

**APRIL  
2020**

# **GET THE FACTS**

**HYDRAULIC FRACTURING IN  
THE RED DEER RIVER  
WATERSHED**

Prepared by: the Red Deer River Watershed Alliance





Photo Credit: Len Langevin



## ABOUT THE RED DEER RIVER WATERSHED

The Red Deer River watershed is the largest headwater sub-basin of the South Saskatchewan River Basin in Alberta (49,650 km<sup>2</sup>). Home to approximately 300,000 people, the watershed originates in the Rocky Mountains and includes 55 urban centres and 18 rural municipalities across central Alberta.

The Red Deer River watershed is made up of 15 smaller sub-watersheds that nest within the larger watershed. These sub-watersheds span five different natural regions and include a rich diversity of lakes, wetlands, creeks, tributaries and upland areas.

## WHAT IS HYDRAULIC FRACTURING?

- Hydraulic fracturing is a technique used to recover oil and natural gas trapped in tight geological formations underground. A mixture of water, sand (or similar material), and chemical additives is injected at high pressure to fracture rocks in the subsurface and help get the oil and natural gas flowing. Most of the natural gas in Alberta is currently extracted using hydraulic fracturing.
- Target formations for hydraulic fracturing are typically 1 – 3 kilometres below ground. To drill a well, companies start by drilling vertically (straight down) and can then start to drill horizontally - making the well resemble the letter “L”. The horizontal path of a well can extend up to 4 kilometres.
- Hydraulic fracturing of a well can occur in one stage or in multiple stages along the horizontal portion of the well. This is called multi-stage horizontal hydraulic fracturing.



# FACTS AT A GLANCE

Here are some quick facts about hydraulic fracturing in the Red Deer River watershed.

## HOW MANY WELLS?

1580 unique wells were hydraulically fractured between 2013 and 2018 in the watershed to recover gas, oil, or coalbed methane.

## WHAT ARE THE MAJOR FORMATIONS?

Major target formations in the watershed include the Duvernay, Montney, and Cardium formations.

## HOW MANY STAGES ARE INVOLVED?

The average number of stages per hydraulic fracturing operation increased from 11 in 2013 to 36 in 2018.

## WHAT REPORTING IS REQUIRED?

The Alberta Energy Regulator requires all companies to report the water and chemicals used in every hydraulic fracturing operation. This information is publicly available on [fracfocus.ca](http://fracfocus.ca).

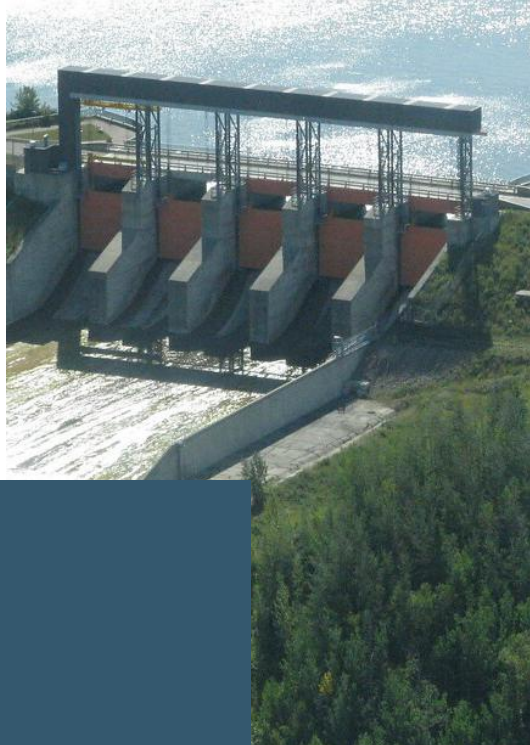
## REPORT METHODOLOGY

With hydraulic fracturing activity on the rise in parts of the watershed, this fact sheet provides basic information about hydraulic fracturing, the sources and volumes of water used for hydraulic fracturing in the basin, and where to go for more information.

The Alberta Energy Regulator provides data on the sources and volumes of water used for hydraulic fracturing in Alberta. The Red Deer River Watershed Alliance analyzed this data to understand trends in the watershed over the period 2013 - 2018.

