OILFIELD WATER,

a resource or a waste stream?

Denny Bullard, PE

July 30, 2018

Uses of water in oil and gas operations

- Drilling fluids
- Hydraulic fracturing
- Secondary recovery (Water flooding)

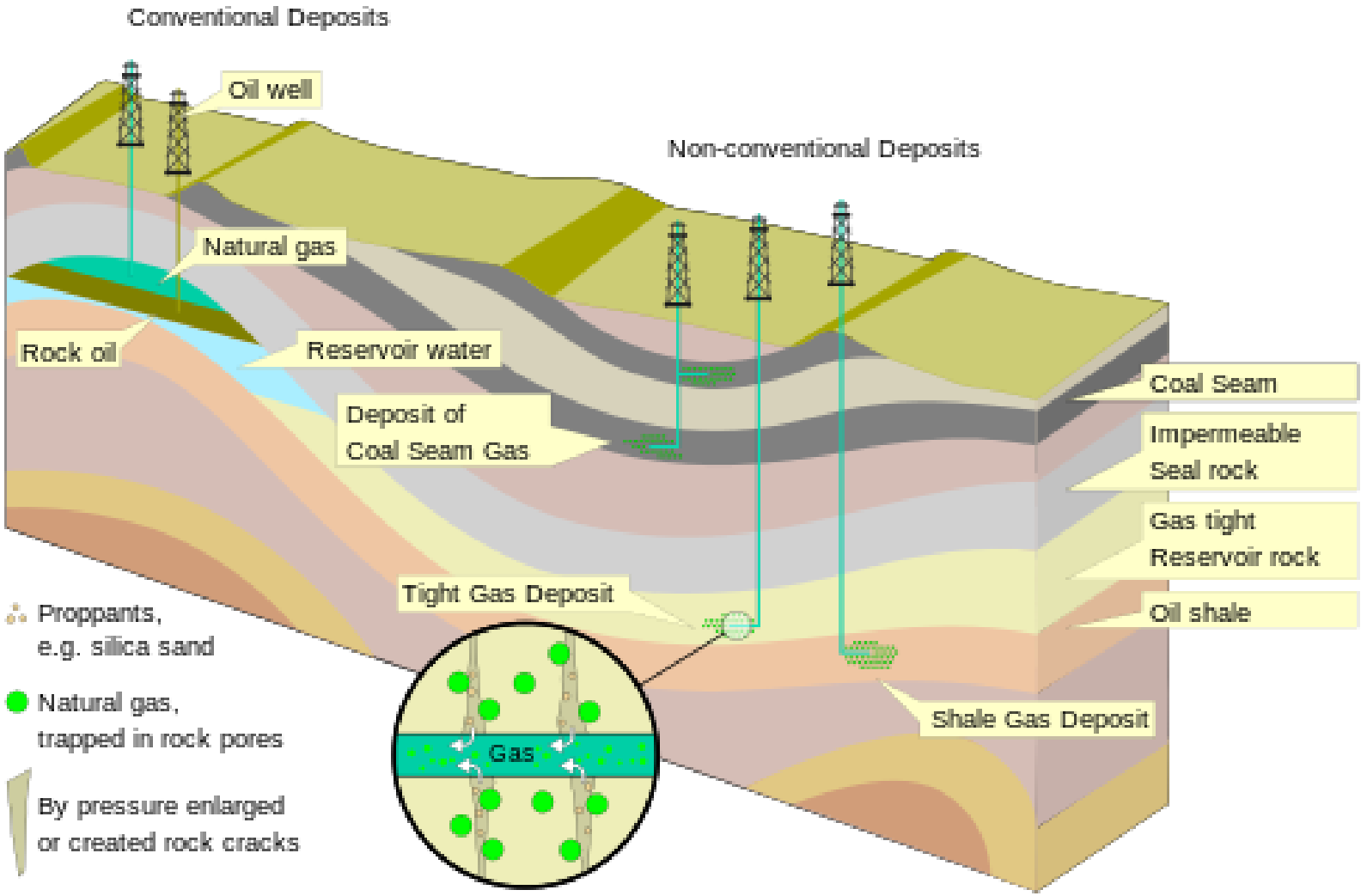
Oilfield produced water

- Almost all oil wells will produce some water.
- Some gas wells will also produce water along with the gas.
- Produced water from all but a few types of reservoirs is not suitable for human consumption without further treating.
- Produced water that cannot economically be treated to be used in production operations must be disposed.
- Disposal can be into salt water disposal wells. If water quality is high enough, it may be discharged on the surface for livestock and wildlife to consume.

