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Non-saline Surface and Groundwater Use for Hydraulic Fracturing in an Area of Duvernay and Montney Exploration and Development, West-Central Alberta

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Summary

Water allocation and use by the oil and gas sector is of interest and concern to many Albertans. This sector has many uses for water, be it for industrial purposes, drilling wells, processing and transporting oil sands ore, extracting oil sands using steam assisted methods, and in enhanced recovery operations to optimize extraction of unconventional hydrocarbons. One of the more current uses for water is for hydraulic fracturing. The volumes of water used in hydraulic fracturing along with the size of the potential resource raise concerns about how much water it might take to fracture the reservoirs in thousands of potential wells, and depending on the source of that water, if that volume of water is available for use without affecting natural systems in unexpected or unacceptable ways. This work focuses on understanding allocations and uses of non-saline water within an area of active exploration and development in Montney and Duvernay formations. Sectoral trends of non-saline water use are evaluated, with a focus on core areas of Duvernay Formation exploration and development in particular to understand the potenial consequences of non-saline water diversions for hydraulic fracturing in comparison to available non-saline water resources. Findings suggest that the effects of development are likely minimal to date, with the need to monitor ongoing development scenarios being important to ensure the conclusion is correct and that future use scenarios continue to have acceptable effects on the non-saline water systems of the area.

Introduction

Much of the focus of recent energy exploration and development activities in Alberta has been in the west-central part of the province, primarily targeting the liquid hydrocarbons in the Devonian-aged Duvernay Formation, and the Triassic-aged Montney Formation (Figure 1). This development relies on hydraulic fracturing to create the pathways for hydrocarbons to move from these low-permeability rocks towards the wellbores. Hydraulic fracturing in turn relies on a reliable supply of water to the well sites when hydraulic fracturing is occurring. Exploration and development scenarios predict the number of wells drilled targeting these formations will increase and therefore the volumes of water required to complete these wells will also likely increase. This work focuses on documenting the current allocations of water across sectors for the entire study area, and current diversion volumes of water for hydraulic fracturing within the core area of current exploration and development focus for the Duvernay Formation (Figure 1). This focused area roughly aligns with the sub-basin boundaries of the Iosegun, Upper Little Smoky River and Waskahigan rivers. Following this initial assessment of the current state of water allocations and diversions for hydraulic fracturing, the work will then focus on comparing the allocation, and diversion volumes to estimates of volume of water resources available within the core area to measure current water stress in that area.

