



HALLIBURTON
100 YEARS

New Mexico Water & Natural Resources Committee Hydraulic Fracturing Overview

Jonathan Smith
Halliburton Global Sales & Marketing – Production Enhancement
09/05/2019

Halliburton Global Footprint



- Locations
- TC Technology Centers
- ★ Corporate Headquarters

Founded in Duncan, OK

1919

Employees

60,000*

140+ Nationalities in 80 countries

Research & Technology Centers

12

Ranking of US Patents Granted in 2018

39th (896 total)

Worldwide Patents Granted Since 1919

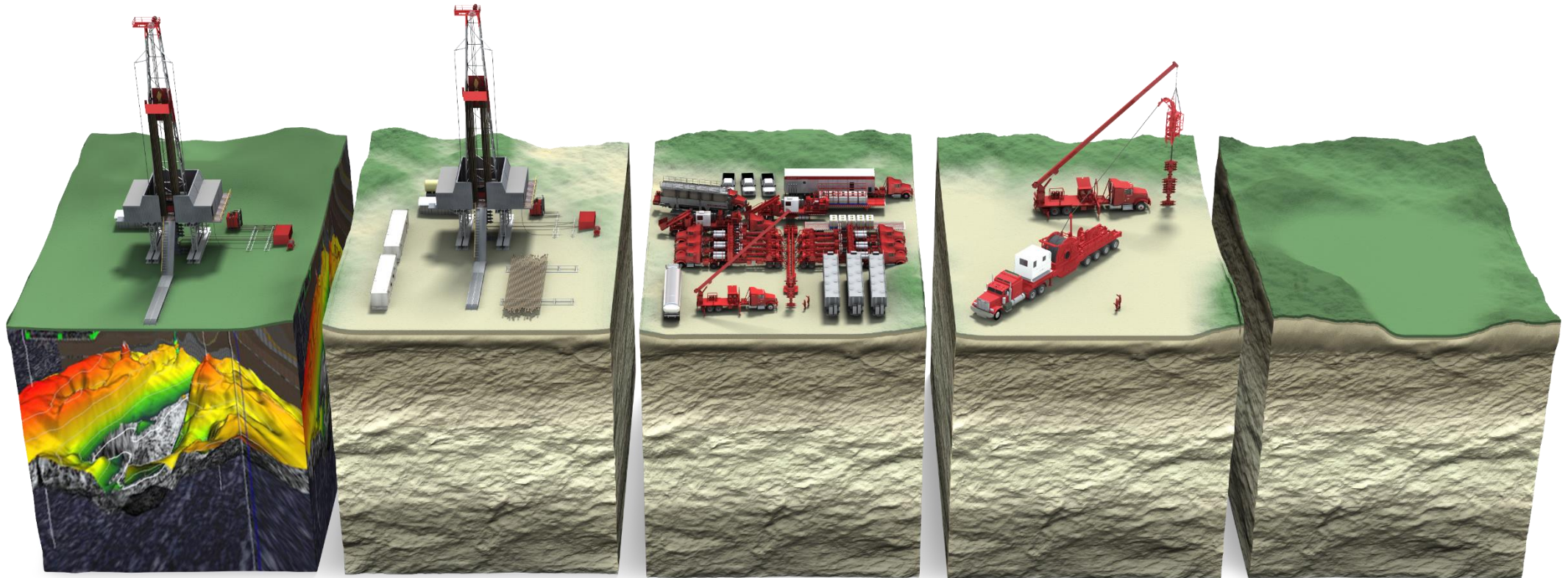
37,000

Fortune 500 List

#146

*approximate estimate

Oilfield Life Cycle



Exploration

Well Construction

Completions

Production

Abandonment

Velma, Oklahoma



The First Commercial Frac Job
March 17, 1949



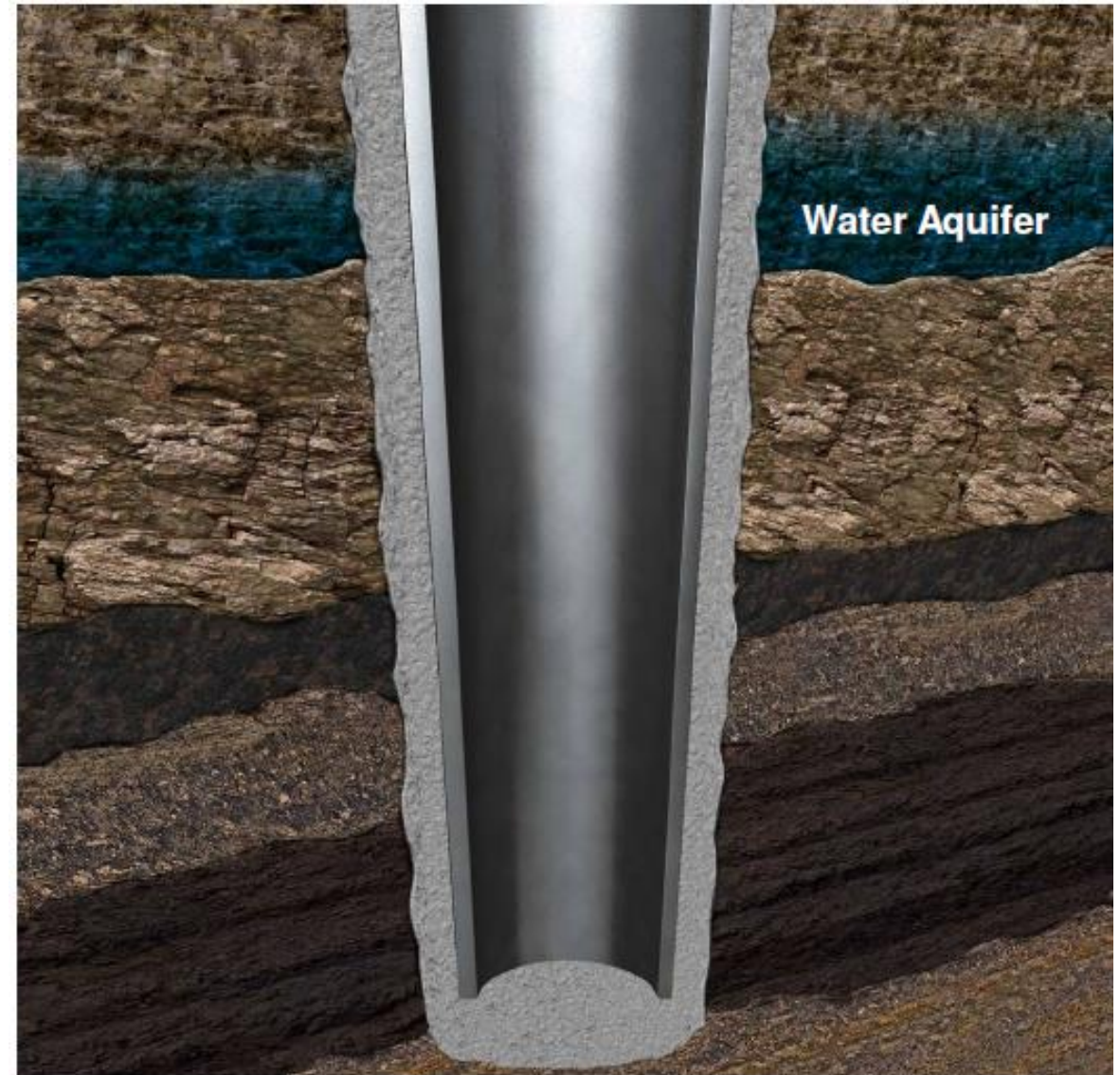
Current U.S. Frac Location



Wellbore

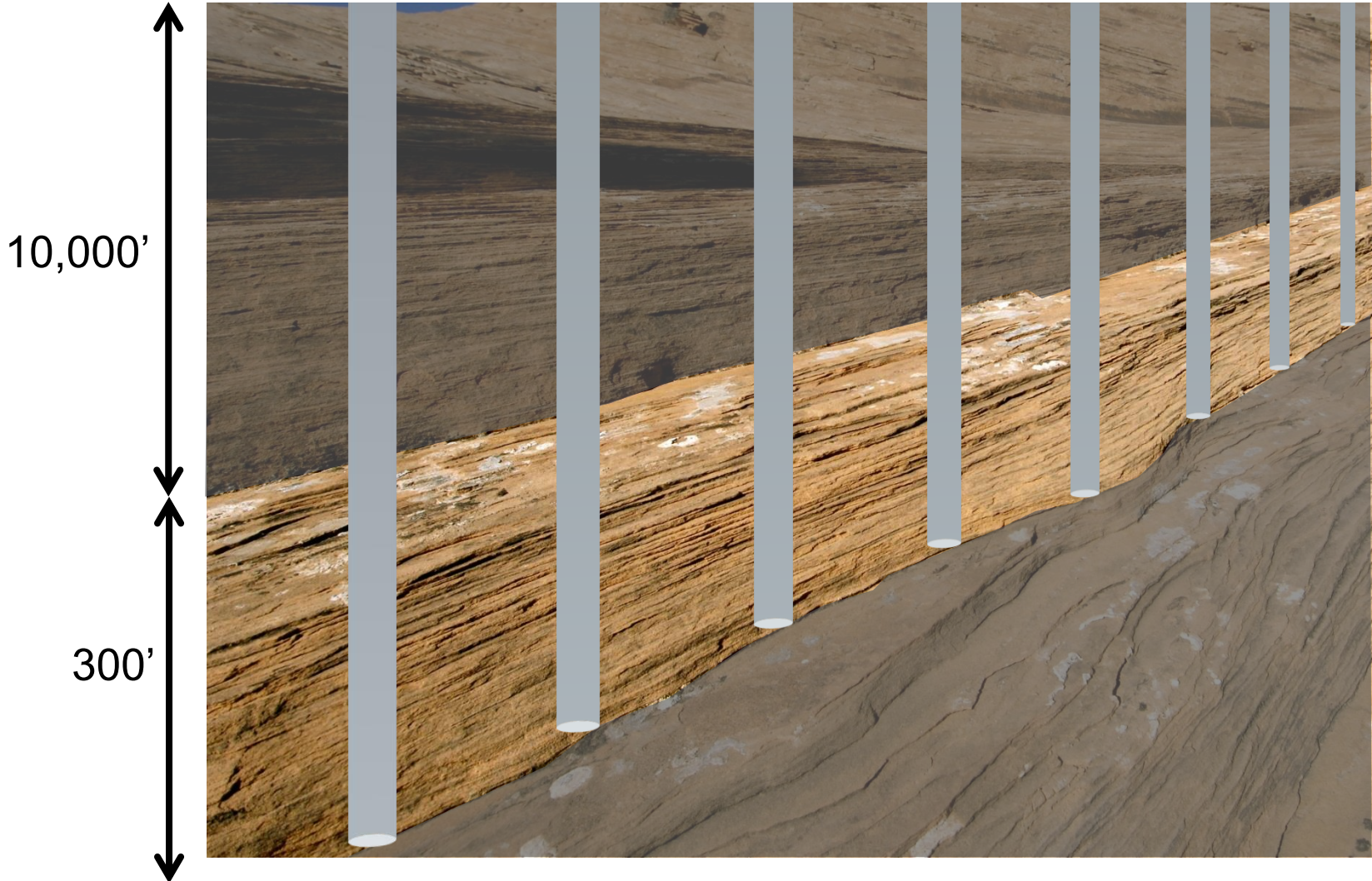
Purpose of Cementing

- Protects ground water
- Bonds and supports the casing
- Restricts fluid movement between formations

