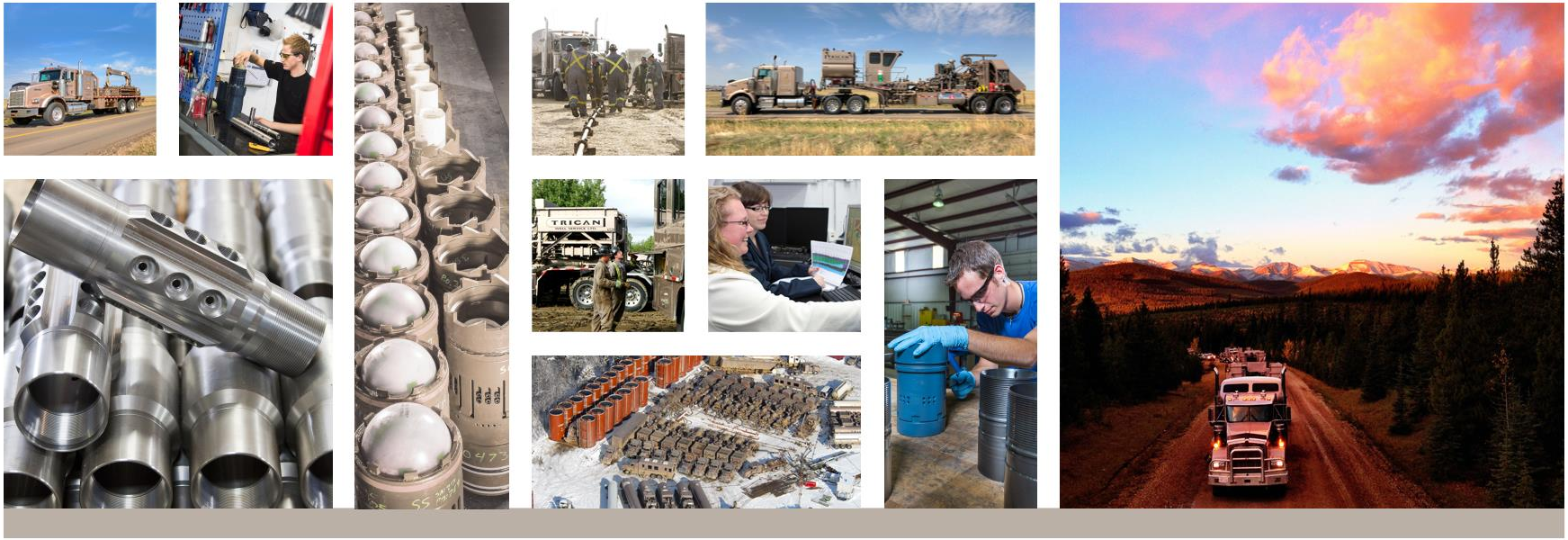


Talking Frac

We're part of the story, let's be part of the conversation

TALKING FRAC

We’re part of the story.

Let’s be part of the conversation.

FRACKING
POLLUTES
AIR

www.frack-off.org.uk


VE CAN'T
PIPE
MONEY
I
PASS
GAS
CUOMO
FRACK
DEMAN
ACTION
NOW
DO NOT
FRACK
OUR RIVER
BAN
DON'T
FRACK
NEW YORK WATER
STOP FRACKING NOW!
United for Action

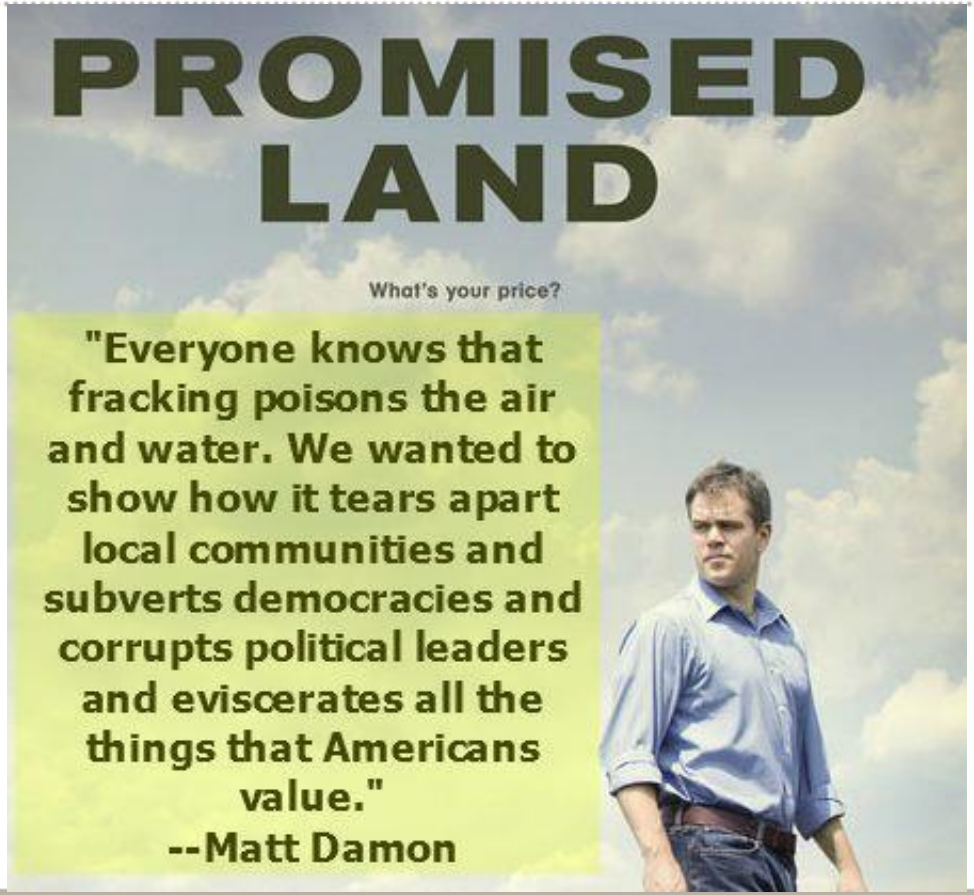
Why Now?

- 1 million fractured wells in USA
- 175 000 fractured wells in Canada
- 70% of all existing wells have been fractured

- First hydraulic fracture treatment was in 1949


TRICAN
TRICAN


ONE WAY
Greene St
MACK
WH14085
OIL & GAS SERVICES


PROMISED LAND
What's your price?
"Everyone knows that fracking poisons the air and water. We wanted to show how it tears apart local communities and subverts democracies and corrupts political leaders and eviscerates all the things that Americans value."
--Matt Damon