The information presented in this fact sheet focuses on water quantity, and does not represent a comprehensive review of the lifecycle of hydraulic fracturing as it relates to key watershed management considerations and potential environmental impacts.





## WHERE IS HYDRAULIC FRACTURING HAPPENING IN THE WATERSHED?

Top 5 sub-watersheds	Overall Condition*
Blindman	C-
Medicine	C-
Threehills	B-
Little Red Deer	B-
Waskasoo	B

\* The 2009 State of the Watershed report assessed 20 indicators of watershed health for each of the 15 sub-watersheds.

Of the 15 sub-watersheds within the Red Deer River basin, these are the top five sub-watersheds with the highest water use for hydraulic fracturing, for the period between 2013-2018.

### DID YOU KNOW?

The Duvernay Formation is a source rock for historical conventional hydrocarbon production, and is now emerging as Alberta's foremost unconventional shale resource.

Source: Alberta Energy Regulator

Based on the total volume of water used for hydraulic fracturing in each sub-watershed (2013-2018), major areas of activity include:

- **Blindman sub-watershed:** The area with highest activity (by water volume), the Blindman sub-watershed has multiple large volume operations (> 50,000 m<sup>3</sup>) clustered between the city of Red Deer, Sylvan Lake, Bentley, and Blackfalds.
- **Medicine sub-watershed:** Located upstream of the city of Red Deer, this area is part of the Lower Headwaters zone and is important for downstream water provision and groundwater recharge.
- **Threehills sub-watershed:** Located downstream of the city of Red Deer, communities include Three Hills, Trochu and the Village of Elnora. This is a largely agricultural area.

The map below shows total reported water use for hydraulic fracturing by sub-watershed for the period 2013-2018. Data is from the Alberta Energy Regulator.



The Alberta Water Use Performance Report shows how water is allocated and used for oil and gas operations. The Alberta Energy Regulator publishes the detailed report online annually at [www.aer.ca](http://www.aer.ca).





