MEMORANDUM

DATE: **September 1, 2016**

TO: **REGULAR MEETING OF COUNCIL OF SEPTEMBER 6, 2016**

FROM: **Wendy Jones, Director of Planning and Development**

SUBJECT: **Interim Report: University of Alberta with Alberta Innovates Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta**

Project Overview:

At the Regular Council Meeting on August 18, 2015 council passed the following resolution: *Council approves commissioning the study (to determine the volume of energy available through geo-thermal energy) in partnership with the University of Alberta and Alberta Innovates and other participating municipalities for a cost of approximately $20,000 to $25,000. Funding to commission this study will be absorbed by the Council Contingency*.

A Letter of Intent was finalized on August 31, 2015 with the Contribution Agreement being acknowledged December 21, 2015.

Project Time Frame: One (1) year with interim reporting.

Final Report Findings: February, 2017

Project Objective:

The purpose of this project is to provide the municipal governments in our target regions the information they require to plan for incorporating the geothermal resource base into their long-term energy strategies and begin the process of commercial development.

Project Work Plan:

The project consists of 5 different work packages, totaling 10 tasks. Each task is associated with its own deliverable. The project concludes with a final report.

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Task Description	Timeline	Milestones/ Deliverables
Task #1.1	12/2015 – 6/2016	3-D maps of the geothermal reservoirs beneath each of the 4 regions in the study
Task #1.2	6/2016 – 7/2016	Volumetric calculations of the total energy available in each reservoir in each location
Task #1.3	7/2016 – 11/2016	Predictive models of the power production potential in each reservoir in each location
Task #2.1	12/2015 – 4/2016	Schematic drawings and cost estimates for a geothermal electric power plant
Task #2.2	3/2016 – 6/2016	Electrical power production estimates using co-produced fluids
Task #2.3	6/2016 – 9/2016	Schematic drawings and cost estimates for a geothermal heated greenhouse array
Task #2.4	9/2016 – 12/2016	Schematic drawings and cost estimates for a geothermal heated timber dryer
Task #3.1	12/2015 – 6/2016	Report on the environmental impacts of using geothermal energy in each of the 4 scenarios detailed in Tasks #4 – 7.
Task #3.2	6/2016 – 11/2016	Report on the regulatory requirement for developing geothermal energy in Alberta
Task #4	12/2016 – 1/2017	Final Report

Interim Report:

The Interim Report findings (Attachment #1) are prepared by the University of Alberta with support from Alberta Innovates. Jonathan Banks, Research Scientist will speak to interim report as a delegate on September 6, 2016.

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Executive Summary:

In order to find the most viable geothermal reservoirs, a 50 km search radius was explored around the town Hinton. In the proposal stage of this study, we targeted 5 "lowest hanging fruit" reservoirs. We were able to investigate 3 of these reservoirs in detail. The Basal Cambrian sandstone was not positively identified in the Hinton Area. Instead, the Gilwood member of the Watt Mountain formation was found as a sandstone unit that immediately underlies Hinton and has significant accumulations to the East and South of the town, albeit outside of the search radius. The Swan Hills and Leduc reefs, which are the area's best geothermal reservoirs, were identified as predicted. The Nisku, Banff and Manville formations were deemed too shallow (i.e. not hot enough) to qualify for "lowest hanging fruit" status, a designation that requires a minimum average temperature of 100° C.

Volumetric power capacity assessments were performed for the 3 reservoirs (Gilwood, Swan Hills and Leduc) for both the entire 50 km search area and a stacking of Swan Hills and Leduc reefs located about 30 km from town, driving East on the Yellowhead highway. We refer to this as the "Obed" Section

In the 50 km search around Hinton the Gilwood lies at depths approaching 4000 m and is ~50 m thick beneath the town of Hinton. It has an average (mean ± 1 standard deviation) temperature of 109.86 ± 19.24 °C and an average porosity of 0.03 ± 0.14. Over a 30 year period, the Gilwood offers a median direct use geothermal heating capacity of ~65 MWt, which equates to an electricity production capacity of ~5.2 MWe. The Obed section may provide 10% of these values

The Swan Hills lies deeper than 4000 m beneath Hinton and > 3500 m in the Obed section. It has an average temperature of 129.55 ± 26.41 and an average porosity of 0.067 ± 0.046. In the Obed section, the Swan Hills has a median 30 – year thermal power capacity of ~62 MWt. This equates to an electricity production capacity of ~5 MWe. In the entire 50 km search area around Hinton, the Swan Hills has a thermal power capacity of ~1.6 GWt, which equates to an electrical power capacity of ~127 MWe.