Where does the water originate?

- Reservoirs
  - Sub-surface rock strata
  - Carbonates, sandstones or shales
  - Hydrocarbons and water are in pore spaces
  - Water drive or solution gas expansion provide energy (pressure)
- Drilling/Completions
  - Wellbore provides pathway from reservoir to surface
  - Perforations in pipe connect reservoir to wellbore
  - Stimulation treatments (frac) increase flow path in reservoir
- Production
  - Maintaining flow from the well
  - Handling fluids on the surface

RESERVOIRS


Conventional Deposits
Oil well
Natural gas
Rock oil
Reservoir water
Non-conventional Deposits
Deposit of
Coal Seam Gas
Coal Seam
Impermeable
Seal rock
Gas tight
Reservoir rock
Oil shale
Tight Gas Deposit
Shale Gas Deposit
Gas
Proppants,
e.g. silica sand
Natural gas,
trapped in rock pores
By pressure enlarged
or created rock cracks

DRILLING RIG

- US Rig Count - 859
  (May 25, 2018)
- Permian Basin – 477
- $15 - $20,000 PER DAY

FRAC OPERATION

WEST TEXAS TANK BATTERY

WELL HEAD (TREE)

- Fluids flow from the reservoir to the surface with the pressure supplied by the reservoir.
- Natural pressure can supply enough energy for fluids to flow all the way through the treating equipment to the initial sales point.

ARTIFICIAL LIFT

When natural reservoir pressure is not sufficient to flow fluids to the surface, artificial lift must be used.

Common lift systems are:

- Beam pumping, sucker rod pumping
- Electric submersible pumps
- Gas lift

Water Handling

- Produced water is 2X to 6X greater than oil volumes in some shale plays
- Water needed for drilling and frac operations, secondary recovery

500,000 Barrel lined storage ponds

PRODUCED WATER RECYCLING

- Generally, only a small portion of water produced from oil wells is part of the stimulation treatment or frac job. The bulk of the water produced is water that originates in the reservoir. Thus, produced water when utilized for any purpose other than disposal is being used for the first time.
- Challenges for using produced water (recycling) include:
  - Quality
  - Availability
  - Processing costs
  - Transportation costs
  - Infrastructure

WATER STUDIES

The Academy of Medicine, Engineering, and Science of Texas (TAMEST)in July, 2017 issued a report titled “The Environmental and Community Impacts of Shale Development in Texas”. One chapter dealt with water quantity and quality and the findings are summarized here.

- Water used in hydraulic fracturing processes in Texas represents a small fraction—less than 1 percent—of total water use statewide. In some regions and locales in Texas, however, water used in hydraulic fracturing represents a significantly larger proportion of local water sources.

- Use of brackish groundwater and produced water for hydraulic fracturing can reduce freshwater use. Increased use of these waters, however, can potentially increase impacts to land and water due to spills and leaks.

- The depth separation between oil-bearing zones and drinking water-bearing zones in Texas makes direct fracturing into drinking water zones unlikely, and it has not been observed in Texas.

- Surface spills and well casing leaks near the surface are the most likely pathways for oil and gas activities to lead to contamination of drinking water sources and environmental damage.

WATER STUDIES cont’d

- In Texas, both economics and risk considerations dictate that much of the produced water will continue to be injected in deep wells or used as fracturing fluid to minimize impacts on other water sources.

THE NEED FOR DATA

- Regardless of the quality or the ultimate use made of the water, reliable data is needed to effectively manage the water producing and handling systems.
- Data uses include:
  - Regulatory reporting
  - Well and equipment status or condition
  - Preventive maintenance
  - Reservoir surveillance