## HOW MUCH WATER IS USED FOR HYDRAULIC FRACTURING?

### DID YOU KNOW?

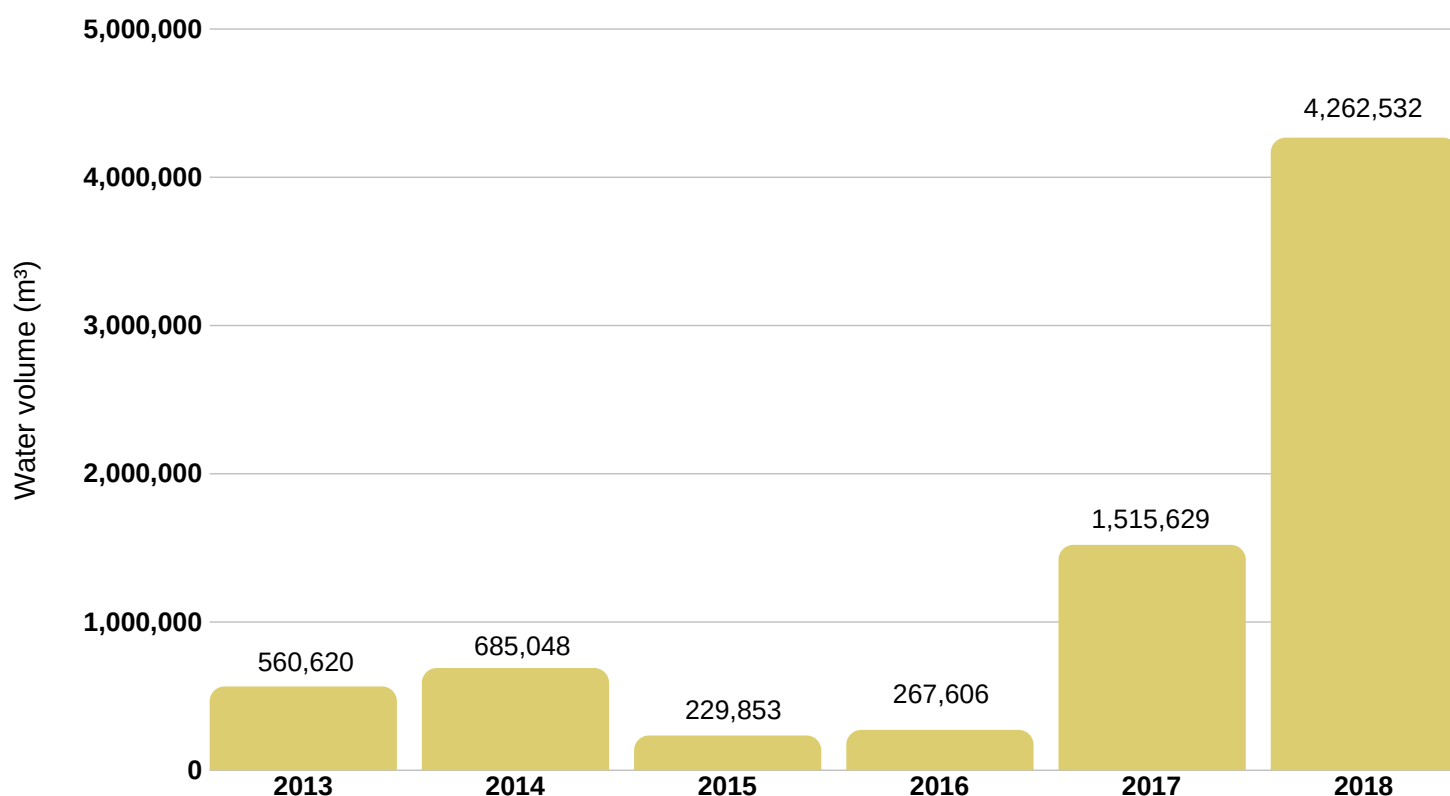
People often think of groundwater and surface water as separate types of water, but in reality they can be connected in complex ways. Groundwater contributes to surface water, and vice versa, although the degree of connectivity can vary based on geology and groundwater depth.

For more information about groundwater and groundwater vulnerability in the basin, the RDRWA encourages readers to review *Blueprint: An Integrated Watershed Management Plan for the Red Deer River Watershed (Phase One: Water Quality)* (2016), available at [www.rdrwa.ca](http://www.rdrwa.ca).

- The reported total volume of water used in the Red Deer River watershed for hydraulic fracturing from 2013 to 2018 was 7,521,288 m<sup>3</sup>. For comparison, this is around 3,009 Olympic-sized swimming pools of water.
- The volume of water used per operation varies based on factors including the geology of the play, technology used, and number of stages. The average volume of water used per hydraulically fractured well in the watershed was 19,550 m<sup>3</sup> in 2018. There is a trend toward larger operations (> 50,000 m<sup>3</sup> per well).
- Water use by hydraulic fracturing is typically consumptive (i.e., water is not returned to its source in the ecosystem).
- Water that is recovered from an operation (as flowback or produced water) is typically considered waste and is usually disposed of through deep well injection. Opportunities to recycle produced water and minimize freshwater use are being explored.

# WATER USE TRENDS

## HOW MUCH WATER DOES HYDRAULIC FRACTURING USE IN THE BASIN?



2018 saw a significant increase in the reported volume of water used for hydraulic fracturing in the basin, particularly in the Medicine, Blindman, Waskasoo, and Threehills sub-watersheds. This increase was driven by an increase in development and a trend toward operations requiring higher water volumes. Reported water use (2013-2018) was calculated using data from the AER.

### ALBERTA SURFACE WATER ALLOCATION DIRECTIVE

In 2019, Alberta Environment and Parks released a Surface Water Allocation Directive (SWAD) to guide water allocation decisions. SWAD attempts to balance ecological needs and economic considerations in allocation decision-making, and it applies to areas where specific water management objectives are not already established. The Directive takes a cumulative water allocation approach to minimize changes to aquatic habitats. Moving forward, there is a need to clarify how SWAD applies at a sub-watershed scale in the basin.