The Leduc reefs approach 3800 m depth beneath Hinton and are as a shallow as 3000 m on the edge of the 50 km search area. They have an average temperature of 122 ± 19.7° C and an average porosity of 0.57 ± 0.35. In the Obed section alone, the Leduc may provide (median) ~120 MWt of thermal power for a 30 year period, which corresponds to ~9.5 MWe of electrical power. In the entire 50 km area around Hinton, the Leduc reefs may provide nearly 800 MWt of thermal power over a 30 – year period, which is equivalent to nearly 65 MWe of electrical power.

All together, we identified nearly 2.5 GWt of thermal power that available in the Hinton area from geothermal energy reservoirs. This is the equivalent of nearly 200 MWe of electrical power. These figures, as well as the all of figures cited above are gross capacity for a 30 – year period.

In the second part of this study, we look forward to working more closely with the Hinton government to formulate a plan to develop these resources.

Summary:

The Electrical Power Capacity: per year for 30 years (MWe) (see slide 9 of the attachment) shows the gross median thermal and electrical energy capacity for both the Obed section and the entire Hinton search radius over a 30 – year period. The search radius around Hinton has a median thermal capacity of 2.45 GW of thermal power and may be utilized on a yearly basis for 30 years. With an electricity conversion factor of 0.08, this represents a median electrical power capacity of 196 MW over the same time frame.

Attachment

1. Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta: Interim Report Highlights for Hinton.

