



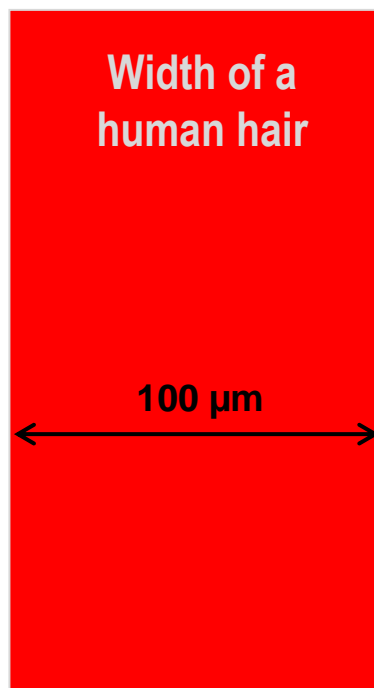
# The Hydraulic Fracturing Process: FACTS

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**HALLIBURTON**

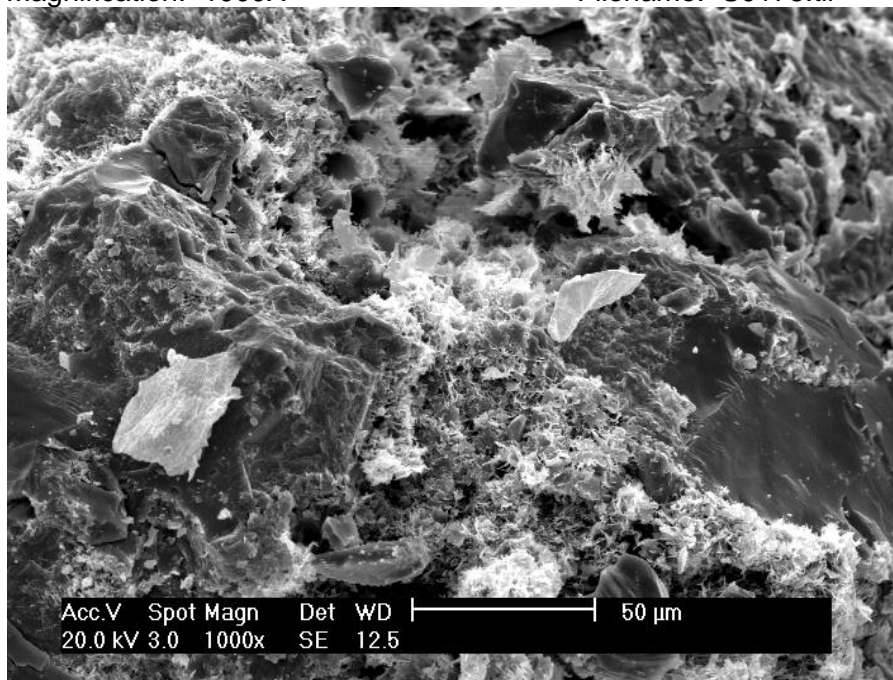
# Why “Frac” a Well?

- **Primarily - to improve well production**
  - Low Permeability Reservoirs – *Require* hydraulic fracturing for economic production rates
  - Medium Permeability Reservoirs – Accelerate recovery from wells
  - High permeability Reservoirs – Bypass near wellbore drilling damage