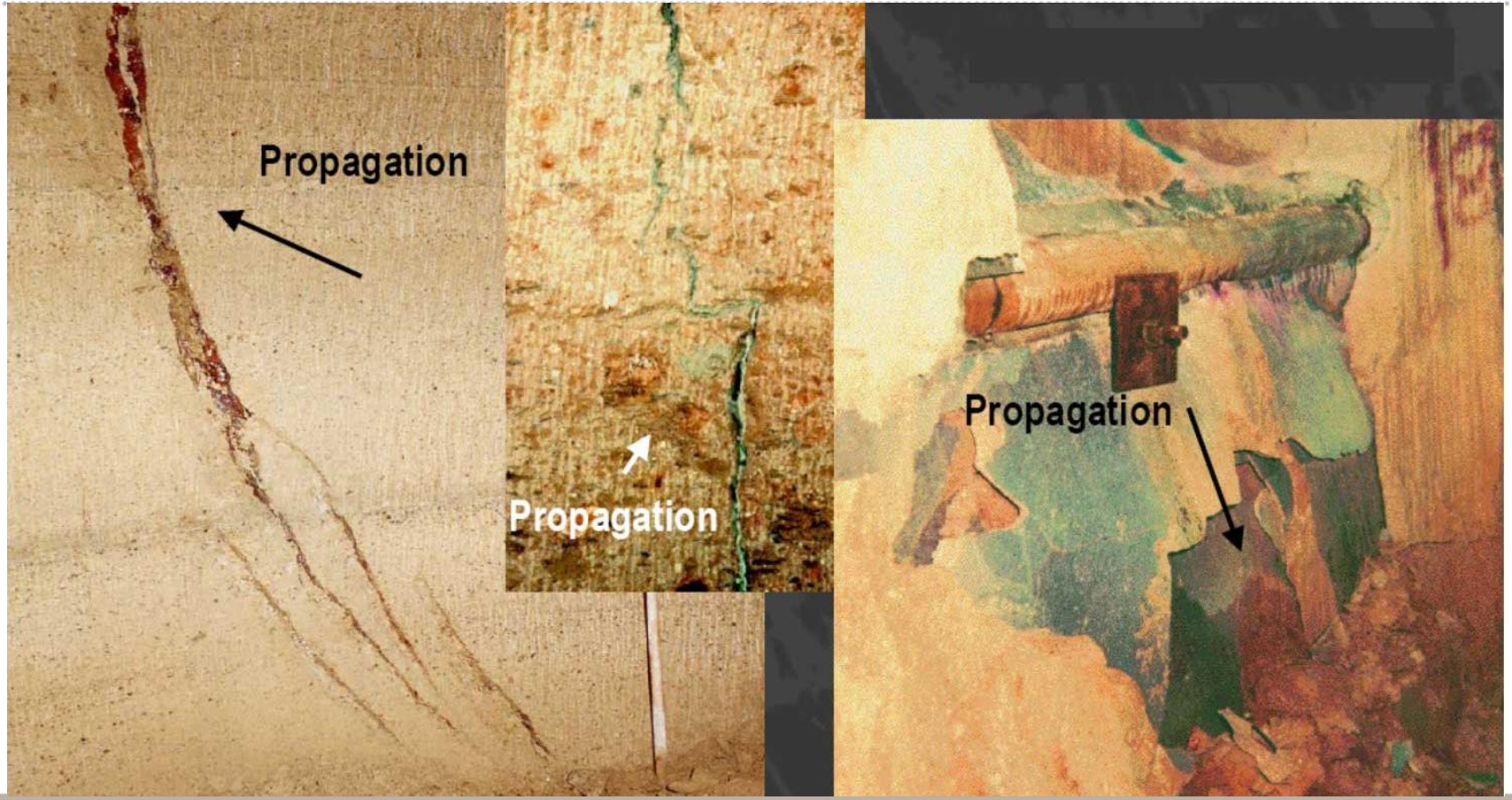
Agenda

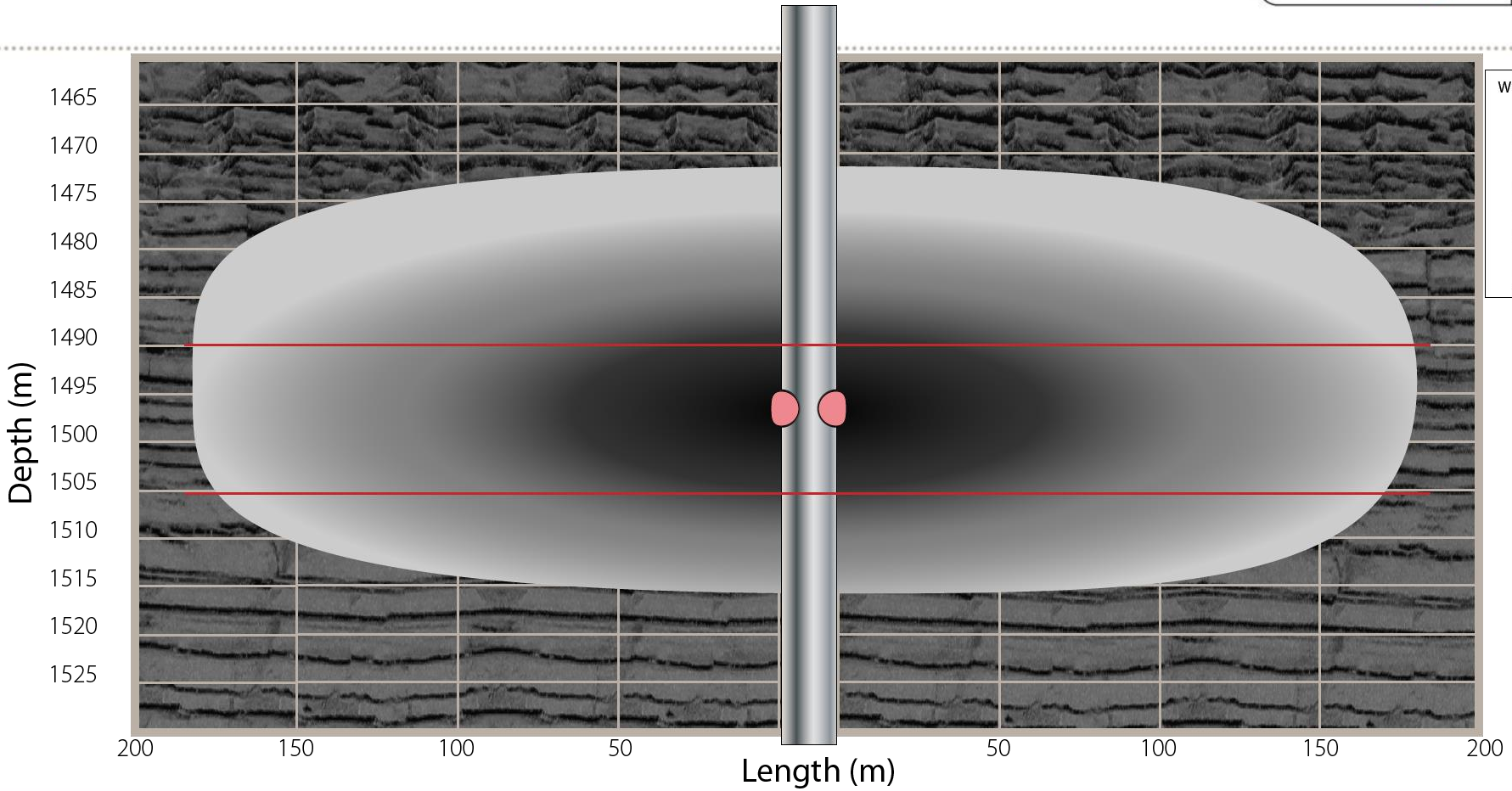
- Explanation of Hydraulic Fracturing
- Public concerns
- Our response to these concerns and the science behind it
- What are we doing to address legitimate concerns?

What is Hydraulic Fracturing?

- Fluid is pumped at pressures that create a crack in the rock
- Sand (proppant) is placed into the cracks
- Cracks stay “propped” by sand trapped in place
- This creates a pathway for natural gas and oil to flow

What does a frac look like?




Width (cm)
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0.2
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0.7
0.8
Depth (m)
1465
1470
1475
1480
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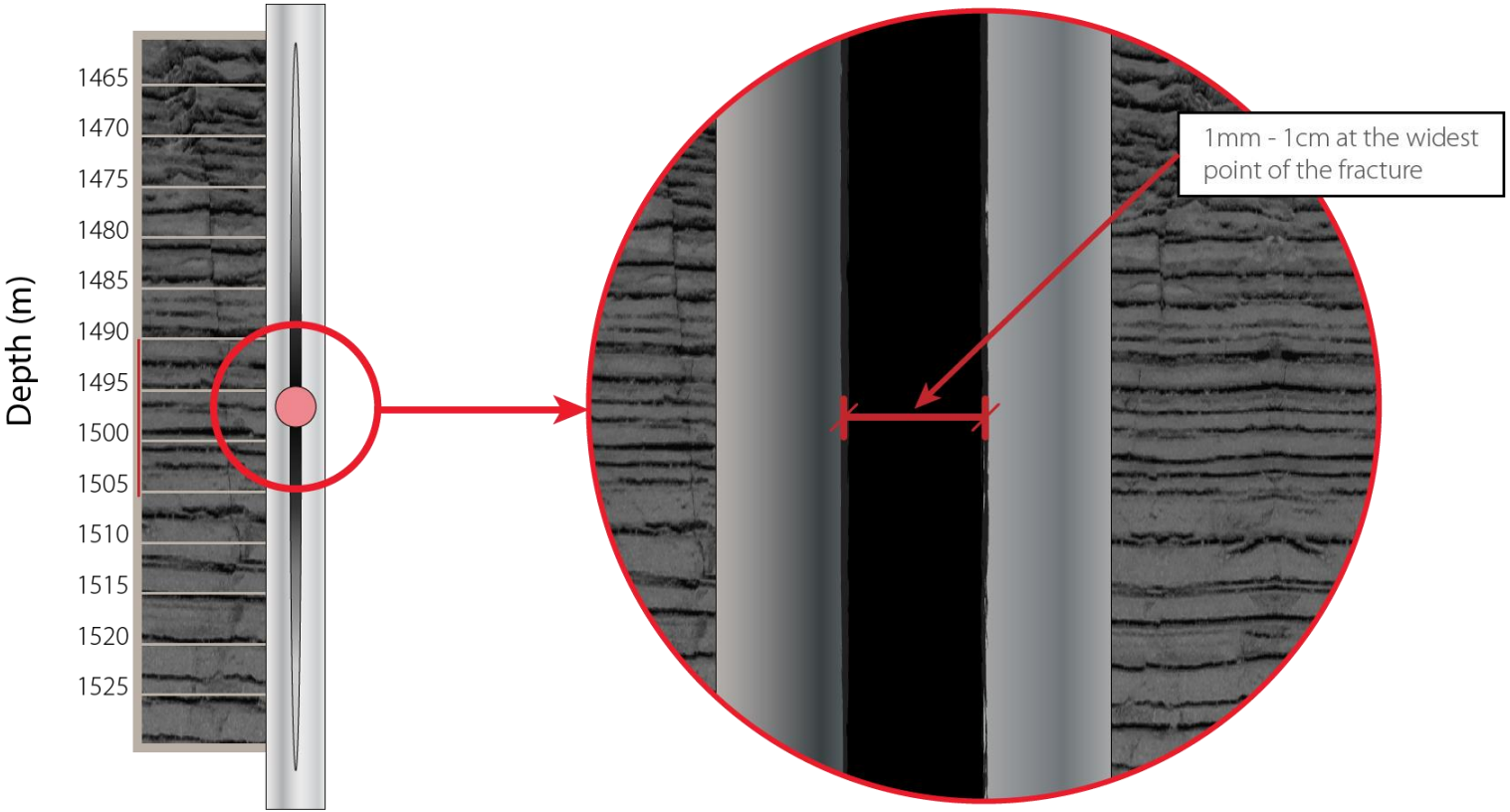
Length (m)


