Hydraulic Fracturing
Drilling the Well
Protecting Ground Water

Definitions and Key Words: The Completed Well

**Wellbore:** the hole drilled by the bit, also called a borehole.

**Casing:** a wellbore may have carbon steel casing (pipe) in it or it may be open (uncased); or part of it may be cased, and part of it may be open. If it is cased it is usually cemented (more than 99% of the time). Has screwed connections

**Tubing:** production conduit for fluids from formation to surface

**Packer:** isolates tubing and production fluids from casing

**Perforations/Perfs:** holes shot through the casing and cement out into the formation rock
Completing the Well: Perforating, Stimulation and Equipping for Production
Definitions and Key Words

Drilling Mud: a specially compounded liquid circulated through the wellbore during rotary drilling operations, also called drilling fluid. Serves to cool the bit and counteract downhole formation pressure.


Definitions and Key Words

Hydraulic Fracturing Fluid (Frac Fluid):


Definitions and Key Words

Chesapeake’s Hydraulic Fracturing Fluid:

- Water and Sand: >98%
- Other: <2%
  - Acid: Used in swimming pools
  - Anti-bacterial Agent
  - Used in disinfectants
  - Breaker: Used in hair color
  - Clay Stabilizer: Used in IV fluids
  - Corrosion Inhibitor: Used in plastics
  - Crosslinker: Used in laundry detergents

Friction Reducer
- Used in cosmetics
- Gelling Agent: Used in toothpastes
- Iron Control: Used in food additives
- pH Adjusting Agent: Used in many bar soaps
- Scale Inhibitor: Used in household cleaners
- Surfactant: Used in deodorant

What is “Hydraulic Fracturing”?

- The use of fluids (hydraulic pressure) to create a crack (fracture) in the Reservoir Rock.

- Continued injection of fluids into the created crack (fracture) to create fracture geometry (height, width, and length).

- The placement of granular solids (prop) into the crack to insure the crack remains open (propped) after the hydraulic pressure is no longer being applied.
Horizontal Well Hydraulic Fracturing Procedure

Horizontal borehole is drilled, cased and cemented.
How Horizontal Well Hydraulic Fracturing Procedure

First completion stage: wellbore is perforated over a selected interval based on petrophysics and other data
The previously perforated interval is hydraulically fractured by pumping fluids (usually viscous liquids) which creates cracks. Many times these cracks are pre-existing.
Proppant, sand or stronger material such as bauxite, is added to the hydraulic fluid during the pumping process and enters into the previously created cracks (continuous process).
The pumps are shut down and plug is set just behind the interval just hydraulically fracture treated and the process is repeated over and over progressively back toward the heel or beginning of the horizontal wellbore, until the entire horizontal wellbore is treated.
Horizontal Well Hydraulic Fracturing Procedure

- **KOP**: kickoff point
- **HMAX**: maximum horizontal depth
- **HMIN**: minimum horizontal depth
- **D**: hydraulic fracture displacement
- **Lr**: reach length
- **Objective Formation**

*Side View*
How the Hydraulic Fracturing Works

Proppant, sand or stronger material such as bauxite, keeps the crack open to allow gas or fluid to flow with less resistance.
Realistic View of a Fractures Created by Hydraulic Fracturing
What Does the Fracture Look Like

- Simple Fracture
- Complex Fracture
- Complex Fracture With Fissure Opening
- Cored Hydraulic Fracture

Diagram showing:
- Planar Hydraulic Fractures
- Complex "Orthogonal" Hydraulic Fracture Network
- Complex "Un-structured" Hydraulic Fractures

Proppant
Bedding Planes
Mapping a Fracture
Other Geometries Based on Actual Hydraulic Fractures Mined Several Months after Well Treatment
Shale Plays