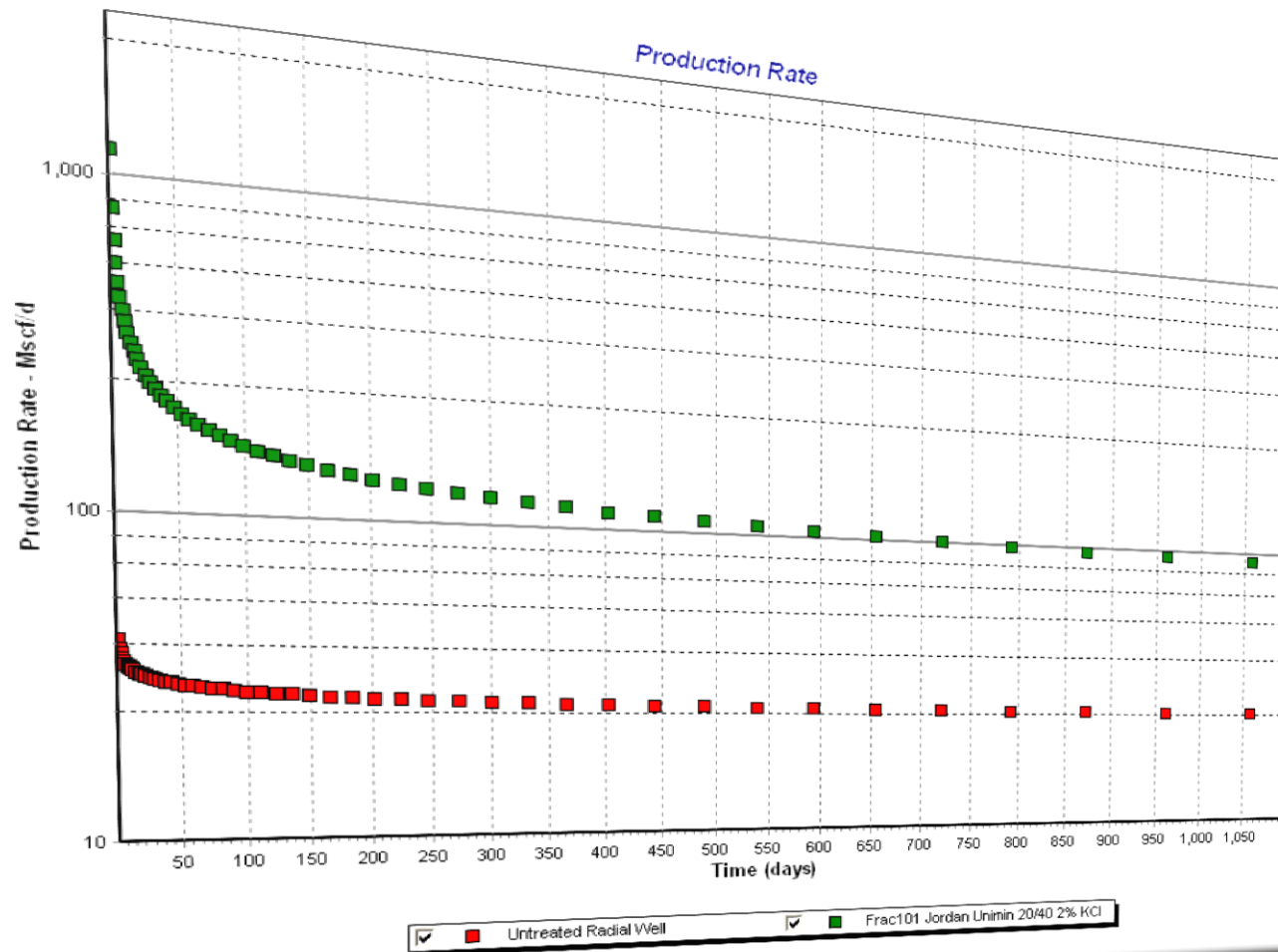


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