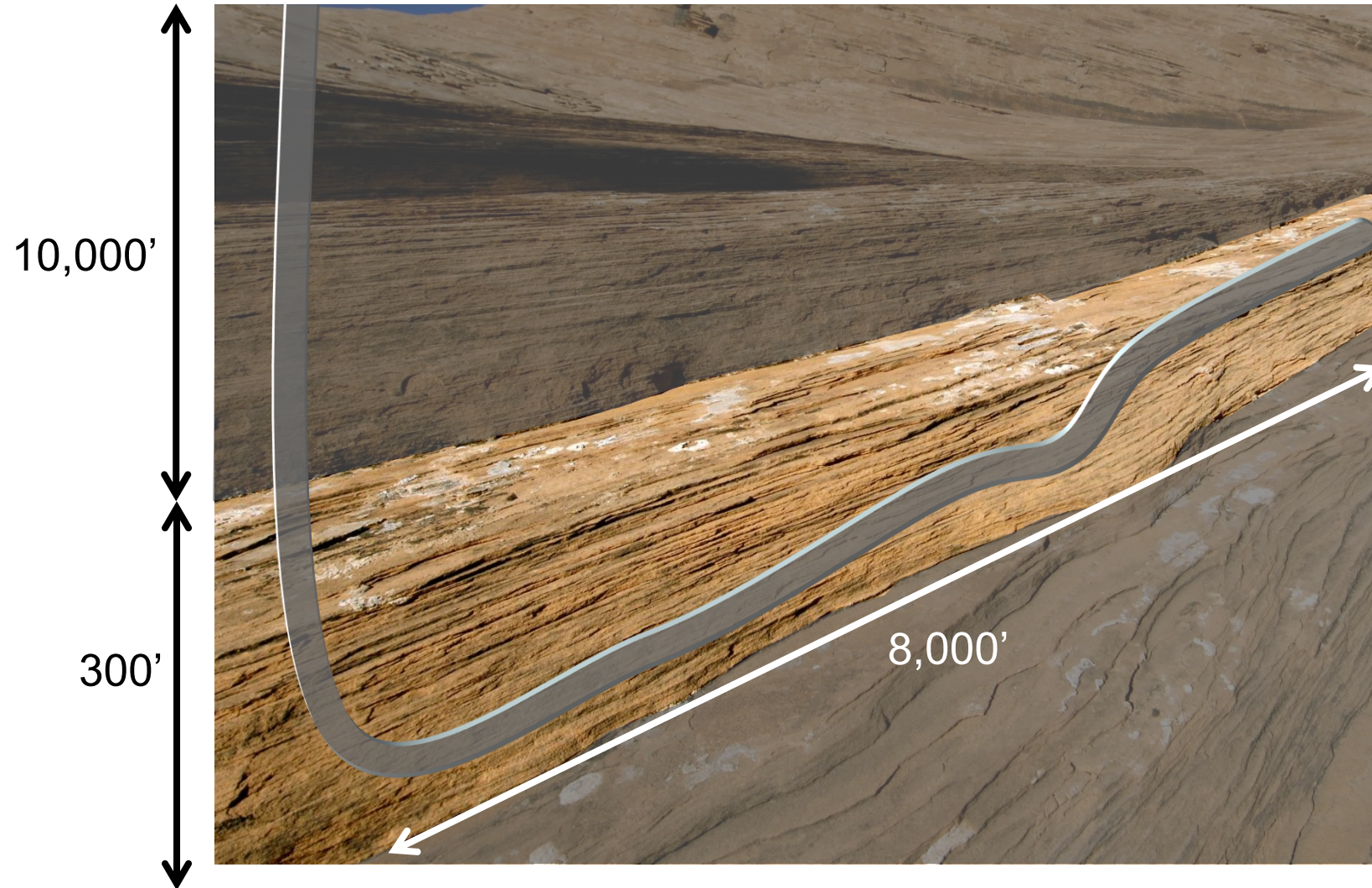


Society of Petroleum Engineers, Cementing Monograph Volume 4, 1990

Why Horizontals?



Why Horizontals?

