/or optimization of low and ultra-low temperature differential heat engines to be considered potential electricity producing resources. The relatively cold (~0 °C) annual average air temperature in Alberta gives the province a strategic advantage in the deployment of this type of technology, which also leads to the potential economic conversion of other waste heat streams into electricity and a significant global export opportunity. Technology development opportunities for direct use geothermal heating exist in optimization of surface and down hole heat exchangers, as well as retrofitting of forced-air heating systems to accept a geothermal input source.

In addition to technology development, we also recommend deeper research into the sites identified in this study, as well as broader exploration through western Alberta. Deeper research includes using well logs and seismic lines to further define the properties of geothermal pools and model long term brine circulation in proposed development areas. Additional exploration targets include the Devonian section beneath Grande Cache, Cambrian sections beneath Fox Creek and Caroline and the deep basin in the far north of the province by Rainbow Lake and High Level. Any location west of the Edmonton-Calgary corridor is suitable exploration site for direct use of geothermal energy. In particular, the area between the southwest margins of Edmonton and the northwest margins of Red Deer is particularly favourable for direct use applications. Additionally, there are direct-use geothermal resources at shallower depths than what we explored here throughout western Alberta.

6.2 Cost Competitive Outlook

Regarding cost competitiveness, we estimate the capital cost for first Alberta adoption of binary-cycle geothermal power technology to be $12,000 - $15,000/kWe, for a pilot scale project. These costs are indicative of a pre-commercial technology that still requires technical and project development de-risking. If we compare these costs with the wind and solar capital costs within the US, we see they are ~10x less expensive (Lazard, 2016). However, another important factor to consider is the capacity factor, i.e. how often a power plant will produce electricity, keeping in mind that the capacity for wind and solar depends greatly on geographical location, generally speaking a wind farm has a capacity factor of roughly 30%, solar farms 15% and geothermal power plant 95%. Therefore, a kWh of geothermal energy from a pilot scale geothermal project is estimated to be ~2x as expensive as wind or solar. Both of these comparisons carry the imperative caveat that wind and solar are fully commercial technologies that have benefitted from extensive research and public subsidies. Geothermal electricity production in Alberta is at a very early project development level compared to wind and solar. This is not because the technical components aren't commercially available but rather because the integrated geothermal system which includes exploration, reservoir modelling, drilling, etc that are needed to access the underground heat source

and delivery it for heat use or electricity generation has never been done in Alberta. The fact that pilot-scale capital costs of geothermal electrical power are 'only' about twice as expensive as full-scale wind and solar on a kWh basis should be seen as an encouraging starting point. As the project development within the province matures, the capital costs of geothermal electricity power need to be reduced to $6,000 - $8,000/kWe to compete with wind and solar on a kWe basis and $4,000-$6,000/ kWe to meet global averages (Lazard, 2016). Specific measures that may need to be taken to achieve these cost reductions are:

- Continued use of existing oil and gas exploration data, including well logs and seismic profiles, to reduce the risk of drilling dry wells
- Repurposing existing oil and gas wells as geothermal slim holes for advanced exploration, reservoir productivity testing and, where possible, full-scale brine production and injection
- Scaling up from pilot scale (1-2.5 MWe) to full field development (> 10 MWe)
- Creating a local manufacturing base for geothermal power plant components, including geothermal well casings, heat exchangers and organic Rankin cycle generators
- Developing and optimizing low and ultra-low temperature differential heat engines

In contrast with electricity production, which requires further technical and economic de-risking, direct use of geothermal energy for various heating purposes is commercially viable technology in the current economic environment. A simple geothermal doublet in Alberta may produce anywhere from 2.5 MWt (at 60 °C and 10 kg/s flow) to 21 MWt (at 100 °C and 50 kg/s flow) of thermal power, considering a 90% efficiency. If this doublet is comprised of repurposed oil and gas wells, the capital costs of a direct use geothermal system may range from $50-500/kWt. The geothermal system for the 1 hectare tomato greenhouse discussed in Section 5.3.1, for example, may have a capital expense of up to $750,000, if a suitable well pair can be found. If this greenhouse were to be heated with natural gas, it would require ~42,500 GJ/year. Using the 10-year average gas price (~3.93/GJ; Alberta Energy Regulator, 2017); this amounts to a ~$165,000/year in fuel expenses alone. The fuel cost savings provided by the geothermal system would pay for the system itself in < 5 years. These costs savings would be accompanied by a CO_2 emissions reduction of ~2,380 tons per year (56kg/GJ; Natural Resources Canada Archives, 2017), representing an additional ~$70,000 in savings a year.

If new wells are required for a district heating system, the capital cost will be considerably more expensive. It is harder to estimate these costs because a detailed design study for any given project may show that is it cheaper to drill several narrow diameter wells than two full size geothermal wells, for which we have price estimates here. Justifying the capital expense of drilling new wells for a direct use geothermal system will require that the project be considerably larger than the 1.5 MWt greenhouse or the 3.3 MWt timber kiln contemplated here. A 10 hectare greenhouse complex run off of full size geothermal production and injection wells may have a capital cost of $800-1000/kWt, for a total cost of $12-15 million. Using the metrics discussed in the previous paragraph, this complex would require ~1,650,000/year in fuel costs and be subject to an additional ~$700,000 in carbon taxes, at current rates. For a large direct use project such as this, the fuel cost savings provided by the geothermal system would pay for the system in < 10 years. This analysis does not consider projected increases in gas prices or the Alberta carbon tax.

6.3 Recommendations

Considering a 30-year production period, west-central Alberta contains >6,000 MWt of thermal power potential and >800 MWe of technically and potentially cost competitively recoverable electrical power potential. This could provide up to 16% of the Government of Alberta's targeted renewable energy capacity by 2030. This is a substantial renewable energy resource that must play an important role in Alberta's energy transition. Whereas electricity production from this resource requires further technical and

economic de-risking, a process that may take some years, direct-use of Alberta's geothermal resources for heating purposes are commercially viable immediately.

To reduce the technical risk, we recommend using direct use geothermal projects to de-risk the project development of electricity production projects. Direct-use projects are both technically and economically safer, because they require lower temperatures, lower flow rates, and shallower wells. Refurbished oil and gas wells may be used in demonstration-scale direct-use projects at a fraction of the cost of drilling the new wells required by an electrical power plant. Focusing on direct use in the near-term (1-3 years) will allow scientists and engineers to observe firsthand the behaviour of a producing geothermal pool without the risk of integrating with an electrical power plant. Knowledge gained through the development and operation of direct-use geothermal systems can then inform best practices for developing geothermal electrical power stations. The construction of pilot-scale geothermal power plants is an intermediate, i.e. 3-5 year, goal.

Currently no regulatory framework exists for geothermal energy development in Alberta. To enable project development of geothermal resources will require clear and concise policy and regulations.

This study provides significant support geothermal energy has an important role to play in Alberta's energy transition. In support of the conclusions and recommendations of this study, the University of Alberta is planning a major investment in expanding our geothermal energy research activities throughout western Canada. Our goal is to see operating direct use geothermal systems in Alberta within 1-3 years, a pilot scale electrical power plant brought online in 3-5 years and a mature industry developing by 2030, providing clean, baseload load heat and power to Albertans.

7 References

Alberta Research Council, Canadian Society of Petroleum Geologists, & Shetsen, I. (1994). Geological atlas of the Western Canada sedimentary basin. [Calgary]: Published jointly by the Canadian Society of Petroleum Geologists and the Alberta Research Council

Andrichuk, J.M. 1958. Cooking Lake and Duvernay (Late Devonian) sedimentation in Edmonton area of central Alberta, Canada. AAPG Bulletin-American Association of Petroleum Geologists, 42:2189–2222

Atchley, S. C., West, L. W., & Sluggett, J. R. 2006. Reserves growth in a mature oil field: The Devonian Leduc Formation at Innisfail field, south-central Alberta, Canada. AAPG bulletin, 90(8):1153-1169

Augustine, C., Field, R., Dipippo, R., Gigliucci, G., Fastelli, I., and Tester, J. 2009. Modeling and Analysis of Sub- and Supercritical Binary Rankine Cycles for Low- to Mid-Temperature Geothermal Resources. GRC Transactions. 33:689-693

Bachu, S. 1993. Basement heat flow in the Western Canada sedimentary basin. Tectonophysics 222(1):119–133

Boyd, T. 2008. Geothermal greenhouse information package. Oregon Institute of Technology. Accessed online at http://www.oit.edu/docs/default-source/geoheat-center-documents/publications/greenhouses/green.pdf?sfvrsn=2 on March 17, 2017.

Dec, T., Hein, F.J. and Trotter, R.J. 1996. Granite wash alluvial fans, fan-deltas and tidal environments, northwestern Alberta: implications for controls on distribution of Devonian clastic wedges associated with the Peace River Arch; Bulletin of Canadian Petroleum Geology. 44:541–565.

Dittman, G.L. 1977. Calculation of brine properties. Lawrence Livermore National Laboratory. Accessed online at https://www.osti.gov/scitech/servlets/purl/7111583/ on February 25, 2017

Dunn, L., Schmidt, G., Hammermaster, K., Brown, M., Bernard, R., Wen, E., ... & Gardiner, S. 2012. The Duvernay Formation (Devonian): sedimentology and reservoir characterization of a shale gas/liquids play in Alberta, Canada. In Canadian Society of Petroleum Geologists, Annual Convention, Calgary

Garland, G., and Lennox, D. 1962. Heat Flow in western Canada. Geophysical Journal International, 6: 245–262

Glass, D. J. 1990. Lexicon of Canadian Stratigraphy, Volume 4, western Canada, including eastern British Columbia, Alberta, Saskatchewan and southern Manitoba. Canadian Society of Petroleum Geologists, 8:109-118

Grasby, S.E., Allen, D.M., Chen, Z., Ferguson, G., Jessop, A., Kelman, M., Majorowicz, J., Moore, M., Raymond, J., and Therrien, R. 2012. Geothermal energy resource potential of Canada. Open-File Report - Geological Survey of Canada. p. 322

Gray, A., Majorowicz, J., and Unsworth, M. 2012. Investigation of the geothermal state of sedimentary basins using oil industry thermal data: Case study from northern Alberta exhibiting the need to systematically remove biased data. Journal of Geophysics and Engineering, 9:534–548

Hemphill, C. R., R. I. Smith, and F. Szabo. 1970. Geology of Beaverhill Lake reefs, Swan Hills area, Alberta. Geology of giant petroleum fields: AAPG Memoir 1:50-90

James, D.P., and Leckie, D.A. (Eds.). 1988. Sequences, Stratigraphy, Sedimentology: Surface and Subsurface — Memoir 15:537-542

Jansa, L. F., & Fischbuch, N. R. 1974. Evolution of a Middle and Upper Devonian Sequence from a Clastic Coastal Plain--deltaic Complex Into Overlying Carbonate Reef Complexes and Banks, Sturgeon-Mitsue Area, Alberta (p. 205). Department of Energy, Mines and Resources

Jones, F., and Majorowicz, J. 1987. Regional trends in radiogenic heat generation in the Precambrian basement of the Western Canadian Basin. Geophysical Research Letters, 14(3):268–271.

Jones, F.; Lam, H.-L.; Majorowicz, J. 1985. Temperature distributions at the Paleozoic and Precambrian surfaces and their implications for geothermal energy recovery in Alberta. Can. J. Earth Sci. 22:1774–1780

Kaufman, J., Meyers, W. J., & Hanson, G. N. 1990. Burial cementation in the Swan Hills Formation (Devonian), Rosevear Field, Alberta, Canada. Journal of Sedimentary Research, 60(6)

Kramers, J. W., & Lerbekmo, J. F. 1967. Petrology and mineralogy of Watt Mountain Formation, Mitsue-Nipisi area, Alberta. Bulletin of Canadian Petroleum Geology, 15(3):346-378.

Lam, H.L., Jones, F.W., and Majorowicz, J.A. 1985. A statistical analysis of bottomhole temperature data in southern Alberta. Geophysics, 50:677–684

Lazard. 2016. Lazard's levelized cost of energy analysis-version 10.0. Copyright 2016, Lazard. Accessed online at https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf on March 20, 2017

Majorowicz, J., and Jessop, A. 1981. Regional heat flow patterns in the Western Canadian Sedimentary Basin. Tectonophysics, 74(3–4): 209–238

Majorowicz JA, Garven G, Jessop A, Jessop C 1999. Present heat flow along a profile across the Western Canada Sedimentary Basin: the extent of hydrodynamic influence. Geothermics in basin analysis. Springer, Berlin, pp 61–79

Majorowicz, J.,Gosnold, W., Grey, A., Klenner, R., and Unsworth, MJ. 2012. Implications of post-glacial warming for northern Alberta heat flow-correcting for the understestimate of the 2 geothermal potential. GRC Transactions 36:693-698

Majorowicz, J., Unsworth, M., Chacko, T., Gray, A., Heaman, L., Potter, D., and Schmitt, D. 2012b. Geothermal energy as a source of heat for oil sands processing in northern Alberta, Canada. Heavy Oil/Bitumen Petroleum Systems in Alberta and Beyond. Co-edited by F.J. Hein, D. Leckie, J. Suter, and S. Larter.

Majorowicz, J. and Moore. 2014. The feasibility and potential of geothermal heat in the deep Alberta foreland basin-Canada for CO2 savings. Renewable Energy. 66:541-549

Meijer Drees, N. C. 1994. Devonian Elk Point Group of the Western Canada Sedimentary Basin. Geological Atlas of the Western Canada Sedimentary Basin, 129-138

Nieuwenhuis, G., Lengyel, T., Majorowicz, JA., Grobe, M., Rostron, B., Unsworth, MJ., and Weides, S. 2015. Regional-Scale Geothermal Exploration Using Heterogeneous Industrial Temperature Data; a Case Study from the Western Canadian Sedimentary Basin. Proceedings of the World Geothermal Congress, Melbourne, Australia, 19-25 April

Oldale, H. S., & Munday, R. J. 1994. Devonian Beaverhill Lake Group of the Western Canada Sedimentary Basin. Geological Atlas of the Western Canada Sedimentary Basin, GD Mossop and I. Shetsen (comp.), Canadian Society of Petroleum Geologists and Alberta Research Council, 149-163

Rottenfusser, B. A., & Oliver, T. A. 1977. Depositional environments and petrology of the Gilwood Member north of the Peace River Arch. Bulletin of Canadian Petroleum Geology, 25(5):907-928

Scott, J.W. and Lund, J.W. 1998. Timber drying at Kawerau. GHC Bulletin, September 1998. Accessed online at http://www.oit.edu/docs/default-source/geoheat-center-documents/quarterly-bulletin/vol-19/19-3/19-3-art5.pdf?sfvrsn=4 on March 17, 2017

Switzer, S. B., Holland, W. G., Christie, D. S., Graf, G. C., Hedinger, A. S., McAuley, R. J., ... & Packard, J. J. 1994. Devonian Woodbend-Winterburn strata of the Western Canada sedimentary basin. Geological Atlas of the Western Canada Sedimentary Basin: Canadian Society of Petroleum Geologists and Alberta Research Council, 165-202

Weides, S., Moeck, I., Majorowicz, J., Palombi, D. and Grobe, M. 2013.Geothermal exploration of Paleozoic formations in Central Alberta. Can. J. Earth Sci. 50:519–534

Weides, S and Majorwicz, JA. 2014. Implications of Spatial Variability in Heat Flow for Geothermal Resource Evaluation in Large Foreland Basins: The Case of the Western Canada Sedimentary Basin. Energies. 7:2573-2594

Weides, S.; Moeck, I.; Majorowicz, J.; Grobe, M. 2014a. The Cambrian Basal Sandstone Unit in Central Alberta—An investigation of temperature distribution, petrography and hydraulic and geomechanical properties of a deep saline aquifer. Can. J. Earth Sci. 51:783-796

Weides, S.; Moeck, I.; Schmitt, D.; Majorowicz, J.2014b. An integrative geothermal resource assessment study for the siliciclastic Granite Wash Unit, north western Alberta (Canada). Environ. Earth Sci. 72:4141-4154

Wendte, J. 1994. Cooking Lake platform evolution and its control on Late Devonian Leduc reef inception and localization, Redwater, Alberta. Bulletin of Canadian Petroleum Geology, 42(4): 499–528

Williams, C. F. 2007. Updated Methods For Estimating Recovery Factors For Geothermal Resources. Proceedings, Thirty-Second Workshop on Geothermal Reservoir Engineering. Stanford University, January 22–24, 2007, SGP-TR-183, 7 p.

Appendix A1: Drilling Cost Statement

Dr. Jonathan Banks
4-02 ESB
University of Alberta
Edmonton, AB
T6G 2E3

Re: Geothermal Well Drilling Cost Estimates

Dr. Banks,

As per our recent conversations, we're forwarding along some preliminary estimates on drilling costs we've been able to develop in conjunction with some of Terrapin's industry partners including Cougar Drilling and PTAC.

A typical geothermal well at a depth of 3,000m with conventional casing design (20"-13-3/8"-9-5/8"-7") is around $5,000,000 - $6,000,000. Not knowing the pressure or temperature, one can assume that the cost could be minimum of around $2,000+ per meter of the well. It goes without saying that there would be variations in this number depending on the current level of drilling activity, the location of the drilling activity and the complexity of the operation, but these numbers should provide reasonable starting points for your models.

Kind regards,

Sean Collins
President
Terrapin Geothermics

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

Appendix A2: Class C cost estimate for a 2.5 MWe Organic Rankine Cycle geothermal power plant

Design Build - Class C Estimate

2.5MW Geothermal Power Generation Plant

Start to finish.
POWER&CONTROL

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

March 3rd, 2017

Attn: Jonathan Banks

CES Power & Control is pleased to provide the following Class C estimate to cover the Design Build of the 2.5MW geothermal power generation plant project.

The following breakdown illustrate a brief description of all task of this project and associate cost including equipment, material and labor.

If any additional information is necessary to evaluate this proposal, feel free to contact any of our team representative outline below.

TASK DESCRIPTION	Total
Project Management	$349,200.00
Engineering Design	$852,000.00
Site Construction Equipment	$21,600.00
Civil and Site Preparation	$444,000.00
Concrete	$21,600.00
Structural Steel	$60,000.00
Buildings	$46,800.00
ORC Equipment	$6,155,600.00
Piping	$784,800.00
Electrical	$2,619,350.80
Instrumentation	$420,000.00
Startup / Commissioning	$109,200.00
Special / Other	$118,800.00
Grand Total:	**$12,002,950.80**

***Note. GST is not included in the price**

Start to finish.
POWER&CONTROL

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

Bid clarification

- Performance or labor and material bond are not included in this proposal.
- Price does not include submersible pump system.
- Price include brine reinjection pump system.
- Price is based on 5 day work week (Monday – Friday), 8 hr. /day. No extra overtime is accounted for.
- Pricing is based on supplied preliminary information.
- Material pricing is subject to commodity price increase.

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

Project organization list

- Stephan Humphreys – Senior Estimating Manager
- Ryan Tuff – Lead Project Engineer
- Katrina Wilson – Project Engineer
- Charles L'Ecuyer – President / CEO

If any questions or concerns on this proposal, please feel free to contact one of our team representative.

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

Regards,

Stephan Humphreys
Lead Estimator / Project Manager

s.humphreys@CESwest.ca

Appendix B1: Report on geothermal fueled tomato greenhouses

Introduction

This report has been developed for Dr. Jonathan Banks, Research Associate at the University of Alberta.
The purpose of this report is to test the feasibility of merging direct heat geothermal technology with commercial scale greenhouses in Alberta.

Research

Based on research conducted by the Alberta Government department of Agriculture and Forestry, (Laate, "*The Economics of Production and Marketing of Greenhouse Crops in Alberta"*, 2013), and through collaboration with local greenhouse and energy experts, this report will go through the current energy demands that tomato greenhouses require in 2017. Once energy demands have been established, this report will outline potential energy savings that can be realized through a geothermal heating system.