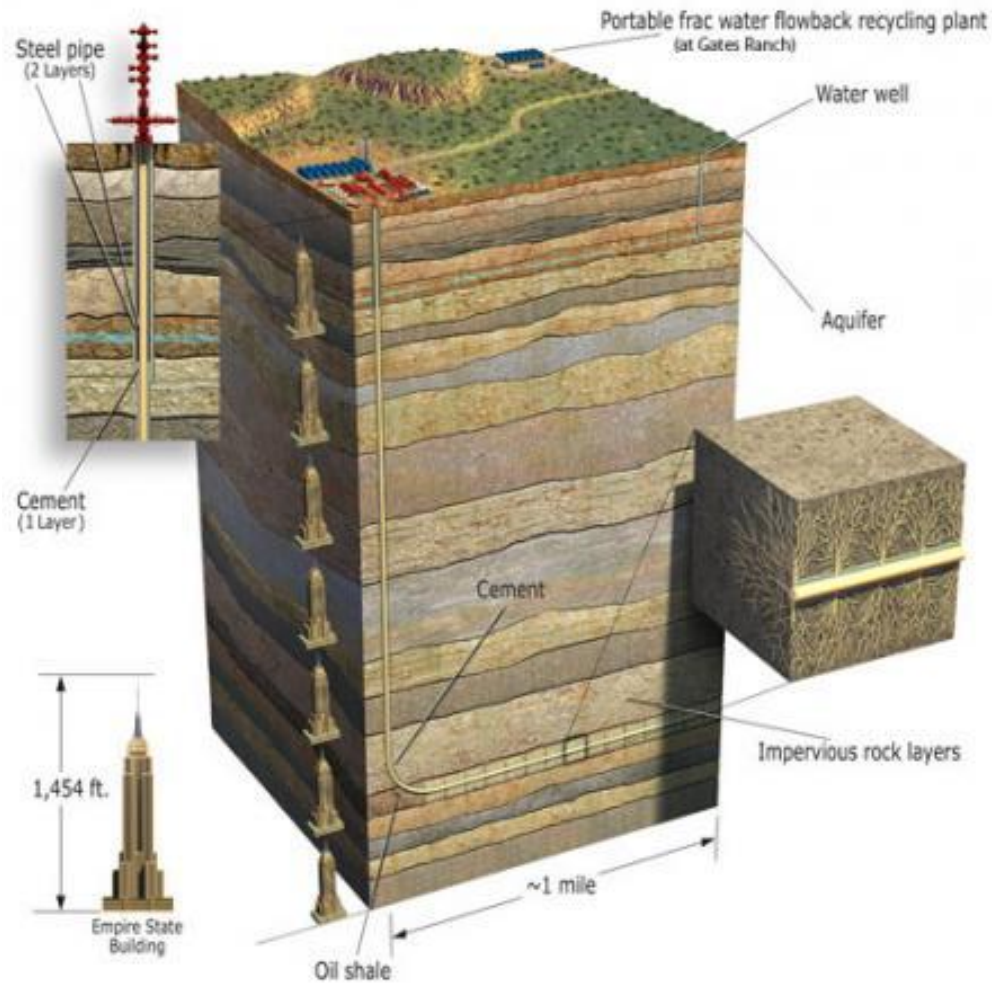