Depth (m)
1465
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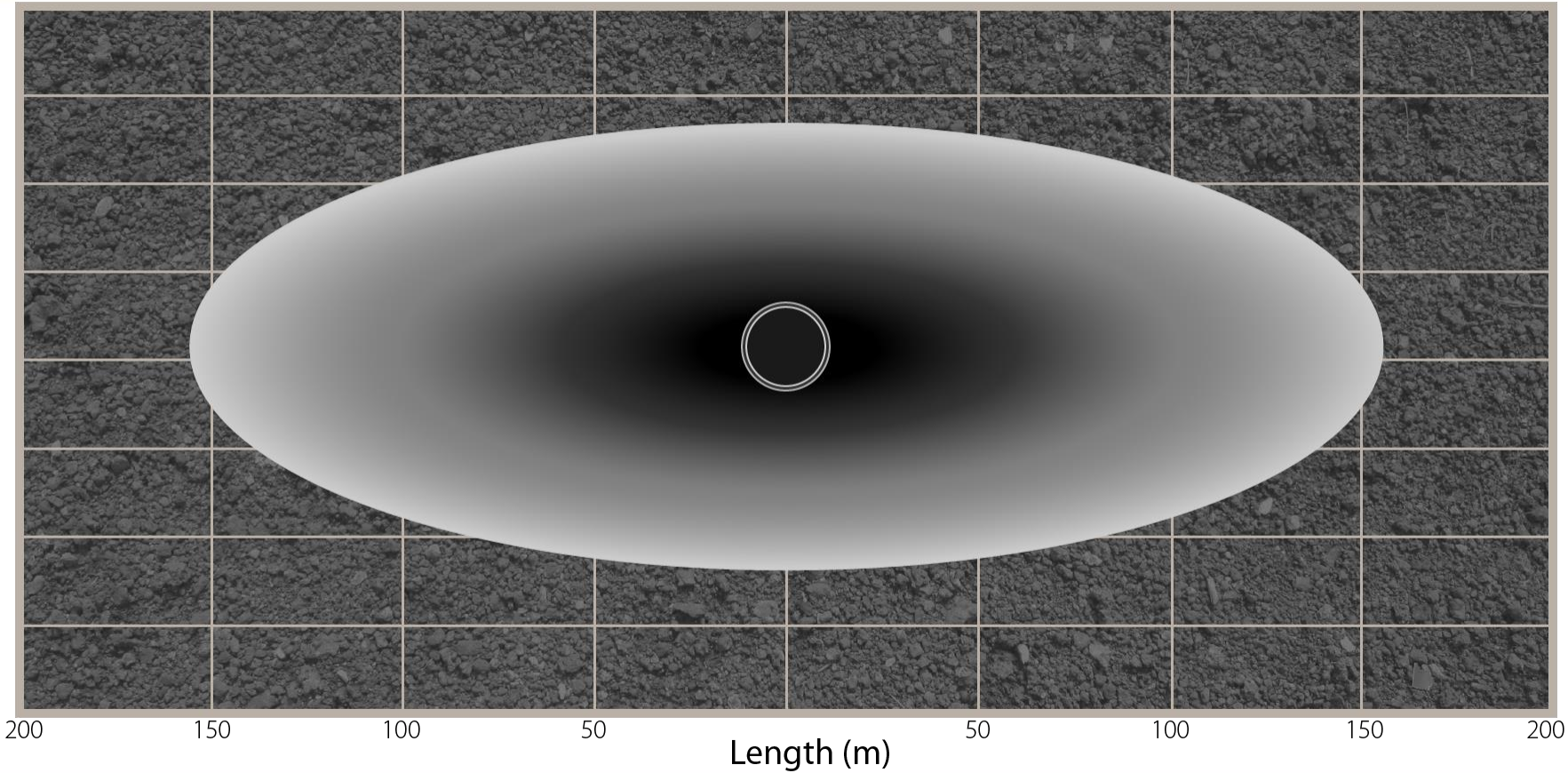
1mm - 1cm at the widest point of the fracture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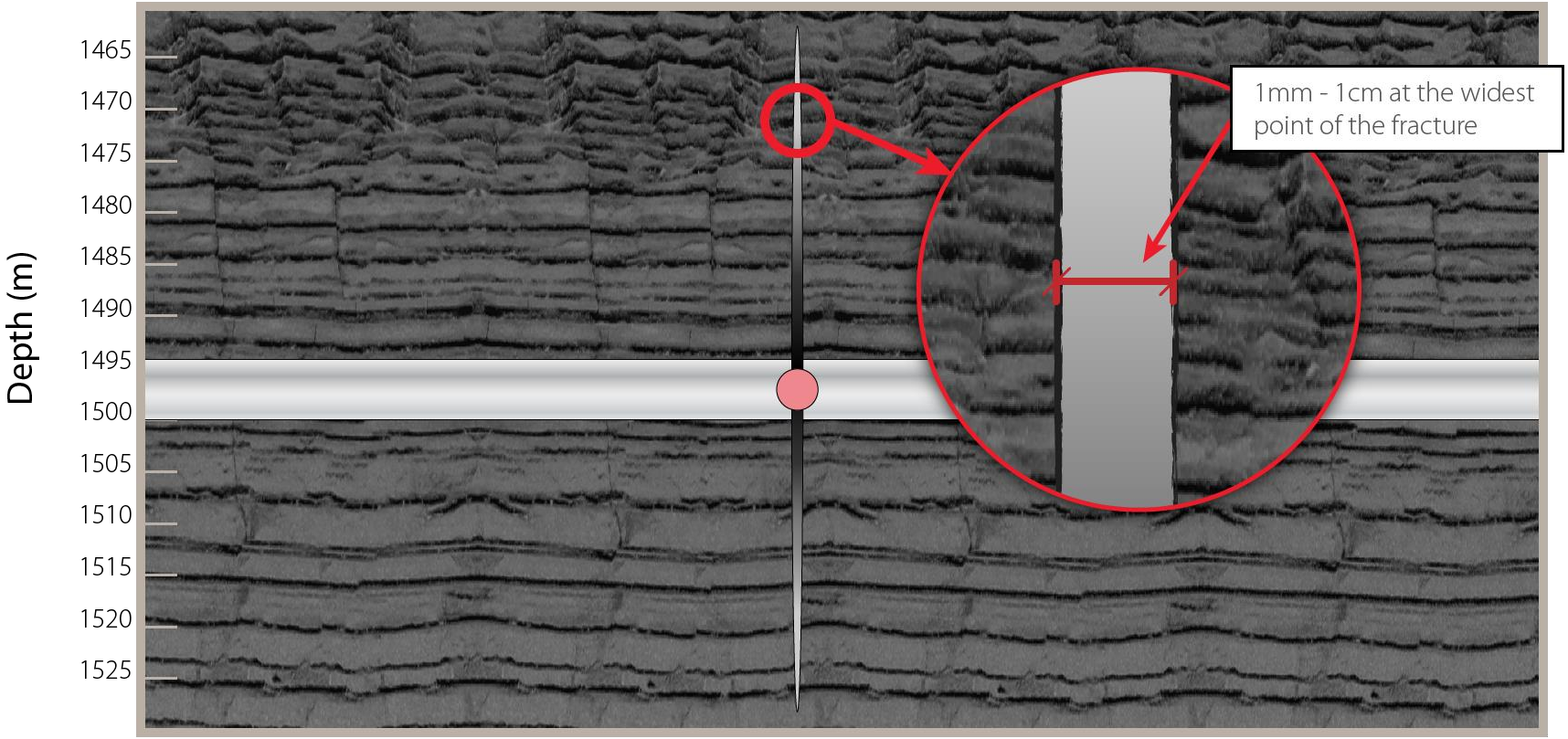
Length (m)


Depth (m)
1465
1470
1475
1480
1485
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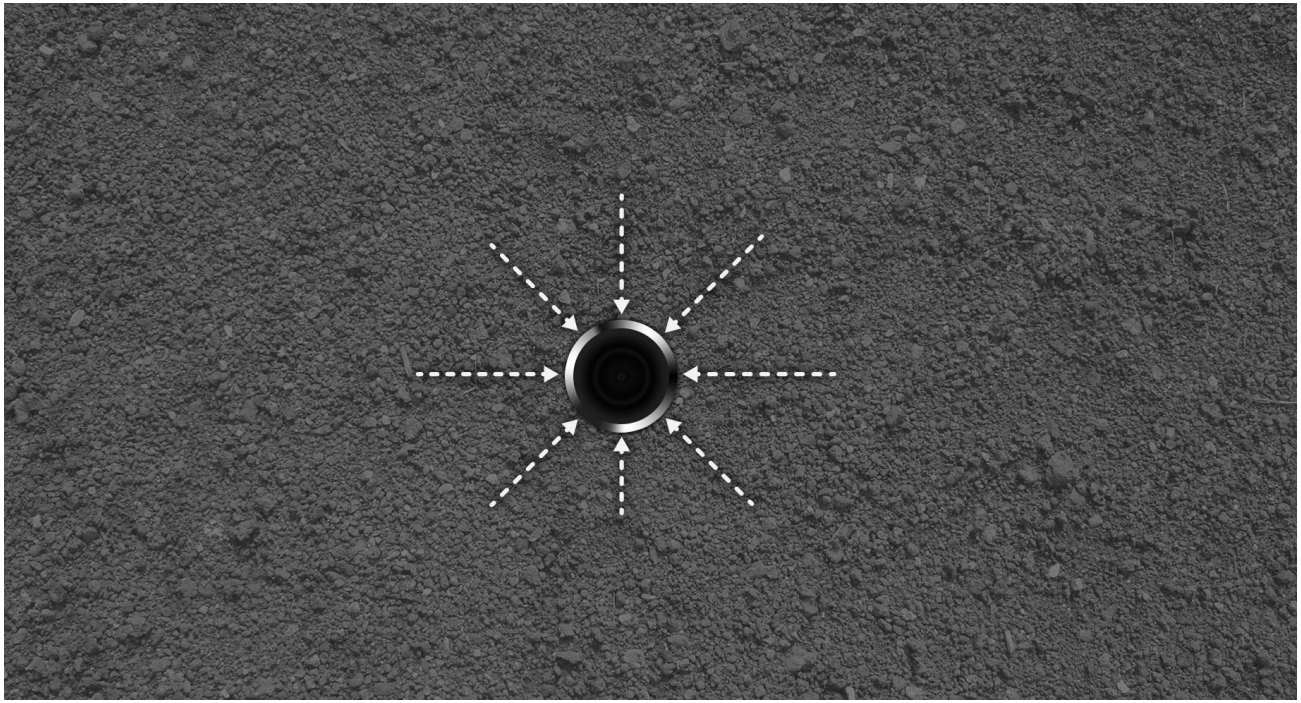
1495
1500
1505
1510
1515
1520
1525
1mm - 1cm at the widest point of the fracture

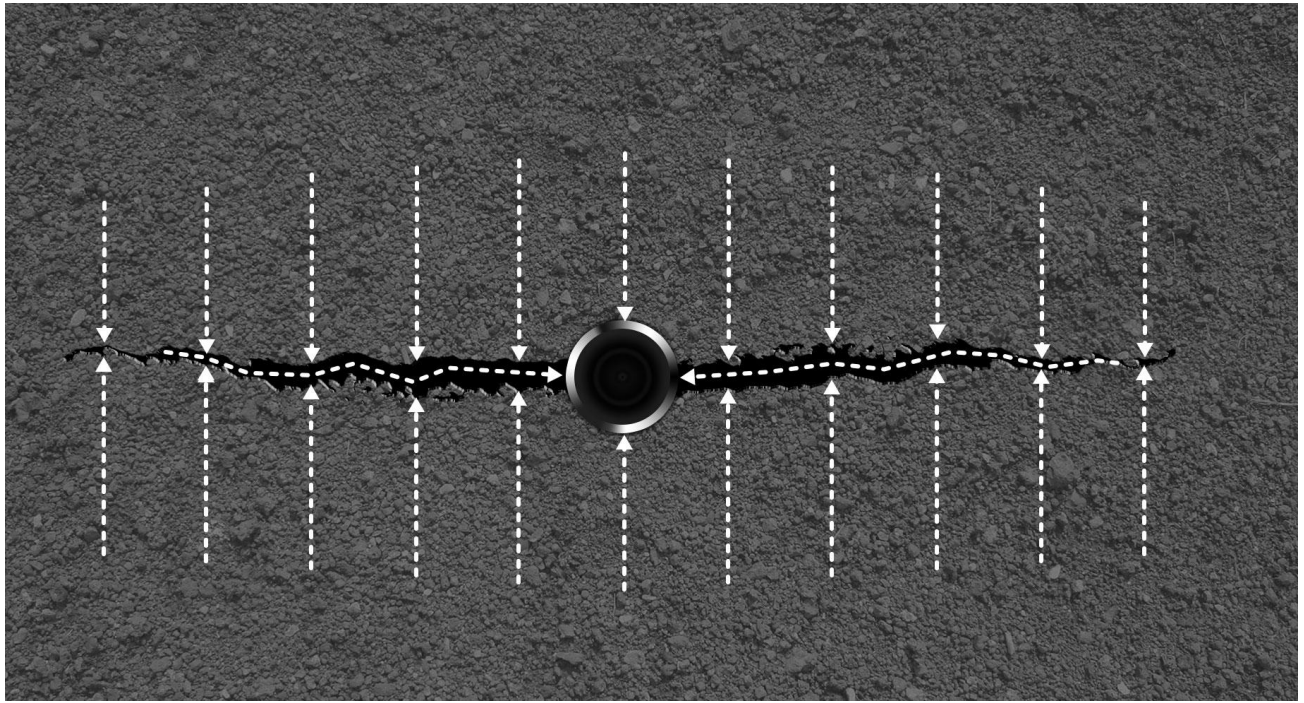
Why Frac?