From Government of Alberta findings, there was a total of 127,500 square meters of commercial greenhouses operating in the province of Alberta in 2010 (Figure 1, Laate, 2013). These greenhouses account for only 5.5% of the total greenhouses in Canada as of 2010. Approximately 41% of the total greenhouses in Canada operate in the Medicine Hat area, the second most populated greenhouse location is Red Deer at 16%. The locations of these greenhouses will play a substantial part in determining the feasibility of a geothermal direct heat system (Laate, 2013).

Survey Region	Industry Area (m^2)	Size of Operation (Sq. M.)				Number of Greenhouses by Region
		< 1,000	1,000 to 2,000	2,001 to 4,000	>4,000	
Fort McMurray	2,788	0	0	2	0	2
Grande Prairie	87,361	11	6	0	11	28
Whitecourt	25,619	4	11	11	2	28
Edmonton	124,535	17	17	4	9	47
Bonnyville	88,290	6	6	4	4	21
Lloydminster	26,022	9	4	6	0	19
Red Deer	189,550	19	13	9	24	64
Calgary	144,052	9	6	9	6	30
Medicine Hat	492,565	2	0	15	58	75
Lethbridge	32,528	2	2	4	4	13
Total Operations	**1,213,311**	**79**	**66**	**64**	**118**	**328**
Percent of Operations	**-**	**24**	**20**	**20**	**36**	**100**

Source: A Profile of the Greenhouse Industry in Alberta in 2010

Figure 1: Number of Greenhouse Operations by Size and Regions in Alberta, 2010 (Laate, 2013)

As of 2010, approximately 79% of all greenhouses in Alberta were heated with natural gas furnaces (Figure 2, Alberta Agriculture and Forestry, 2013). Out of the 328 greenhouses that reported, only 2% used a renewable resource, bio fuel (Figure 2, Alberta Agriculture and Forestry, 2013).

Systems	Responses	Percent of Responses
Natural Gas Furnace	300	79
Hot Water	131	30
Steam	17	4
In-floor heating	19	4
Propane Furnace	17	4
Soil Heating	19	4
Electric	9	2
Stove Pipe Heater	17	4
Coal Deckker	47	12
Bio-therm	2	1

Source: Profile of the Greenhouse Industry in Alberta, 2010 **N = 328**

Figure 2: Type of Heating system Used in Greenhouses, 2010 (Laate, 2013)

Region	Fuel Type					Total by Region
	Natural Gas	Coal	Wood	Oil/Propane	Electric	
Fort McMurray	0	2	0	2	0	4
Grande Prairie	26	2	4	4	4	41
Whitecourt	28	4	2	0	0	34
Edmonton	39	11	0	2	0	51
Bonnyville	17	0	2	4	2	26
Lloydminster	19	0	0	0	0	19
Red Deer	56	13	0	2	2	73
Calgary	30	4	0	2	0	36
Medicine Hat	73	9	0	0	0	81
Lethbridge	13	2	0	0	0	15
TOTAL	300	47	9	17	9	382
Percent of Growers	**79**	**12**	**2**	**4**	**2**	**100**

Source: Profile of the Greenhouse Industry in Alberta, 2010 **N = 328**

Figure 3: Type of Fuel used in Greenhouse Operations in Alberta, 2010 (Laate, 2013)

As per 2013, the average commercial tomato producing greenhouses used a total of $12.73 per square meter for heating. (Laate, 2013) Based on a total of 196,859 square meters of tomato greenhouses in Alberta in 2010, the average cost for heating these buildings was $2,506,015.07 per year.

Extrapolating the average cost of natural gas in Alberta from 2013 (Alberta Energy, http://www.energy.alberta.ca/NaturalGas/1322.asp) to present and analyzing this with the average cost of heating a greenhouse in Alberta, it has been determined that the average greenhouse needs approximately 4.5 GJ of natural gas per sq. m. per year. The price of natural gas since 2013 has been very volatile, seeing swings of over 100% from one year to the next, or in the case of a small 1 hectare greenhouse, over $70,000 in variable cost fluctuation on heating.
Based on Government of Alberta findings (Laate, 2013), the average commercial tomato greenhouse generates a revenue of approximately $107.88 per sq. m./year and has a production cost of $94.54 per sq. m./year. This leaves a margin of $13.34 per sq. m./year. Of the operating cost, heating costs contribute up to 13% of the total. Any increases to the price of natural gas can quickly turn the economics of a greenhouse into the red.

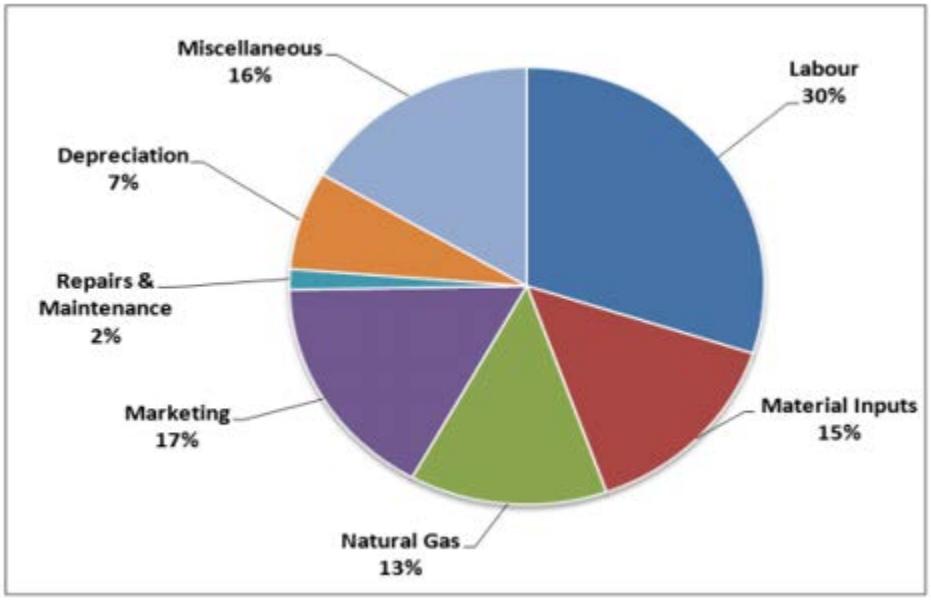


Figure 4: Breakdown of Greenhouse Tomato Production Costs in Alberta, 2011 (Laate, 2013)

Using the previous information, along with the gas prices over the last 4 years and present/future carbon tax, the following graph (Figure 5) outlines the average cost to heat a 1 hectare greenhouse in Alberta. The average greenhouse in Alberta will also incur costs associate with heating equipment at approximately $38.89 per sq. m.

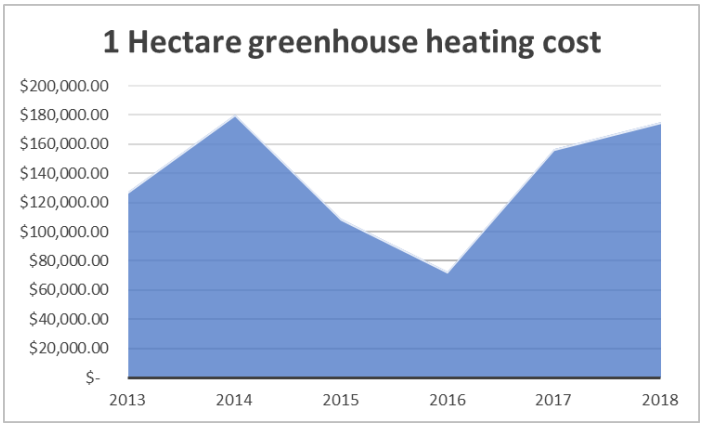


Figure 5: Average Cost to Heat a 1 Hectare Greenhouse in Alberta

The agriculture industry is not greatly affected by the Alberta carbon tax implemented in 2016. Agriculture is given up to an 80% tax exemption on carbon tax related to fuels. This 80% tax exemption is represented within this report and calculations (Figure 6).

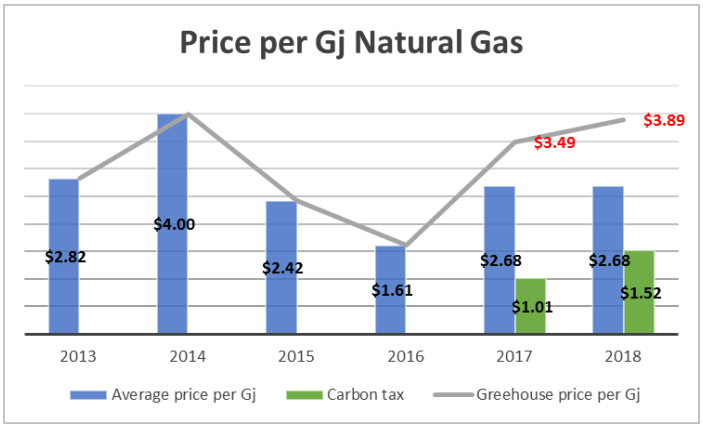


Figure 6: Price per GJ of Natural Gas with Relation to Alberta Carbon Tax Exemptions

Conclusion

From research into greenhouses in Alberta and market analysis of vegetables and energy, a renewable energy heating system could save the average 1 Hectare greenhouse over $180,000 per year in heating costs (Simard, M., and Neyes, R.).
With an average heating load of 4.5 GJ per sq. m. per year and a fixed cost of $38.89 per sq. m. for equipment, the economics for renewable energy heating are promising.
Using these numbers, a 1 hectare greenhouse requires a heating load of approximately 4,500 GJ and has a fixed heating equipment cost of $388,900. With a push to curb our agricultural energy requirements in Alberta through the Growing Forward 2 program, it seems that the agriculture carbon tax exemption may only be a bridge to help this industry make the jump to renewables and energy efficiency.

References

Alberta: Energy. (2017). *Alberta gas reference price history*. Retrieved from http://www.energy.alberta.ca/NaturalGas/1322.asp

Laate, E.A. (2013). The economics of production and marketing of greenhouse crops in Alberta. Retrieved from http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/agdex4369/$FILE/821-59.pdf

TMX NGX. (2017). *NGX Alberta market price*. Retrieved from http://www.ngx.com/?page_id=243

Subject Matter Experts//Personal Communications:
Matthew Simard, Alternative Energy Technologist and Journeyman Electrician
Robert R. Neys, B. Sc and Master Gardener

Appendix B2: Statement regarding timber kiln opportunities

Dr. Jonathan Banks
4-02 ESB
University of Alberta
Edmonton, AB
T6G 2E3

Re: Timber Drying Economics and Industrial Interest

Dr. Banks,

Terrapin Geothermics has been exploring the preliminary economic viability of geothermal timber drying and the overall interest in this technology from the forest products industry. This work has shown strong initial interest, with several productive meetings taking place with the senior executives throughout Alberta's forest products industry.

Throughout these conversations, a few key findings emerged. The first was that the heating demand for timber kilns is quite significant with some facilities quoting a heating demand of over 11 million BTU's per hour. This quote was given for a facility with dimensions of 24' x 48' x 84', creating a total kiln air volume of 96,768 cubic feet. A second theme that emerged was the sense that affordable, reliable, "green" heat could play a role as a significant variable for industry partners contemplating future builds. For kilns that are using natural gas combustion for heating, there also appears to be a viable case for retrofitting these facilities for geothermal heating, particularly when modeling the impact $30-$50/tonne carbon pricing will have on natural gas costs in the future. It is worth nothing that facilities that are currently producing their input heat via hog fuel would demonstrate poor economics for retrofit use as their current input fuel costs are very low.

Based on our conversations with industry, our understanding of the technical inputs required for timber drying and the information provided by your Deep Dive Analysis, we are cautiously optimistic that a market exists to demonstrate geothermal timber drying in Alberta. This also presents a unique investment attraction pathway for municipalities looking to specifically attract forest product manufactures to their region.

Kind regards,

Sean Collins
President
Terrapin Geothermics

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

Appendix C1: Summary of Organic Rankine Cycle process flow modelimg
(full model contained in separate .xlsx file)

The Organic Rankine Cycle (ORC) operates on the same principle as a steam-powered turbine generator power plant, but instead of water it uses a refrigerant which boils at a lower temperature. This lower boiling point allows for lower temperature heat sources to be utilized. The common refrigerant R134a was selected as the working fluid due to its ideal thermodynamic properties together with considerations for health, safety, environmental impact, and cost.

In this analysis the ORC converts geothermal energy contained in brine into electrical energy. The inlet brine temperatures considered are 120°C or 140°C. The brine is considered to be exiting the ground at flow rates of 30kg/s or 50kg/s. Three different cases were evaluated for each temperature and flow rate: Rated (winter ambient air temperature of -20°C), Operating (typical average ambient air temperature of 1.7°C), and Nominal (summer ambient air temperature of 20°C). The net power production and the overall efficiency of the plant was calculated for each of these cases.

The ORC pressurizes R134a and then boils it in heat exchangers before sending the vapour to a turbine which reduces the pressure and creates power to drive an electrical generator. The maximum pressure, (P_{max}) and minimum pressure (P_{min}) the turbine operates between is dependent on the type of working fluid and ambient temperature, as well as considerations of material strength and cost. Iterations with different P_{max} and P_{min} were done to ensure maximum energy conversion efficiency with reasonable equipment costs. Maximum efficiencies were obtained by setting P_{max} = 2.5MPa for all cases, while P_{min} was determined to be 0.2MPa, 0.45MPa, and 0.8MPa for the Rated, Operating, and Nominal cases, respectively.

The vapour from the turbine must be condensed back into a liquid in order to be pumped back up to the boiler pressure, thereby completing the cycle. For the condensing process air cooled heat exchangers (ACHEs) were used. ACHEs use fans to pass ambient air across tubes wherein the R134a is condensed. ACHEs are cost effective when the ambient temperature is moderate or cool and preferred when water consumption should be minimized.

29-24213 Twp. Rd 554
Sturgeon County, AB T8T 1X9
780-669-3202 – 1800-669-7317
services@CESwest.ca
CESwest.ca

It is possible to produce up to 1.8 MW of power to export to the grid with this plant design, which assumes conservative equipment performance. The overall efficiency ranges from a low of ~2% in the middle of a hot summer day and a high of ~13% on a very cold day in winter. The efficiency changes so drastically with the outside temperature because of how much easier it is to condense the R134a when it is cold outside. Condensing at a lower temperature reduces the backpressure on the turbine which increases its performance, resulting in more electricity generated. Condensing on a hot day also requires considerably more fan power by moving a larger volume of air to remove the waste heat from the ORC cycle.

The following equations characterize the plant performance:

$$Power\ Production = Generator\ Output - Pumping\ Power - Fan\ Power - \ Parasitic\ Loads$$

$$Overall\ Efficiency\ = \frac{Power\ Production}{Heat\ Transfered\ into\ the\ ORC\ from\ the\ Brine}$$

Appendix C2: Optimization study for Organic Rankine Cycle engines in geothermal systems

Deep Dive Analysis: Binary Power Plant Model for Prospective Geothermal Wells

Casey Lavigne

Iceland School of Energy
Reykjavik University

March 6, 2017

Abstract

A basic model was created in EES for a prospective geothermal binary power plant. Various working fluids were evaluated for efficiency in an Organic Rankine Cycle under the constraints of geothermal exit temperature and saturated vapour at the turbine inlet. The temperature and pressure of the first reservoir model was 135°C and 45 MPa respectively. At a geothermal exit temperature of 95°C, the highest efficiency was determined to be 11.4%, leading to a specific net power of 16.5 kW/(kg/s). The lower geothermal exit temperature of 80°C led to an efficiency of 9.9% with a corresponding net power output of 22.7 kW/(kg/s).

A second well with reservoir conditions of 105°C and 25 MPa was also modelled. The highest efficiency found for an exit temperature of 85°C was calculated to be 9.1%, yielding a specific net power output of 5.6 kW/(kg/s). A lower geothermal exit temperature of 70°C resulted in a cycle efficiency of 6.7% and net power output of 9.8 kW/(kg/s).

Literature review yielded a plant cost estimate of $2.93 MUSD based on an average of specific investment costs. Drilling costs have a potential to make up an additional 30-100% investment depending on the knowledge of the field.

Further analysis is recommended, including comprehensive cooling design and superheating allowance, to potentially increase the efficiency of the modelled ORC.

1. Introduction

A deep-dive analysis was performed by the University of Alberta in partnership with Alberta Innovates and multiple municipalities around Alberta to assess the potential for geothermal exploitation of reservoirs near those municipalities. The researchers mapped the lithological structures at various locations, constructed preliminary reservoir models, and estimated total reservoir energy storage.

As a complement to this analysis, basic power plant modelling was performed to estimate potential steady state electricity production from a prospective geothermal binary system. Using two different well conditions, cycle efficiency and corresponding power output was determined for an organic rankine cycle (ORC) using various working fluids.

2. Methodology

The binary power plant cycle was modelled using Engineering Equation Solver (EES). EES is a program that can solve large systems of non-linear algebraic and differential equations. Its use is amplified by its extensive library of thermodynamic fluid properties.

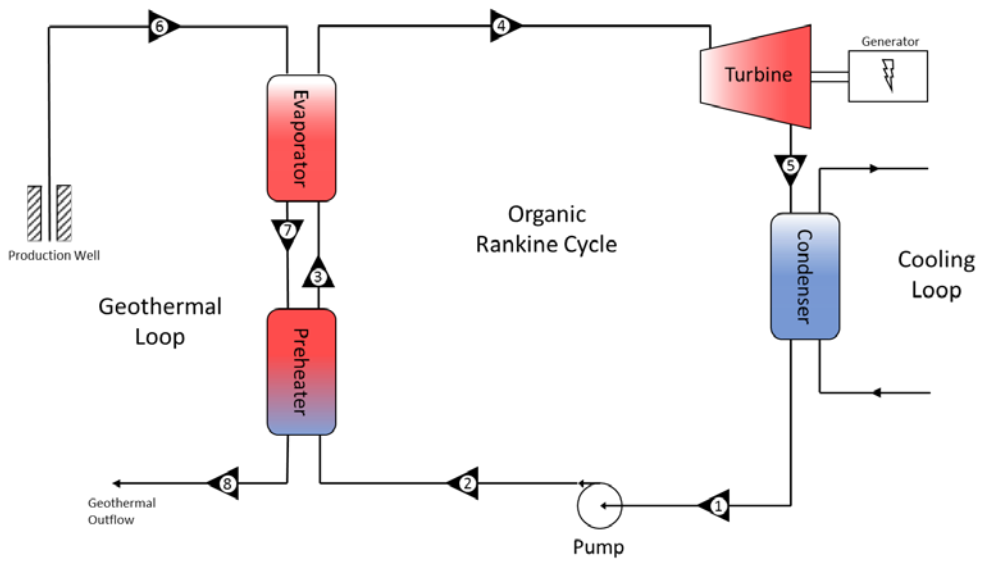


Figure A. Schematic of geothermal binary system used for modelling

In this analysis, EES was used to set up a system of thermodynamic equations to describe the binary power plant model and subsequently solve for those thermodynamic states which optimized the heat transfer from the geothermal fluid to the working fluid in the ORC. See Figure 1 for a schematic of the cycle as modelling in EES.

2.1. Optimization

Due to the expedient nature of the analysis, heat exchanger design was not used to as a factor in the optimization. Instead, the energy input was calculated from the difference between reservoir temperature and conservative geothermal outflow temperatures, with the implication that different-sized heat exchangers would be used for each outflow temperature. The energy transfer to the working fluid was controlled by the specification of a pinch point. The pinch point of a heat exchanger is a measure of its efficiency and is the smallest temperature difference between the two fluids that can be achieved at any point in the heat exchanger.

The output of the evaporator was restricted to saturated vapor state, i.e. no superheating was considered. With these constraints, the model was then optimized for efficiency by varying evaporator pressure while allowing the model to adjust the binary mass flow rate accordingly. For most working fluids, the optimization arrived at the maximum pressure allowed by the constraints of the model, namely the pinch point and saturated vapour specifications.