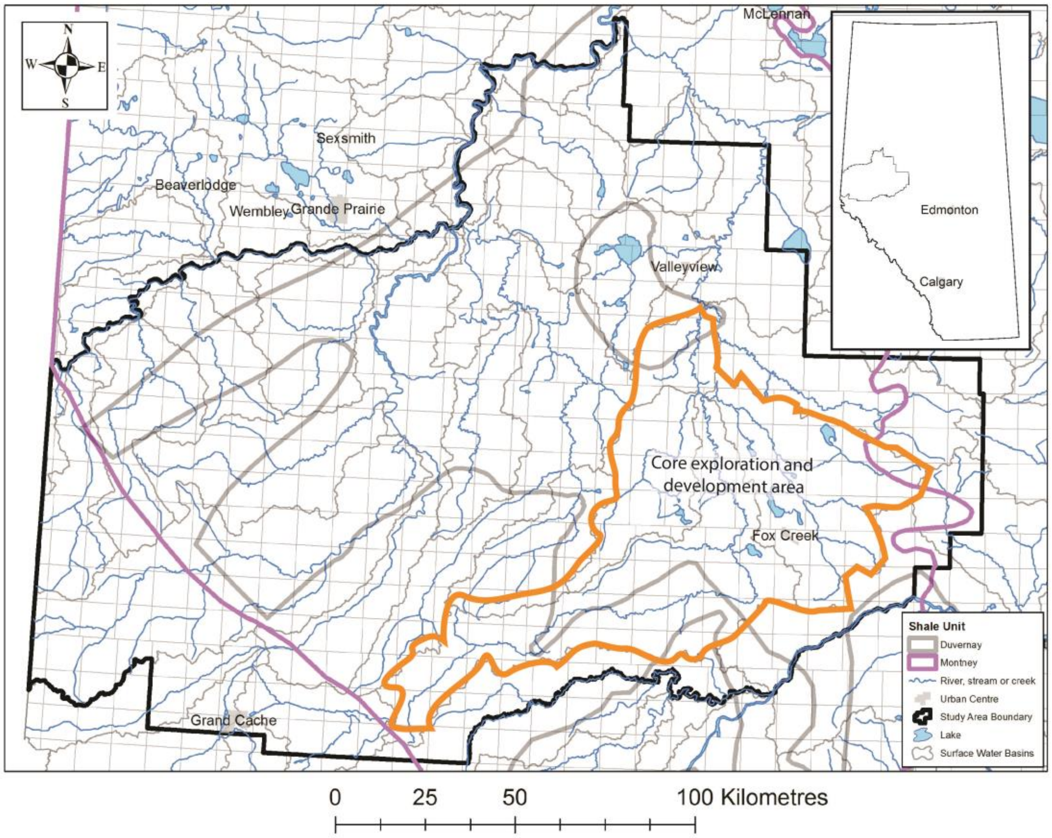

Figure 1. Study area location

Method

The approach used the following workflow:

1. Assess overall potential water demand within the region
2. Examine the specific water demands from hydraulic fracturing within the region
3. Compare the overall water allocation across sectors, and diversion volumes for hydraulic fracturing to the availability of water within the region to assess the potential for stress on the water systems within the region

Potential users of non-saline water, for purposes other than general household uses, or limited agricultural uses, are required to apply for a licence for that use. The licence application will include information on the proposed water use, the duration of the proposed diversion, and the volume of water that is being asked for on an annual basis. These allocation data were obtained for the 2013 to 2015 period and used to provide an overview of the total possible diversion of water for the region, and were broken down by sector to allow for a cross-sector comparison.

While the allocation volumes provide an estimate of the potential overall demand for water, the actual volumes of water diverted for use are frequently less than the total allocation volumes. Since 2013, the Alberta Energy Regulator (AER) has required that companies carrying out hydraulic fracturing operations report on the volumes of water diverted for use, the source of that water, and the timing of that diversion of water. This data set was assessed to summarize water diversions for hydraulic fracturing.

In addition to requiring that companies report on water diversion volumes for hydraulic fracturing, the AER also requires that companies report on volumes of water used for hydraulic fracturing, as well as point of use. This dataset was assessed to summarize water use for hydraulic fracturing.

Lastly, the concepts of sustainable yield as outlined in Pierce et al. (2013), and surface water basin yield (Kienzle (2010), and Foundary Spatial (2014)) are used to compare total allocations to assess the overall potential stress on the water systems. The comparison between diversions for hydraulic fracturing and the yield estimates was also completed to assess the contribution of these diversions to the overall potential water-stress level.

Results and Conclusions

Surface water allocation for all sectors appears to be only a small fraction of basin yield within the 3 sub-basins where Duvernay Formation exploration and development are expected to be concentrated first (core exploration and development area), and is an even smaller fraction of overall basin yield for the entire study area. Surface water diversions for hydraulic fracturing are consistently below basin yield within the 3 core sub-basins. Surface water allocations increased during the 2013 to 2015 period, with the largest occurring in the Upper Little Smoky River basin.

Allocations of groundwater for all sectors have increased between 2013 to 2015. The percentage of all allocations accounted for only a small portion of total sustainable aquifer yield in 2015. Examining the percentage of allocations within the 3 core sub-basins in comparison to the sustainable aquifer yield shows that the greatest percentage of yield is being allocated in the Iosegun River sub-basin, followed by the Waskahigan River, and lastly by the Upper Little Smoky River. The percentage of sustainable aquifer yield that has been diverted for hydraulic fracturing is low as well.

Evaluation of allocations, diversions and yield values would suggest that between 2013 to 2015 only a small fraction of non-saline water yield is used for oil and gas activity in west-central Alberta. These findings must be incorporated with other information (e.g. changes to landscape) to more fully describe the potential impact of water use in this region.

References

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