- Normal production- all fluid passes through a restricted area around the metal casing (well)
- This causes pressure loss and slow production
- Lack of contact with reservoir - inefficient recovery



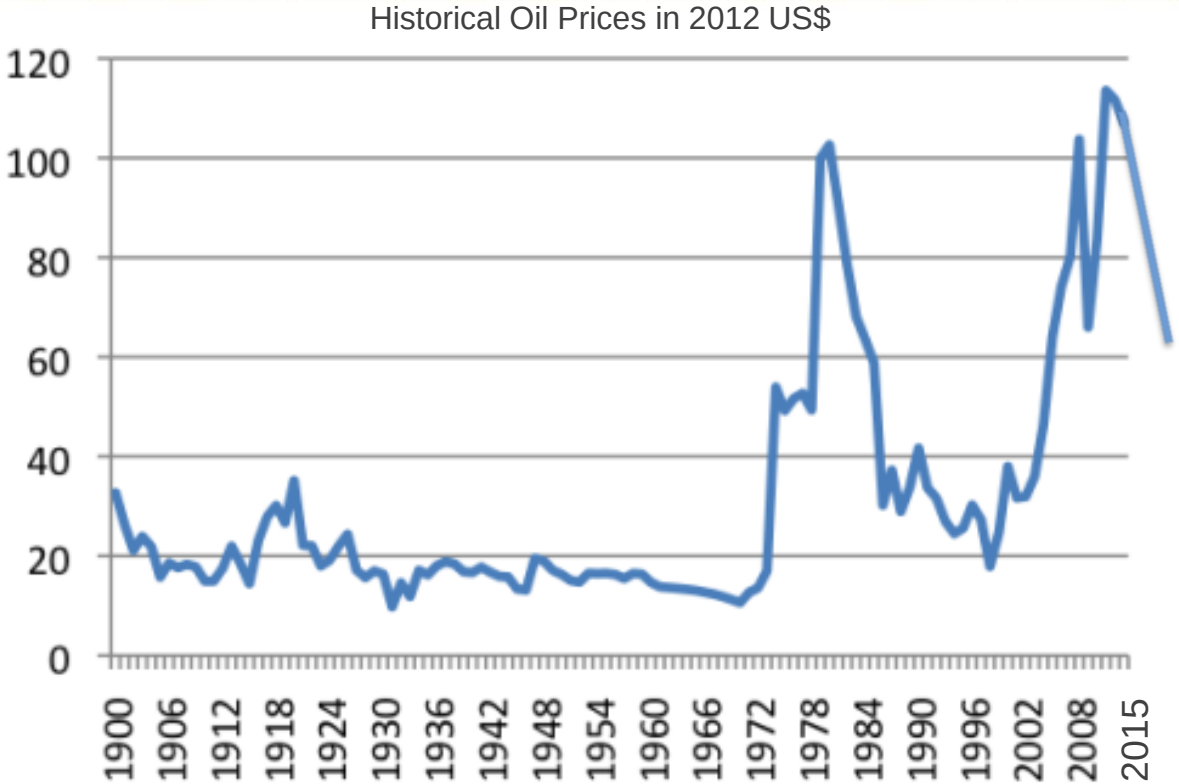
Why Frac?

- Fluid flows into the fracture and then into the well
- Provides more surface area contact with reservoir
- No more restriction

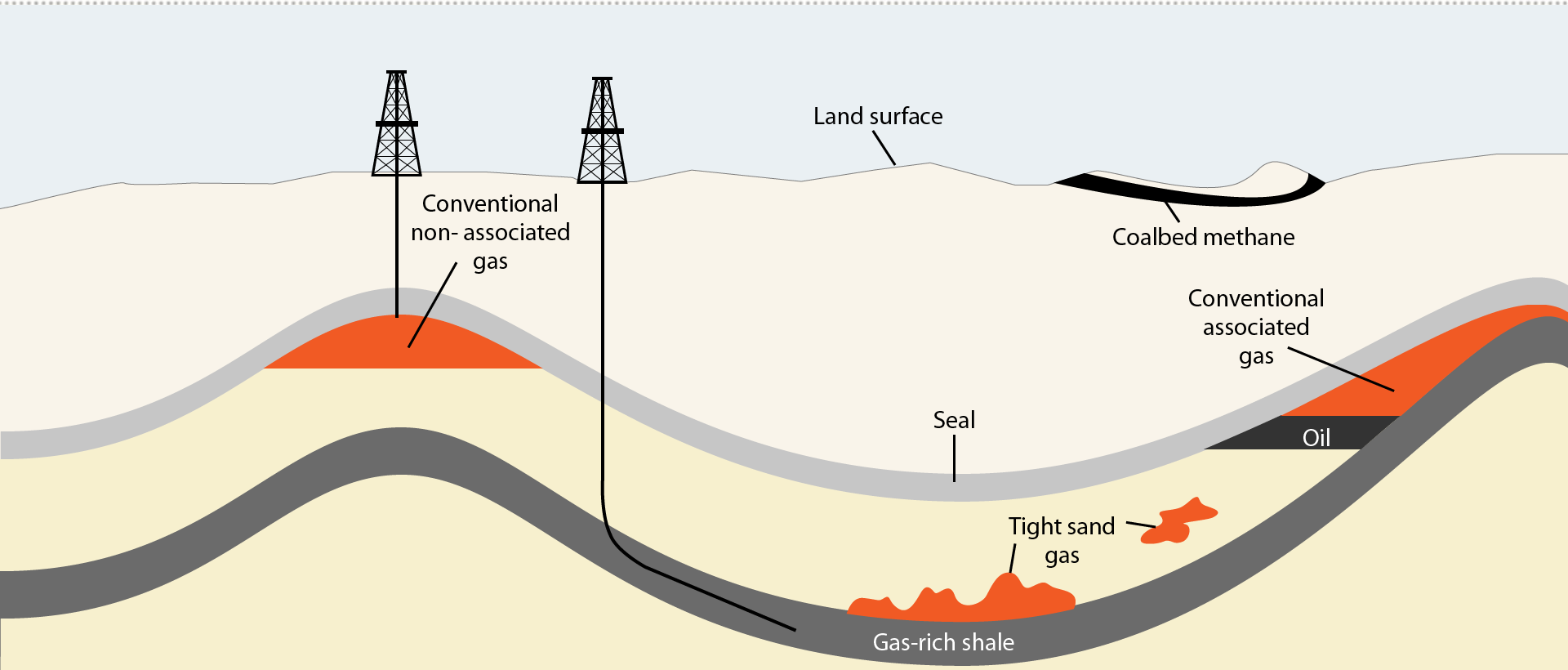


Why Frac?

- Energy renaissance
- Previously uneconomic reservoirs
- Innovation in horizontal drilling is the big technological story
- Unconventional sources of oil and natural gas (shale)