# WATER ALLOCATION

## TYPES OF LICENSES

The Alberta Energy Regulator (AER) regulates the allocation of water for hydraulic fracturing operations and issues licenses to operators to obtain surface water and groundwater. Licenses may be term licenses or Temporary Diversion Licenses (TDLs).

Term licenses are issued as an annual allocation volume, and can be multi-year. TDLs are short-term licenses issued for a few weeks up to several months.

## TERM VS. TDL ALLOCATIONS

Using data from February 2020, term surface water allocations in the basin are:

- Agriculture - 31%
- Industrial - 23%
- Commercial - 4%
- Municipal - 27 %
- Water Management - 12%
- Other - 3%

0.76 % of all term allocations are for hydraulic fracturing (considered part of the Industrial category).

If both term and TDL licenses are considered, hydraulic fracturing (horizontal and vertical) accounts for 2.73% of all surface water allocations in the basin. As of February 2020, approximately 8.4 million cubic metres of water were allocated toward hydraulic fracturing in the basin (vertical and horizontal). 73% of this water was allocated using TDLs. Not all water that is allocated is used.

Allocation data are not cumulative across years and are not directly comparable with the water use and source data presented (different time periods).

## BASIN-SCALE TRENDS

Under the Approved Water Management Plan for the South Saskatchewan River Basin (2006), there is a total surface water allocation target for the Red Deer River watershed of 600,000 cubic decametres ( $1 \text{ dam}^3 = 1,000,000 \text{ L}$ ). This target is for surface water allocations in a given year.

In February 2020, total surface water allocations in the basin (including all sectors) were  $307,045 \text{ dam}^3$ , including term ( $300,904 \text{ dam}^3$ ) and TDL ( $6,141 \text{ dam}^3$ ) licenses. This equates to 51% of the allocation target. Basin-scale allocation trends may mask local patterns of water availability and allocation.



# WATER SOURCE TRENDS IN THE BASIN

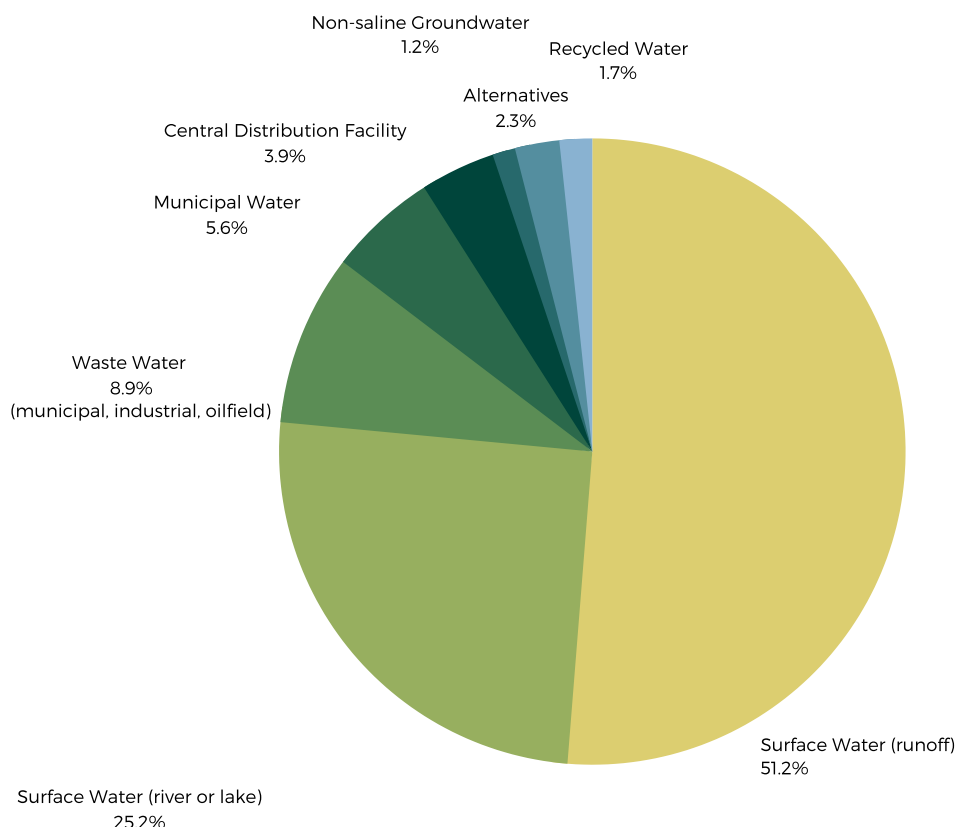
## WHERE DOES THE WATER COME FROM?