3. Assumptions

3.1. Geothermal Fluid

The output from two wells, representing two different reservoirs, was to be modelled. As specified by the project lead, the temperature and pressure conditions of the two reservoirs were 135°C and 45 MPa (450 bar) for Well 1 and 105°C and 25 MPa (250 bar) for Well 2. The input pressure for Well 1 was decreased to 400 bar to account for likely heat exchanger pressure limitations. A drop in pressure due to piping friction would be very low relative to the reservoir pressures and would have little effect on the specific heat capacity, therefore, no piping pressure losses were considered.

3.2. Working Fluid Selection

Several working fluids, common in binary use, were evaluated in the models. Aside from R134a, all fluids considered are retrograde, or "dry", fluids that have a positive-sloping vapour saturation curve (DiPippo, 2012). Cycles that utilize dry fluids are in no danger of condensation during the expansion through the turbine, which can lead to turbine failure and/or additional maintenance. The fluids used in this model are n-butane, isobutane, n-pentane, isopentane, toluene, and R134a.

3.3. Condenser

There are two general categories of condensers, defined by the medium used for cooling. Water-cooled systems can be once-through, meaning that the water gains heat from the working fluid through a heat exchanger and then exits the system, or they can be set up as a closed loop wherein the exit water is cooled in a cooling tower and then reenters the heat exchanger. Closed-loop water-cooled systems and air-cooled systems both require fan-driven cooling towers, increasing the parasitic load on the system and decreasing the cycle efficiency (Mendrinos, Kontoleontos, & Karytsas, 2006). The decision between cooling systems is largely determined by regional environmental conditions, such as average and seasonal ambient air temperatures, humidity, and availability of water supply.

Due to region and relative small size of plant, a once-through water-cooled system is implied for this model. A conservative condenser temperature leads to a negligible cooling water pumping power for a basic model such as this.

3.4. Preheater and Evaporator

The initial state of the ORC is saturated liquid from the condenser. The saturated liquid is then pumped to pressure equivalent to that the of evaporator and sent through the preheater and evaporator to exit as a fully saturated vapour (quality = 1). There is potential for a higher cycle efficiency by lowering the evaporator pressure and adding a superheater, however, this was not considered for this model (DiPippo, 2012).

Efficiency of the preheater is specified by a pinch point temperature, typically in the range of 3-10°C (Marcuccilli & Thiolet, 2010). As a reasonable compromise between prospective exchanger efficiency and corresponding cost, a pinch point temperature of 5°C is used for this analysis.

Many binary systems have a minimum geothermal exit temperature of 60°C or higher to avoid silica deposition. Silica content is expected to of negligible concentration in the water of the model reservoirs, therefore, there was no geochemically-imposed limit on the heat transfer from the geothermal water.

3.5. Efficiencies

Typical values used in literature are used for the efficiencies of the ORC pump, motor, turbine, and generator. A value of 95% is used for the efficiency of both the motor and the generator (Mendrinos, Kontoleontos, & Karytsas, 2006). Pump efficiency was defined as 80% as per Frick et al. (2015) and 85% was used for the turbine efficiency as per Dickson & Fanell (2003).

4. Results

4.1. Well 1

Model inputs of Well 1 were 135°C and 400 bar. The model was run at various evaporator pressures for each working fluid for geothermal exit temperatures of 80°C and 95°C.

4.1.1. Cycle Efficiency

The hydrocarbon fluids performed similarly for both geothermal exit temperatures. The highest efficiency was found at the highest allowable evaporator pressure, considering a minimum pinch point of 5°C, for all fluids except R134a which found a maximum efficiency at an intermediate pressure. The resultant cycle efficiency at various evaporator pressures is shown in Figure 2 and Figure 3 for both exit temperatures.

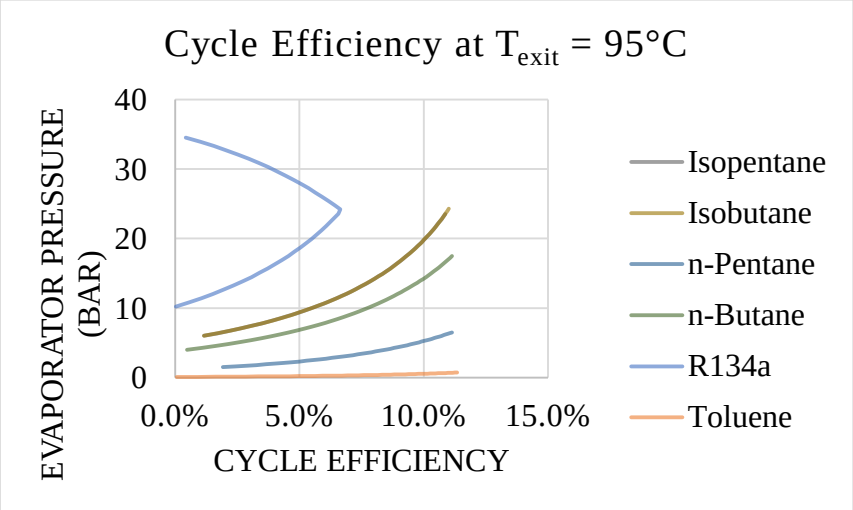


Figure B. Efficiencies of working fluids at different evaporator pressures for exit temp of 95C

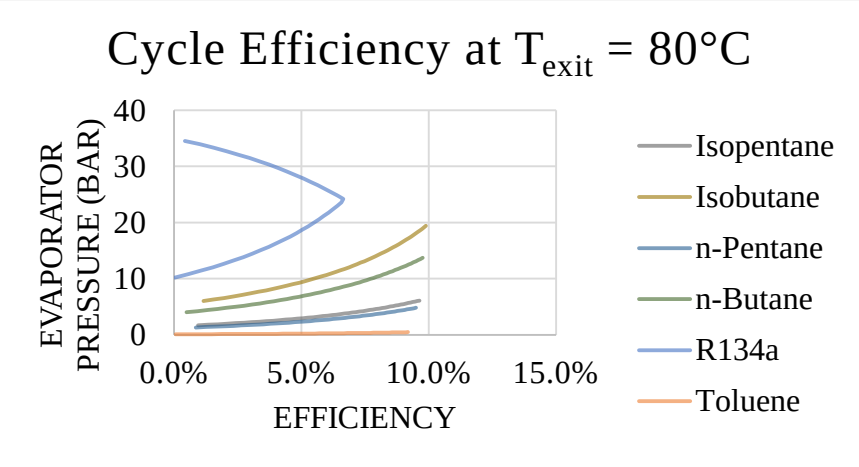


Figure C. Efficiencies of working fluids at different evaporator pressures for exit temp of 80C

Due to the fact that no superheating is considered in the model, the cycle efficiency decreases as exit temperature decreases. As shown in Figure 4, the highest efficiency shown was 11.4% for exit temperature of 95°C and 9.9% at an 80°C exit temperature.

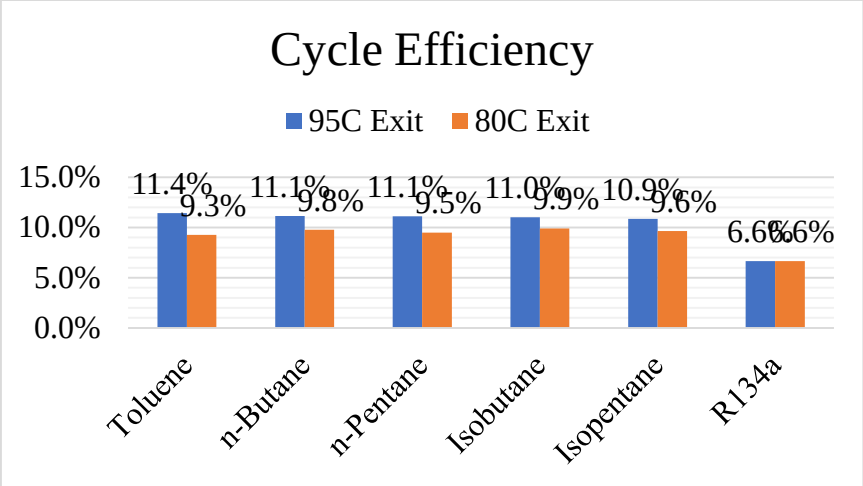


Figure D. Cycle efficiencies for all working fluids at both exits temperatures for Well 1

4.1.2. Power

Using the energy input from the geothermal fluid at each exit temperature, a net power output per unit mass flow rate can be calculated for the maximum efficiency of each working fluid. Figure 5 shows the net power output of the most efficient working fluid for a range of geothermal mass flow rates. The most efficient working fluids can supply 1 MW of power at low geothermal mass flow rates and in excess of 2.2 MW at 100 kg/s.

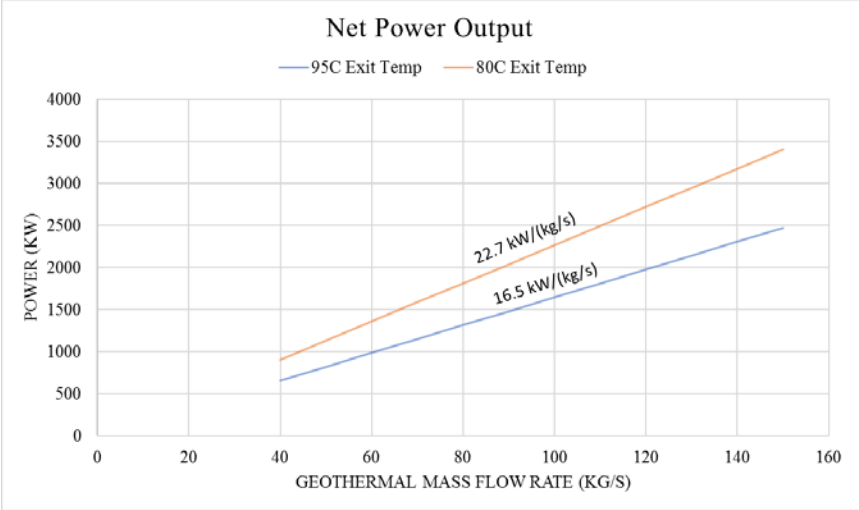


Figure E. Power output of binary model for a range of geothermal mass flow rates

4.2. Well 2

Model inputs of Well 1 were 105°C and 250 bar. The model was run at various evaporator pressures for each working fluid for geothermal exit temperatures of 70°C and 85°C.

4.2.1. Cycle Efficiency

The hydrocarbon fluids again performed similarly for both geothermal exit temperatures. The highest efficiency was found at the highest allowable evaporator pressure, considering a minimum pinch point of 5°C, for all fluids

except R134a which experienced a decrease in efficiency just before its maximum evaporator pressure. The resultant cycle efficiency at various evaporator pressures is shown in Figure 6 and Figure 7 for both exit temperatures.

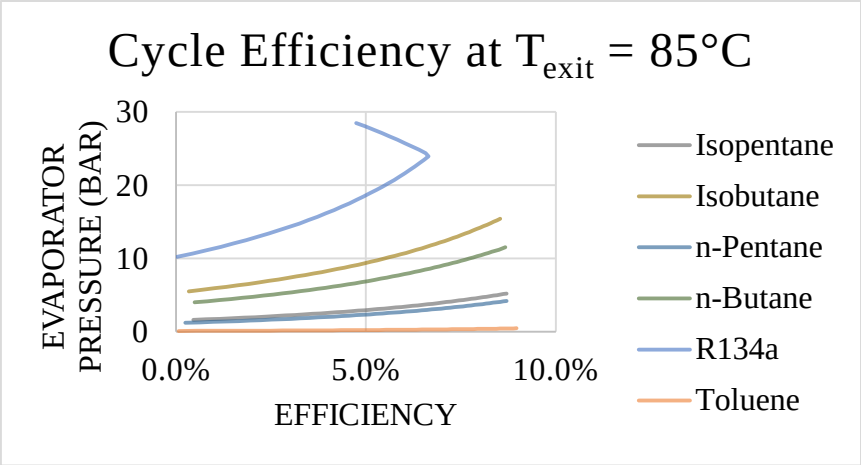


Figure F. Efficiencies of working fluids at different evaporator pressures for exit temp of 85C for Well 2

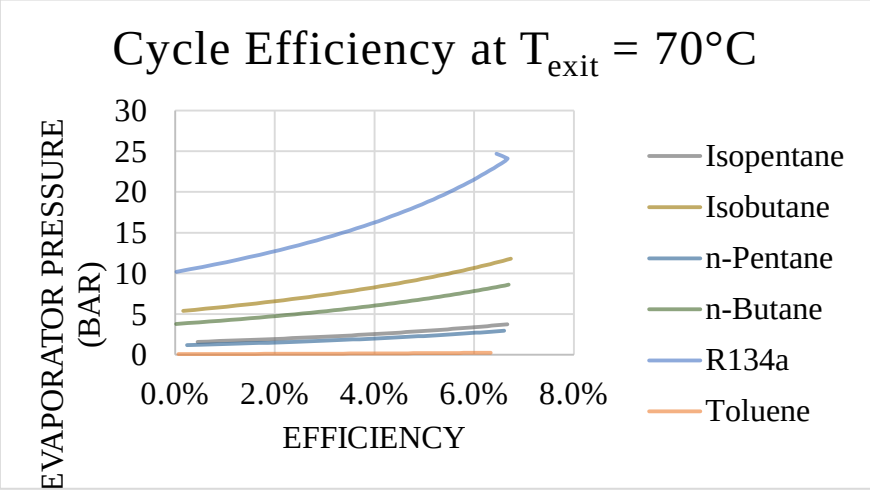


Figure G. Efficiencies of working fluids at different evaporator pressures for exit temp of 70C for Well 2

Due to the fact that no superheating is considered in the model, the cycle efficiency decreases as exit temperature decreases. As shown in Figure 8, the highest efficiency shown was 9.1% for exit temperature of 85°C and 6.7% at a 70°C exit temperature.

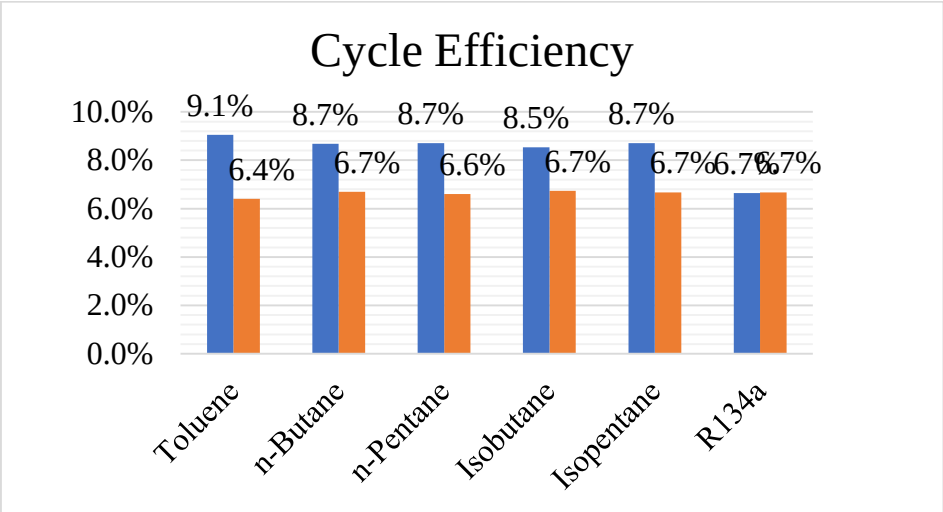


Figure H. Cycle efficiences for all working fluids at both exits temperatures for Well 2

4.2.2. Power

Using the energy input from the geothermal fluid at each exit temperature, a net power output out per unit mass flow rate can be calculated for the maximum efficiency of each working fluid. Figure 9 shows the net power output of the most efficient working fluid for a range of geothermal mass flow rates. The most efficient working fluids can supply 1 MW of power at a geothermal mass flow rate of 100 kg/s with a 70°C exit temperature.

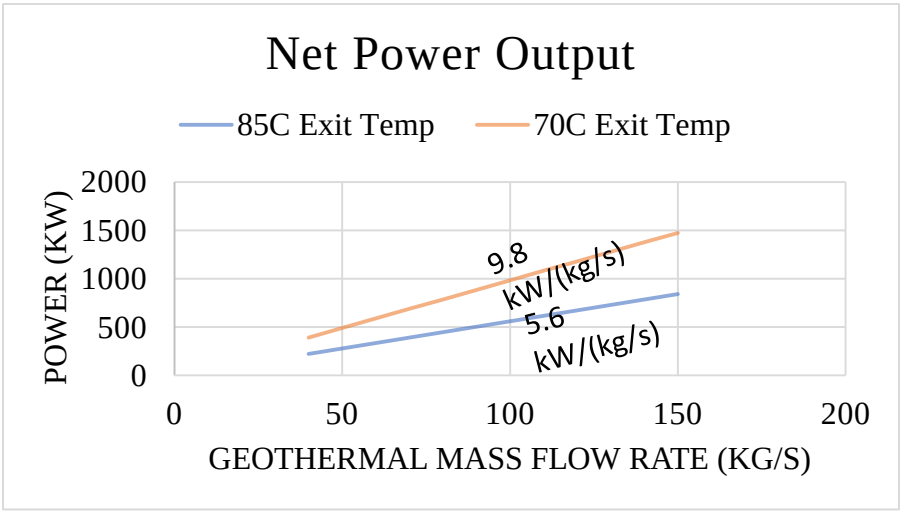


Figure I. Power output of binary model for a range of geothermal mass flow rates

5. Further Optimization

The model developed for the deep-dive analysis was basic in nature in accordance with the current reservoir output estimates. However, more detail can be added to the model to derive less conservative and potentially more accurate results. These additional optimizations:

- Superheating – A superheater can be modelled to potentially increase the net power output at lower evaporator pressures and lower working fluid mass flow rates.

- Condenser Design – The cooling system can be further refined in both choice of system and design of heat exchanger to potentially lower the condenser temperature and allow a larger pressure drop through the turbine, resulting in a higher power output.

- Supercritical Operation – Some binary systems have been able to achieve more efficient heat transfer by operating in the supercritical zone of the working fluid (Marcuccilli & Thiolet, 2010).

- Advanced Binary Cycles – The binary cycle efficiency could be increased by modifying the cycle simply to include a recuperator, or further complexity could be added by introducing a high and low pressure combined cycle (DiPippo, 2012).

6. Cost

A general literature review was completed to estimate the specific cost of a binary system. Some ranges have a cost spread up to 100% (see Table 1 for summary), with an average value of $2925 USD/kW. Therefore, the estimate for a 1 MW binary plant would require an approximate investment of $2.93 MUSD.

Table A. Specific binary system plant costs from literature

Specific Plant Cost (USD/kW)	Source
2000 - 4000	Roos et al. (2013)
2000 - 3750	Jung et al. (2014)
3750 (3000 EUR)	Quoilin et al. (2013)

Note this encompasses plant cost only, not drilling costs which are a significant portion of the investment costs involved in developing a geothermal field. Table 2 provides drilling costs in known and unknown fields as described by one report. As expected, the cost and standard deviation is higher for drilling in unknown fields due to a lower success rate.

Table B. Expected specific cost of drilling for a geothermal power plant (Stefansson, 2002)

Drilling Cost	Expectation Value (USD/kW)	Range with standard deviation (USD/kW)
Known Field	1170	1130 - 1949
Unknown Field	1805	1402 - 3119

7. Conclusion

This report detailed the findings of the optimization of a geothermal binary power plant utilizing an ORC to produce electric power. Several working fluids were used in the EES model to determine a maximum efficiency for a given geothermal fluid exit temperature. It was determined that the two reservoir conditions could conservatively produce 1-3 MW in an ORC, and likely more, depending on number of wells and well flow rates. Also, the estimated power outputs would likely increase with an optimization which allows for superheating of the working fluid.