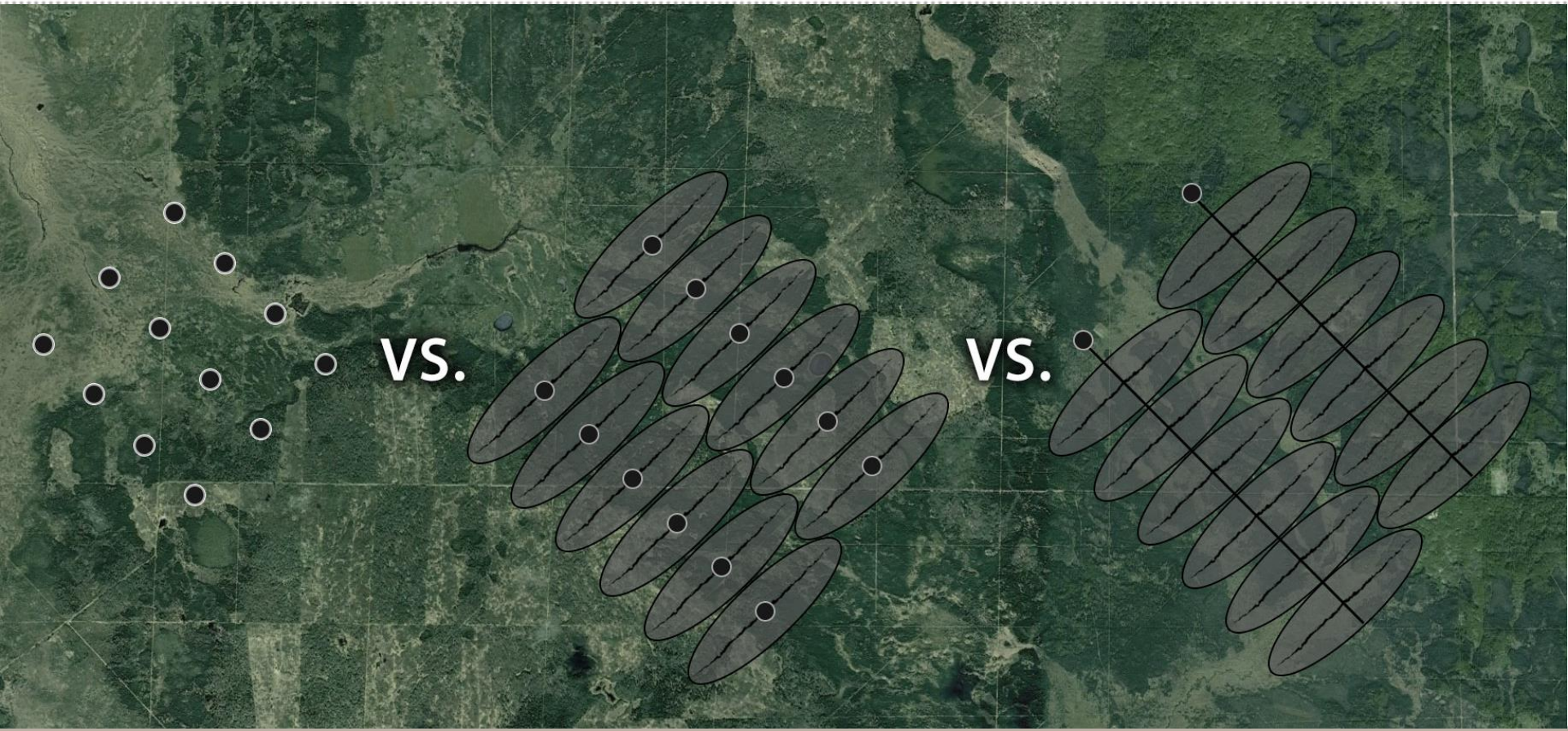


Why Frac? Conventional vs. Unconventional

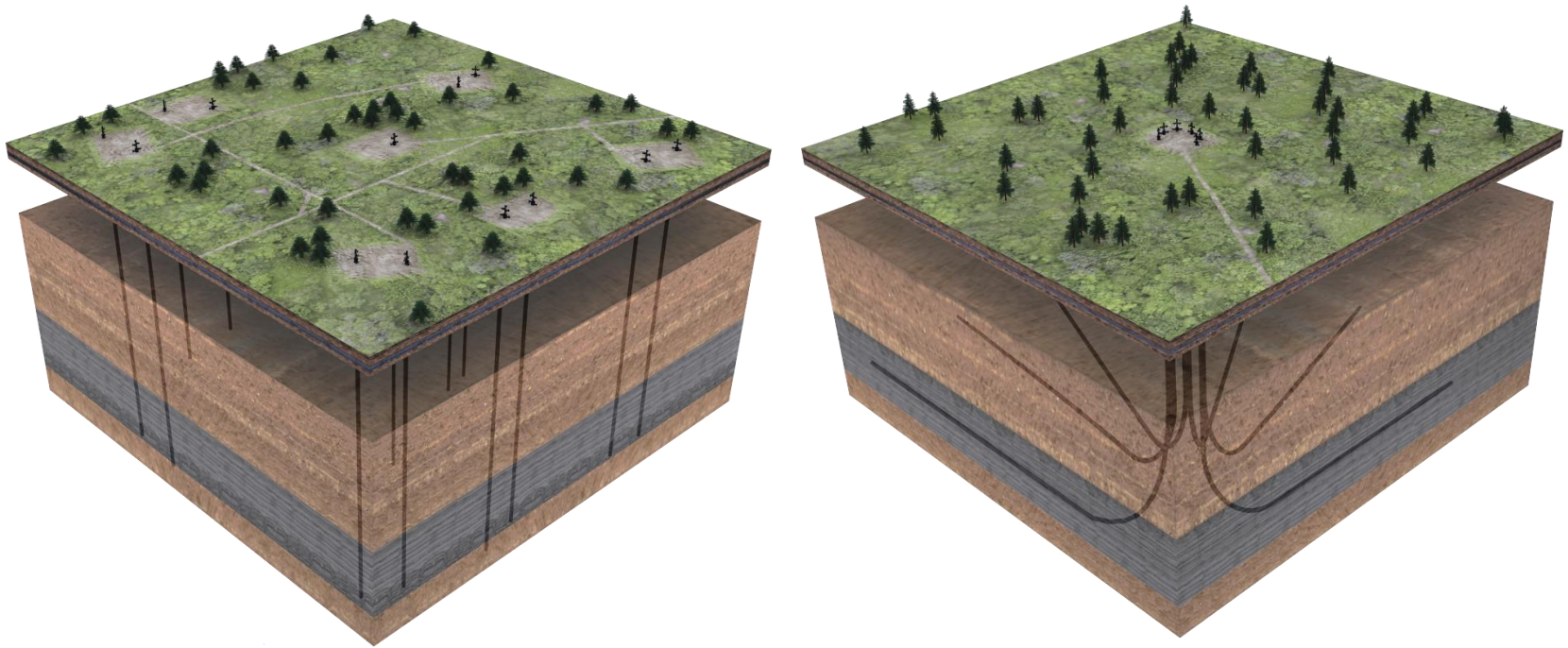


Source: U.S. Energy Information Administration and U.S. Geological Survey

Why Frac

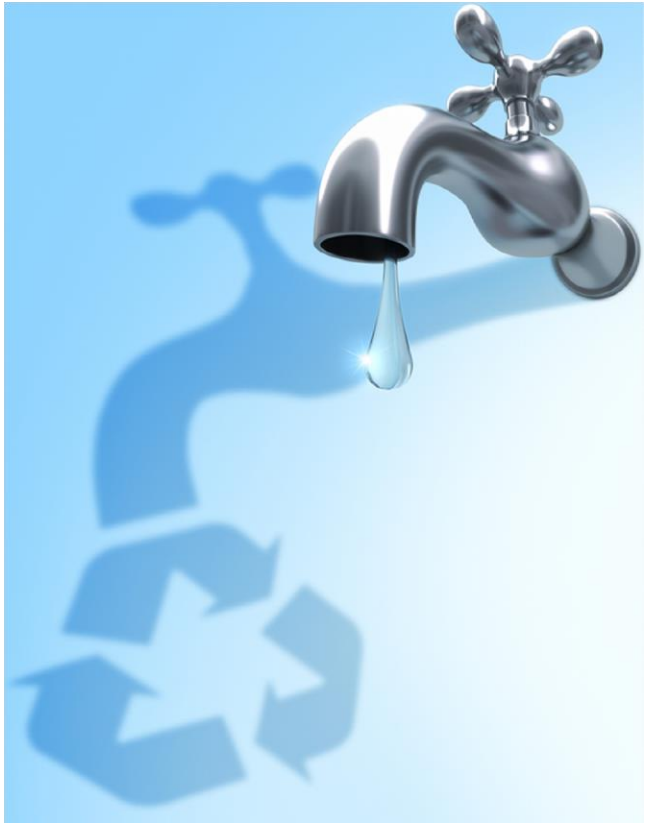


Less Surface Disturbance



Water Usage

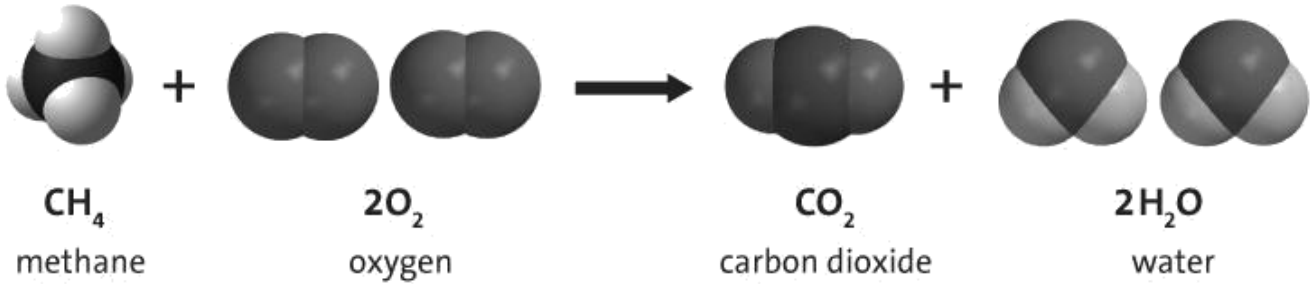
- Re-using and/or recycling frac fluid
- Partnering with counties and farmers to collect stagnant water or gray water
- Water is reused for subsequent jobs, treated or pumped into disposal wells
- Using produced (undrinkable) and sources of brine water



Water Usage

- The fracturing process require a significant amount of water

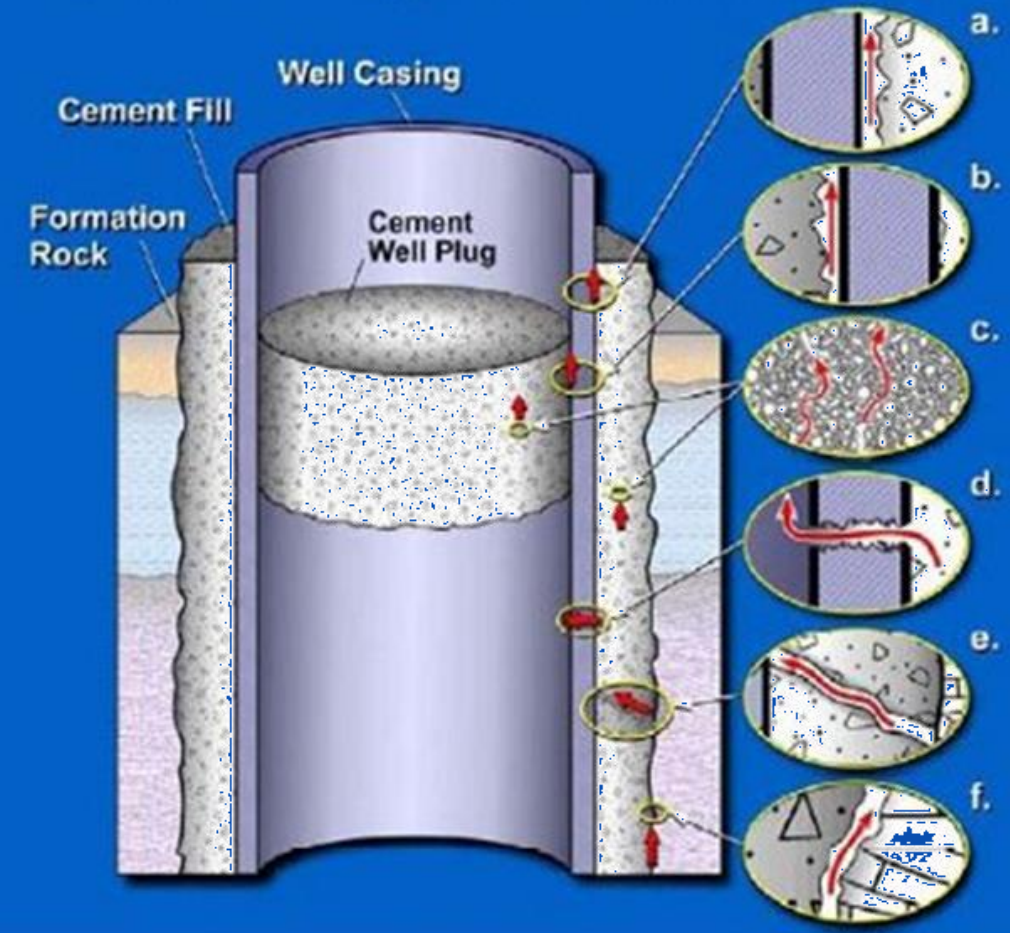
- How much is 2000 cubic meters? (Average water for one horizontal frac)
  - **Calgary usage** in approximately **5.8 minutes**
  - A 5,000 megawatt coal-fired **power plant** in **2 hours**
  - A **golf course** in **3.7 days**



Do fractures contaminate groundwater?

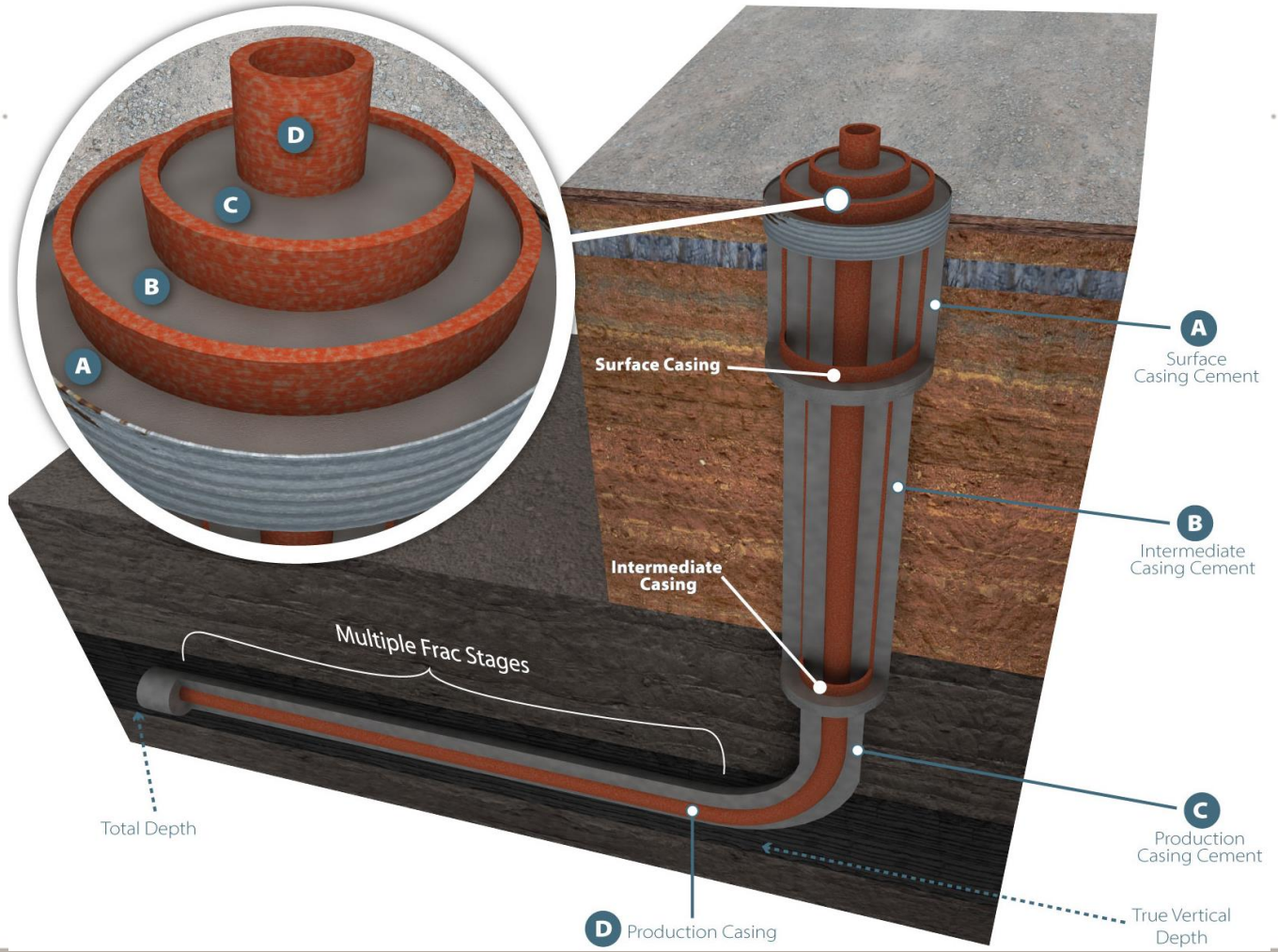
- Wellbores are cased and cemented (metal pipe and cement layers)
  - This seals and isolates all fresh water areas from oil and gas areas, and isolates the oil and gas areas from one another
- Fracturing occurs after the vertical part has been sealed with 2-3 layers of metal casing and cement
- Fracturing occurs far below fresh water areas
- Highly regulated in Canada
  - Alberta Energy Regulator (AER) Directive, 008, 083

