Unconventional Oil and Gas

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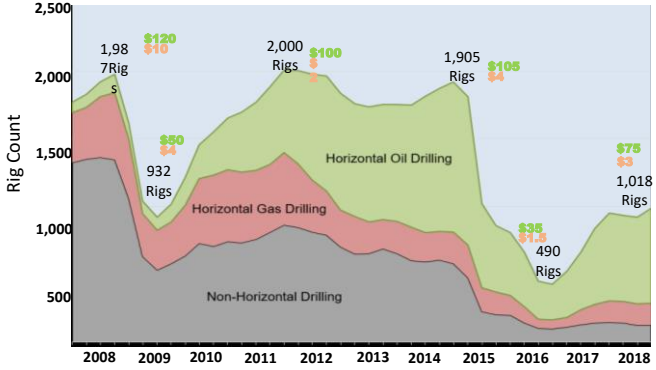
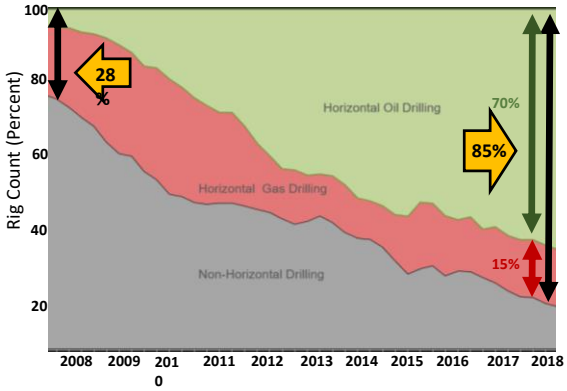
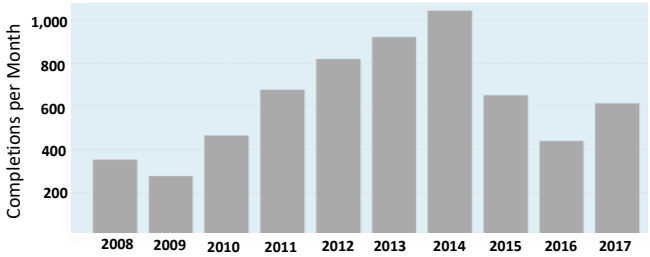
Presentation Outline

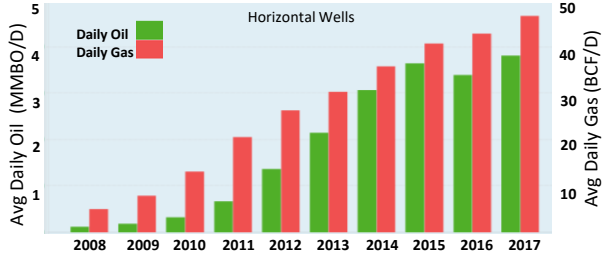
- Unconventional oil and gas development activity in the US
- Trends and observations
- Potential and issues of major basins

Historical Rig Activity in the United States



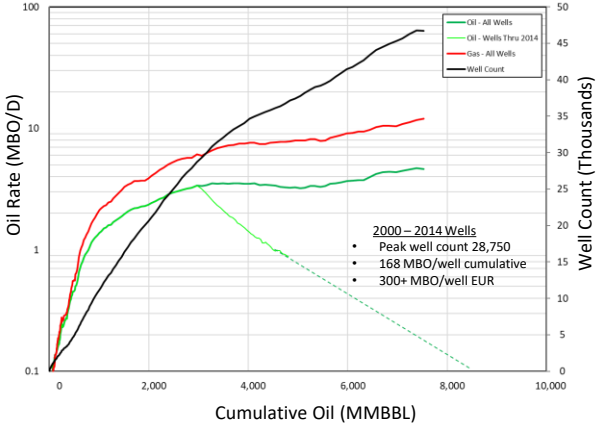






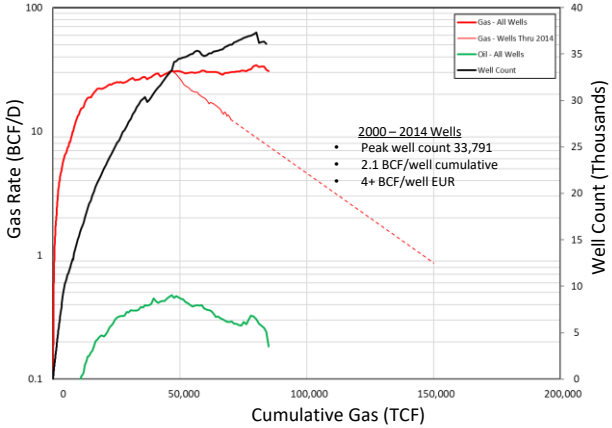
Impact of Horizontal Drilling – Wells Drilled from 2000 to 2014

Bakken, Eagle Ford, and Permian HZ Oil Wells



- Cumulative production for Pre-2015 oil wells: 4.8 billion barrels of oil (BBO), 9.0 trillion cubic feet (TCF) of gas
- Estimated ultimate recovery (EUR): ~9 BBO, ~15 TCF