# Why “Frac” a Well? (contd..)



Predict-K 7.5

# Horizontal Well Construction & Frac Process



Source: Fracfocus.org

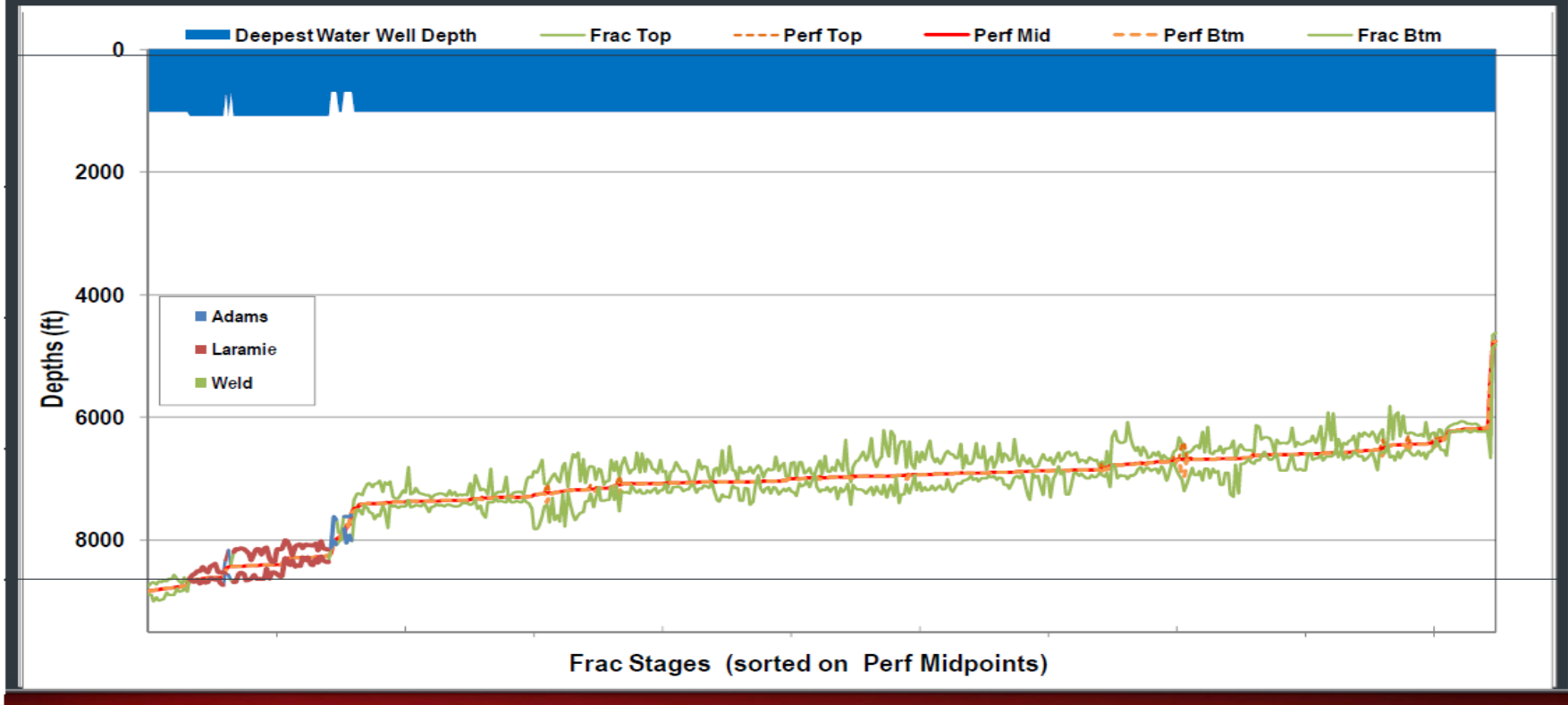
# Horizontal Well Frac Video

Predict-K 7.5

# Frac Height Growth

## Mapped microseismic height for Niobrara

- Top: shallowest microseism; Bottom: deepest microseism
- Aquifers: USGS deepest water well levels by county





# Fracturing Fluid Systems

- Water fracs
  - Friction reducers
  - Low linear gel conc
- Gelled water
  - Guar, HPG, CMHPG, HEC, etc
  - Crosslinked
- Gelled Oil
- Energized systems
  - $N_2$ ,  $CO_2$
  - Foams or assist
- Hybrids
  - Water pad, gelled Sand Laden Fluid