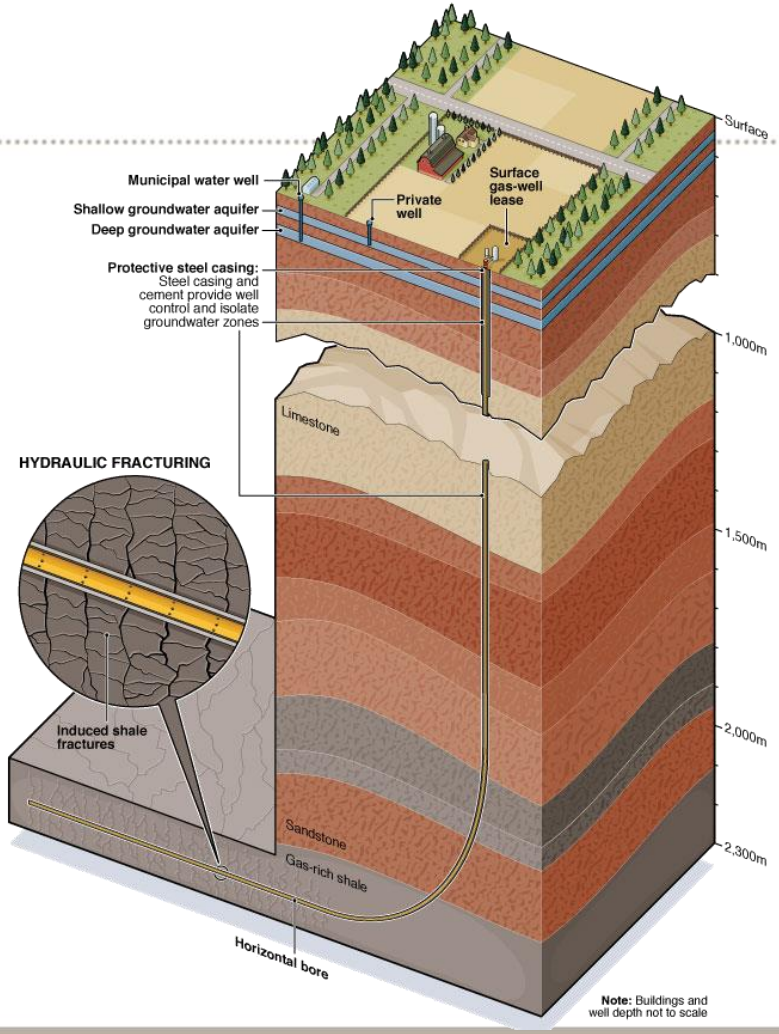
Potential Gas Migration Paths along a Well



Well Construction

- 2-3 layers of steel casing and cement
- Always at least 2 layers near freshwater





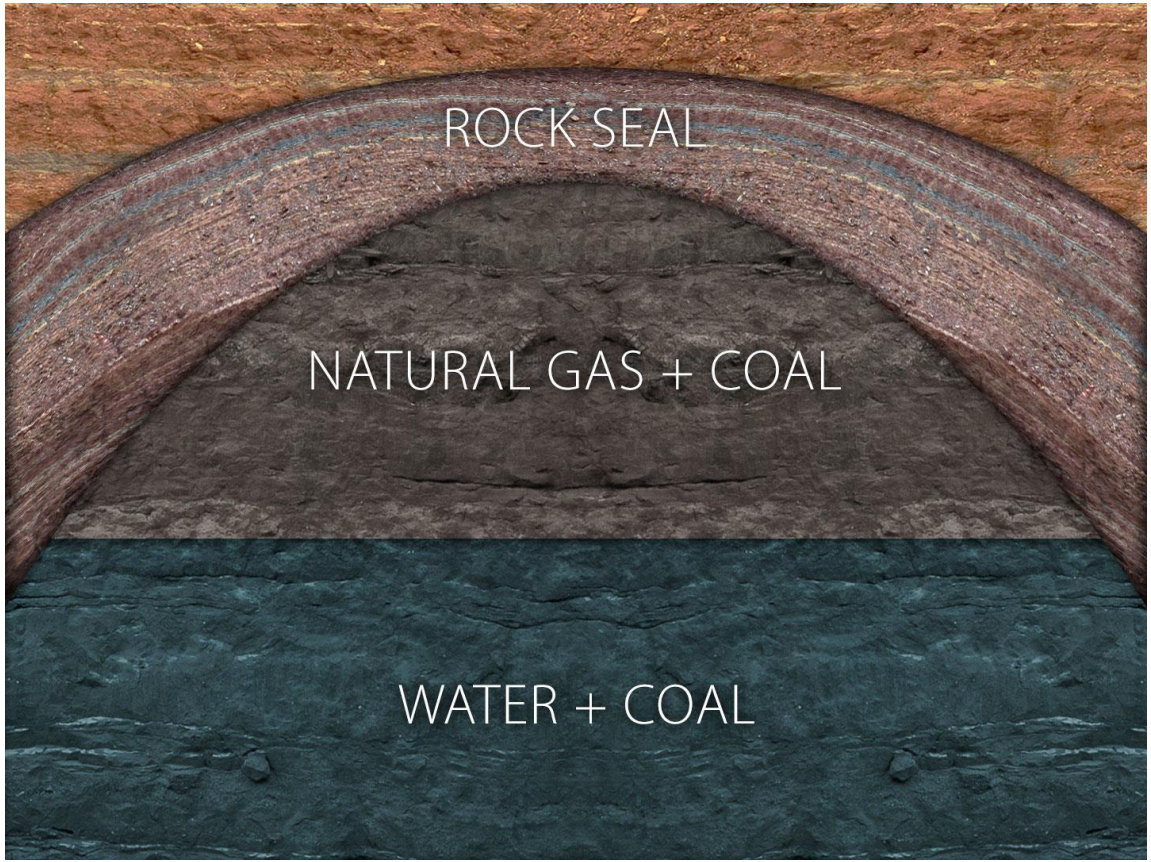
Fracturing occurs 600 m – 4 km below any fresh water zones

I can light my tap water on fire!

- Coalbed methane (natural gas)
- Occurs close to surface
- Brita® filter
- Natural degradation of coal produces methane gas
- Gas on top of water

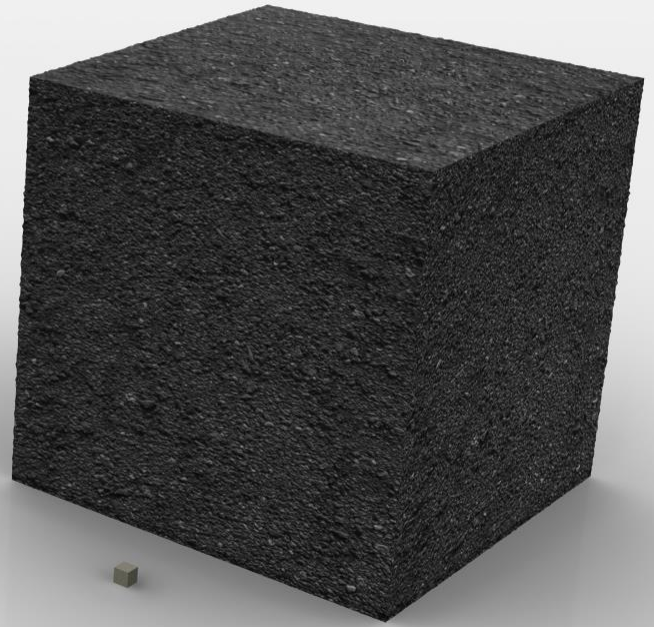
Geological Traps

- Oil or gas occurs in a geological trap
- Repeated drawing from a water well can result in gas production
- Hydraulically fractured with nitrogen only
- AER directive 35 – Base of groundwater protection