While the electric generation efficiencies are low relative to fossil-fueled power plants, it is of less concern as the fuel in geothermal project is free and renewable. Also, a binary power plant such as the one modelled can act as an enterprising cooling mechanism for a direct use heating system. The usage of the geothermal exit water (at

temperatures between 70°C and 95°C) in downstream applications can greatly increase the efficiency of the overall system.

References

Dickson, M., & Fanell, M. (2003). *Geothermal Energy: Utilization and Technology*. Paris, France: UNESCO.

DiPippo, R. (2012). *Geothermal Power Plants (3rd Edition).* Oxford: Elsevier.

Frick, S., Kranz, S., & Saadat, A. (2015). Improving the Annual Net Power Output of Geothermal Binary Power Plants. *World Geothermal Congress.* Melbourne, Australia.

Jung, H. C., Krumdieck, S., & Vranjes, T. (2014). Feasibility assessment of refinery waste heat to power conversion using an ORC. *Energy Conversion and Management*, 396-407.

Marcuccilli, F., & Thiolet, D. (2010). Optimizing Binary Cycles Thanks to Radial Inflow Turbines. *World Geothermal Congress.* Bali, Indonesia.

Mendrinos, D., Kontoleontos, E., & Karytsas, C. (2006). *Geothermal Binary Plants: Water or Air Cooled?* Pikermi Attikis, Greece: Centre for Renewable Energy Sources.

Quoilin, S., Van Den Broeck, M., Declaye, S., & Dewallef, P. (2013). Techno-economic survey of Organic Rankine Cycle (ORC) systems. *Renewable and Sustainable Reviews*, 168-186.

Roos, C. J., Northwest, C., & Center, A. (2009). *An overview of industrial waste heat recovery technologies for moderate temperatures less than 1000 F.* Northwest CHP Application Center.

Stefansson, V. (2002, April). Investment cost for geothermal power plants. *Geothermics*, pp. 263-272.

REQUEST FOR DECISION

SUBJECT:	**Policy 4001 - Security Deposits for Residential Construction to Proposed Residential Developments**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	INFRASTRUCTURE & PLANNING	GM:	GG	PRESENTER:	GG

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy 4001/4001-01, EES 01 and new Policy 4001

RECOMMENDED ACTION:
MOTION: That Council adopt Policy 4001 as presented with changes.

MOTION: That Council rescind Policy 4001/4001-01 (Dated November 26, 2013) and Policy EES 01.

BACKGROUND/PROPOSAL:
During the regular scheduled Council meeting on July 12, 2016 it was requested that Administration review and bring back to the Policy Review Committee Policy 4001 "Security Deposits for Access Construction to Proposed Residential Developments" for the sole purpose of reducing the security deposit within the policy.

Public roads constructed for the purpose of residential access within a Government Road Allowance are designed to meet the guidelines of Alberta Transportation for public access.

The original security deposit was set at 20% of the estimated cost of construction or to a maximum of $50,000.00. The estimated cost of construction is compiled from data collected by the consultant tasked to the project.

Administration suggested that we continue to have a security deposit in place with reducing the security deposit to 10% or to a maximum of $30,000.00 to be submitted prior to any onsite construction.

During the regular scheduled Council meeting on September 27, 2016 Council tabled Motion: 16.09.381: *"That Council table motion 16.09.380 and refer Policy 4001 back to the Policy Review Committee so that an administration fee and deposit of $5,000.00 may be incorporated."*

The Policy Review Committee reviewed Policy 4001 with changes on March 13, 2017.
MOTION: 17.03.005.
"*The Policy Review Committee recommends the Security Deposits for Residential Road Construction to proposed Residential Developments Policy be submitted to Council for approval once changes have been made."*

Policy 4001 revised changes read as follows:

2.1 The applicant will provide an administration fee in the amount of $2,500.00 in the form of cash or certified cheque to cover administration costs such as preliminary planning & design.

2.2 If the applicant fails to move forward with the project after preliminary planning is initiated Greenview will retain the administration fee.

2.3 If the applicant proceeds with the project, the administration fee of $2,500.00 becomes part of the total security deposit of $5,000.00 required for construction by the applicant.

Administration has requested that Council rescind old Policy 4001/4001-01, EES 01.

BENEFITS OF THE RECOMMENDED ACTION:

1. This change would reduce the burden on persons looking to access this program.

DISADVANTAGES OF THE RECOMMENDED ACTION:

1. The reduction of barriers may increase the chances of persons seen abusing the program.

ALTERNATIVES CONSIDERED:

Alternative #1: Council could raise or lower the security deposit.

FINANCIAL IMPLICATION:

Direct Costs: There are no direct costs associated to the recommendation.

Ongoing / Future Costs: There are no ongoing or future costs associated to the recommendation.

STAFFING IMPLICATION:

There are no staff implications associated to the recommendation.

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

Using that framework outline the proposed level of public engagement associated with the recommended action.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Notification given to the Records Management on the revised Policy 4001 and the policies rescinded.

ATTACHMENT(S):

- New Policy 4001
- Old Policy 4001/4001-01
- Policy EES 01

POLICY

Title: SECURITY DEPOSITS FOR RESIDENTIAL ROAD CONSTRUCTION TO PROPOSED RESIDENTIAL DEVELOPMENTS

Policy No: 4001

Effective Date:

Motion Number:

Supersedes Policy No: 4001/4001-01 (Nov 26/13), EES 01

MUNICIPAL DISTRICT OF GREENVIEW NO. 16

"A Great Place to Live, Work and Play"

Purpose: To establish a process whereby security deposits are required from applicants for the construction of residential roads.

DEFINITIONS

Permanent Residency means an approved permanent residence which is continuously occupied for more than six months.

POLICY

1. Greenview is required to provide or ensure legal access to property but is not required to provide physical access. When Council authorizes a road to be constructed to provide physical access to a quarter section(s) or a parcel of land, the road shall be constructed under the following conditions:

    1.1 All new roads being constructed to a quarter section(s) or a parcel of land shall be constructed through the quarter section as per Greenview's Engineering Design & Construction Standards' cul-de-sac section.

    1.2 Residential roads will be constructed to the specifications as outlined in the Greenview Engineering Design & Construction Standards.

    1.3 When the quarter section line or property line lies within a low area, muskeg, creek or other physical barrier unsuitable to access the parcel, the road shall be constructed sufficiently past such barrier to surpass any hindrance.

    1.4 When a low area, muskeg, creek or other physical barrier does not allow for acceptable access and would create substantial increase to the cost of the project, the issue will be brought to Council for review.

2. Upon Council approval for the construction of road access on a road allowance to unoccupied lands for the purpose of proposed residential development, the following conditions apply:

POLICY

2.1 The applicant will provide an administration fee in the amount of $2,500.00 in the form of cash or certified cheque to cover administration costs such as preliminary planning & design.

2.2 If the applicant fails to move forward with the project after preliminary planning is initiated. Greenview will retain the administration fee.

2.3 If the applicant proceeds with the project, the administration fee of $2,500.00 becomes part of the total security deposit of $5,000.00 required for construction by the applicant.

4. The security deposit will be returned or refunded to the applicant, without interest, if permanent residency is established within three years of the date of approval of residential road construction. Where this has not been met, or the property has been sold prior to the fulfillment of this condition, the security will be forfeited.

5. Construction of a residential road will not commence until the specified security has been provided by the applicant and an agreement outlining terms and conditions has been entered into by the applicant.

6. Dedication of road widening, as determined by the General Manager, Infrastructure & Planning, will be required on land owned by the applicant adjacent to or abutting the residential road construction project.

7. Payment of the security deposit must be received within ninety (90) days from Council approval to construct, and prior to the project proceeding.

POLICY

Title: SECURITY DEPOSITS FOR ACCESS CONSTRUCTION TO PROPOSED RESIDENTIAL DEVELOPMENTS

Policy No: 4001

Approval: Council

Effective Date: November 26, 2013

Supersedes Policy No: (EES 22)

MUNICIPAL DISTRICT OF GREENVIEW NO. 16

"A Great Place to Live, Work and Play"

Policy Statement: The Municipal District of Greenview No. 16 (Greenview) is committed to providing access to residential developments when feasible. To protect the best interests of the Greenview road networking system it is appropriate to confirm that the proposed access will be utilized for its intended purpose of providing access to residential development in order to justify the construction of the proposed access. Deposits will be collected from applicants in order to demonstrate commitment to residential development.

Purpose: The purpose is to establish a process whereby security deposits are required from applicants for the construction of residential access roads in order to ensure the obligations of the developer are fulfilled.

Principles:

1. Where Council approves a request for the construction of road access on a road allowance to unoccupied lands for the purpose of proposed residential development, the applicant will provide security in the form of cash/certified cheque or Irrevocable Letter of Credit to ensure that the residential development takes place.

2. The security deposit shall be 20% of the estimated cost of access construction, up to a maximum of $50,000. The amount of the deposit may be varied if there are other considerations provided by the landowner (such as borrow material) that give value to the project.

3. The security deposit will be returned or refunded to the applicant, without interest, if permanent residency is established within three years of the date of approval of access construction. Where this has not been met, or the property has been sold prior to the fulfillment of this condition, the security will be forfeited.

4. Construction of an access road will not commence until the specified security has been provided by the applicant and an agreement outlining terms and conditions has been entered into by the applicant.

POLICY

5. Dedication of road widening, as determined by the General Manager, Infrastructure & Planning, will be required on land owned by the applicant adjacent to or abutting the access construction project.

6. Payment of the security deposit must be received within ninety (90) days from Council approval to construct, and prior to the project proceeding.

Regulations:

1. None.

Approved: 13.11.644

PROCEDURE

MUNICIPAL DISTRICT OF GREENVIEW NO. 16

"A Great Place to Live, Work and Play"

Procedure Title: SECURITY DEPOSITS FOR ACCESS CONSTRUCTION TO PROPOSED RESIDENTIAL DEVELOPMENT

Procedure No: 4001-01

Approval: CAO

Effective Date: November 26, 2013

Supersedes Procedure No: EES 22

1. **Definitions**

1.1. Residential Access means to meet the specifications as outlined in the Greenview Engineering Design & Construction Standards.

1.2. Permanent Residency means to continuously occupancy for more than six months.

2. **Responsibilities**

2.1. Council Members, Board Members and Greenview Staff to:

2.1.1. Provide access to residence within the M.D. of Greenview.

2.2. Council Members and Senior Management:

2.2.1. Approve residential access that will be utilized by ratepayers using a system that will allow the access for be function for many years.

2.3 Senior Management to:

2.3.1 Recommend and investigate the need and cost of the proposed access.

2.4 Supervisors to:

2.4.1 Receive the request and investigate all details needed to complete the potential construction.

2.5 Corporate Services Staff to:

2.5.1 Manage all security deposit and refund accordingly once permanent residency is established.

3. **End of Procedure**

Approved: 13.11.645

POLICY NUMBER: EES 01

POLICY TITLE:	**ACCESS DEFINITION FOR ROAD REQUESTS**	**Page 1 of 1**
Date Adopted by Council / Motion Number:		**09.12.661**

PURPOSE:

To provide a definition of what constitutes suitable physical access to a quarter of land or a parcel of land.

POLICY:

The M.D. is required to provide or ensure legal access to property but is not required to provide physical access. When Council authorizes a road to be constructed to provide physical access to a quarter section(s) or a parcel of land, the road shall be constructed under the following conditions.

1.0 All new roads being constructed to a quarter section(s) or a parcel of land shall be constructed to the quarter section line with a suitable turn-around.

2.0 When the quarter section line or property line lies within a low area, muskeg, creek or other physical barrier unsuitable to access the parcel, the road shall be constructed sufficiently past such barrier to surpass any hindrance.

3.0 When a low area, muskeg, creek or other physical barrier does not allow for acceptable access and would create substantial increase to the cost of the project, The issue will be brought to Council for review.

(Original signed copy on file) _____
REEVE

_____
C.A.O.

REQUEST FOR DECISION

SUBJECT:	**Valleyview & Districts Agricultural Society – Aggregate**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	COMMUNITY SERVICES	GM:	DM	PRESENTER:	DM

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy (cite) – N/A

RECOMMENDED ACTION:
MOTION: That Council approve the provision of 190 tonnes of Greenview aggregate valued at $5,225.00, delivery included, to the Valleyview & District Agricultural Society grounds, Valleyview, with funds to come from the Community Service Miscellaneous Grant.

BACKGROUND/PROPOSAL:
The Valleyview & District Agricultural Society has recently conducted construction of a multi-use building at the Agricultural grounds. The organization plans to build a covered walkway between the cow palace and the new building which will allow the utilization of both buildings together and in the future room for washing animals, as a result, the multi-use building will be constructed wider than previously planned to accommodate this added feature.

The Agricultural Society has restricted themselves to a strict budget to accomplish goals and for that reason are requesting at total of 190 tonnes of ¾" crush gravel, with 140 tonnes of ¾" crush gravel spread on the roads and 50 tonnes of ¾" crush gravel stockpiled for them to spread manually on the specific ground areas requiring it.

The Agricultural Society is provided with a Greenview operational grant in the amount of $14,500.00 annually.

The Community Service Miscellaneous Grant has a balance of $330,535.81 as of May 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of providing aggregate to the Valleyview & District Agricultural Society is that Greenview would be providing support to a local progressive non-profit organization that benefits Greenview residents and the region.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantage to providing aggregate to the Valleyview & District Agricultural Society grounds.

ALTERNATIVES CONSIDERED:

Alternative #1: Council has the alternative to deny the request for aggregate, provide an alternate amount of gravel or exclude the delivery. Greenview presently supports other non-profit organizations (i.e. community halls with aggregate).

FINANCIAL IMPLICATION:

Direct Costs: $5,225.00

Ongoing / Future Costs: N/A

STAFFING IMPLICATION: N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Community Service staff will notify the organization as to the status of the request.

ATTACHMENT(S):

- Valleyview & District Agricultural Society – Aggregate Request

2155-VOA

VALLEYVIEW & DISTRICTS AGRICULTURAL SOCIETY
BOX 1226
VALLEYVIEW, ALBERTA
T0H 3N0
valleyviewagsociety@gmail.com

April 12, 2017

M. D. of GREENVIEW
Council Members

A big thank you to the M.D. of Greenview for your help with the construction of a multi use building at the Ag. Grounds. We plan to build a covered walk way between the cow palace and the new building which will allow for utilization of both buildings together and in the future room for washing animals. For this reason we are constructing the building wider than previously planned, adding more to the cost. We are pretty excited as this building will be a huge asset to the Agricultural Society and will provide much needed space as we seem to be getting busier every year.

We are on a pretty tight budget this year and were wondering if the M.D. could possibly donate some gravel for the roads and 40 yards of ¾ crush. We haven't put gravel on the roads for quite some time and the years of wet weather have taken a toll on the roads. With so many people coming and going it is important to keep up the roads.

The next big event at our facility is 4-H Regional Days and this involves members from all over the Peace Region with a wide variety of projects. We are pretty excited to host this event at our facility. We hope you will consider this request and would like to thank you again for all your support. It is very much appreciated.

JoAnn Clarke,
Secretary
Valleyview & Districts Agricultural Society

REQUEST FOR DECISION

SUBJECT:	**Alberta High School Rodeo Association – Funding Request**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	COMMUNITY SERVICES	GM:	DM	PRESENTER:	DM

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy (cite) – N/A

RECOMMENDED ACTION:
MOTION: That Council sponsor the Alberta High School Rodeo Association in the amount of $1,500.00 for the 2017 Provincial Finals in Olds, Alberta on June 2 – 4, 2017, with funds to come from the Community Service Miscellaneous Grant.

BACKGROUND/PROPOSAL:
The Alberta High School Rodeo Association is the largest youth rodeo association in the Province of Alberta competing from as far north as Keg River to as far south as the American border, drawing contestants from 145 communities. The association's mission statement is "promote the sport of rodeo and the highest type of conduct and sportsmanship, and expose its positive image to the general public; preserve the western heritage, offer a privilege of family bonding, offer an opportunity of continuing education and maintain the highest regard for the livestock."

The Alberta High School Rodeo Association is requesting sponsorship to share in the excitement and success of the provincial champions for the 2017 Provincial Finals in Olds, Alberta, June 2 – 4, 2017. The sponsorship funding will support both girls and boys who maintain excellent academic requirements in their schools and represent the best of the best in their rodeo events.

The Community Service Miscellaneous Grant has a balance of $330,535.81 as of May 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of sponsoring the Alberta High School Rodeo Association with "Full Saddle" sponsorship is that Greenview will be recognized at this high profile event as an organization that supports academic achievements.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantage to sponsoring the Alberta High School Rodeo Association with "Full Saddle" sponsorship.

ALTERNATIVES CONSIDERED:

Alternative #1: Council has the alternative to alter or deny the sponsorship funding to the Alberta High School Rodeo Association. If sponsorship funding is not provided the organizers will be required to seek sponsorship from other contributors to support the youth with their rodeo career initiatives.

FINANCIAL IMPLICATION:

Direct Costs: $1,500.00

Ongoing / Future Costs: N/A

STAFFING IMPLICATION: N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Community Service staff will notify the organization as to the status of the request.

ATTACHMENT(S):

- Alberta High School Rodeo – Sponsorship Request

The Alberta High School Rodeo Association is the largest youth rodeo association in the Province of Alberta. With 314 contestants competing from as far north as Keg River to as far south as the American border, we are an expansive association that has a common goal for all of our contestants. The membership draws contestants from 145 different communities in Alberta.

Our mission statement reads: “promote the sport of rodeo and the highest type of conduct and sportsmanship, and expose its positive image to the general public; preserve the western heritage; offer a privilege of family bonding; offer an opportunity of continuing education and maintain the highest regard for the livestock”.

The 2017 Provincial Finals will be held in Olds, Ab on the weekend of June 2-4. There will be approximately 36 contestants in each rodeo event, competing for the title of Provincial Champion and the right to move on and represent Alberta at the NHSRA Finals in Gillette, Wyoming. Contestants work hard all year to earn the right to compete at our provincial finals; it is the culmination of many miles driven, many hours practicing, and a wide scope of competition and a little bit of luck.

The AHSRA is currently seeking companies to share in the excitement and success of our Provincial champions through our Saddle Sponsorship program. You will be supporting both girls and boys that maintain excellent academic requirements in their schools and represent the best of the best in their rodeo events. The girls’ events represented are: Barrel Racing, Pole Bending, Goat Tying, Breakaway Roping, Cutting, Team Roping (boys and girls) Queen and High Point. The boys’ events represented are: Bareback Riding, Saddle Bronc Riding, Bull Riding, Tie Down Roping, Steer Wrestling, Cutting and High Point.

Please find attached our Saddle Sponsorship Opportunity. During these trying economic times in our province, we are so thankful for the companies that are able to support the youth and our western lifestyle. We thank you so much for your financial support while the AHSRA moves through this transition year.

Sincerely,

Board of Directors AHSRA

Saddle Sponsorship Opportunity:

Full Saddle - $1500.00.

- Company lettering on both fenders of Championship Saddle
- Program and Announcer recognition at the Provincial Finals
- Recognition on AHSRA Website – visitation 1400+ hits per month
- Announcer recognition for the 2017/2018 season at each AHSRA rodeo

Half Saddle - $750.00

- Company lettering on one fender of Championship Saddle
- Program and Announcer recognition at the Provincial Finals
- Recognition on AHSRA Website – visitation of 1400+ hits per month
- Announcer recognition for the 2017/2018 season at each AHSRA rodeo

Company Name to appear on Saddle:

_____

Company Contact Name:

_____

Address:_____

_____

Phone Number: _____

Sponsorship Amount (Cheque payable to AHSRA): _____

If you have a specific event you'd like to sponsor please indicate here, we do our upmost to accommodate our sponsor's requests. _____

Please email this form to: Corrine Shuckburgh - tomcor@theshucks.ca and mail a copy along with your cheque to: Betty Leischner

AHSRA – Saddle Sponsorship

RR1 Site 7 Box 1

Olds, AB, T4H 1P2

REQUEST FOR DECISION

SUBJECT:	**Grande Prairie Stompede Association – Funding Request**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	COMMUNITY SERVICES	GM:	DM	PRESENTER:	DM

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy (cite) – N/A

RECOMMENDED ACTION:
MOTION: That Council enter into an agreement with the Grande Prairie Stompede Association providing funding in the amount of $75,000.00 per year for a three year term, with funds to come from the Community Service Miscellaneous Grant.