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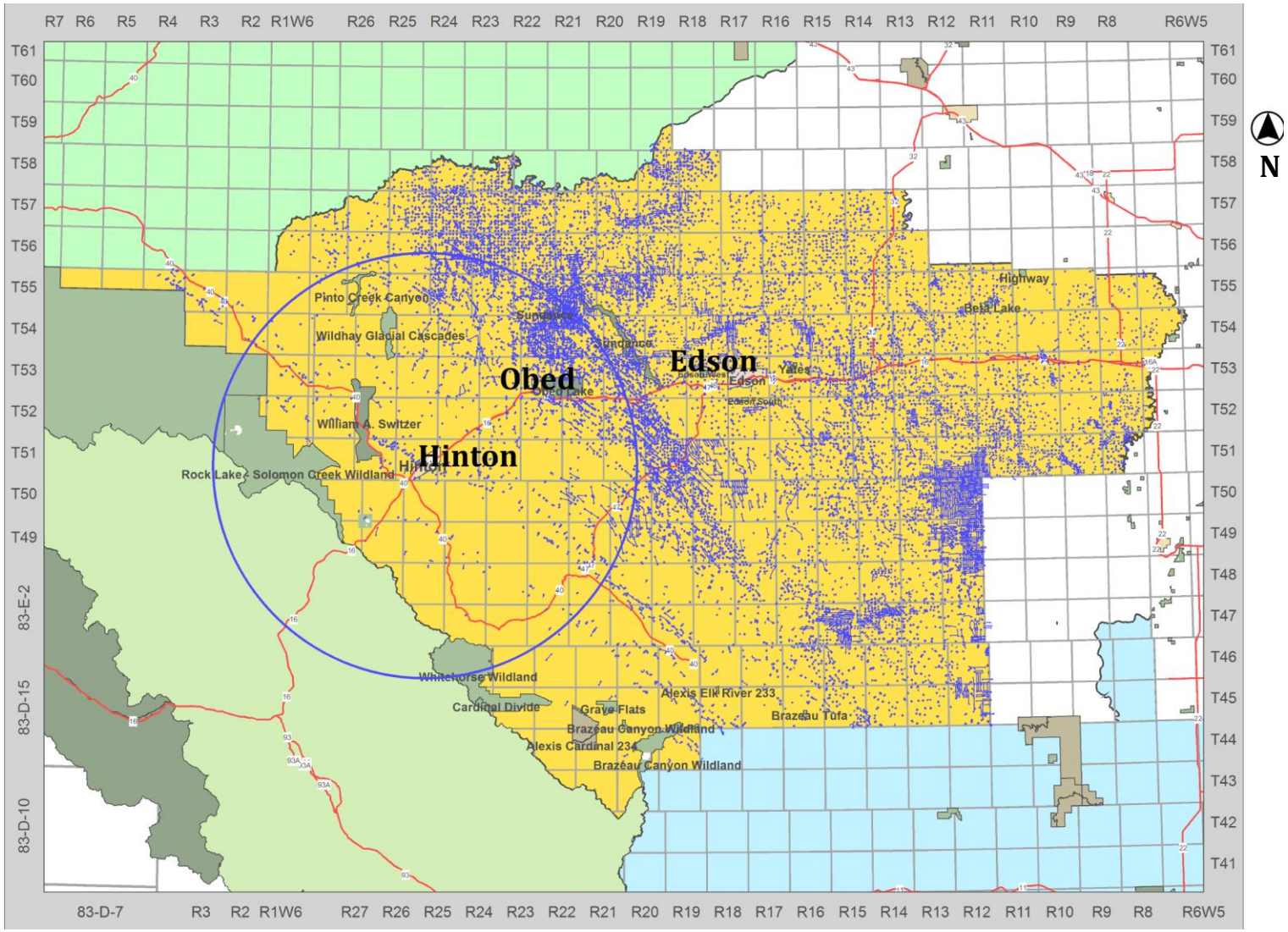
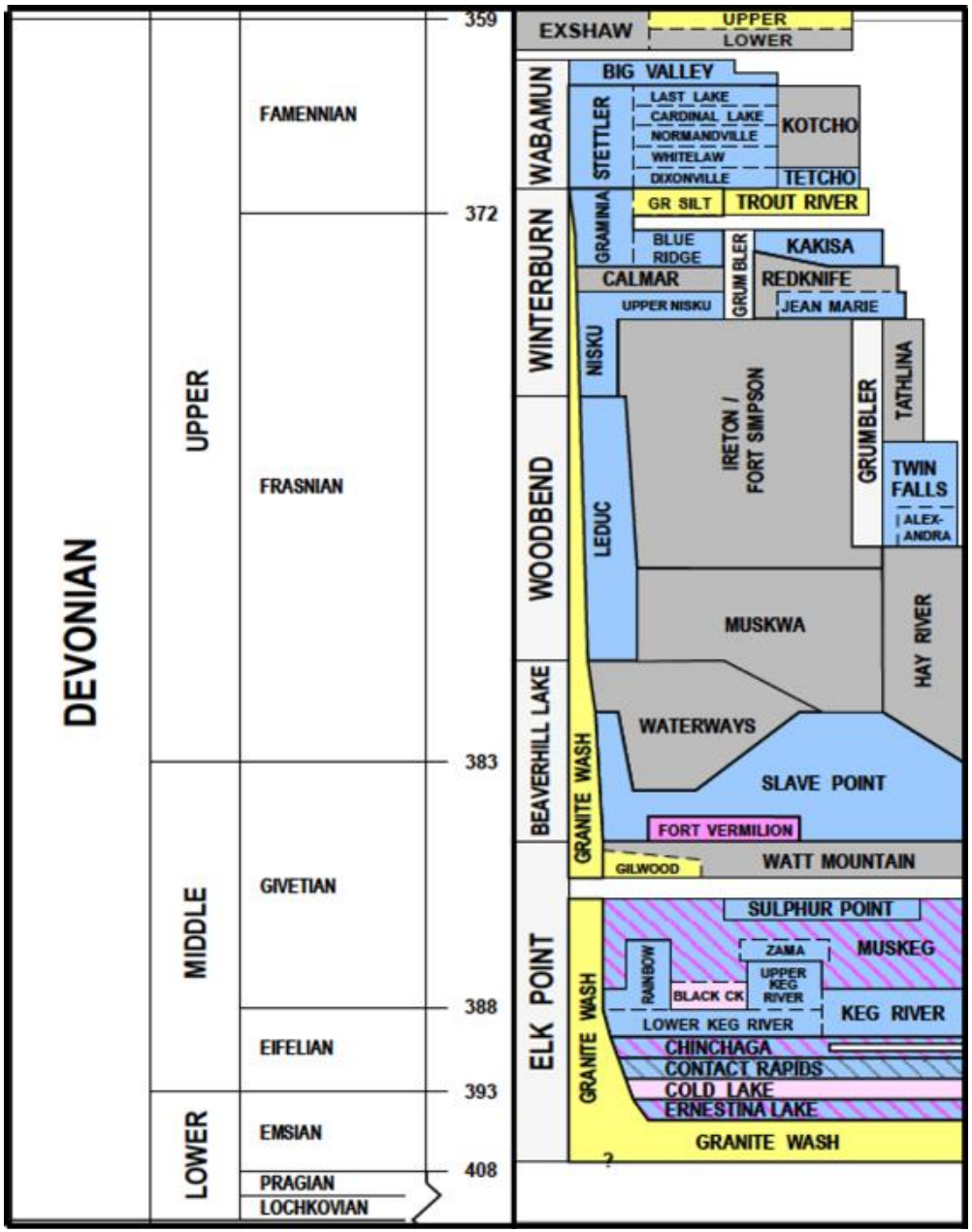
Deep-Dive Analysis of the Best Geothermal Reservoirs for Commercial Development in Alberta