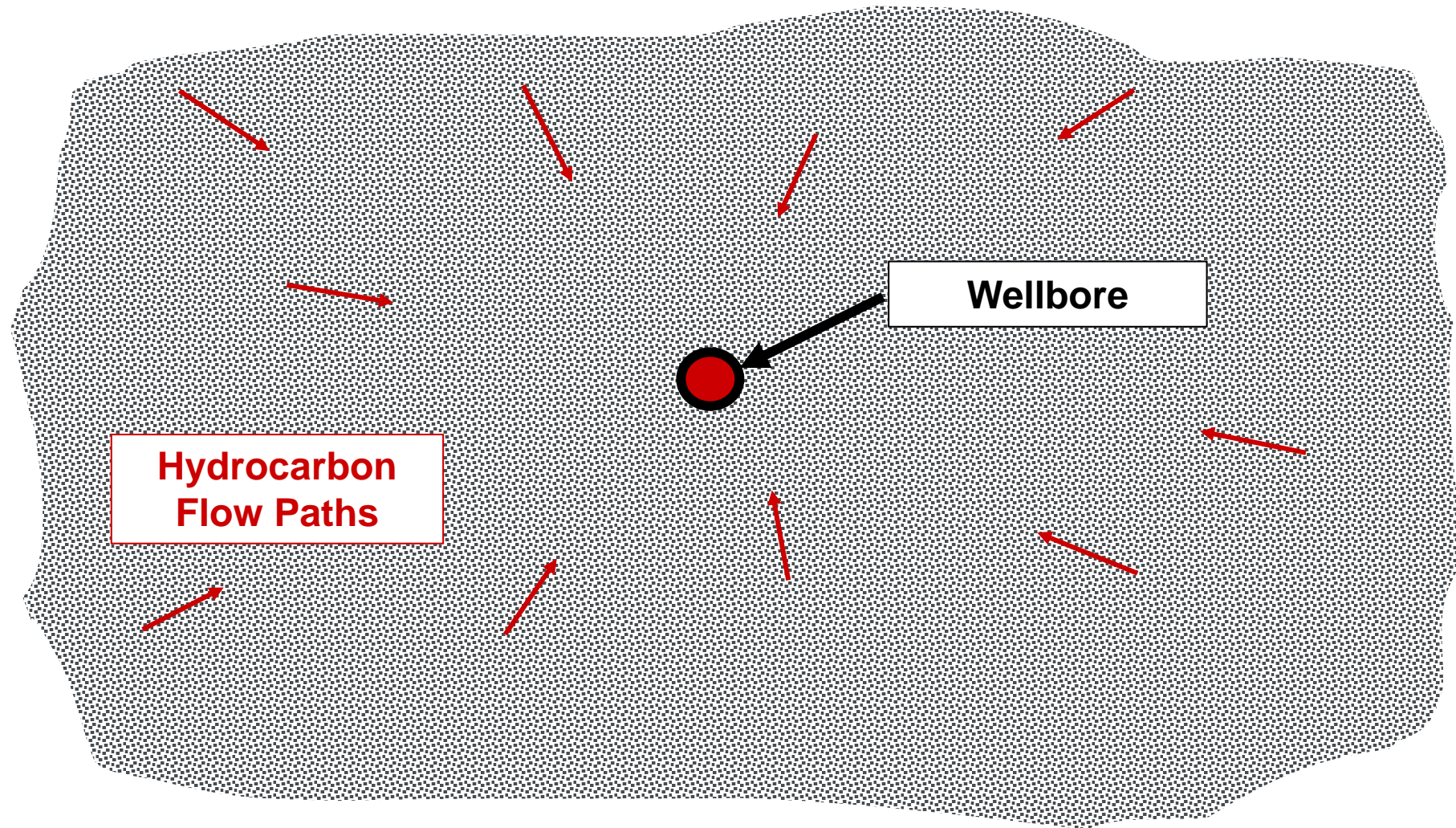


Maximize
Reservoir
Contact

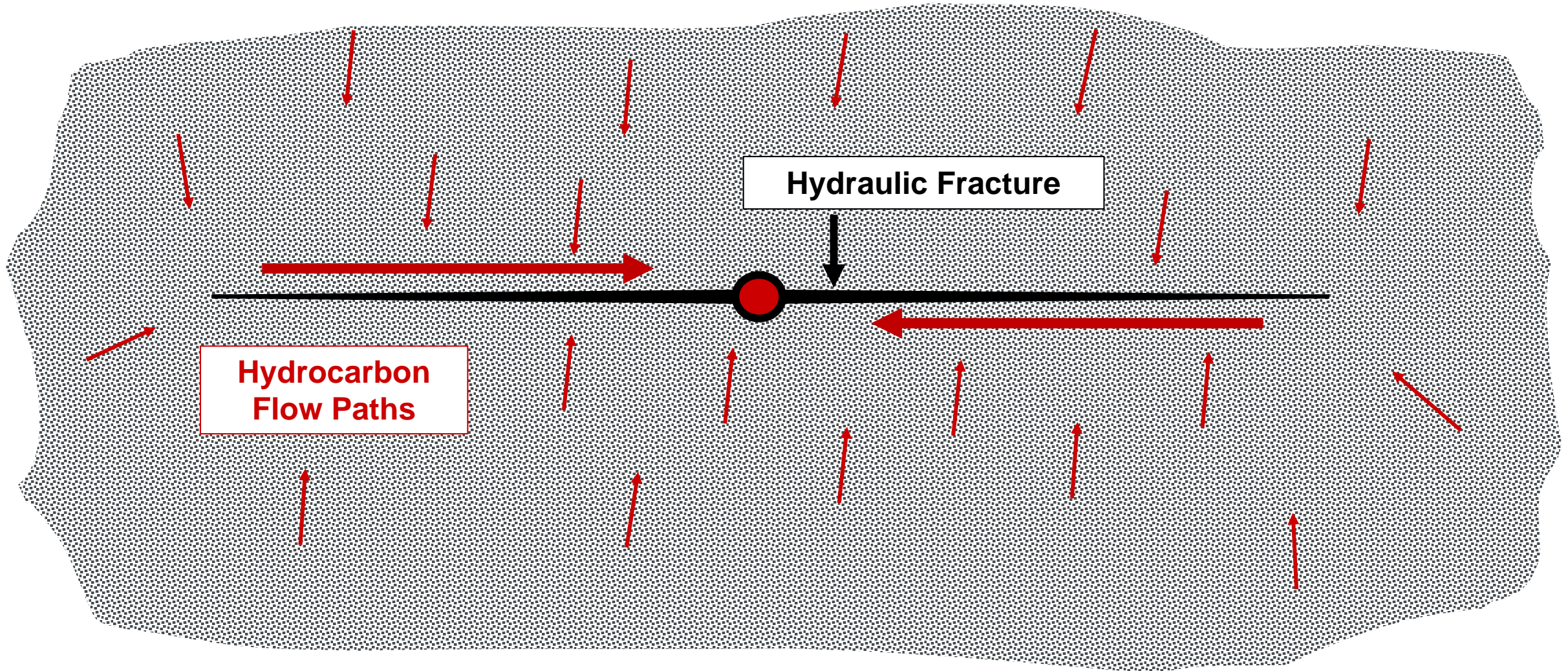
Minimize
Environmental
Footprint

Lower the
Overall \$/Barrel
of Oil

Normal Hydrocarbon Flow

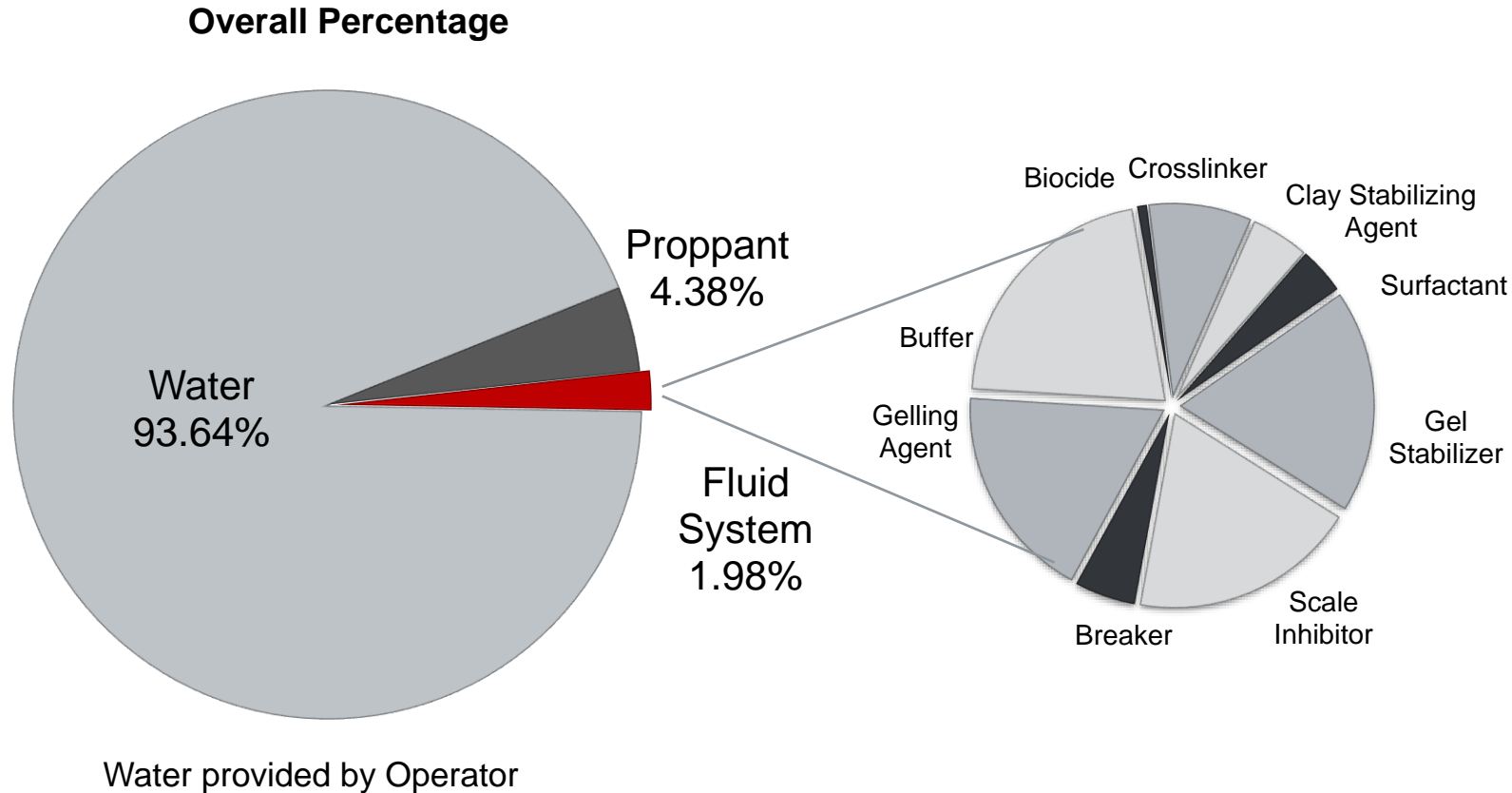


