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Alberta No. 1 – the Province's first conventional deep geothermal power project

Catherine Hickson, Darrell Cotterill, Katie Huang, and Mark Kumataka
Terrapin Geothermics Ltd.

Abstract

In Canada's western provinces, the Western Canada Sedimentary Basin (WCSB) is known to host warm to hot brines in large extractable volumes from permeable, hydrocarbon-bearing units. In Alberta's northwestern region, the Municipal District of Greenview (MDGV) has been actively supporting preliminary resource investigations within its lands. These investigations have led to the determination that there appears to be an economically viable resource under the MDGV and, in particular, near a new Heavy Industrial District (HID) development planned for a large tract of land south of the City of Grande Prairie. Alberta No. 1, as the project has been named, will provide the industrial park, referred to as the Tri-Municipal Industrial Park (TMIP), with anticipated electrical and thermal energy produced by the project. Underlying the MDGV are hot sedimentary aquifers (HSAs) that form part of the WCSB. These aquifers show high potential for heat energy, with several possible approaches for extraction (Hickson et al. 2020b). Research suggests that temperatures above 120°C are attainable at depths of 3,500 m and below. The target formations at these depths include the Beaverhill Lake Group, the Gilwood, the Granite Wash, the basement unconformity, and the basement itself. The designated exploration area is situated over a thick reef deposit of Leduc Formation with skirting deposits of shale-rich Duvernay Formation. Only two wells within the TMIP have been drilled to the basement, and only a handful of wells have been drilled below the Duvernay Formation. There is limited flow rate test data on the target formations; however, extrapolating from similar target formations elsewhere suggests that flow rates in production wells will exceed 80 l/s and the total flow rate required for 8MWe (gross) generation is 300 l/s. Fluid chemistry modelling of existing analytical data suggests that there will be no major issues with mixing of formation waters and proposed injection into the producing reservoir of the Leduc Formation.

Summary

The MDGV is located in northwestern Alberta, Canada and encompasses the County of Grande Prairie and the City of Grande Prairie. The Alberta No.1 project site is situated south of the City of Grande Prairie in Section 19, Township 067, Range 04 West of the 6th Meridian (Figure 1). The MDGV has a significant energy resource in the form of heat below the oil and gas reservoirs currently being tapped by wells drilled within the MDGV for hydrocarbon production. This resource will be tapped in the Alberta No. 1 geothermal electricity generation and direct heat project led by Terrapin Geothermics (Terrapin). The planned TMIP near the project will include several significant heat and electricity off takers.

The project was funded initially by the MDGV and Terrapin, with the data being gathered and analyzed in response to a request for proposals from Canada's Federal Department of Natural Resources (NRCan). Additional funding came through the "Emerging Renewable Power Program" (ERPP) which sought to provide support for projects that have the potential to

produce at least 5MWe (net) electrical power. Funding of $CDN25.4 million for Alberta No. 1 was announced in August 2019 under the ERPP (Hickson et al. 2020a).