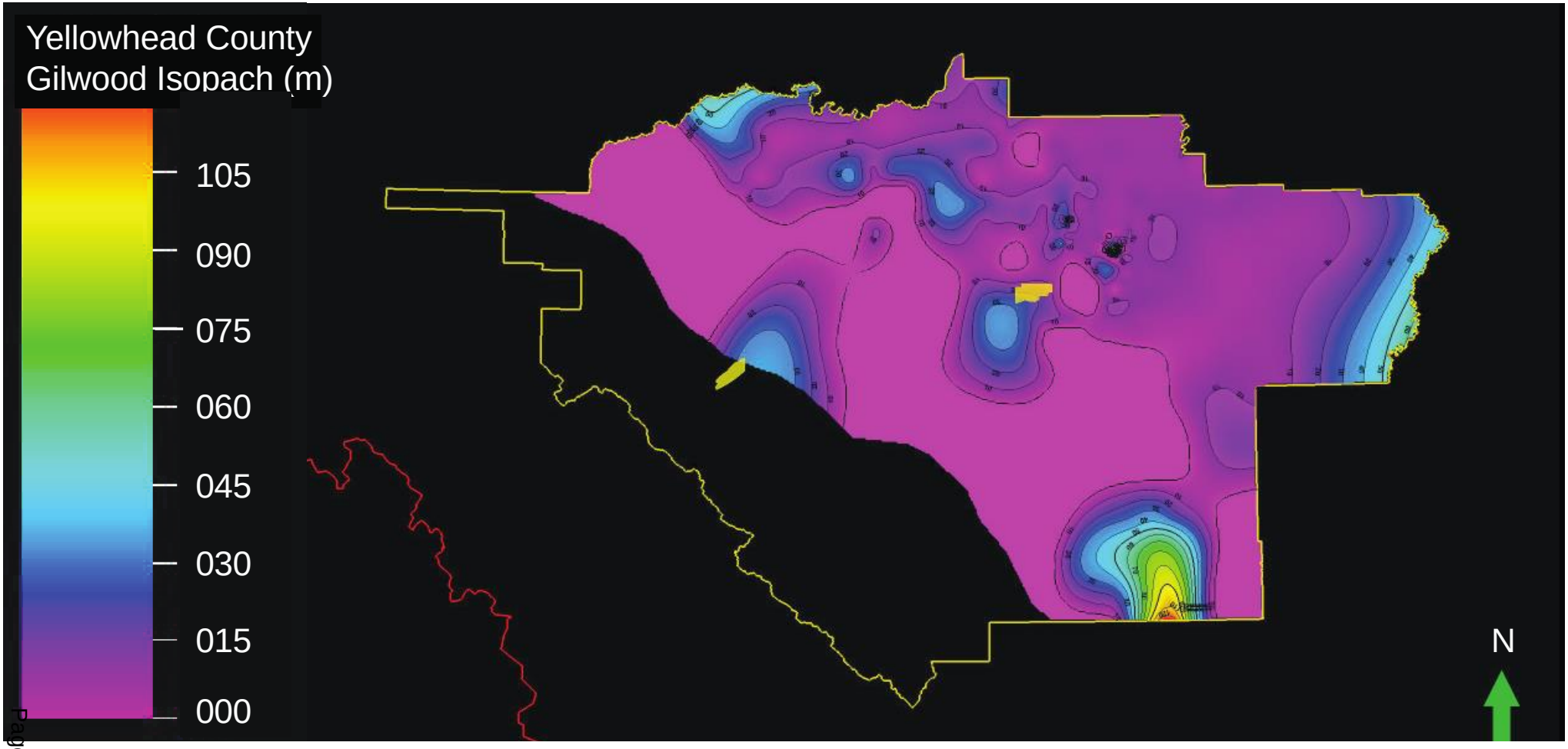
Interim Report:
Hinton

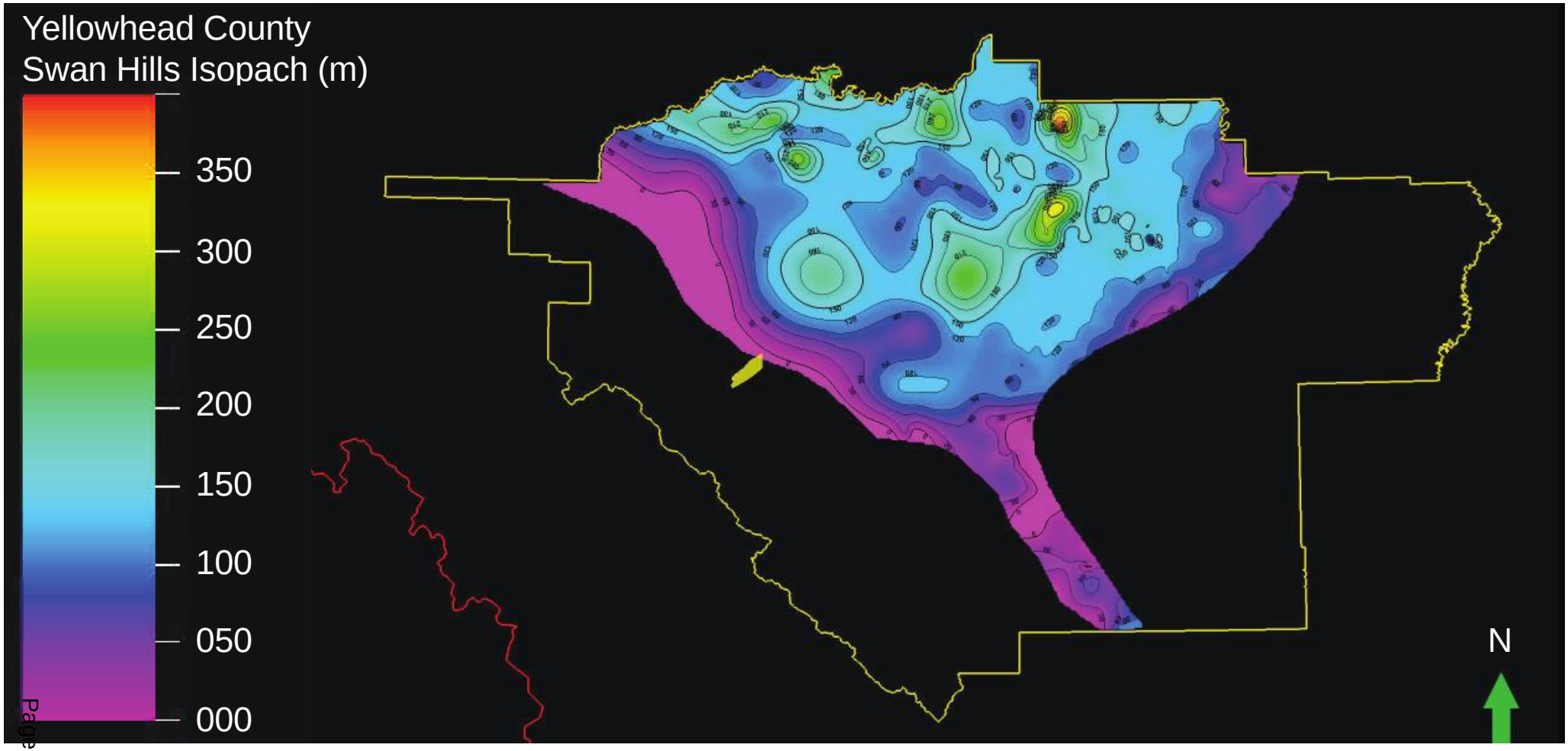

R7 R6 R5 R4 R3 R2 R1W6 R26 R25 R24 R23 R22 R21 R20 R19 R18 R17 R16 R15 R14 R13 R12 R11 R10 R9 R8 R6W5
T61 T60 T59 T58 T57 T56 T55 T54 T53 T52 T51 T50 T49 T48 T47 T46 T45 T44 T43 T42 T41
83-E-2
83-D-15
83-D-10
83-D-7
N
Pinto Creek Canyon
Wildhay Glacial Cascades
Obed
Obed Lake
Edson
Edson South
Yates
Highway
Bella Lake
William A. Switzer
Hinton
Rock Lake - Solomon Creek Wildland
Whitehorse Wildland
Cardinal Divide
Grave Flats
Brazeau Canyon Wildland
Alexis Cardinal 234
Alexis Elk River 233
Brazeau Tufa
Brazeau Canyon Wildland