### DID YOU KNOW?

76% of the total water sourced for hydraulic fracturing in the basin from 2013-2018 was surface water. This includes 51% from "surface runoff", 14% from lakes, and 11% from rivers.

The AER defines runoff as water that is collected from a surface depression (e.g., borrow pit, gravel pit, dugout, stormwater collection pit, ditches). Some surface runoff sources like gravel pits may also be connected to groundwater and local aquifers.

Groundwater, both non-saline and saline, makes up a small fraction of the water used for hydraulic fracturing in the basin.



### SOURCES OF WATER By Major Category (AER)

**96%** NON-SALINE

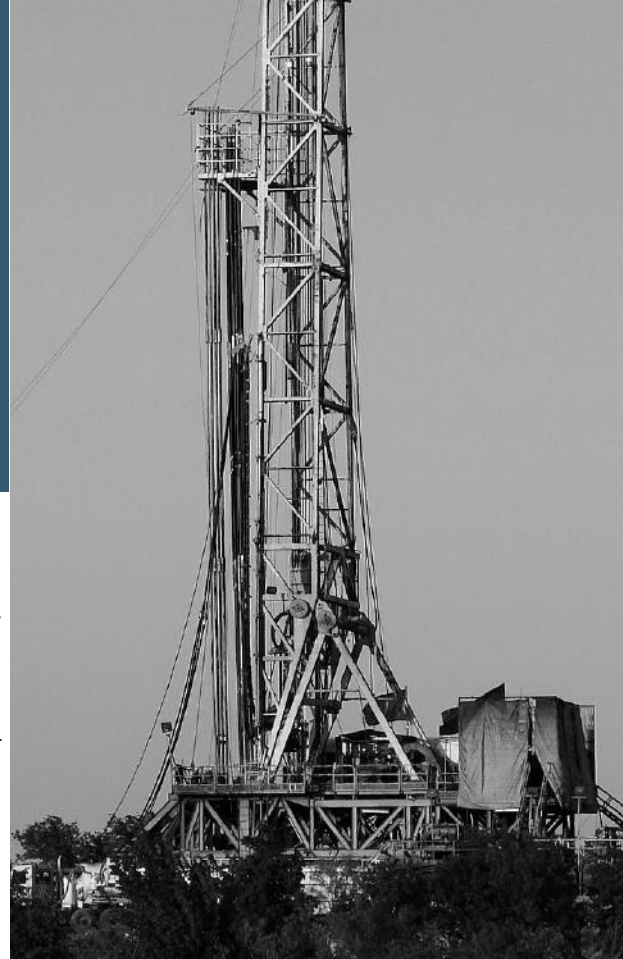
**2.3%** ALTERNATIVE  
(SALINE GROUNDWATER, PRODUCED WATER, RECYCLED AT STANDALONE FACILITY)

**1.7%** RECYCLED  
(AT WELL SITE)

- The total reported volume of water sourced in the Red Deer River watershed for hydraulic fracturing from 2013 to 2018 was 8,931,969 m<sup>3</sup>. For comparison, this is around 3573 Olympic-sized swimming pools of water.
- 84.2% of the water or waste water sourced for hydraulic fracturing over the period 2013 to 2018 was actually used.
- Data for water use and sourcing reflects *reported* water volumes, based on *Directive 059* reporting to the AER.

# CAN HYDRAULIC FRACTURING CAUSE EARTHQUAKES?

- Hydraulic fracturing has been linked to induced seismic events in the Red Deer region. The Alberta Energy Regulator / Alberta Geological Survey indicates that recent earthquakes (19 March 2018 – Local Magnitude ( $M_L$ ) 3.13; 4 March 2019 –  $M_L$  4.18) in the region were induced by hydraulic fracturing, and other smaller clusters of events in the Duvernay East Shale Basin were also induced (Schultz et al., 2019).