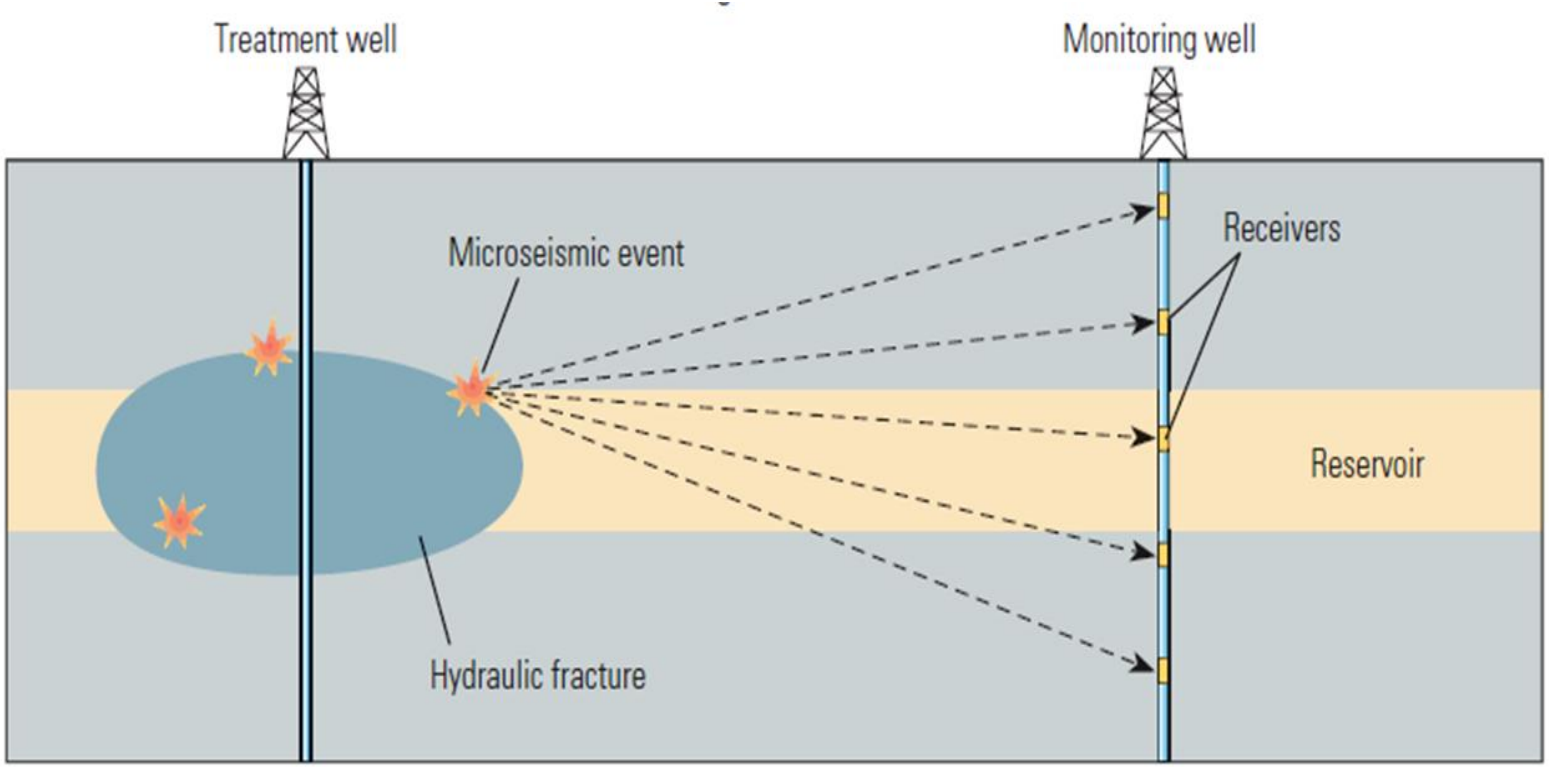


Can fracs grow up into fresh water aquifers?

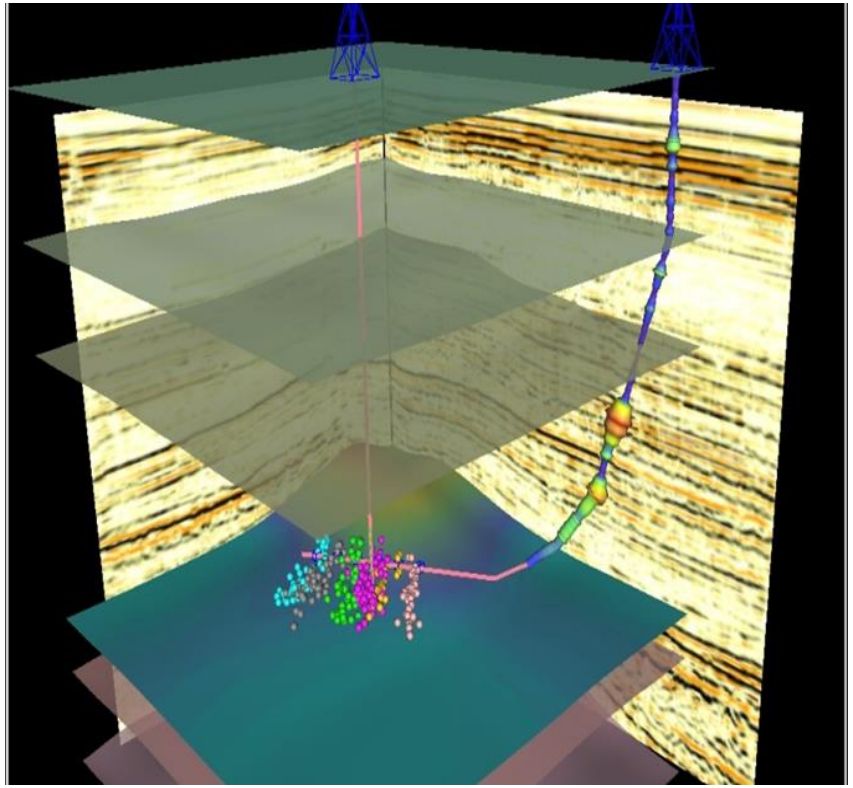
- A fracture can only grow to the volume of water and sand injected, minus the water that flows back or leaks off into the permeable formation
- Volume of fracture = volume of sand put in fracture = Length x Width x Height
- Say 100 tonnes of sand put in (a big frac), the volume of that sand is 37 m^3
- 37 m^3 vs. 1-5 km of rock above

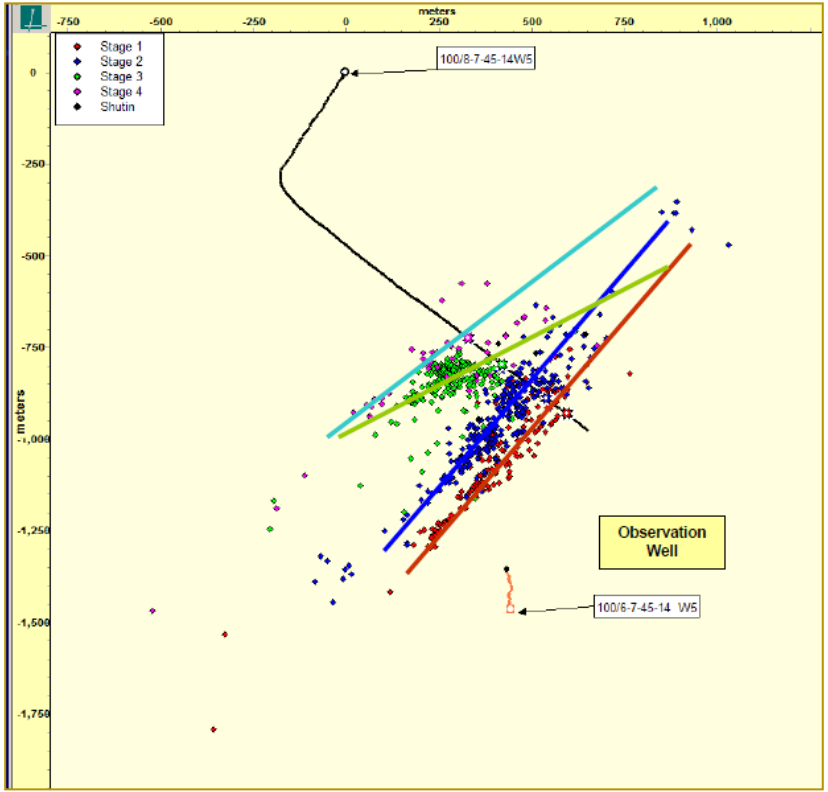


How can we measure dimensions of a fracture?



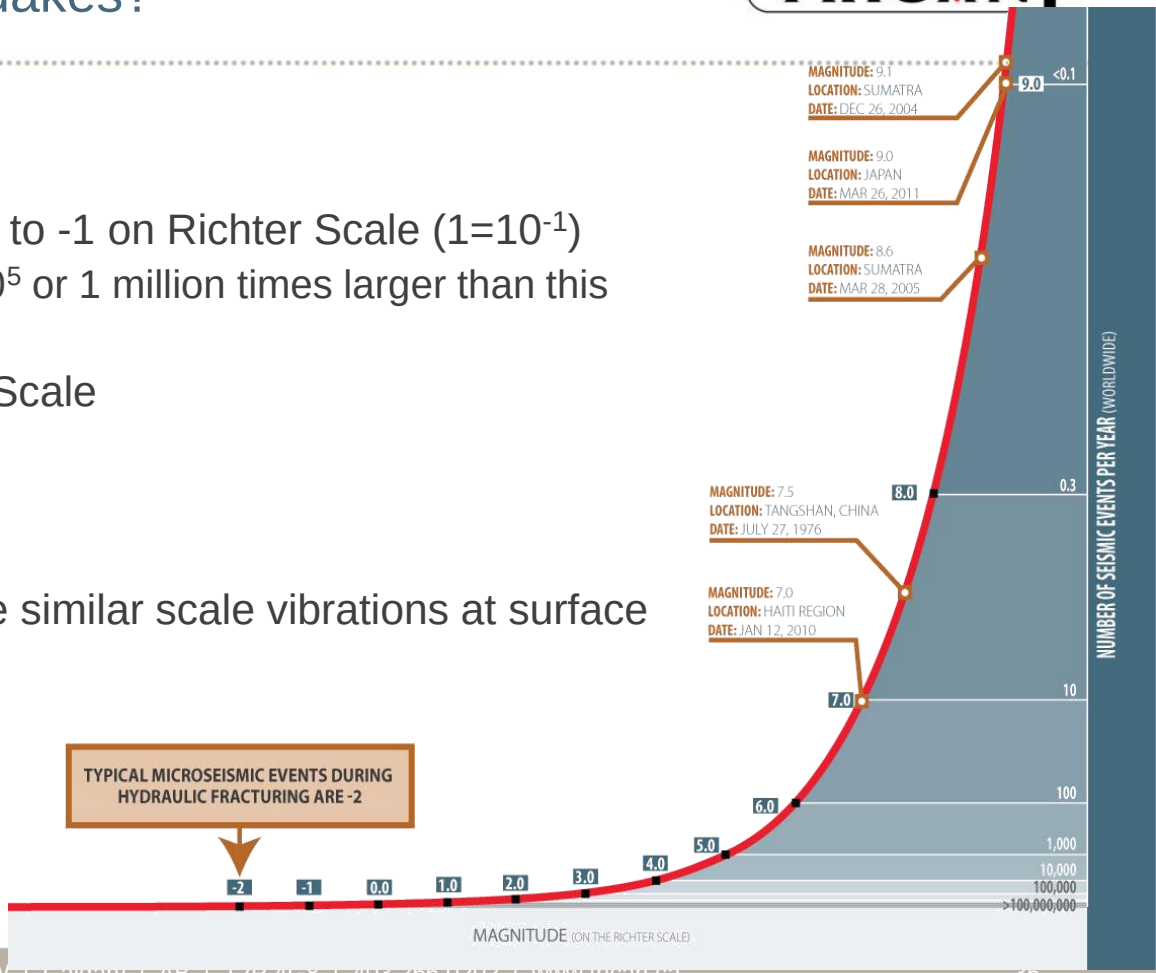
Real Data




meters
-750
-500
-250
0
250
500
750
1,000
Stage 1
Stage 2
Stage 3
Stage 4
Shutin
100/8-7-45-14W5
0
-250
-500
-750
-1,000
-1,250
-1,500
-1,750
meters
Observation Well
100/6-7-45-14 W5

Can Fracturing Cause Earthquakes?