Flow With a Fracture



Basic Components of a Conventional Fracturing Fluid

Typical Additives Used in Fracturing Fluid and COMMON HOUSEHOLD ITEMS



SODIUM CHLORIDE
used in table salt



ETHYLENE GLYCOL
used household cleaners



BORATE SALTS
used in cosmetics



SODIUM/POTASSIUM CARBONATE
used in detergent



GUAR GUM
used in ice cream

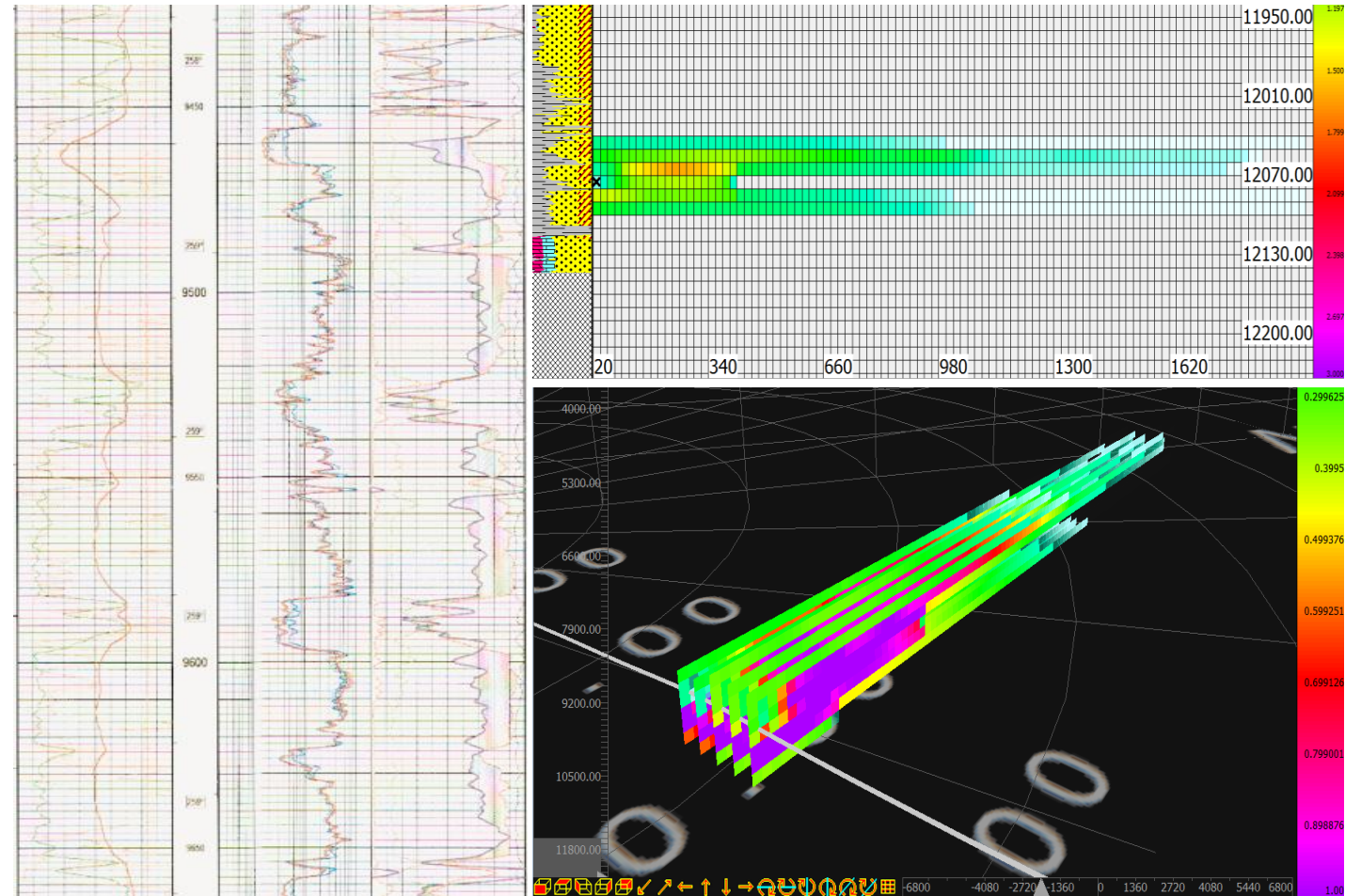


ISOPROPANOL
used in deodorant

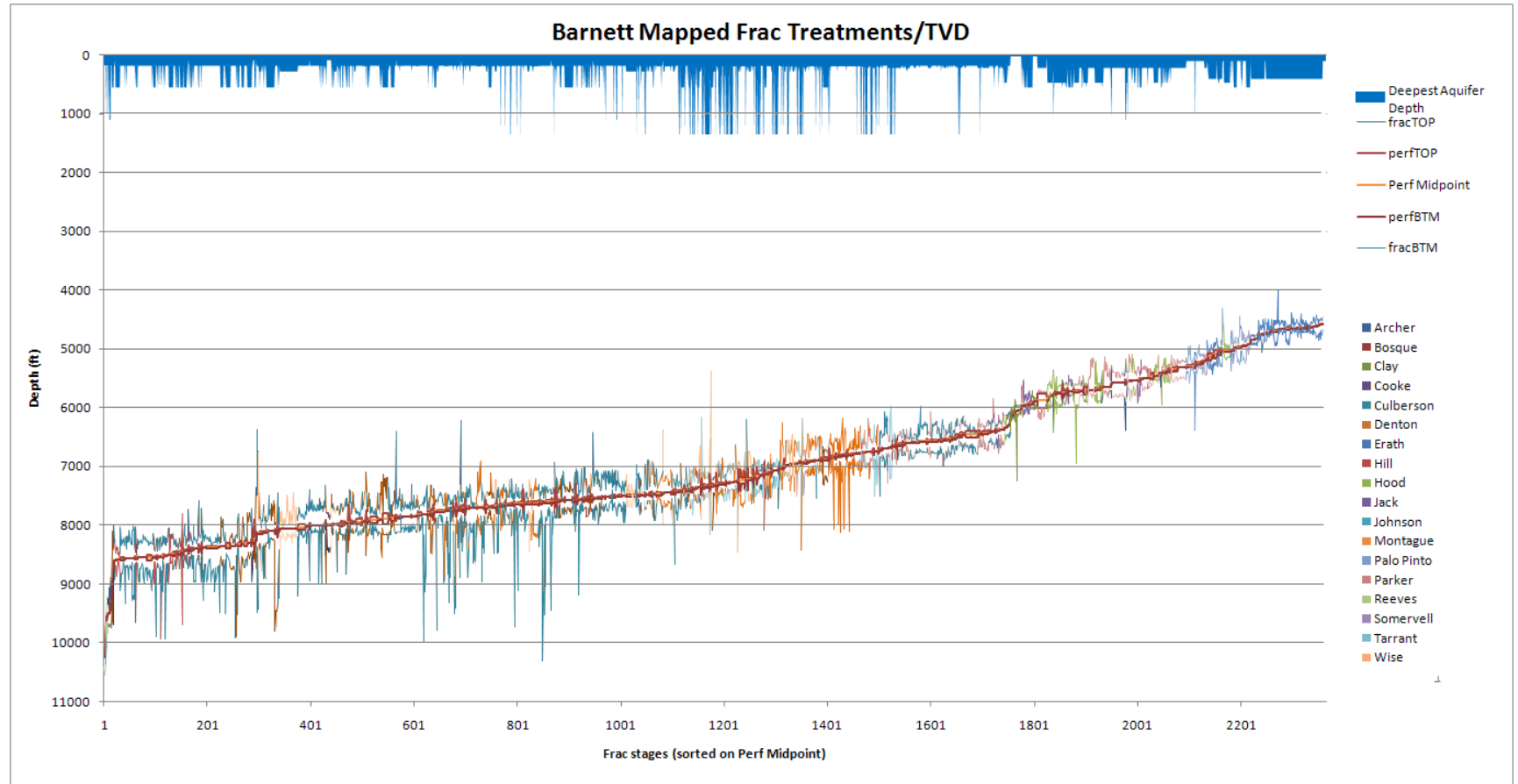
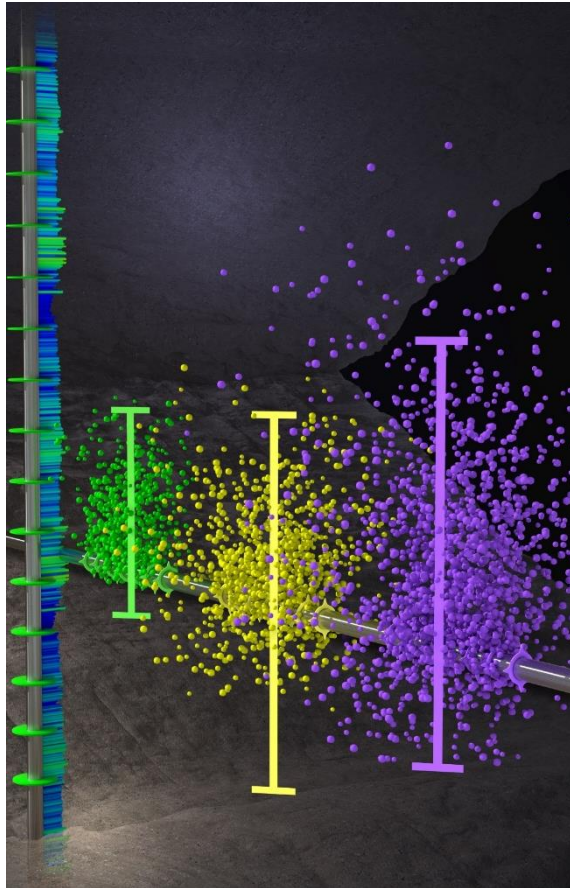