BACKGROUND/PROPOSAL:
The Grande Prairie Stompede Association has made a presentation to Greenview Council in 2016 outlining their initiatives and financial status. The association is celebrating "The Cowboy Way" 40 year anniversary in 2017, proudly promoting Canadian western heritage throughout the region. The Stompede has evolved into a million dollar operation that hosts approximately 30,000 people annually, ran entirely by volunteer members.

The group is inviting Greenview to invest in a Sustainability Fund with a three year commitment for $75,000.00 per year. The fund would allow for the future sustainability and strategic positioning of the Stompede for years to come. The 2016 revenues were reduced by $267,000.00 of disposable income resulting from the downturn in the economy. The Sustainability Fund investment would allow Greenview to be recognized as a Strategic Partner and to have a seat on the group's Sustainability Sub-Committee.

The Grande Prairie Stompede Association had made an initial request in December of 2016, however Greenview Administration was recently made aware that the request was not forwarded to Council for their consideration.

Greenview has contributed $50,000.00 to the Teepee Creek Rodeo Association capital project in 2017, as well as a contribution in 2016 for their anniversary celebration.

The Community Service Miscellaneous Grant has a balance of $330,535.81 as of May 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:

1. The benefit of entering into an agreement with the Grande Prairie Stompede Association is that Greenview will be recognized as a contributing partner in the Grande Prairie Stompede which is attended by a large diverse audience, thus enhancing Greenview's economic development profile and opportunities.

DISADVANTAGES OF THE RECOMMENDED ACTION:

1. The disadvantage of the recommended motion is that $75,000.00 of the Community Miscellaneous Grants budget will be committed for both the 2018 and 2019 budget years.

ALTERNATIVES CONSIDERED:

Alternative #1: Council has the alternative to deny entering into an agreement with the Grande Prairie Stompede Association Sustainability Fund or alter the funding commitment provided. If the funding commitment is altered or denied the organizing group will be required to seek a funding commitment from another source.

FINANCIAL IMPLICATION:

Direct Costs: $75,000.00

Ongoing / Future Costs: Future costs will include funding of $75,000.00 per year for two additional consecutive years.

STAFFING IMPLICATION: N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Community Service staff will notify the organization as to the status of the request.

ATTACHMENT(S):

- Grande Prairie Stompede – Funding Request

BOX 1338, GRANDE PRAIRIE, AB T8V 4Z1
780-532-4646 | GPSTOMPEDE.COM |

December 1, 2016

Municipal District of Greenview No. 16
Reeve and Council
4806 – 36 Avenue, Box 1079
Valleyview, AB T0H 3N0

Subject: Request for Municipal Partnership to launch Sustainability Fund for the 40th Anniversary

Dear Reeve Dale Gervais:

Stompede successfully delivers an event which promotes several local chuckwagons and rodeo athletes, as we highlight the World Professional Chuckwagons and the Pro Rodeo sport while delivering world class entertainment in a cabaret and including a Midway for families to enjoy in the north region. The Grande Prairie Stompede Association is celebrating The Cowboy Way in our 40th year. We are proud to promote Canadian Western Heritage and highlighting our local athletes and community throughout the region, the provinces and Canada.

Stompede has evolved into a 1 million dollar operation that hosts #30,000 people annually which is organized by volunteer members. Most recently in the past 5 years, Stompede has injected over $250,000 back into local organizations by engaging in their participation to deliver the event to the community. In 2016 $267,000 of revenue was not generated and fell from categories of disposable income from the downward turn in the economy.

We appreciate the opportunity to deliver this information and would invite the MD of Greenivew No. 16 to invest in a Sustainability Fund with a 3 year commitment for $75,000 per year. This fund will allow for the future sustainability and strategic positioning of Stompede to ensure it exists for the next 40 years.

For this investment the MD of Greenview would be recognized as a 'Strategic Partner' and mutually agreed upon recognition would be created to highlight your commitment for our western heritage. There will be a Sustainability sub-committee formed with regional representation who would meet quarterly. This committee has the suggested composition: (1) Stompede Director, (2) members at large, (4) municipal partners.

The fund would be created and the initial vision is to draw 15% of funds annually into the operation of Stompede with benchmarked deliverables upon the recommendation of the Sustainability Committee which would enhance the consumer experience on a yearly basis. This fund would also start the process to develop an overall 3 – 5 year operations plan.

We welcome input and discussion from the Municipality and are committed to working together to find solutions to the ever-changing economic climate which will mitigate the financial risk and guarantee our continued successes.

Respectfully Submitted,

Terri Ellen Sudnik, President
The Grande Prairie Stompede Board of Directors

Box 1338, Grande Prairie, AB T8V 4Z1
780-532-4646 | GPSTOMPEDE.COM |

REQUEST FOR DECISION

SUBJECT:	**Grande Prairie River Rats Association – Jet Boat Race Funding Request**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	COMMUNITY SERVICES	GM:	DM	PRESENTER:	DM

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy (cite) – N/A

RECOMMENDED ACTION:
MOTION: That Council approve sponsorship in the amount of $5,000.00 to the Grande Prairie River Rat Association for the June 16 – 18, 2017 Jet River Race, Grande Prairie, with funds to come from the Community Service Miscellaneous Grant.

BACKGROUND/PROPOSAL:
The Grande Prairie River Rat Association will be hosting a three day jet river race (Capstan Hauling Rat 200) from June 16 – 18th within Grande Prairie. The race is approximately 200 miles in length on some of the most challenging waters racers will face. The race is an opportunity to showcase Greenview with participants and spectators from all over Canada in attendance. Sponsorship opportunities for the 2017 Jet River Race range from $150.00 - $5,000.00.

Greenview sponsored the organization in the amount of $5,000.00 in 2016 as they hosted the World Jet Boat Championship.

The Community Service Miscellaneous Grant has a balance of $330,535.81 as of May 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of sponsoring the Grande Prairie River Rat Association for the 2017 Jet River Race is that Greenview will be supporting a local organization in showcasing the region.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantage to sponsoring the Grande Prairie River Rat Association for the 2017 Jet River Race.

ALTERNATIVES CONSIDERED:
Alternative #1: Council has the alternative to alter or deny the requested sponsorship for the 2017 Jet River Race. If the sponsorship request is altered or denied the organizing group will be required to seek additional sponsorship elsewhere.

FINANCIAL IMPLICATION:

Direct Costs: $5,000.00

Ongoing / Future Costs: N/A

STAFFING IMPLICATION: N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Community Service staff will notify the organization as to the status of the request.

ATTACHMENT(S):

- Grande Prairie River Rat Association – 2017 Grant Application
- Jet Boat Race Sponsorship Opportunities

GRANT APPLICATION INSTRUCTIONS

Overview

Grant requests directed to the MD of Greenview must meet a number of criteria in order to be successful. Each application must contain all required information, include all applicable supporting documentation and be submitted on or prior to specified deadline.

The MD is committed to supporting sustainable activities that positively impact the ratepayers of the MD, and is faced with allocating a limited amount of resources among an ever growing list of applicants. This process is intended to help make the best use of limited funds.

You are **ineligible** to receive a grant if any of the following conditions exist:

1) You are not a registered charity or a registered not for profit society in active status.
2) The grant application is not complete.
3) A current financial statement is not included.
4) A detailed budget for the grant expenditure is not included.
5) A final report remains outstanding from a previous grant application.

Name of Organization

Full legal name of the organization as registered under Corporate Registries or the Societies Act. Organizations not registered or currently listed as inactive are ineligible for grants.

Mailing Address of Organization

This should include full address and postal code.

Contact Name(s)

First and last name of contact(s).

Contact Telephone Number(s)

Please include a phone with message capabilities, cell phone or work number if possible since most calls from the MD will come during the day.

Position Held

The person making the application should normally be a member of the executive of the organization or be specially appointed by way of motion.

Purpose of the Organization

Outline in a few sentences the purpose of the organization, including how long it has been in operation and its overall objective(s). Include an overall budget for the next year of operations.

Purpose of the Application

Outline in a few sentences what these specific funds would be used for and attach a detailed budget for the proposal. The outline should include the estimated number of participants/users impacted, other social or economic impacts of the application, cooperation with or funding from other groups and the impact on the organization/users if the grant is denied.

Past Financial Statements

Provide an approved copy of your most recent financial statements. Approval can be via signatures of two board members or as prepared by an accountant, based on your organizations legislated requirements.

Funding Sources that Denied this Application

List other funding sources applied to that denied this application.

Previous Grant and Reporting History (if applicable)

List the last two grants received from the MD, including purpose and amount. Please note that starting with the October 2010 application process, final reports **MUST** be filed with the MD within 90 days of completion of the grant expenditure. Failure to provide a final report will result in rejection of all future applications until applicable report(s) are filed.

Final Report Content

Within 90 days of the completion of the grant expenditure, a report must be filed with the MD verifying expenditure of the grant. This report should include:

1) Name of Organization
2) A summary of actual expenditures of grant funds compared to submitted budget
3) A short written description of activities, number of participants, successes etc.
4) Signatures of two members of the organization's executive

Municipal District of Greenview

Grant Application Checklist

1) Have all final reports from previous grant applications been filed? ☑
2) Has the application been fully completed and signed? ☐
3) Have you attached an overall budget for your organization for the next year? ☐
4) Have you attached a detailed budget for the grant application? ☐
5) Have you attached your approved financial statements for the last year available? ☐
6) Have you attached other supporting documentation if applicable? ☐
7) Is everything you provided clearly written and easy to understand? ☐

Municipal District of Greenview #16
Box 1079 Valleyview, AB T0H 3N0
Phone: (780) 524-7600

GRANT APPLICATION

Organization Information:

Name of Organization: Grande Prairie River Rats Association

Address of Organization: Box 1371, Grande Prairie

Contact Name and Phone Number: Penny 780-532-0097

Position of Contact Person: Organiser

Purpose of organization:
The River Rats promote our beautiful rivers, family and keeping the rivers clean & safe .
Also in a yearly event we bring Jet Boat race Teams in to compete and entertain the crowds

What act are you registered under? Grande Prairie River Rats Assoc Registration No. 500058953

Grant Information:

Total Amount Requested 10,000.00 (Operating) _____ (Capital)

Proposed Project: _____

Operating costs are the costs of day-to-day operations.
Capital costs are costs more than $2,500, which is not consumed in one year and/or those costs, which add value to property owned and operated by the organization.

FORM A **must** be filled out with **all** grant applications. Fill out FORM B for any capital requests.

.

Municipal District of Greenview #16
Box 1079 Valleyview, AB T0H 3N0
Phone: (780) 524-7600

Additional Information:

Have you previously applied for grant from the M. D. of Greenview?

Yes [✔] No [ ]

List the last two grants your organization has received from the M.D. of Greenview

1. Amount $ 5000 Year 2016

Purpose: Marketing for our 2016 Jet Boat Championship

2. Amount $ 25000 Year 2015

Purpose: Marketing for our 2015 World Jet Boat Championship

Have you provided the M.D. of Greenview with a final completion report for grant funds received?

Yes [✔] No [ ]

If no, why has the report not been filed?

Have you applied for grant funds from sources **other** than the M.D. of Greenview?

Yes [✔] No [ ]

Have you received grant funds from sources **other** than the M.D. of Greenview?

If yes; who, purpose and amount?
City of Grande Prairie $1000.00 marketing

Have you performed any **other** fund raising projects? If yes; what and how much was raised?

Coupon for restaurants $1200.00
Program for Racers $17500

Municipal District of Greenview #16
Box 1079 Valleyview, AB T0H 3N0
Phone: (780) 524-7600

By signing this application, I/we concur with the following statements:

- The organization applying for the grants is registered with Corporate Registries or under the Societies Act;
- The grant application is complete and includes all supporting documentation, including most recent financial statement (based on legislative requirements of our organization), balance sheet, current bank balances and current year detailed operating budget or completed Form "A".
- The grant shall be used for only those purposes for which the application was made;
- If the original grant application or purposes for which the grant requested have been varied by the M.D. of Greenview Council, the grant will be used for those varied purposes only;
- The organization will provide a written report to the M.D. of Greenview within 90 days of completion of the grant expenditure providing details of expenses, success of project and significance to the ratepayers of the municipality; failure to provide such a report will result in no further grant funding being considered until the final report is filed and grant expenditure verified;
- The organization agrees to submit to an evaluation of the project related to the grant, and;
- The organization will return any unused portion of the grant funds to the Municipal District of Greenview #16 or to request approval from the Municipality to use the funds for an optional project.

Applicant Information:

Name: Penny Batt

Signature: _____

Address: 6475-701A TWP, Grovedale,AB T0H 1X0 (Box 198)

Telephone Number: 780-532-0097

Date: Feb 7.2017

Municipal District of Greenview #16
Box 1079 Valleyview, AB T0H 3N0
Phone: (780) 524-7600

APPLICATION FOR GRANT
FORM A - **OPERATING**

REVENUE		**Previous Year Actual 20__**	**Current Year Estimates 20__**	**Next Year Proposal 20__**
1.	Fees			
2.	Memberships			
3.	Other income (please list)			
4.	Grants (please list)			
5.	Donations (please list)			
6.	Interest Earned			
7.	Miscellaneous Income			
	TOTAL REVENUE			
	(add up items 1-7)			
EXPENSES				
8.	Honourariums/Wages/Benefits			
9.	Travel Expenses			
10.	Professional Development			
11.	Conferences			
12.	Cleaning & Maintenance			
13.	Licensing Fees			
14.	Office Supplies			
15.	Utilities (phone, power, etc.)			
16.	Rent			
17.	Bank/Accounting Charges			
18.	Advertising			
19.	Miscellaneous			
20.	Capital Purchases (please list)			
	TOTAL EXPENSES			
	(add up lines 8-20)			
	NET BALANCE			
	(subtract Total Expenses from Total Revenue)			

Cash on Hand $ _____
Current Account Balance $ _____
Savings Account Balance $ _____
_____
Accounts Receivable $ _____
Inventory to Dec 31, 20___ $ _____
Buildings $ _____
Furniture/Fixtures $ _____
Land $ _____
Equipment $ _____

Operating Loans $ _____
Other Loans $ _____
Accounts Payable $

*Please submit your organization's most recent financial statement (based on your organizations legislated requirements) with the grant application.

Municipal District of Greenview #16
Box 1079 Valleyview, AB T0H 3N0
Phone: (780) 524-7600

APPLICATION FOR GRANT
FORM B - **CAPITAL**

Purpose for Grant (please provide full description and detailed project budget);

The Rat 200 Jet Boat Championship is a yearly event held on the Smokey & Wapiti Rivers.

Race teams will start arriving on Friday June 16th for the Registration and Show and Shine.

This is truly an opportunity to showcase the MD of Greenview #16 with an exciting event.

A budget of $50,000 to host the Race in the MD of Greenview # 16.

There are Marketing and advertising opportunities to promote the host community of the M

#16 bring awareness to the sport and to attract spectators, racers.

Estimated Completion Date: June 18.2017

Quotes for Project (minimum of three quotes if available. Attach additional quotes if required):

1. _____

Amount $_____

2. _____

Amount $_____

3. _____

Amount $_____

*Please submit your organization's most recent financial statement (based on your organizations legislated requirements) with the grant application.

2017 TBA Rat 200 Jet River Race

2017
Sponsors Package Opportunities

"The Capstan Hauling Rat 200" is a 3-day Jet River Race hosted by The Grande Prairie River Rat Association a non-profit group.

Grande Prairie's race is approximately 200 miles on some of the most challenging Race Rivers the world has to offer. This is the 1st of 4 races in the Canadian Jet River Championship with racers competing for the title of "Canadian Champion", with the sanctioning body CBF.

For the Canadian Championship we enjoy watching boats from Canada, USA & sometimes New Zealand & Mexico.
Some local racers to watch for are; Barry Fenton, Craig Sparkes, Tim Greber, Mark Rodacker, Travis Hodges, Darin Cage, Tim Wilmot, Rick Hollingworth, Don Hodges & Kelly Locke.

Race schedule for this year's race is as follows:

Day 1
Technical Inspection, Registration and Show & Shine
Date June 16th
Time 5:00pm to 8:00pm
Place The Den Pub and Carvery Parking Lot 10702 - 108A Street

Day 2
Date June 17th
Smoky Flats to O'Brien Park
Circuit Racing at O'Brien Park

Day 3
Date June 18th
Wapiti Gardens to O'Brien Park
Circuit Racing at O'Brien Park

Awards presentation will be held at the Nitehawk Ski Chalet at approximately 5:00 pm,
All sponsors are encouraged to attend to participate in the awards ceremony.

2017 TBA Rat 200 Jet River Race

Sponsorship Opportunities

Title Race Sponsor, $5,000

- Your company decal on every registered boat.
- Headliner on all posters and advertising leading up to and including race.
- Full-page ad in race program.

Gold Class Sponsor, 5 available $2500

- Unlimited, Spec Jet, A, CX, & FX
- Your company decal on all boats in class sponsored.
- Recognized on all posters and advertising leading up to and including race*.
- ½ page ad in the program.

Silver Sponsor, $1400

- ½ page ad in the program.

Bronze Sponsor, $700

- ¼ Page ad in the program

Leg Fast Time Sponsor, $500 each

- Business card size ad in the program

Business Card, $300.00

- Business card size ad in the program

Coupon Page $300…

- Your coupon- page fits up to 8 Coupons per page

Friends of "The Rat 200" $150.00

- Name listing

All sponsors will also be verbally acknowledged as awards are presented.

*Posters will be printed by May 1, 2017 and program ads must be in by May 31.2017.

2017 TBA Rat 200 Jet River Race

We truly thank you for your consideration of sponsoring this exciting event. Please join us at the Show & Shine and get an opportunity to meet the racers and coordinators at The Den Pub and Carvery Parking Lot 10702 - 108A Street Grande Prairie.

Autographs & memorabilia will be available, vote for your favorite boat to get the best in show award.
If you want to become involved we would be happy to talk to you there.

And of course please do come out and cheer on the racers, they love the fans.

CONTACTS:
Brian McGregor 780-814-4433
Tim Greber 780-831-5240
Penny Batt 780-532-0097

Grande Prairie
RIVER RATS
ASSOCIATION

REQUEST FOR DECISION

SUBJECT:	**Meeting Date for Municipal Planning Commission Meeting**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	SAR
DEPARTMENT:	PLANNING & DEVELOPMENT	GM:	GG	PRESENTER:	SAR

RELEVANT LEGISLATION:

Provincial – *Municipal Government Act, RSA 2000, s. 195 - 197*

Council Bylaw/Policy – Bylaws 13-692 and 13-699

RECOMMENDED ACTION:

MOTION: That Council hold the November 2017 Municipal Planning Commission meeting on Wednesday, November 8, 2017, commencing at 9:00 a.m. in the Council Chambers, Administration Building, 4806 – 36 Avenue, Valleyview, Alberta instead of November 15th, 2017.

BACKGROUND/PROPOSAL:

Council had accepted the meeting dates for the 2017 Municipal Planning Commission meeting at the Council Organizational meeting on October 25, 2016. Typically the monthly Municipal Planning Commission meetings are scheduled on the second Wednesday of the month or after the first Council meeting of the month. This would result in the meeting being held on November 15, 2017. However, Municipal Planning Commission Members will be attending the Alberta Association of Municipal Districts and Counties (AAMDC) that week. As such, the November 14, 2017, Council meeting had also not been scheduled. Members of the Municipal Planning Commission had discussed holding the Municipal Planning Commission meeting one (1) week earlier, on November 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:

1. The benefit to the recommended action is that there would be no delay in reviewing the proposed Subdivision, Land Use Amendments or Development Permit applications.