**EARTHQUAKES ASSOCIATED WITH HUMAN ACTIVITIES ARE REFERRED TO AS INDUCED SEISMICITY (AS OPPOSED TO NATURAL SEISMICITY). THEY INCLUDE BOTH SMALL EVENTS THAT CANNOT BE FELT, BUT ARE MEASURABLE BY SENSITIVE INSTRUMENTS, AND LARGER EVENTS THAT CAN BE FELT AND THAT MAY CAUSE DAMAGE.**

- In Western Canada, 3 out of every 1000 hydraulically fractured wells are associated with seismicity that can be felt at the ground surface ( $MW > 3$ ) (Atkinson et al., 2016). Regions with higher hydraulic fracturing activity have also been shown to be more prone to earthquakes (Bao and Eaton, 2016).
- The AER has created seismic protocols to limit the impact and potential of induced earthquakes from hydraulic fracturing in the Red Deer Region (*Subsurface Order No. 7*). Hydraulic fracturing is prohibited within five kilometres of the Dickson Dam if operations are targeting the Duvernay formation or below, and all operators in the region are required to follow a “traffic light protocol” to reduce the hazard of induced seismicity.

## AER Traffic Light System – Duvernay Zone, Red Deer



March 2019

Alberta Energy Regulator

# ABOUT THE RDRWA

The Red Deer River Watershed Alliance (RDRWA) was established in 2005 as the official Watershed Planning and Advisory Council (WPAC) for the Red Deer River Watershed, as designated under the Government of Alberta's *Water for Life* Strategy. The RDRWA is a multi-sector, collaborative, not-for-profit organization that assesses watershed conditions, leads in watershed planning, and promotes the good stewardship and proper management of water resources.

## DATA DISCLAIMER

This fact sheet presents a high-level overview of hydraulic fracturing trends within the Red Deer River Basin, for general informational purposes only. Subject matter experts from multiple sectors provided data and expertise to support the process, however this document is not a comprehensive scientific report. The analyses should be regarded as preliminary and used with discretion.

The data used to calculate the volumes of water sourced and used for hydraulic fracturing come from the Alberta Energy Regulator. Water allocation data was obtained from Alberta Environment and Parks.

## REFERENCES

Alberta Energy Regulator. 2019. Subsurface Order No. 7

Atkinson, G.M., D.W. Eaton, H. Ghofrani, D. Walker, B. Cheadle, R. Schultz, R. Shcherbakov, K. Tiampo, J. Gu, R.M. Harrington, Y. Liu, M. van der Baan, and H. Kao. 2016. Hydraulic Fracturing and Seismicity in the Western Canada Sedimentary Basin. *Seismological Research Letters*, Volume 87(3).

Bao, X., and D.W. Eaton. 2016. Fault activation by hydraulic fracturing in western Canada. *Science* 354: 1406-1409.

RDRWA. State of the Watershed Report. Aquality, 2009.

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Schultz, R., Pawley, S.M. and Hauck, T.E. 2019. Preliminary overview of the 2018 and 2019 earthquakes near Red Deer, Alberta; Alberta Energy Regulator/Alberta Geological Survey, AER/AGS Open File Report 2019-12. 10p.





## FOR MORE INFORMATION

If you have questions or concerns about a proposed or active energy project in your area, the RDRWA has compiled a list of contacts below.

### **Alberta Energy Regulator Customer Contact Centre**

Telephone: 1-855-297-8311

E-mail: [Inquiries@aer.ca](mailto:Inquiries@aer.ca)

### **Alberta Environment Non-Emergency Inquiries**

Toll Free: 1 877 944-0313

Email: [AEP.Info-Centre@gov.ab.ca](mailto:AEP.Info-Centre@gov.ab.ca)

### **To Report an Incident or Emergency**

Call 1-800-222-6514 (Energy and Environmental Emergency 24-Hour Response Line) immediately if you witness, or are aware of, unreported problems regarding energy development.