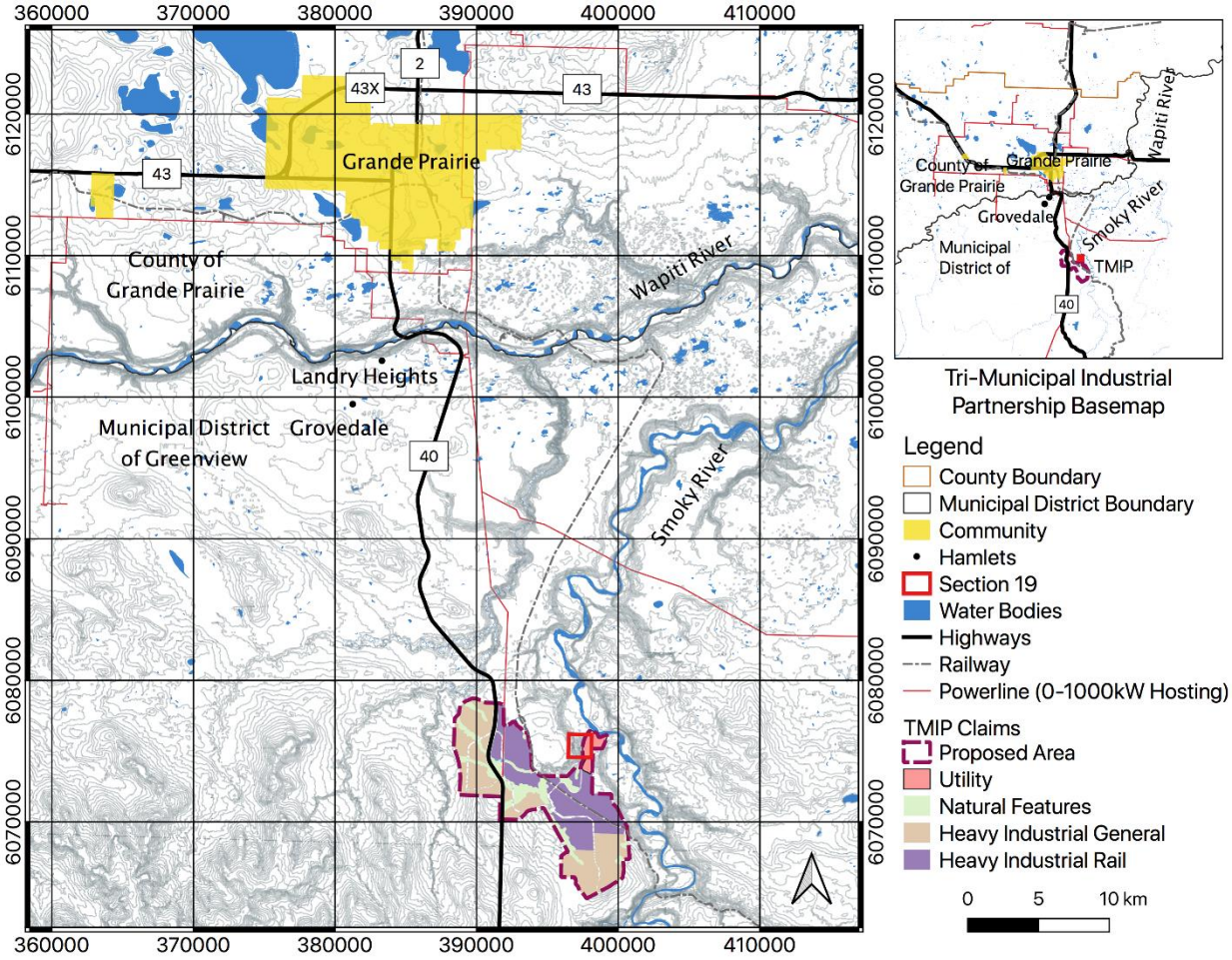

Figure 1. The project (red square) is located within the Municipal District of Greenview, south of the City of Grande Prairie.

Given the large number of drilled and producing oil and gas wells in the region, there is a possibility that co-produced fluids can be extracted and utilized in parallel with oil and gas production using the existing drilled infrastructure. However, Alberta No. 1 will not be repurposing oil and gas wells for several reasons. First, the well diameters in oil and gas production zones (4 ½ or 5 ½ inches and sometimes 7 inches) do not provide sufficient flow mass for economic production of geothermal fluids. There may be options for waste heat generation from these wells with development of more efficient wellhead generators and/or built infrastructure that has heating requirements and is in close proximity.

In addition to the narrow well bore diameters, upper well casing sizes are often too narrow to accommodate the high capacity pumps needed for electrical generation from moderate

temperature, gas-saturated fluids (i.e. fluids below <170°C). Pumping the well reduces adiabatic expansion cooling, but many of the wells represent older infrastructure. However, because there are so many wells, the use of abandoned, orphaned, or wells that have been in service for long periods of time has been reviewed. This review raised concerns over wells, particularly the older ones, that may have well bore integrity issues. Re-entering and reusing wells must be done with caution and must carry out appropriate well integrity testing to ensure that the cement and casing integrity is adequate for the desired use. Re-entering wells for the purpose of flow testing and bottomhole temperature (BHT) measurements will be considered as an aspect of the exploration phase of this project, but it is unlikely that wells will be repurposed for geothermal use. For these reasons, Alberta No. 1 is developing a conventional deep geothermal resource through drilling of purpose drilled wells.

It should be emphasized that any produced geothermal fluid can be used for either indirect utilization (power generation), or direct utilization purposes (heating commercial-scale buildings, greenhouses, district heating, providing waters for spas and swimming pools, lumber drying, etc.). The ERPP development fund was established to promote the generation of electricity from renewable sources and did not take into account the energy potential from projects accessing thermal energy from geothermal sources such as HSAs. However, for Alberta No. 1, the thermal energy potential is highly valuable for planned greenhouse gas emission offset use within the TMIP. Work is currently underway to complete the well prognosis including well design and other necessary technical work prior to drilling the first wells at Alberta No. 1.

Alberta No. 1 is poised to change the geothermal landscape in Alberta. Despite having to overcome a number of hurdles, the project has the potential to demonstrate the value of geothermal energy as a transformative industry in Alberta. Base-load power and direct-use applications in the context of a municipally driven and private sector initiative will unlock the industry in Alberta.

The data gathered through the early stage drilling will provide the scientific foundation for the actual flow rates achievable in the target formations as well as the true BHT. Only when the exploration drilling is completed will the commercial value of the resource be known. The project anticipates drilling to begin mid-2020. If the first wells are deemed successful following extensive flow and reservoir tests, additional drilling will follow. Generation of power could be as early as 2023

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