# Additives Used in Frac

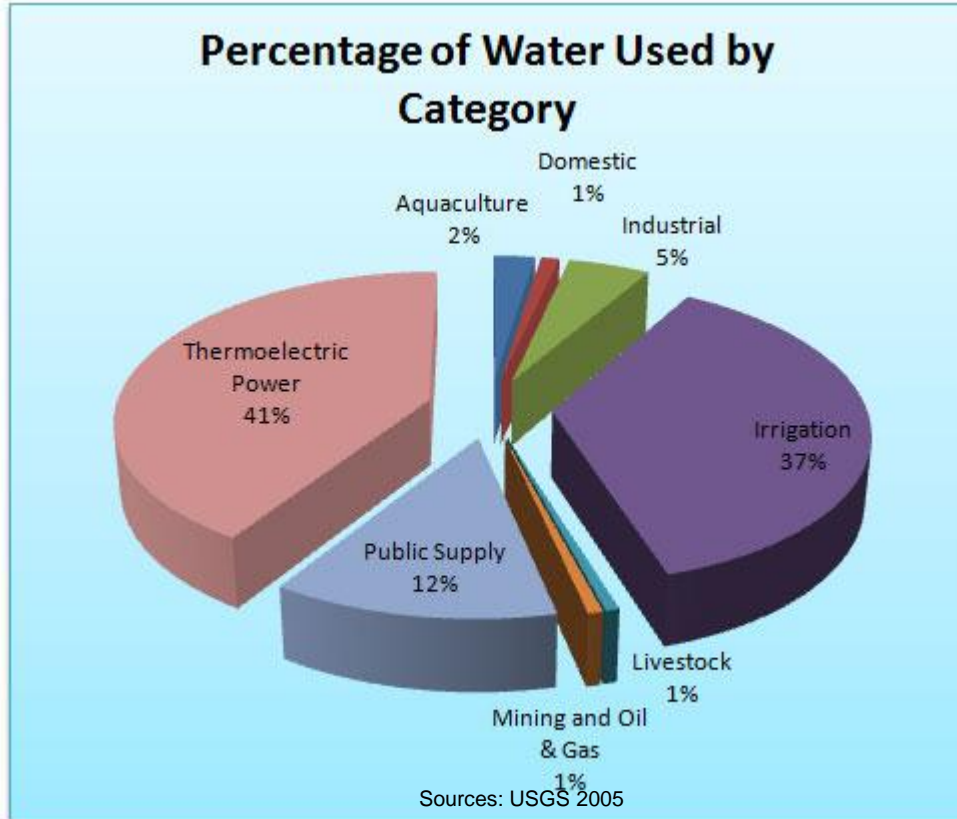


Example of Typical Niobrara Shale Fracing Fluid Makeup

Sources: Fracfocus, USGS, GWPC, NYSDEC2011



# Water Usage in Hydraulic Fracturing



- Typical Niobrara well frac uses ~3.0 million gallons of water.
- Compare this to
  - NYC uses ~4.5 million gallons in approximately 6.3 mins.
  - A 1000 megawatt coal-fired power plant uses 4.5 million gallons in 10.8 hrs
  - A golf course uses ~4.5 million gallons in 22.5 days for irrigation
  - 6.75 acres of corn uses ~4.5 million gallons in one season for irrigation.

# New Technology: CleanStim™ Frac Fluid

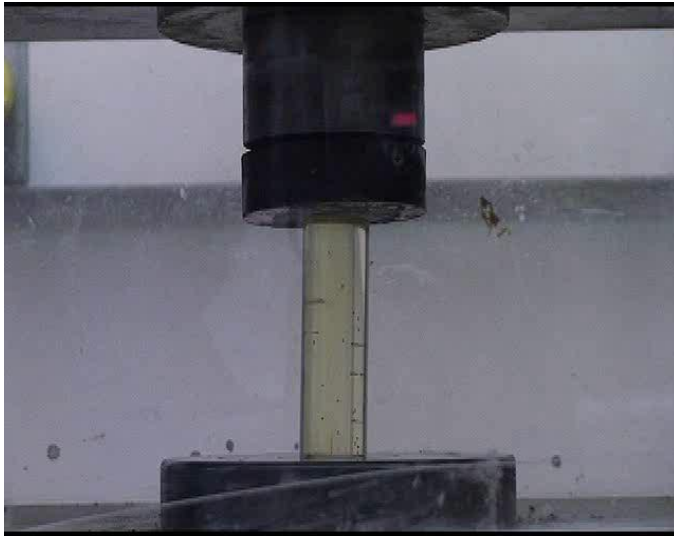


**CleanStim™**  
**Crosslinked Gel w/ proppant**

**CleanStim™**  
**Crosslinked Gel**

**CleanStim™**  
**Linear Gel**

# New Technology: WellLock™ Resin System



- Gas impermeable secondary barrier
- Ideal for squeeze applications, micro annuli repairs and for permanent plug and abandonment
- Compressive strengths upto 18,000 psi.

# Summary

- Unconventional resources require hydraulic fracturing to be economic
- Formations targeted for fracturing are generally thousands of feet below ground
- Few additives are used in low concentrations to make frac fluids
- There is science behind the process
- Halliburton has developed next generation environmentally friendly fluid systems.
  - Moving towards using 100% recycled water for frac

# Thank you, questions?