- Yes, but not large or destructive
- Typical fracture treatments are -3 to -1 on Richter Scale ($1=10^{-1}$)
  - A magnitude 5 earthquake is 10^5 or 1 million times larger than this
- Largest measures 4.4 on Richter Scale
  - Horn River (2.2-3.8)
  - Fox Creek (4.4)
- Passing trucks or trains can cause similar scale vibrations at surface
- Dams (6.3), construction, mining geothermal (6.6)



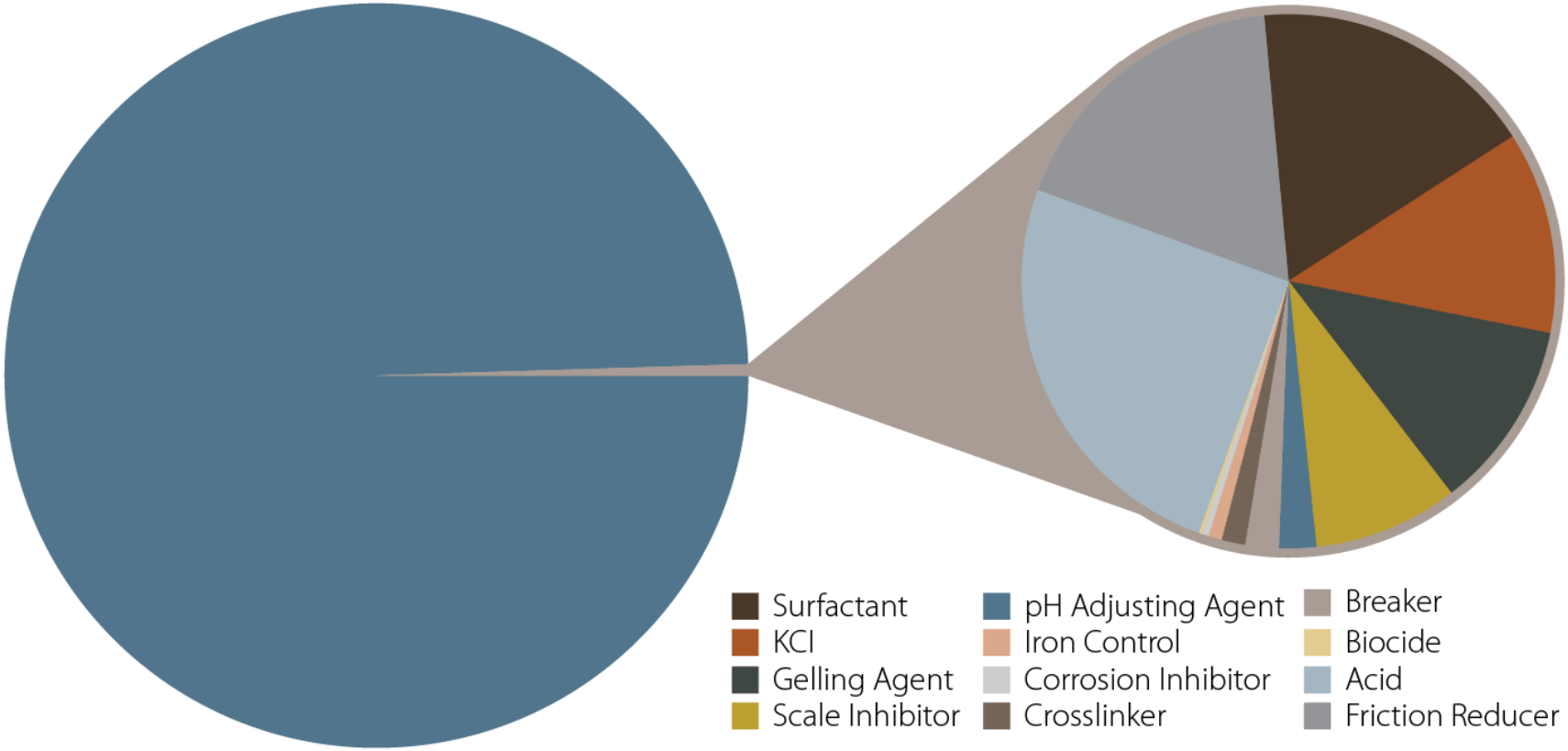
Fracturing Additives

- A typical frac fluid requires additives
  - Friction reducer or viscosifier
  - Breaker
  - Clay Stabilizer (seawater substitute)
  - Flowback enhancer
  - Scale inhibitor
  - Biocide (when water source has bacteria in it)

Fracturing Additives: common uses

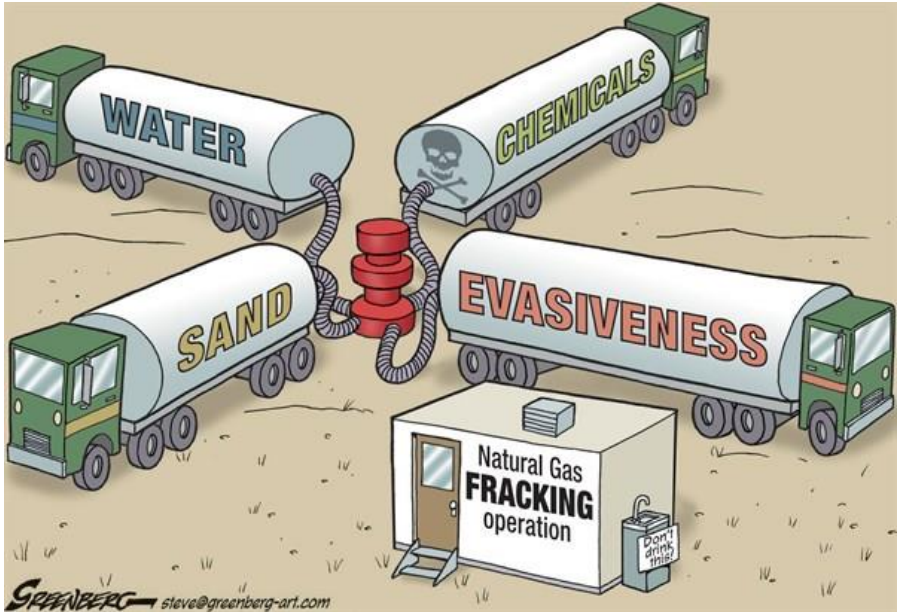
Ingredient	Common Name	Carrier Fluid use	Common use
Gellant	Guar bean gum	Water viscosifier	Cosmetics and food
Crosslinker	Borate salt	Water viscosifier	Detergent, cosmetics
Breaker	Sodium borate salt	Gel breaker for flowback	Laundry detergent
Friction Reducer	Polyacrylamide	Minimizes friction between fluid and pipe	soil conditioner for farming
Clay Control	Salt compound	Prevent clay swelling	Additive for feed/farming
Flowback Enhancer	Surfactants	Flowback carrier fluid	Cosmetics, soaps
Scale Inhibitor	Polyamine	Prevents scale from forming on pipes	Water treatment, hot tubs
pH Control	Sodium carbonate	Maintains gel crosslinker	Soap, hot tubs
Bactericide	DBNPA (amide)	Kills bacteria in mix water	Hot tubs

Fluid Composition

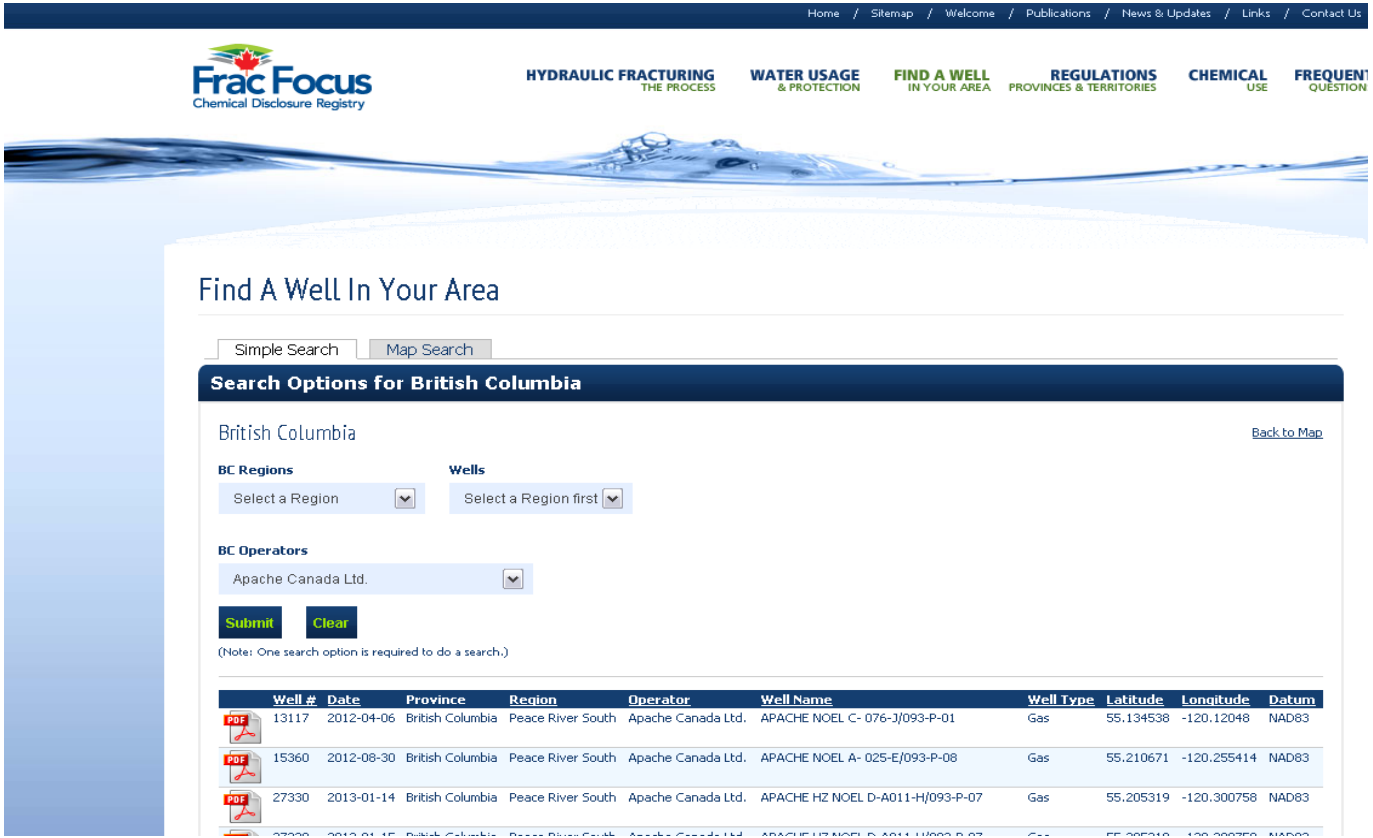


Additive Disclosure

- Fracturing is in the spotlight in the media
- Shows the public we are transparent and have nothing to hide
- Highlights our non-regulated “green” fluid systems
- A record of what was pumped into any well in case of litigation



Additive disclosure



Additives & Environment – where are we headed?

- Green lines of frac fluids and additives
- Challenging suppliers to provide green options
- Containment barriers and absorbent pads under equipment
- Dry add guar (powdered) instead of slurried with oil (mineral or diesel)
- Natural gas powered fracturing equipment
- Reducing water requirements (3R’s)

Summary

- Not a new technology
- Causes small, non destructive earthquakes like many other industrial activities
- Uses relatively little water; still trying to reduce our water usage
- Allows us to produce more natural gas – clean burning, bridge fuel
- Wells are cased and cemented before fracturing occurs to protect aquifers
- Fracturing is performed far below the surface and cannot propagate to fresh water zones
- Fracturing additives are made from widely used chemical; trying to improve these to improve handling safety (people and environment)
- Additive disclosure is mandatory

http://www.csur.com/resources/understanding-booklets