Fracture Modeling

- Geomechanical properties to build frac model
 - Poisson's ratio
 - Young's modulus
 - Pore pressure
 - Minimum horizontal stress
 - » Why wells aren't always drilled N-S or E-W
- Properties derived from
 - Well logs
 - Core testing
 - DFIT



Fracture Height Determination

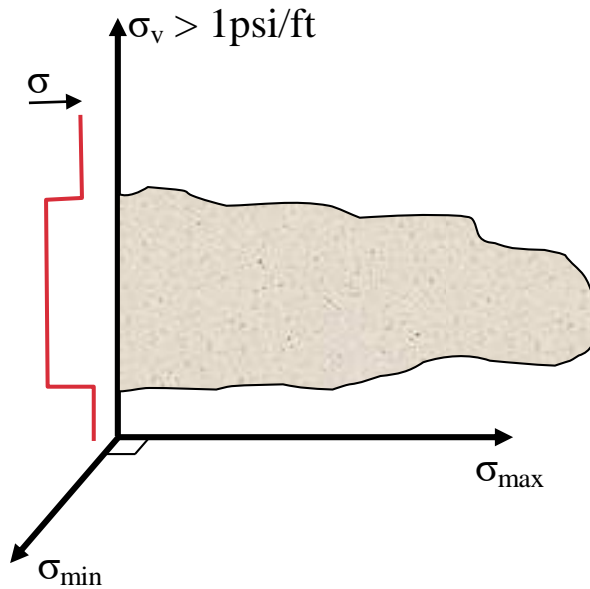


Kevin Fisher, "Data Confirm Safety of Well Fracturing,"
The American Oil & Gas Reporter – July 2010

Hydraulic Fracturing

An Engineered Process

Hydraulic Fracturing Equation



$$\sigma_{\min} = \left[\begin{matrix} \nu \\ 1-\nu \end{matrix} \right] \left[\sigma_z - \alpha_1 P_R \right] + \alpha_2 P_R + \sigma_{fec}$$

Fracture Design Pump Schedule

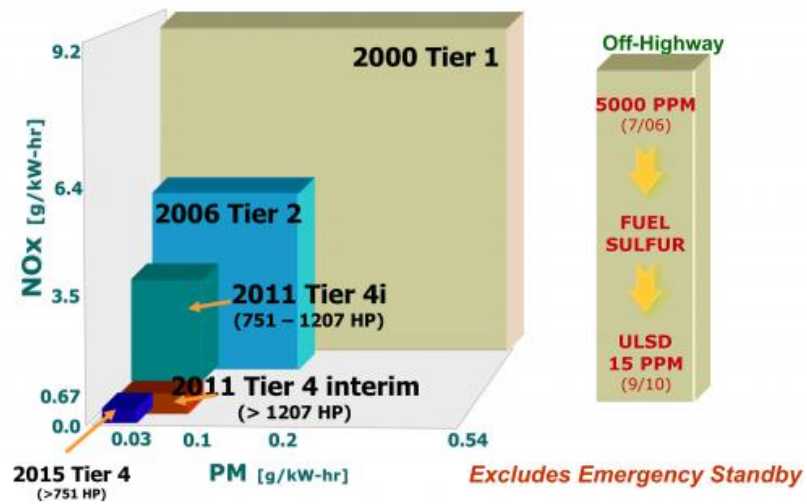
Stage #	Flow Path	Fluid System	Prop Type	Stage Time (min)
1 - 1	Shut-In			0
1 - 2	In	20# Water Frac G		39.3
1 - 3	In	20# Water Frac G	SAND - PREMIUM - 20/40, BULK, SK (100003678)	17.82
1 - 4	In	20# Water Frac G		6.39
1 - 5	In	15% Hydrochloric Acid		1.06
1 - 6	In	20# Water Frac G		16.46
1 - 7	In	20# Water Frac G	SAND-CRC PREMIUM-20/40, BULK (101357961)	7.02
1 - 8	In	20# Water Frac G	SAND-CRC PREMIUM-20/40, BULK (101357961)	10.32
1 - 9	In	20# Water Frac G	SAND-CRC PREMIUM-20/40, BULK (101357961)	8.96
1 - 10	In	20# Water Frac G	SAND-CRC PREMIUM-20/40, BULK (101357961)	6.31
1 - 11	In	20# Water Frac G		10.37
1 - 12	Shut-In			0
Total				124.01