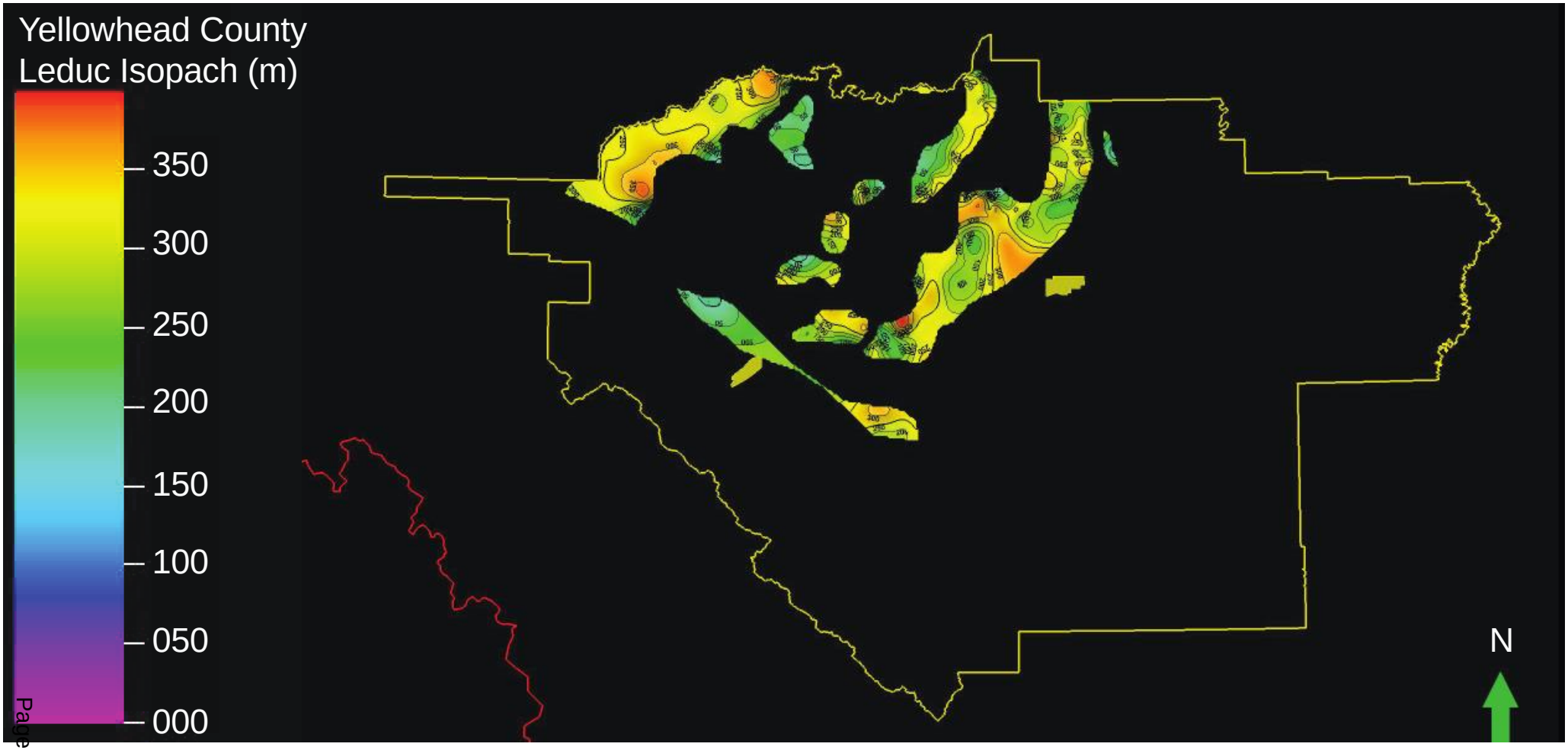

DEVONIAN
UPPER
MIDDLE
LOWER
FAMENNIAN
FRASNIAN
GIVETIAN
EIFELIAN
EMSIAN
PRAGIAN
LOCHKOVIAN
359
372
383
388
393
408
WABAMUN
WINTERBURN
WOODBEND
BEAVERHILL LAKE
ELK POINT
EXSHAW
UPPER
LOWER
BIG VALLEY
STETTLER
LAST LAKE
CARDINAL LAKE
NORMANDVILLE
WHITELAW
DIXONVILLE
KOTCHO
TETCHO
GRAMINIA
GR SILT
TROUT RIVER
BLUE RIDGE
GRUM BLER
KAKISA
CALMAR
REDKNIFE
UPPER NISKU
JEAN MARIE
NISKU
IRETON / FORT SIMPSON
GRUMBLER
TATHLINA
TWIN FALLS
ALEX-ANDRA
LEDUC
MUSKWA
HAY RIVER
WATERWAYS
SLAVE POINT
GRANITE WASH
FORT VERMILION
GILWOOD
WATT MOUNTAIN
SULPHUR POINT
ZAMA
MUSKEG
RAINBOW
BLACK CK
UPPER KEG RIVER
KEG RIVER
LOWER KEG RIVER
CHINCHAGA
CONTACT RAPIDS
COLD LAKE
ERNESTINA LAKE
GRANITE WASH
?