DISADVANTAGES OF THE RECOMMENDED ACTION:

1. There are no perceived disadvantages to the recommended action.

ALTERNATIVES CONSIDERED:

Alternative #1: Council may consider not scheduling a Municipal Planning Commission for November 2017. However, Administration does not recommend this alternative as it would delay the process of applications that have been received by Planning and Development.

FINANCIAL IMPLICATION:

There are no financial implications to the recommended motion.

STAFFING IMPLICATION:

There are no staffing implications to the recommended motion.

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

If the November 8, 2017, date for a Municipal Planning Commission is agreed upon, Planning and Development will advertise the change accordingly and proceed with applications for review at the meeting.

ATTACHMENT(S):

- Schedule A – MGA
- Schedule B – Bylaws 13-692 and 13-699

(5) No matter other than that stated in the notice calling the special council meeting may be transacted at the meeting unless the whole council is present at the meeting and the council agrees to deal with the matter in question.

1994 cM-26.1 s194

Council committee meetings

195 The municipality must give at least 24 hours' notice of a council committee meeting

(a) to the members of the council committee, and

(b) to the public.

1994 cM-26.1 s195

Method of giving notice

196(1) Notice of a council or council committee meeting is deemed to have been given to a councillor or member of a council committee if the notice is delivered to an adult person at the councillor's or member's home or place of business.

(2) Notice of a council or council committee meeting to the public is sufficient if the notice is given in a manner specified by council.

1994 cM-26.1 s196

Public presence at meetings

197(1) Councils and council committees must conduct their meetings in public unless subsection (2) or (2.1) applies.

(2) Councils and council committees may close all or part of their meetings to the public if a matter to be discussed is within one of the exceptions to disclosure in Division 2 of Part 1 of the *Freedom of Information and Protection of Privacy Act*.

(2.1) A municipal planning commission, subdivision authority, development authority or subdivision and development appeal board established under Part 17 may deliberate and make its decisions in meetings closed to the public.

(3) When a meeting is closed to the public, no resolution or bylaw may be passed at the meeting, except a resolution to revert to a meeting held in public.

1994 cM-26.1 ss197,738;1995 c24 s23

Right of public to be present

198 Everyone has a right to be present at council meetings and council committee meetings conducted in public unless the person chairing the meeting expels a person for improper conduct.

1994 cM-26.1 s198

Schedule "B"

BYLAW NO. 13-692
of the Municipal District of Greenview No. 16

A Bylaw of the Municipal District of Greenview No. 16, in the Province of Alberta, to establish the procedures for the conduction of Regular, Organizational and Special Council meetings.

Meeting Procedure Bylaw

1. This Bylaw is called the "Meeting Procedure Bylaw".

2. The definition of any word or term used in this bylaw which is defined in the Municipal Government Act shall have the same definition as the word or term as specified in the Municipal Government Act.

Application

3. This Bylaw shall govern Regular Council Meetings, Organizational Meetings and Special Council Meetings.

4. When a matter arises related to the proceedings in a meeting which is not covered by a provision of this Bylaw or the Municipal Government Act, the matter shall be decided by reference to *Robert's Rules of Order*.

5. In the event of a conflict between the provisions of this Bylaw and *Robert's Rules of Order*, the provisions of this Bylaw shall apply.

Meetings of Council

6. At the Organizational meeting each year, Council shall establish the dates and times in which to hold regular Council meetings.

7. When the meeting day falls on a statutory holiday, the meeting shall be held the following day which is not a statutory holiday, unless otherwise set by resolution of Council.

8. As soon as there is a quorum present after the hour fixed for the meeting, the Chair shall take the Chair and call the meeting to order. If a quorum is not present within thirty (30) minutes after the time fixed for regular or special meetings, the Chief Administrative Officer shall record the names of the members present, and the Council shall stand adjourned until the next Regular or Special Council meeting.

9. The Chief Administrative Officer shall record the time of arrival and departure of Council members at meetings should a member of Council arrive late at a meeting or depart prior to the completion of the meeting.

10. In the case that the Reeve and the Deputy Reeve are not in attendance within thirty (30) minutes after the hour appointed for a meeting and a quorum is present, the Chief Administrative Officer shall call the meeting to order and a Chair shall be chosen by the Councillors present who shall preside during the meeting until the arrival of the Reeve or Deputy Reeve.

Agendas and Order of Business

11. Prior to each Regular meeting, the Chief Administrative Officer shall prepare a statement of business to be known as the "Agenda" of all business to be brought before the Council at such meeting, and to enable the Chief Administrative Officer to do so, all documents and notices of delegation intended to be submitted to the Council shall be received by the Chief Administrative Officer not later than 12:00 noon, Tuesday of the week prior to the Regular Council meeting.

12. The Chief Administrative Officer shall place at the disposal of each member of Council, a copy of the Agenda and all supporting materials not later than 4:30 p.m., the Thursday before the Regular meeting.

13. Where the deadlines in Sections 11 and 12 are not met, the Agenda and supporting materials shall be deemed to be acceptable by Council when the Agenda is adopted at the Regular meeting.

14. The business of the Council intended to be dealt with shall be stated in the agenda in the following order:

    a. Call to Order.
    b. Adoption of Agenda.
    c. Adoption of the previous minutes.
    d. Business arising out of the minutes.
    e. Public Hearings.
    f. Delegations.
    g. Bylaws.
    h. Old Business.
    i. New Business.
    j. Councillor Reports.
    k. Correspondence.
    l. Confidential items.
    m. Adjournment.

15. The order of business established in the foregoing paragraph shall apply unless altered by the Reeve or presiding officer without objection by a member of Council, or otherwise determined by a majority vote of the members present, and the vote upon a matter of priority of business shall be decided without debate.

16. Once the agenda has been adopted by Council, matters may only be added to the agenda by resolution with the support of two-thirds (2/3) of the Council Members present.

17. The Chief Administrative Officer is authorized to publish the order of business of any Council or Committee meetings in advance of the meeting and prior to the adoption of the Order of Business, and at the discretion of the Chief Administrative Officer, to release to the public or the media all, or any portions of the prepared Agenda materials.

18. Draft bylaws and policies are to be placed initially on the Committee of the Whole or Policy Review Committee agendas, as appropriate, prior to being presented at a Regular or Special Council meeting, unless otherwise directed by Council by resolution or unless the matter is emergent and there is no opportunity to place the item on the agenda of a Committee of the Whole or Policy Review Committee meeting agenda prior to being placed on a Regular or Special Council meeting agenda.

Conduct of Meetings

19. Every Council member, delegation and staff member shall address the Chair, but shall not speak until recognized by the Chair.

20. The Chair may, upon request of a member of Council, authorize a person in the public gallery to address Council, only on the topic being debated at that time in the meeting and within time limits specified by the Chair.

21. Procedures for the conduction of Public Hearings shall be established by Bylaw approved by Council.

Motions

22. A Council Member wishing to make a motion shall indicate same to the Chair by utilizing the method specified by the Chair. This may include using an electronic device such as a button on a microphone or other such similar electronic device or, in the absence of such a device or at the discretion of the Chair, the Council Member may indicate their intention to place a motion on the floor by lifting his or her hand and waiting for the Chair to recognize them prior to proceeding with making the motion.

23. Motions do not require a seconder.

24. A motion may be withdrawn by the mover at any time before voting, subject to there being no objection from any other member of Council.

25. Any Councillor may require the motion under discussion to be read at any time during the debate, except when a Councillor is speaking.

26. The mover of a motion shall be present when the vote on the motion is taken.

27. The following motions are not debatable by Council:

a. Adjournment.
b. Take a recess.
c. Question of privilege.
d. Point of order.
e. Limit debate on the matter before Council.
f. Division of a question.
g. Table the matter.

28. Where a question under consideration contains distinct propositions, the vote upon each proposition shall be taken separately when any member so requests or when the Chair so determines in his or her opinion it is appropriate to do so.

29. Whenever the Chair is of the opinion that a motion is contrary to the rules and privileges of the Council, the chair shall appraise the member thereof immediately, before putting the question, and shall cite the rule or authority applicable to the case without argument or comment, unless otherwise decided by a two-thirds majority vote of the members present.

30. A motion to adjourn the meeting shall be in order except:

a. When a Councillor is in possession of the floor; or
b. When it has been decided that the vote now be taken; or
c. During the taking of a vote.

Delegations

31. Council will allow delegations to attend Council meetings in accordance with the provisions of this Bylaw. Delegations are normally to present to the Committee of the Whole, but where time restrictions or other issues require, the Reeve may permit a delegation to be placed on the Regular or Special Council agenda.

32. Anyone wishing to be heard before Council at a Council meeting will be allowed to do so upon providing a written request for same to the Chief Administrative Officer prior to the agenda deadline. The request must identify the issue or topic to be addressed and any supporting documentation to be provided to Council.

33. Notwithstanding the forgoing, Council will not receive delegations from parties which have, or may reasonably be expected to have, current or pending litigation or other legal proceedings involving the Municipal District of Greenview No. 16.

34. Delegations shall be limited to a five (5) minute presentation period unless a longer period of time is approved by the Reeve prior to the meeting, or at the time that the meeting agenda is reviewed;

35. For each meeting, all delegations will be advised to attend the meeting at the same scheduled time, and delegations will be heard by Council sequentially in the order in which they appear on the agenda;

36. At the meeting, the Chief Administrative Officer shall indicate to the Chair when five (5) minutes have elapsed in the allocated presentation time. The Chair, upon being notified of the allocated time having expired, may request that the delegate wrap up their presentation or provide additional time;

37. In preparing audio/visual materials to be presented at the meeting, delegates are required to limit the number of PowerPoint slides, or such similar visual aids, or pictures and at all times such presentation is limited to the five (5) minute time restriction. Any such electronic presentation is to be provided by the Delegation via email or removable USB memory device, in a compatible file format, to the Executive Assistant prior to the date of the meeting;

38. Council will allocate no more than two (2) hours per meeting for receiving delegations;

39. All delegates must address the Chair during their presentation. Delegates' conduct is subject to the rules of conduct provided within this Bylaw and any other Bylaw enacted by Council;

40. Delegates may only address the issue or topic identified in their delegation request;

41. Following the presentation, Council may ask questions of the delegate, and may discuss the subject of the presentation or defer discussion to a later date;

42. Any party wishing to attend a Council meeting as a delegation is restricted to one presentation on the same topic every six (6) months. Under exceptional circumstances, the Chair may vary this restriction in the event that new or compelling information is brought to light which would warrant allowing the party to be present as a delegation again within the six (6) month period. As well, this restriction shall not apply when Council, by resolution, invites a party to attend a Council meeting as a delegation.

Organizational Meeting

43. An organizational meeting of Council shall be held annually as required by the Municipal Government Act.

44. At the Organizational meeting, Council shall establish, by resolution, for the forthcoming year:

    a. The selection of Reeve and Deputy Reeve.
    b. The dates and times for the Regular Council meetings.
    c. The dates and times for Standing Committees of Council including the Committee of the Whole.
    d. Membership on Committees, Boards, Commissions, etc.
    e. Any such other related business as required by the Municipal Government Act.

45. If the Organizational meeting follows the general municipal election, each Councillor shall take the prescribed Oath of Office as the first order of business.

46. Until the Reeve has been selected and has taken the Oath of Office, the Chief Administrative Officer shall Chair the meeting.

Electronic Meetings

47. Council may conduct Regular Council or Special Council meetings by means of electronic or other communication facilities.

48. A Councillor may participate in a Regular Council or Special Council meeting by means of electronic or other communication facilities.

49. Councillor who participate in meetings by means of electronic or other communications will verbally provide their vote to the Chief Administrative Officer.

General

50. The Chief Administrative Officer may publish the unadopted minutes.

51. Notice of a Council meeting or Council Committee meeting to the public is sufficient if the notice is posted in the lobby at the main Administrative Office of the Municipal District of Greenview.

52. Policies No. CO 05, CO-06 and CO-07 are hereby deleted.

53. This Bylaw shall come into effect at the first Regular Council or Special Council meeting that occurs after the meeting in which this Bylaw is given final reading.

Read a first time this 12 day of February, AD, 2013.

Read a second time this 26 day of February , AD, 2013 .

Read a third time and finally passed this 26 day of February AD, 2013.

(Signed original on file)
REEVE

(Signed original on file)
CHIEF ADMINISTRATIVE OFFICER

MUNICIPAL DISTRICT OF GREENVIEW NO. 16

BYLAW NO. 13-699

A BYLAW TO AMEND BYLAW 13-692 – 2013 MEETING PROCEDURE BYLAW FOR THE MUNICIPAL DISTRICT OF GREENVIEW NO. 16

1. Bylaw No. 13-692, being the Meeting Procedure Bylaw for the Municipal District of Greenview No.16, is hereby amended by replacing in Section 12 the words "not later than 4:30 p.m., the Thursday before the Regular meeting" with the words "not later than 4:30 p.m., the Wednesday before a Regular meeting".

2. The remainder of Bylaw 13-692 remains in effect and in force.

3. This bylaw shall come into effect on final passing.

Read a first time on this 14 **day of** May, **2013.**

Read a second time on this 14 **day of** May, **2013.**

Read a third time and passed on this 14 **day of** May, **2013.**

Municipal District of Greenview No. 16

(Signed Original on File)
Reeve

(Signed Original on File)
Chief Administrative Officer

REQUEST FOR DECISION

SUBJECT:	**Grande Prairie and District Victim Services**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	COMMUNITY SERVICES	GM:	DM	PRESENTER:	DM

RELEVANT LEGISLATION:
Provincial (cite) – N/A

Council Bylaw/Policy (cite) – N/A

RECOMMENDED ACTION:
MOTION: That Council approve Pearl Sponsorship in the amount of $1,000.00 to the Grande Prairie and District Victim Service for the 2017 Annual Dinner and Auction, with funds to come from the Community Service Miscellaneous Grant.

BACKGROUND/PROPOSAL:
The Grande Prairie and District Victim Services Unit is a non-profit charitable society that provides a highly skilled, compassionate level of service to any victim of crime or tragedy. We provide support, information and referrals during times of crisis, trauma or tragedy to those who are a victim of crime or have experienced a sudden death or family crisis.

The organization will be hosting their 2017 Annual Dinner and Auction on May 13, 2017 and is requesting sponsorship support. The event is a major fundraiser for the organization allowing them to fulfill a vital community need.

Greenview has previously provided sponsorship in the amount of $1,000.00 to the Grande Prairie and District Victim Services for the annual event.

The Community Service Miscellaneous Grant has a balance of $330,535.81 as of May 8, 2017.

BENEFITS OF THE RECOMMENDED ACTION:
1. The benefit of providing sponsorship to the Grande Prairie and District Victim Services for the annual event is that Greenview will supporting an organization that provides a valuable service to the community.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantage to providing sponsorship to the Grande Prairie and District Victim Services.

ALTERNATIVES CONSIDERED:

Alternative #1: Council has the alternative to alter or deny the sponsorship to the Grande Prairie and District Victim Services for the annual event.

Alternative #2: Council has the alternative to support Administration's recommendation to approve the sponsorship to the Grande Prairie and District Victim Services for the annual event, however this may be precedent setting as Greenview may receive sponsorship requests from other organizations of a similar nature.

FINANCIAL IMPLICATION:

Direct Costs: $1,000.00

Ongoing / Future Costs: N/A

STAFFING IMPLICATION: N/A

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Administration will notify the Grande Prairie and District Victim Services regarding Council's decision.

ATTACHMENT(S):

- Grande Prairie and District Victim Services – 2017 Sponsorship Request

April 7, 2017

Dear Lianne:

I am pleased to advise that Grande Prairie and District Victim Services will be resuming our annual Dinner and Auction and are looking for your support. This year's event will be held at the Crown and Anchor on Saturday, May 13, 2017.

Last year, in consideration of our gracious supporters we decided to forgo our major fundraising event due to the economic downturn. As many people are aware, this often results in our services being more in demand. In 2016, we opened 1,763 files and logged 19,296 volunteer hours, which represents an increase of 160 files and 600 additional hours over 2015.

Now that the economy is recovering and times are more encouraging, we have resumed our fundraising efforts. In addition to applying for grants to offset our budget, we also look to the community for assistance through fundraising.

Our major fundraiser this year is the *Doors Opening Dinner and Silent Auction;* a nod to our continued efforts to reach out and open doors in the communities we serve. It is our hope that you will be willing to support us in our efforts; we are specifically looking for outdoor items, concert, event or sporting packages/tickets or a monetary donation that prospective bidders can use to celebrate the fun that summertime brings to the Peace Country.

Our sponsorship packages are also available and are attached for your information.

We also hope that you, your employees, friends and others will attend this event to celebrate with us. Tickets are $25 and you can reserve yours by contacting Grande Prairie and District Victim Services at 780-830-5703.

Grande Prairie and District Victim Services Unit is a non-profit charitable society that provides a highly skilled, compassionate level of service to any victim of crime or tragedy. We provide support, information and referrals during times of crisis, trauma or tragedy to those who are a victim of crime or have experienced a sudden death or family crisis. For more information, please visit our website at www.grandeprairievictimservices.com.

Sincerely,

K. Patricia Colosimo-Andreeff
President
Board of Directors

Grande Prairie & District Victim Services
Sponsorship Opportunities

PRESENTING SPONSOR ($5,000)

- Primary logo placement at the function
- Primary logo placement on printed material utilized at various functions attended by VSU (one year)
- Business name placed in a thank you ad in the local paper.
- Primary logo placement on our website for one year
- Charitable Tax Receipt

SAPPHIRE ($2,500)

- Logo placement the annual fundraiser
- Logo placement on the VSU website for six months
- Charitable Tax Receipt

PEARL ($1,000)

- Logo placement at annual fundraiser
- Logo placement on website for three months
- Charitable Tax receipt

FRIEND OF VICTIM SERVICES ($500)

- Written signage at fundraiser
- Logo placement on website for one month
- Charitable Tax receipt

REQUEST FOR DECISION

SUBJECT:	**Expression of Interest Book Hiring Procedure**				
SUBMISSION TO:	REGULAR COUNCIL MEETING	REVIEWED AND APPROVED FOR SUBMISSION			
MEETING DATE:	May 9, 2017	CAO:	MH	MANAGER:	
DEPARTMENT:	INFRASTRUCTURE & PLANNING	GM:	GG	PRESENTER:	GG

RELEVANT LEGISLATION:
Provincial (cite) –
Council Bylaw/Policy (cite) –

RECOMMENDED ACTION:
MOTION: That the Committee of the Whole recommend direction regarding the guidelines for Administration to craft a policy for the hiring process in the use of the Expression of Interest book.

BACKGROUND/PROPOSAL:
Administration has requested clarity when hiring from the Expression of Interest (EOI) book to assist in the procedure of hiring contractors that responded to Greenview's public advertisement in the local newspapers and radio.

Administration has created a list of questions that will assist in discussions with Council to aid in crafting a Policy for clarification and set procedures during the hiring process from the EOI book. During the course of the discussion it is anticipated that further questions will arise and that, as part of the discussion Administration will present Council with several scenarios and seek Council's opinion on how those scenarios would be resolved.

The feedback and answers provided by the members of Council will be used to craft a policy accordingly. As part of the discussion, Staff will also advise Council on possible staffing implications associated with various directions being taken.

As a note, the EOI book is utilized (or potentially utilized) by multiple Greenview staff within multiple departments including Construction, Operations, Ag Services, Recreation, Facility Maintenance and, Environmental Services.

BENEFITS OF THE RECOMMENDED ACTION:
1. The Benefit to the recommendation is that Administration should have clarity and direction in when creating the policy for hiring equipment from within the Expression of Interest book.

DISADVANTAGES OF THE RECOMMENDED ACTION:
1. There are no perceived disadvantages associated with the recommendation.

ALTERNATIVES CONSIDERED:

Alternative #1: Council could decide not to create a policy for hiring contractors.

Alternative #2: Council could leave the hiring responsibility for staff to Administer.