Fracture Treatment



Minimizing Our Environmental Footprint

Evolution of EPA Off-Highway Emission Standards



Containerized Sand Delivery System

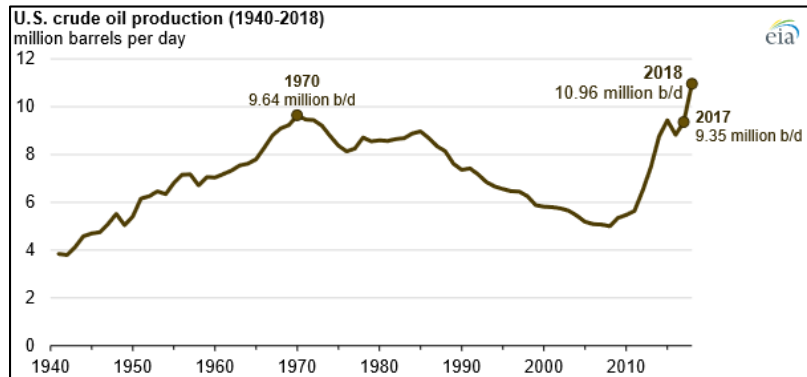
Efficient proppant management system.

- Step change in proppant management
- Elimination of dust
- Reduced footprint & noise
- Reduces truck congestion

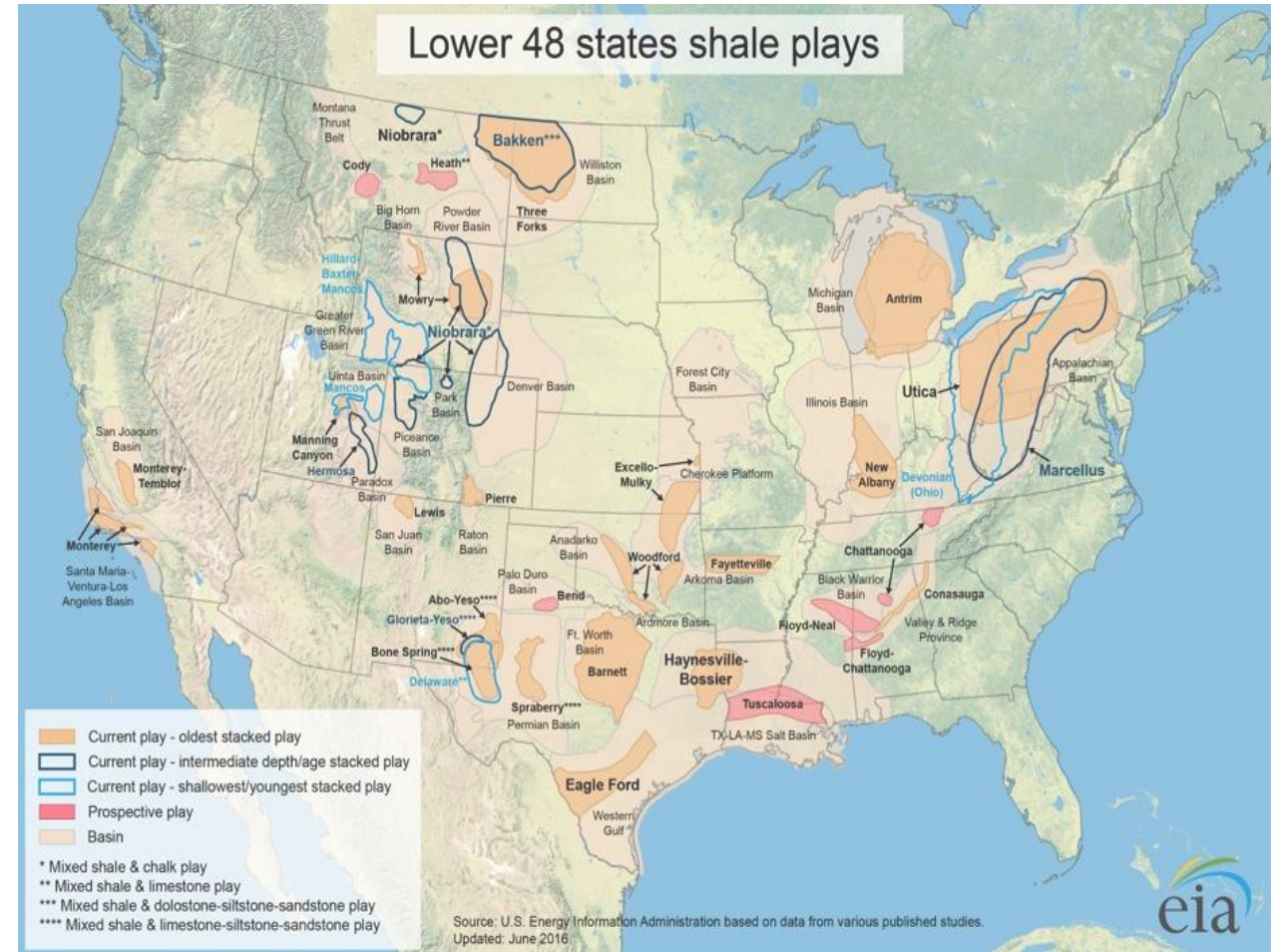


Hydraulic Fracturing – Turning Dry Holes into Producers

- America's oil & natural gas production has nearly doubled since 2005



- Hydraulically fracture horizontal wells key technical breakthrough
- Utilized in more than two million wells
- Up to 95 percent of new wells drilled today are hydraulically fractured





THANK YOU