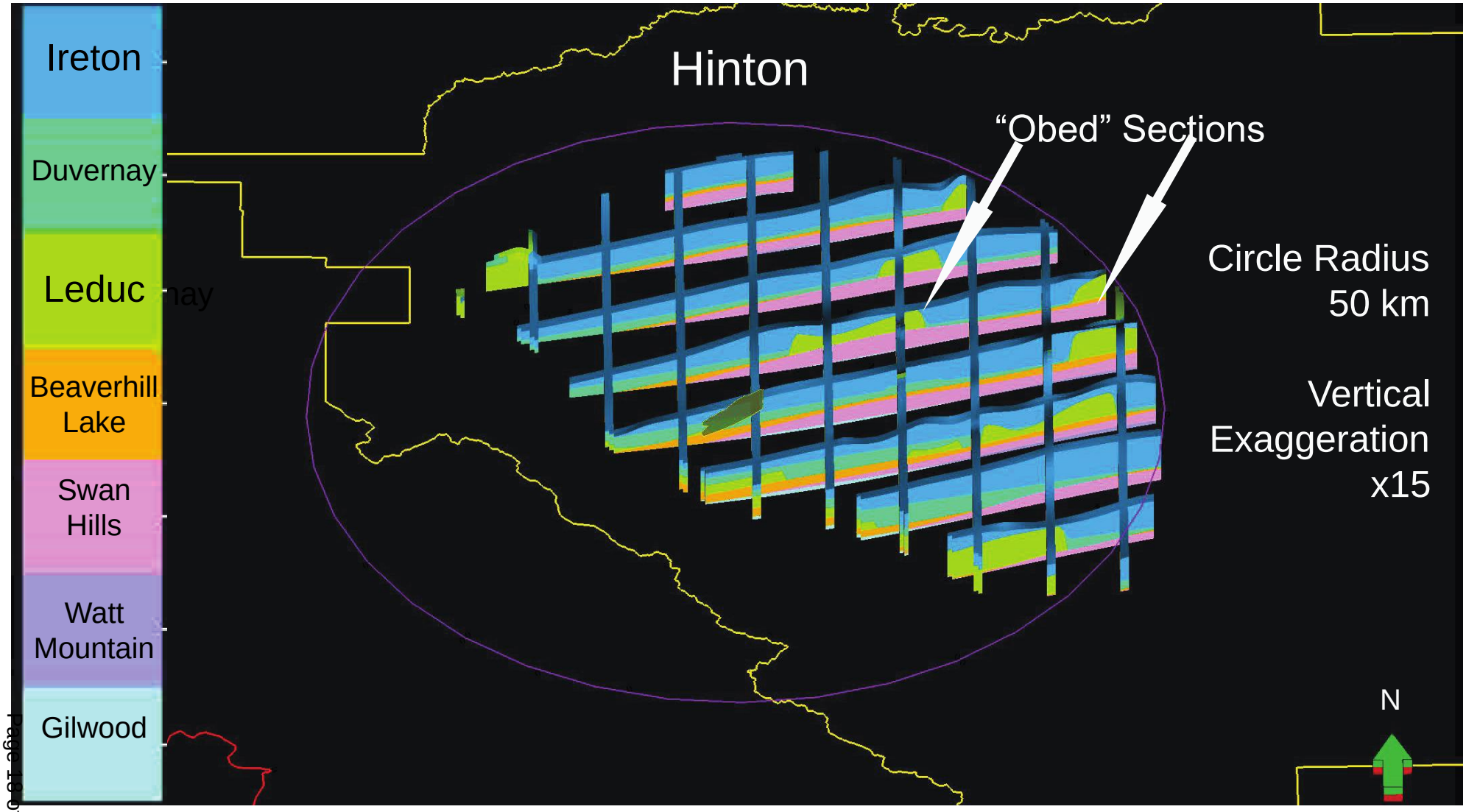
Top Geothermal Reservoirs within 50 km of Hinton, AB