FINANCIAL IMPLICATION:

Direct Costs: There are no direct costs associated from the recommendation.

Ongoing / Future Costs: There are no future costs associated from the recommendation.

STAFFING IMPLICATION: Dependent upon the directions of Council.

PUBLIC ENGAGEMENT LEVEL:

Greenview has adopted the IAP2 Framework for public consultation.

Using that framework outline the proposed level of public engagement associated with the recommended action.

INCREASING LEVEL OF PUBLIC IMPACT

Inform

PUBLIC PARTICIPATION GOAL

Inform - To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.

PROMISE TO THE PUBLIC

Inform - We will keep you informed.

FOLLOW UP ACTIONS:

Policy drafted for the Policy Review Committee.

ATTACHMENT(S):

- EOI Discussion Questions

EOI Discussion Questions:

1. What defines a Greenview Business?
    - Mailing address/PO Box?
    - Tax Roll?
    - Location of residence and/or location of business/equipment?
    - Will Valleyview, Fox Creek & Grande Cache be considered part of Greenview?
    - Other?

Consideration: All of the above methods contain flaws. There is no single perfect method to define a Greenview business or that would prevent a contractor from circumventing the system.

2. Do Greenview businesses get priority when hiring?
    - How will Greenview businesses with equipment based outside of Greenview be treated?
    - When will outside contractors be hired?

3. Does Greenview treat the contractor's lists similar to a "batting order" in baseball? I.E. Once you have had your turn, you return to the bottom of the list.
    - Will late additions to the list be accepted?
    - Will there be one list covering all of Greenview or will there be different lists based on geography/wards/location to work, etc.?

4. Does Greenview hire only one piece of equipment from one company first and does that company then move to the bottom of the list?
    - If there are separate/multiple lists are contractors allowed to be on both and if so, does being offered work on one list move the contractor to the bottom of all lists?

Consideration: Multiple supervisors wanting to hire equipment may produce confusion or add addition constraints in attempting to maintain the list order.

5. When is a contractor considered to have had their turn?
    - Does Greenview make a call for a piece of equipment and give a maximum period of time to respond? If so, what is the length of time?
    - If no response, does that contractor move to the bottom of the list?
    - When a call is made with no answer do we leave a message?

6. Will the list be followed in cases of emergency?

7. Will Greenview place a work cap on contractors (days, dollars, tonnes hauled, hours, etc.)?
    - Is Council's goal to allow for equality of opportunity (everyone has equal opportunity to do work), or equality of result (everybody has roughly the same amount of work)?
    - Does this mean that Greenview will change out road building contractors, haulers, etc. such as FTR road stabilization project or other longer duration projects?

Consideration: Separate from this decision, Greenview will already have to re-assess how some longer-term and/or larger projects are conducted given legislation/agreements such as the New West Partnership Trade Agreement.

8. If Greenview hires an operator that cannot fulfill the duties required as determined by Administration, they will be sent home. Will they be considered for future work?
    - Who will determine operator quality?
    - If a company continues to send unqualified operators, when does Greenview disqualify the company?

Consideration: A report card system is already being put in place by Administration as a way of documenting contractor performance/concerns/issues, etc.

9. If an Operator is removed from a site for conduct related reasons (verbally abusive, complaining, etc.) will they or the company be considered for hire again?
    - What constitutes conduct related reasons?
    - If so, what timeframe will they banned for?
    - If the individual is an Operator employed by a company, will the company be given the opportunity to replace that Operator and keep their equipment working on the job?

Consideration: Some Operators are employees working for the company owner. Others are Owner/Operators. Will they be treated the same regarding removal from site? If companies are allowed to replace Operators while keeping equipment on site this means that an Owner removed for conduct (or other reasons) would be allowed to keep their equipment working on a job even though they were removed.

10. If a piece of equipment continues to break down, when do we send it home?
    - Is that contractor replaced with another contractor?

11. How many absent/tardy days without notice or reason does Greenview allow?
    - Does missing safety meetings, job orientations, late starts, etc. qualify under this heading?

12. If an Operator or Company leaves for other employment, will Greenview still consider that company for any future job?
    - If so, will there be a length of time that Contractors will not be considered for work?

13. Are there other times when a contractor will be banned from participating in the EOI book (other than if they are involved in legal action versus Greenview)?

Manager's Report

Function: **Infrastructure & Planning**

Submitted by: **Grant Gyurkovits, General Manager Infrastructure & Planning**

Date: **4/28/2017**

General Manager, Infrastructure & Planning, Grant Gyurkovits

Preparation for Council Agendas. Completing oil field applications through RoaData. General progress meetings with WSP and Opus. Capital project meetings with I&P managers, Senior Leadership meetings. Administrative Day Luncheon.

Manager Construction & Maintenance, Kevin Sklapsky

- I&P was successful in filling the Municipal Engineer position. Congratulations Michael Mikael who started on April 24, 2017.
- I&P was successful in filling the Engineering Technologist position. Congratulations Biqu (Eric) Fu who started on April 24, 2017.
- Working alongside the consultants on the Economy Creek project to get water policy approval for an identified wetland. We feel the process is working out much better and smoother after having a meeting with AEP representatives, therefore expecting the approval soon.
- Working alongside the consultants on the Twp. 672 Regional Landfill connector road. Updating materials and equipment costs for the final review of the Scope of Work.
- The latest traffic count on the Forestry Trunk Road was completed in January 2017 at km 121.5 as part of the Resource Road application for a future phase 4 project. There was a total of 245 vehicles, with 144 passenger vehicles and 101 trucks. We are planning on completing more traffic counts throughout Greenview which will also include the Forestry Trunk road in 2017.

Supervisor, Facility Maintenance, Alfred Lindl

- The last three fire pump trailers went out to Grande Cache, all fire water pumps and trailers are out at their designated locations.
- PSB-DeBolt and Grovedale: working on warranty deficiencies with Southwest and Fields Engineering. The furniture request for the office in DeBolt are on order.
- Water Points; installation of security cameras, security system and card readers on following water points are in progress for NFC-SSH-SWH-Goodwin-Crooked Creek-Little Smoky-DeBolt-Grovedale-South Wapiti

Manager Operation, Gord Meaney

Tenders and Quotes

The following tenders listed below were approved through the 2017 Operations Capital Budget.

Tenders

The Light Duty Truck tender was posted on the APC and the results are listed below. Windsor Ford of Grande Prairie was awarded the tender. The three companies that were non-compliant did not provide pricing on all vehicles listed in the tender package. The tender included 2-½ ton, 8-¾ ton, 3-1 ton and 1 service truck (c/w a tool box and hoist for a total of $775,967.80. The 2017 budget for this tender was $815,000.00

Company	Total Price	Year	Comments
Ken Sargent GMC	$594,996.87	2017	Non-compliant
Doug Marshall Motor City	$620,224.00	2017	Non-compliant
Whitecap Chevrolet Buick GMC	$657,243.00	2017	Non-compliant
Windsor Ford	**$705,617.80**	**2017**	**Awarded**

The box and hoist for the new service truck was sent out to three companies for quotes and the results are listed below. Dematco Inc. from Acheson was awarded the contract.

Company	Price	Comments
Dematco	**$70,350.00**	**Awarded**
General Body and Equipment	$78,939.71	-
Brutus Truck Bodies	$79,735.00	-

Two Wheeled Loaders were posted on the APC and the results are listed below. Doosan of the Peace from Grande Prairie was awarded the tender. The budget for this tender was $1,100,000.00

Company	Make	Model	Total Price	Comments
CEM Heavy Equipment	Hyundai	HL970	$657,200.00	**Serviceable Only in Leduc**
Doosan of the Peace	**Doosan**	**DL420-S-US21**	**$753,476.00**	**Awarded**
Rocky Mountain Equipment	Case	1021G	$792,000.00	-
Wajax	Hitachi	ZW310-5B	$798,000.00	-

Strongco	Volvo	L150H	$862,500.00	-
SMS Equipment	Komatsu	WA7470-8	$904,940.00	-
Brandt	John Deere	744K-11HL	$1,038,000.00	-
Finning	Cat	966M	$1,108,000.00	-

Crushing contract estimates for engineering have been requested from Opus and WSP for the Westview Pit on the FTR and the SML's south of Fox Creek.

Quotes for our culverts have been sent to three companies as well.

On RR 65A there were signs indicating that it was a "no truck route". After inspecting this road and discussing the options the Roads Supervisor Operations pulled the signs which lifted the restrictions. Apparently these signs were installed several years ago based on a political decision and now their purpose has expired as several residents on that road have heavy equipment and trucks parked in their yards.

East Sector

- Repaired culverts on Twp. 674/RR 234, Twp. 690/RR225, Twp. 673A/RR225 and TWP. 720/Hwy. 49.
- Fixed washouts at Twp. 694/RR 224 and Twp. 691/RR 234.
- Clean out frozen culverts.
- Fix road blow-outs at Twp. 694/RR 215 and Swan Lake Road.
- Spot gravel on roads at RR 230 North by the bridge deck, Twp.720/RR 262 and Twp. 681 West of Hwy.43.

West Sector

- Spot gravel on roads between km. 27 – 50 on the FTR. As well as DeBolt and Grovedale areas.
- Simonette Bridge was cleaned off.
- Patched holes on Twp. 694.
- Responded to Ledcor calls for Hwy. 666.
- Culvert on RR 22, 3.5 km. north of Hwy. 43 was repaired.
- Culvert issues in The Victor Lake and Grande Cache Lake co-ops addressed.
- Working on collapsed culverts in the DeBolt and Grovedale areas.
- Steaming culverts.

Shop

- Training/servicing on the new road sweeper.
- Continue to work on equipment due to in-house servicing in Grovedale.
- Received three quotes for the box and hoist for the new service truck.

Manager Environmental Services, Gary Couch

Water and Distribution

- The concrete water reservoir for the new Ridgevalley water plant is now completed and the walls for the building will be going up in the coming weeks.
- Awaiting proposed locations and design on new Grovedale water treatment plant. Exploring alternative plant locations, water servicing concepts for Landry heights, and water and sewer servicing concepts for Grovedale.
- Replacing transformer at Little Smoky water treatment plant to avoid further unnecessary power failure issues.
- DeBolt second reverse osmosis train is on line after some re-plumbing to correct some pipes that were a safety concern. SCADA and electrical upgrades are progressing well also.
- Developing a work plan for Puskwaskau and Sturgeon Heights water points.

Wastewater

- Preparing for the start-up of the new septage receiving station in Grovedale. Letters being sent to all current customers/haulers to set up pin numbers and access codes for a May 29 start.
- Finalizing design work on new industrial lagoon and preparation of tender documents.

Solid Waste

- The new Multi-Lift bin truck tenders closed on April 28 with 12 submissions. Administration will review all tenders for compliance prior to awarding. Results will be listed on the next Managers Report.
- Making some adjustments to a few transfer stations for better access and containment of recycled goods.
- New "Take It or Leave It" buildings are being set up at all remaining manned transfer stations in 2017. Grovedale and New Fish Creek will be the first two sites.
- Three more recycle sheds have been built for New Fish Creek, Grovedale, and DeBolt to help enhance the e-waste, oil jugs, and hazardous waste areas.
- Administration will meet with Alberta Environment and Parks in Grande Prairie today to clarify transfer station /landfill requirements for Greenview.
- The annual reports for our existing landfills as well as the Regional Landfill have been submitted to Alberta Environment and Parks.

Manager Planning & Development, Sally Rosson

- Planning Staff are scheduling dates for review of the Draft Grovedale Area Structure Plan with the Citizen Panel and Council.
- Watch for upcoming Summer Meadows to Mountains articles for Wetland and Fire Smart information.
- Updated Fire District Maps for Grovedale & DeBolt to be placed in a framed display at these new Municipal Service Buildings.
- Changes to the Draft Land Use Bylaw (LUB) 17-779 that will be updated based on outcomes from the discussion at the meeting held on April 26, 2017 with Council.
- The Request for Decision for First Reading will be forwarded to Council on May 23rd just prior to referral notifications being circulated to the affected landowners, appropriate government agencies and adjacent municipalities.

- The affected landowners whose property will have changes to their current zoning will be given written notification and explanation of the update.
- The Draft LUB will be available on Greenview's Website and provided at the reception areas in Valleyview, Grovedale & Grande Cache Office's for the public to obtain a copy. Depending on the responses received, the anticipated Public Hearing date for the Draft LUB has been tentatively scheduled for June 27, 2017.
- Following is a breakdown of the new Applications received in the various Planning & Development categories for the month of April 2017 including the total numbers for the first quarter activity:

Type of Development:	April Amount	Year to Date (1st Quarter)
Business Licenses:	Two	Six
Development Permit Applications:	Twenty-one	Ninety-four
Lease Referrals:	Three	Thirty-one
Land Use Amendments (re-designation):	None	Two
Subdivision Applications:	None	Ten

Manager's Report

Function: **Community Services**

Submitted by: **Dennis Mueller, General Manager Community Services**

Date: **5/9/2017**

General Manager Community Services, Dennis Mueller

Administration in conjunction with the Greenview Regional Multiplex Fundraising Chairman have approved a final version of the Corporate Sponsorship package designed by RC Strategies. A meeting with the Greenview Regional Multiplex Fundraising Chairman has been scheduled to discuss arrangements of a formal presentation of the sponsorship booklets with potential sponsors. Details of the event will be provided to Council upon the established and confirmed venue booking.

The Project Manager is proceeding with the required processes involved for the demolition of the W.D. Stevenson building. The demolition is slated to initiate and conclude this summer.

Agricultural Services Manager, Quentin Bochar

Pest Control Program

The past month was relatively quiet on the predator control front, with almost no predator activity. Conversely, beaver activity has picked up with the changing of the season. The Problem Wildlife Officer has been working in close contact with the Operations Department in trying to alleviate some of the known beaver problems that impact Greenview's network of roads and bridges.

Vegetation Management Program

Agriculture Services Administration attended a second meeting scheduled with the Grande Cache area Coops and Enterprises regarding invasive species control and traditional use plants. A representative from one of the pesticide manufacturers came to speak to the group to explain the process of registering chemicals for invasive plant control through Health Canada's Pesticide Regulatory Management Agency. A very good meeting was conducted with representatives from three of the Cooperatives & Enterprises.

The Peace River Region Ag Feldman's Association hosted the Annual Industrial Corridors Meeting in Peace River. At this meeting, Alberta Transportation and other groups meet with the Agricultural Fieldmen from the region to discuss invasive plant management plans.

Economic Development Officer, Kevin Keller

Fox Creek Business Support Network

Greenview sponsored the April 18th luncheon and guest speaker at the Fox Creek Business Support Network monthly meeting. Guest Speaker Todd Hirsch, Economist for Alberta Treasury Branch discussed Alberta's current and future economic standing to the well-attended event in Fox Creek. Special thanks is conveyed to the Communications Department for the support they provided with this event.

CARES Grant Reception

On April 7, 2017 Reeve Gervais, Councillor Burton and Administration attended a reception hosted by the Province of Alberta Minister of Energy Margaret McCuaig-Boyd in Fairview Alberta. The reception acknowledged the awarded Community and Regional Economic Support (CARES) Grant recipients for Northwestern Alberta. Additionally, Greenview was acknowledged for the Greenview / DevCo Socio-Economic study initiative for the Big Mountain Project.

Coordination of the Inaugural monthly meeting of Tri-Municipal Industrial Partnership Administrations

The first of the ongoing monthly meetings for the participating municipal administrations of the Tri-Municipal Industrial Partnership was conducted to streamline the operational activities.

Upcoming Meetings

- **Peace Region Economic Development Association (PREDA) (Meeting -** May 5, 2017
- **Peace Petroleum Show -** May 17 & 18, 2017
    - Greenview will have an outdoor and indoor booth at this event.

Green View Family and Community Support Services (FCSS) Manager, Lisa Hannaford

The Community Volunteer Income Tax Program has completed over 450 returns filed by six volunteers. This program brought back 1.9 million dollars into the community, generated by federal rebates and incentives including Child Tax Benefit, Goods and Services Tax (GST), working income tax benefit, and guaranteed income supplement.

Green View Family and Community Support Services (FCSS) hosted two volunteer appreciation dinners in 2017. In Valleyview over 160 people attended the dinner, with 20 individual and five groups being nominated for volunteer contributions. In Grovedale approximately 40 people attended, and 10 nominations were received. Both events were successful and over 96% of participants were in agreement that, "the volunteer appreciation event makes me feel recognized for what I do."

The FCSS Northwest Spring Regional meeting will be hosted May 17 & 18 in Grande Cache. Various board members and staff from the FCSS programs in the region will be attending.

A community education event called the "Blanket Exercise" is scheduled at the Memorial Hall on May 29th at 9:00 a.m. This 3 hour interactive workshop guides participants through a summarized version of historic events of Canada's indigenous people from pre-contact to colonization up to the colonialism as it continues today. The HEART Team encourages Council members from the Town of Valleyview, Greenview and Sturgeon Lake Cree Nation to attend this exercise. Following a luncheon, the afternoon session will focus on the cycle of domestic violence, effects on children and strategies to break the cycle. While an RVSP is encouraged for the morning session, the afternoon workshop is open to all community members.

Protective Services Manager, Jeff Francis

Fire Department

On April 8th the DeBolt Fire Department moved into the Public Service Building.

The Fire Services Coordinator has begun working closely with the Grovedale and DeBolt Fire Departments to modernize the levels of service provided by Greenview. The intent of our working group is to review the services our fire departments deliver to the communities and bring a level of service policy for Council to approve that reflects the emergency services Greenview is providing. We hope to have the draft policy ready for Council's review at the Committee of the Whole meeting on July 18th. Protective Services Administration is working closely with the fire chiefs to ensure the policy meets both the legal requirements of occupational health and safety and the needs of our communities. It is critical the fire departments input is taken into serious consideration as our volunteer firefighters represent Greenview.

A fire department level of service policy is a statement that itemizes each aspect of emergency services provided by Greenview. The policy is a requirement stipulated by Alberta Occupational Health and Safety. The policy can be modified to bolster services at Council's discretion and as required to address further needs as identified in the future.

Health & Safety

Staff from Human Resources and Safety are assessing schedules and content for the May 8, 2017, "All Staff Day." Michael Kerr known as the "Workplace Energizer," will be the speaker for the event. Administration is attaining the required training providers for the May 2017 event is proceeding well. The safety courses are regularly scheduled during the two weeks in May to ensure staff with expiring certificates have the opportunity to attend. Greenview requires all staff to maintain, a minimum, current First Aid, Fire Extinguisher and WHMIS. Required courses are also made available throughout the year and based on job tasks.

Emergency Management

As reported last month Greenview received a grant to host a regional emergency exercise which took place on April 4, 2017 at the new Public Service Building in Grovedale. The exercise turned out to be an overwhelming success with 48 participants from 12 different agencies. The objective of this project was to conduct a one-day emergency planning workshop, including a tabletop exercise, with multiple agency partners to strengthen the coordination of multi-agency response procedures in the event that a large incident were to threaten a community.

Recreation Services Manager, Stacey Wabick

Swan Lake

Swan Lake is once again transitioning from a very successful ice fishing season into the camping season. This facility was used extensively throughout the winter of 2016/17 and included visitors making the trip from all over Alberta. In an effort to continue to provide a positive experience for visitors Administration has entered into preliminary discussions with Canfor regarding the completion of an agreement for cost share maintenance. This agreement was in place for many years prior to the expiry that occurred this past winter.

Sasquatch & Partners Initiative

Greenview joined the Sasquatch & Partners Initiative in March of 2017. The program was created by Clearwater County in 2013, and focuses on educating outdoor recreation enthusiasts through the use of positive messaging related to good land stewardship practices. This is primarily accomplished through strategically placed signage and awareness campaigns. In an effort to begin program implementation, Administration is in the process of having signs drafted for areas that experience high outdoor recreation use. Other progress includes joining the programs partners to have a children's activity book created and some merchandise to assist in creating additional awareness. The next step in moving this initiative forward is to complete a review of the recreation inventory data. This review will assist in determining the location of areas experiencing high recreation use, as well as corresponding locations that are suitable for the placement of signage.