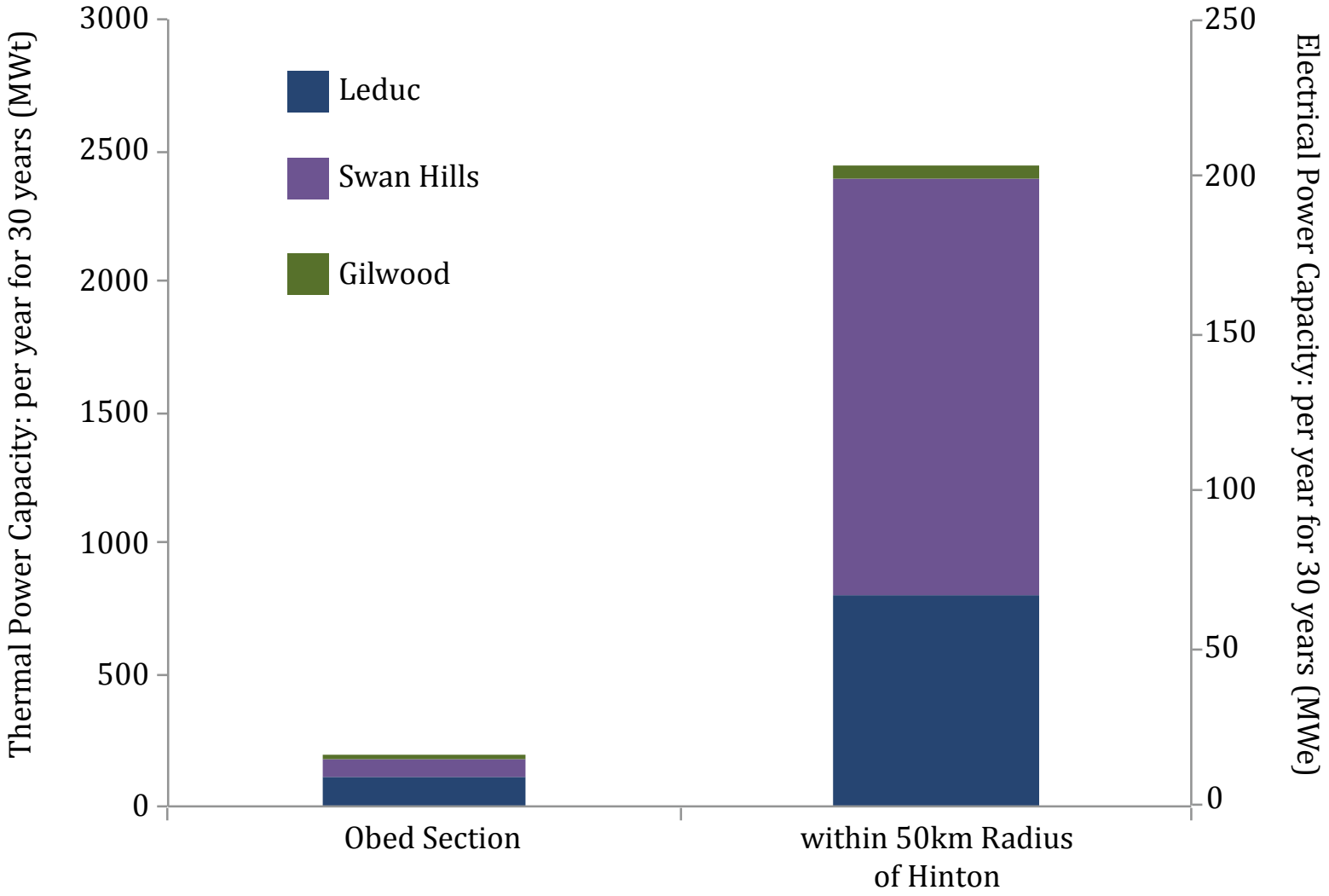
Formation	Depth to Top	Temperature	Porosity
Leduc	3200 – 3800 m	122.24 ± 19.7˚ C	5.7 ± 3.5%
Swan Hills	~3500 m	129.55 ± 26.41˚ C	6.7 ± 4.6%
Gilwood	~4000 m	109.89 ± 19.24˚ C	3.0 ± 1.4%


Yellowhead County
Gilwood Isopach (m)
105
090
075
060
045
030
015
000
N


Yellowhead County
Swan Hills Isopach (m)
350
300
250
200
150
100
050
000
N


Yellowhead County
Leduc Isopach (m)
350
300
250
200
150
100
050
000
N


Ireton
Duvernay
Leduc
Beaverhill Lake
Swan Hills
Watt Mountain
Gilwood
Hinton
"Obed" Sections
Circle Radius 50 km
Vertical Exaggeration x15
N


Thermal Power Capacity: per year for 30 years (MWt)
3000
2500
2000
1500
1000
500
0
Leduc
Swan Hills
Gilwood
250
200
150
100
50
0
Electrical Power Capacity: per year for 30 years (MWe)
Obed Section
within 50km Radius of Hinton

MEMORANDUM

Date: August 30, 2016

To: **Regular Council Meeting of September 6, 2016**

From: **Mike Schwirtz, Chief Administrative Officer**

RE: **Error on Tax Rate Bylaw #1102**

During the January 12, 2016, Standing Committee meeting, there was consensus by Council to direct Administration to apply the Evergreens Capital Requisition to a maximum of $300,000 per year. The total Capital Requisition for 2016 was $496,162.56.

When the tax rate bylaw was passed at Regular Council on May 3, 2016, an error was made by Administration and as a result the full amount of the Evergreens Requisition, amounting to an Operations Requisition of $218,879.04 and the Capital Requisition of $496,162.56, for a total of $715,041.60 was included in the bylaw.

The financial differences charged to the taxpayer are shown in the attached spreadsheet (Attachment #1). For example, a property assessed at $299,900.00 would have paid $84.72 towards the capped $300,000 Capital Requisition in 2016. As a result of the entire $496,162.56 Capital Requisition being collected in 2016 this property owner will now be required to pay $116.78, a difference of $32.06 in 2016.

It is important to note, and is by no means rationale for this error, that regardless of the amount collected in any given year the entire amount of the Capital requisition must be collected eventually. This is not extra money being collected from the taxpayer - it is money that would have been collected in a future year.

Administration apologizes to Council and to our taxpayers for our error. We will add a subsequent check and balance on Bylaw changes to ensure that this type of error does not occur in the future.

Attachment

1. Comparison of the rates

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