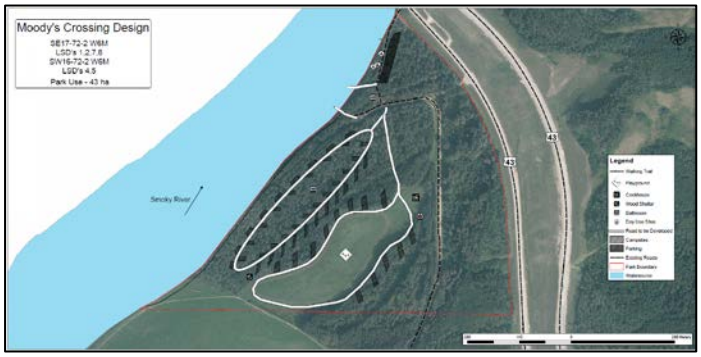
Grovedale Fish Pond

A new cookhouse has been erected at the Grovedal Fish Pond. This is a large building that will allow multiple groups or familys to take shelter from the sun or rain while visiting the site. While the exterior of the building has been completed, Administration will continue to work at the site on other items such as landscaping around the building and installing firepits and other amenities inside of it.

Ridgevalley Walking Trails

The concept plan, design and survey have been completed for the Ridgevalley Walking Trail. As proposed, this plan will have the walking trail crossing land owned by 4 different landowners. Administration has met with all 4 landowners and is currently awaiting the acceptance of the plan from them.

Moody's Crossing Enhancement Project (Hwy 43 Bridge over the Smoky River)



Administration has begun the process to develop a day use area, campground and boat launch on the Smoky River where highway 43 crosses the river between DeBolt and Bezanson. To begin, Administration completed a series of site visits to collect data that is used to create a concept plan and formal sketch of the proposed development.

A formal sketch has been completed with a corresponding management plan and an application for a Department Miscellaneous Lease has been submitted to the Province of Alberta through the Alberta Electronic Disposition System. Administration is now awaiting direction from the province for First Nations

Consultation, management plan amendments and any other concerns that may require addressing. Administration is being proactive in this regard by currently addressing a significant number of protective and consultative notations that exists on the same landbase.

A separate lease will need to be obtained in order to formalize a boat launch on the site. Administration will first concentrate on lease approval for the day use and camping areas. The lease for the boat launch will be transitioned in as the lease progresses

Johnson Park

Opus Stewart Weir has completed a required survey under the lease process and it has been submitted to the Government of Alberta. Once the survey is reviewed and accepted, Greenview will hold the lease title on Johnson Park. In an effort to continue to move this project forward, Administration has begun completing some field reconnaissance to best determine how a phase one (1) strategy can be implemented this summer.

Grande Cache Lake Day Use Area

Greenview continues to strive to provide a positive experience for all who visit Greenview recreation sites. In an effort to ensure this, the Grande Cache Lake Day Use Area bathroom has been identified for replacement in 2017. As such, a tender is currently being advertised and once this process is complete an installation schedule will established.

Little Smoky Recreation Area (Ski Hill)

Greenview has agreed to provide support to the Little Smoky Recreation Area by having recreation staff research and report on potential options for a campground at this location. Administration has been in contact with the MD of Smoky River to request an information package. Information requested includes air photos, available GIS data and existing lease information. Once this information is received, a series of field visits will be completed in an effort to collect data for the creation of a concept plan. A timeline for this work has not yet been established.

Manager's Report

Function: **Corporate Services**

Submitted by: **Rosemary Offrey, General Manager Corporate Services**

Date: **4/30/2017**

General Manager Corporate Services, Rosemary Offrey

The 2016 audited financial statements and financial information returns were submitted to Municipal Affairs on time. Although the timing was close, Administration is pleased to report that Greenview did not need a submission extension for these statements this year!

The budget book has been published and is ready to upload to Greenview's website, however, due to the size of the book, Administration has been looking at options before uploading the book to the website. Options are: to remove some of the information pages from the book before the website will accept the upload; purchase a larger subscription for $1,000/year to enable the book to be uploaded onto the website; or use the Greenview Drop Box and put the link to the Drop Box on the website.

Administration signed a lease contract with QMS Ltd., for two apartments. Initially the apartments were supposed to be available for June 1st. However, due to the inclement weather the move in date has been pushed to July 1st. Due to the current lack of apartments, there are two staff members (Municipal Engineer and Engineering Technologist) who are staying at the Paradise Inn until the apartments are ready on July 1st.

I participated in the Emergency Table Top Exercise in Grovedale on April 4th, this was a worthwhile event that had a good attendance from many of Greenview's support organizations. I also attended the staff breakfast at Grovedale on April 6th, this is always a very pleasant event. It is good for the senior leadership team to get to know the field staff and vice versa.

I participated in the interviews for the Corporate Services Admin Support position and am pleased to report that we have chosen an internal candidate who has accepted the position. This position will be cross trained to cover the Accounts Receivable/Utility position when the Finance Coordinator, AR/Utilities, is away. The position will also assist the Finance Manager with minor duties that the manager can shift from her desk.

On April 21st, I, along with Phil Dirks and Chris Pan, participated in the Audit Committee meeting to review the 2016 Financial Statements with Reeve Gervais and Councillor Dale Smith, Manager, Finance and Administration, Finance Officer, Financial Reporting and my executive assistant.

On April 28th, my executive assistant and I attended a Questica Regional User Conference at Strathcona County in Sherwood Park. The group has been set up to provide ongoing feedback to the supplier and to provide advice among the group participants. All in all it was a worthwhile conversation. These face to face sessions will be scheduled annually with ongoing feedback provided throughout the year.

A couple of months ago, members of Council asked how much was spent on the FTR in 2016. Based on the verification of the capital funding and the operational funding, in the 4th Quarter updated report, I can verify that the total funding spent on the FTR was $11,190,701. ($5,329,696 (cap) and $5,861,005 (operational)). This cost includes dust control, graveling, grader contract, and the capital expenditures.

Finance & Administration Manager, Donna Ducharme

Along with the other duties Donna is tasked with daily, she is working on finishing the audit adjusting entries as requested by the auditors for the 2016 audit. She also attended the GRWMC meeting in Fox Creek and performing the month end procedures.

Human Resources – Recruitment & Retention, Jocelyn Moe

Positions filled since last report: 1) Engineering Technologist 2) Administrative Support, Corporate Services 3) FCSS Summer Program Coordinator

Open Competitions are as follows; 1) Maintenance Technician, Grovedale – Interviews Scheduled 2) Outdoor Recreation Facility Labourer (Seasonal) 3) Administrative Support, Reception Corporate Services 4) Utility Operator

There have been no resignations or terminations since last report.

Information Systems, Shane Goalder

Shane is pleased to report that he has received the equipment for the Nutanix Server Project. He is scheduling the upgrades with PCIT to be completed during the month of May. The upgrade will not affect Greenview's operations. During the month of April, he has setup of multiple new users and issued digital communication tools for:

- Recreation Coordinator
- Engineering Technologist
- Municipal Engineer

- Seasonal Staff (Weed Inspectors, Groundskeepers, Mowing and Brushing Crews)

Shane has also worked with the Facilities Maintenance department to set up new access cards and FOBs for buildings with the new access card systems.

He assisted with the Audio and Visual setup for the Family and Community Support Services Volunteer Appreciation Evening on April 26th, 2017.

Update – Install of acoustic panels in Council Chamber.

The panels were scheduled for install in April. On April 28th, 2017, Shane received an email from the supplier advising that due to it being a busy time of year for them, the install date is now tentatively set for June 2017. The supplier has been advised that this delay is unacceptable and that Administration expects the work to be completed in May 2017.

CAO's Report

Function: **CAO**

Date: **May 9th, 2017**

Submitted by: **Mike Haugen**

Grande Cache Medical Clinic

Work on resolving this issue continues to move forward. Contact has been made with both the landlord and the doctors and it appears that a workable solution may be present. Administration will continue to work on details and bring this issue to a conclusion.

Certified Local Government Manager

Myself and Administration would like to congratulate Rosemary Offrey on obtaining her professional designation as a Certified Local Government Manager (CLGM). Rosemary will be presented with new credentials at the Society of Local Government Managers conference later this month.

Modernized Municipal Government Act Changes

As a result of engagement efforts such as the Continuing the Conversation initiative that Council was involved in, the Province has introduced Bill 8: An Act to Strengthen Municipal Government. The Act makes several changes to the proposed Modernized Municipal Government Act. Some of the changes include (excerpts copied from the Provincial Release – some minor changes have not been included in this report):

<u>Indigenous Collaboration</u>

What's changing: *Municipalities will be allowed to invite neighbouring Indigenous communities to collaborate on future regional service delivery and enter into agreements with them. Municipalities will also be required to notify neighbouring Indigenous communities of any new municipal development plans or area structure plans.*

What this means: *These changes are a "first step" to improving the relationship between Indigenous communities and municipalities. Requiring municipalities to notify adjacent Indigenous communities of any new municipal development plans or area structure plans mirrors current legislation regarding statutory plan preparation where municipalities must notify adjacent municipalities of the plan preparation.*

During consultation, Greenview supported that ability to enter into service agreements and ICFs with Indigenous Communities. Greenview did not support the mandatory creation of policies outlining how these same communities would be consulted with. The proposed change appears to be a compromise on this front and should not present undue or unreasonable burden on Greenview.

Parental Leave

What's changing: *Municipalities will be enabled to provide for extended councillor parental leave by bylaw. The* MGA *will be amended to exempt councillors from disqualification when absent under the provisions of a local parental leave bylaw.*
What this means: *This change allows councils to locally determine their parental leave process and to address any concerns about an extended absence that would potentially result in a gap in councillor responsibilities according to their local needs and circumstances. This change aligns with existing absence provisions within the* MGA *that allow a councillor to miss a substantial number of council meetings, while maintaining their duties as an elected official.*

During consultation, Greenview was supportive of this change.

Environmental Well-Being
What's changing: *Fostering environmental well-being will be included in the* MGA *as a municipal purpose.*
What this means*: Expanding municipal purpose in the* MGA *to include fostering environmental well-being will give municipalities a clear signal to consider the environment in a multitude of operational and growth decisions. Municipalities will not be able to pass bylaws that conflict with provincial legislation on environmental matters.*

During consultation, Greenview remained neutral regarding this change as details were (and are) not known. Municipalities cannot pass bylaws that conflict with Provincial legislation now so stating this does not change anything.

Notifications of Amalgamations and Annexations
What's changing: *The municipality initiating an amalgamation or annexation will be required to notify all local authorities operating or providing services within the affected municipalities. For the purposes of an amalgamation, the notice must also include proposals for consultation with all local authorities operating or providing services within the affected municipalities. The municipality initiating an annexation will also be required to notify the Minister of Municipal Affairs.*
What this means: *All local authorities operating or providing services in the affected municipalities will be notified and engaged with during the amalgamation and annexation processes.*

During consultation, Greenview was supportive of this change.

Ministerial Enforcement of Directives
What's changing: *The Minister will be provided with the same remedies to address municipal non-compliance with a Ministerial directive as are currently available to address non-compliance with an ALSA regional plan. The MGA will continue to limit the use of these powers to extraordinary circumstances.*

What this means: *Additional options will be available to the Minister in the rare instances where municipal non-compliance has reached the level of last resort. These options include ministerial authority to suspend the authority of council to make bylaws, to exercise bylaw-making authority, and to withhold monies otherwise payable to a municipality. The Act will include additional restrictions on how the Minister may be able to apply these options, including a 14 days' notice period to the municipality, to ensure these powers are used only as a last resort.*
Ten days' notice to the Minister will be required when a municipality intends to apply for injunctive relief against a decision or order of the Minister and an order of the Minister will remain in effect while a review of that order is underway.

During consultation, Greenview was supportive of this change.

Reserve Land Assembly Area Contribution Structure

What's changing: *Municipalities will be provided with increased flexibility to use a reserve land assembly area contribution structure that would support land dedication and development parameters with respect to assembly of parks and school sites, including through a regulation.*
What this means: *This change allows municipalities to continue using the existing MR, SR, and MSR provisions of the* MGA *or, at the municipality's discretion, use an alternative optional structure that allows half of the currently allocated 10 per cent reserve land to be taken in cash as part of a 'reserve land assembly area contribution' towards assembling larger school sites and/or parks. This change is different from the* MGA*'s money-in-place of reserve provisions in that it includes the costs required for the servicing of the reserve sites and promotes an equitable distribution of costs required to assemble and service the sites.*

During consultation, Greenview was supportive of this change.

Joint Use and Planning Agreements

What's changing: *Mandatory joint use and planning agreements (JUPA) will be required between municipalities and school boards, through amendments to the MGA and the School Act.*
What this means: *This change will require all municipalities to have JUPAs with the school boards operating within their borders that consider:*

- *establishing a process for discussing matters relating to:*
    - *the planning, development, and use of school sites on municipal reserves, school reserves, and municipal and school reserves in the municipality;*
    - *transfers of municipal reserves, school reserves, and municipal and school reserves in the municipality;*
    - *disposal of school sites;*
    - *the servicing of school sites on municipal reserves, school reserves, and municipal and school reserves in the municipality; and*
    - *the use of school facilities, municipal facilities, and playing fields on municipal reserves, school reserves, and municipal and school reserves in the municipality, including matters relating to the maintenance of the facilities and fields and the payment of fees and other liabilities associated with them;*
- *how the municipality and the school board will work together collaboratively;*
- *a process for resolving disputes;*
- *a time frame for regular review of the agreement; and*
- *any other provisions the parties consider necessary or advisable.*

During consultation, Greenview was supportive of this change.

Off-Site Levies: Provincial Transportation Systems

What's changing: *Enable off-site levies, by bylaw, to be charged for municipal road projects that connect to or improve the connection to provincial highways; and require municipal statutory plans within 1.6 km of a provincial highway to be referred to the Minister of Transportation for review.*

What this means: *This gives the authority to municipalities to charge off-site levies for road projects that connect to provincial highways. This tool will provide municipalities with an option to proportionally levy new development to help fund the cost of road connections to provincial highways consistent with existing Alberta Transportation policy. It will also help ensure municipal planning and development and provincial highway planning and development will be co-ordinated to create safer roads for everyone. The Government of Alberta will still be responsible for provincial highways.*

During consultation, Greenview was supportive of this change.

Intermunicipal Off-site Levies

What's changing: *Enable municipalities to jointly create off-site levy bylaws for projects that benefit portions of two or more municipalities, including the expanded uses introduced in the MMGA and the ASMG (libraries, police stations, fire halls, community recreation facilities, connection of a municipal road to a provincial highway).*

What this means: *This change enables municipalities to define a benefiting area for off-site infrastructure that extends across two or more municipalities, and to charge off-site levies to developments in the municipalities benefiting from the infrastructure.*

During consultation, Greenview was supportive of this change.

Off-site Levy Agreements

What's changing: *Validate existing off-site levy bylaws and related fees and charges for the expanded facilities established under the MMGA.*

What this means: *In 2002, the MGA was amended to include off-site levies for roads and grandfathering provisions were put in place to recognize existing agreements. Similar to 2002, this change validates existing off-site levy development bylaws and related fees and charges that were imposed for the expanded facilities established under the MMGA and the ASMG ensuring bylaws and fees and charges that were imposed are honoured*.

During consultation, Greenview was supportive of this change.

Off-site Levies on Schools

What's changing: *The MGA is being amended to exempt school boards from paying off-site levies on public school site lands for school building projects.*

What this means: *School boards will be exempt from paying off-site levies on non-reserve lands when a public school site is developed for a school building project.*

During consultation, Greenview was neutral regarding this change give the lack of clear details associated with it.

Conservation Reserve

What's changing: *Clarify that municipalities may include conservation goals and objectives in their municipal development plans and area structure plans. Allow for reimbursement of purchase costs incurred for CRs to be considered during annexation processes. Enable municipalities to dispose of conservation reserve lands, through a public process, when substantive changes occur that eliminate the land's conservation value. Clarify that land designated as a conservation reserve is exempt from paying municipal property taxes.*

What this means: *Municipalities will be allowed to include policies addressing conservation reserve in municipal development plans and area structure plans. Municipalities will also be allowed to dispose of CR lands. The change ensures the public is involved in the disposal process and that any money received through disposal continues to support conservation. Lastly land designated as CR will, like other reserve land categories, retain its designation and reimbursement of purchase cost will be accounted for during the annexation processes.*

During consultation, Greenview was supportive of parts of this change and neutral regarding the ability to dispose of land. It appears that concerns regarding the disposal may have been addressed.

Compliance with the Linked Tax Ratio

What's changing: *Create authority for a regulation that will require non-complying municipalities to comply with the tax rate ratio of 5:1 over a period of time.*

What this means: *Municipalities with property tax ratios above 5:1 will be required to change their non-residential and residential property tax rates over a period of years to bring them into compliance. Municipalities would continue to set their own tax rates but within the ratios set out in the regulation.*

During consultation, Greenview was neutral on this item. This change will have no impact on Greenview.

Access to Assessment Information

What's changing: *Allow municipalities to request information regarding DIPs within their jurisdiction, subject to confidentiality restrictions that do not preclude use of the information in an appeal.*

What this means: *By allowing municipalities to access information, a balance will be created in the information access rights of industrial property owners and municipalities. This information could be used by the municipality to determine if the assessment was prepared correctly, to determine if an appeal is warranted, and to prepare a case.*

Municipalities will be required to sign a confidentiality agreement to protect sensitive corporate information including information received by the provincial assessor from property owners.

During consultation, Greenview was supportive of this change.

Taxation of Provincial Agencies

What's changing: *Make property held by a provincial agency taxable for the purposes of property taxation.*

What this means: *This change requires provincial agencies, as defined in the Financial Administration Act, to support the municipalities in which they operate in consideration of the municipal services they receive (such as fire protection) through property taxes. Properties that are associated with health regions that receive financial assistance from the province, housing management bodies established under the Alberta Housing Act, schools, colleges, and universities will continue to be exempt.*

During consultation, Greenview was supportive of this change.

Corrections to Assessments Under Complaint

What's changing: *The MGA will be amended to clarify the process to be followed if an assessment that is under complaint is amended. In such cases, the complaint will be cancelled and all taxpayer rights reset, unless the amended assessment has been agreed to by both parties (in which case no further appeal or amended assessment notice is required).*

What this means: *The process for revising an assessment that is under complaint will include:*

- *sending the amended assessment notice and rationale for the changes to the assessed person or complainant, assessment review board or Municipal Government Board;*
- *requiring the assessment review board or Municipal Government Board to cancel the complaint, notify the property owner of the cancellation, and refund the complaint fee;*
- *allow the assessed person or a municipality to file a complaint about the amended assessment notice within 60 days of the "assessment notice date"; and*
- *establish a process to ensure that the property owner or municipality may request information regarding an amended assessment notice under Section 299 and 300.*

An amended assessment notice is not required if an assessment is revised as a result of a complaint being withdrawn by agreement between the complainant and the assessor.

An assessor will not be permitted to revise an assessment after an assessment review board or the Municipal Government board has rendered a decision on a complaint regarding the assessment.

During consultation, Greenview was supportive of this change.

Grande Cache Environment/Infrastructure

The Grande Cache Community Coordinator is reviewing road ownership and maintenance practices in the Grande Cache area.

The Solid Waste Contract with the Town of Grande Cache has been signed. The Town is moving forward with implementing this service.

A noxious weed awareness campaign for the communities is being developed.

Susa Creek is struggling with illegal dumping of goods such as appliances. A community clean-up program is being explored for this spring and would involve all Coops and Enterprises

Upcoming Dates:

Federation of Canadian Municipalities	June 1st - 4th
Ratepayer BBQ – Valleyview	June 13th

Ratepayer BBQ - Grovedale	June 20th
Ratepayer BBQ - DeBolt	July 11th
Ratepayer BBQ - Grande Cache	September 19th