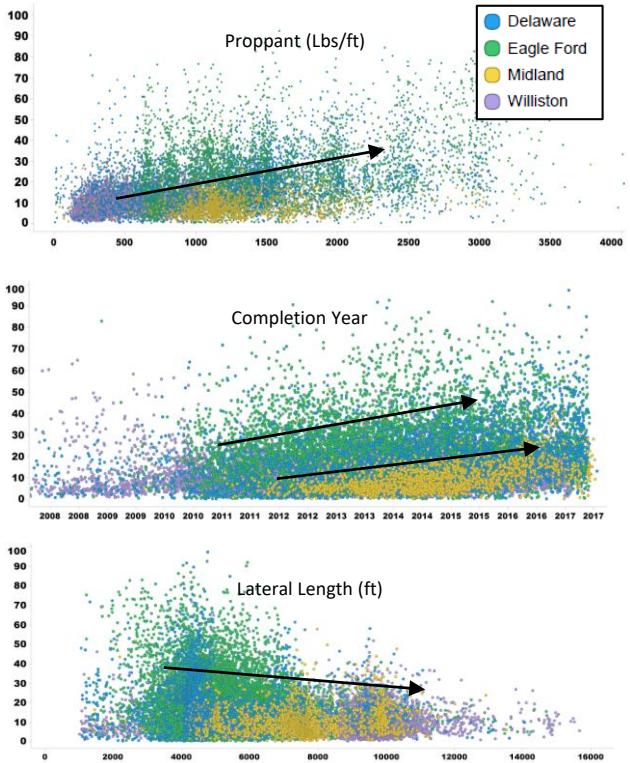
Marcellus, Haynesville, Utica, Eagle Ford, Barnett, Woodford, and Fayetteville HZ Gas Wells

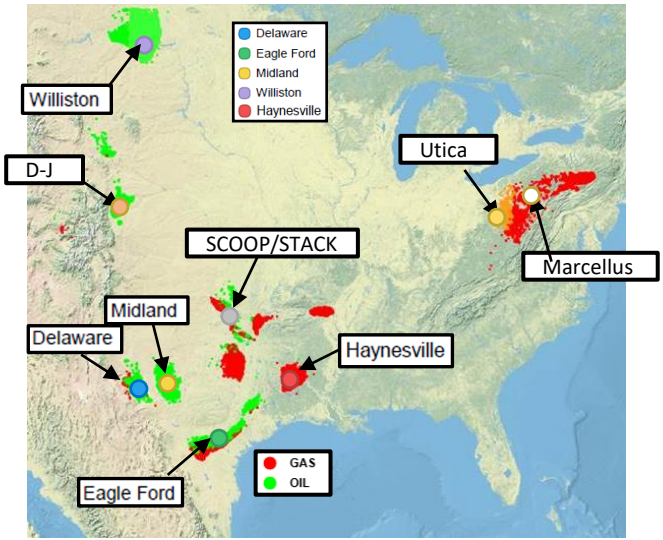


- Cumulative production for these gas wells: 70 TCF, 0.7 BBO
- Estimated ultimate recovery: ~150 TCF, ~1.4 BBO

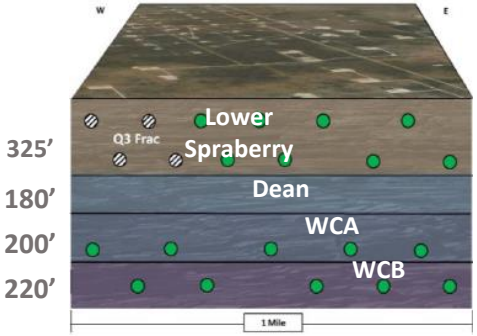
Well Performance Trends Normalized by Lateral Length

1st Year Cumulative Oil / Lateral Length (BO/ ft)

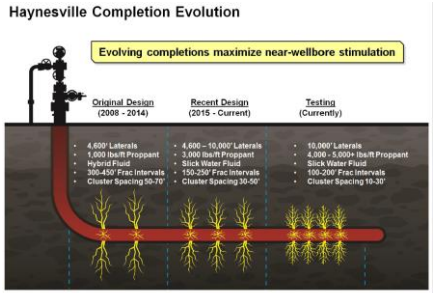




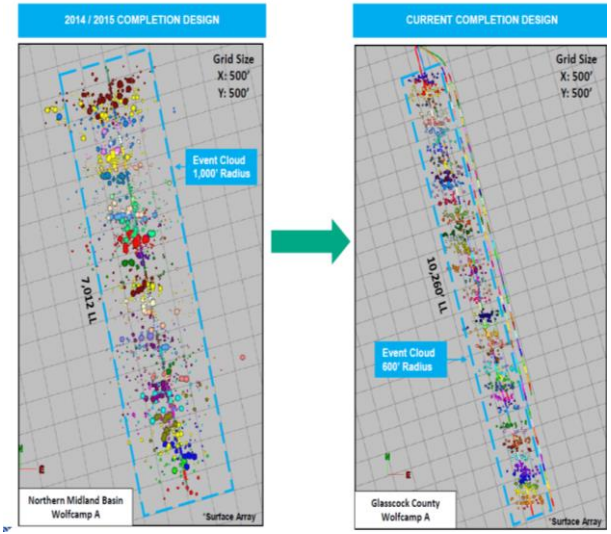
Well Spacing and Improving Completions



Excerpts from RSP Permian 2Q17 Investor Presentation



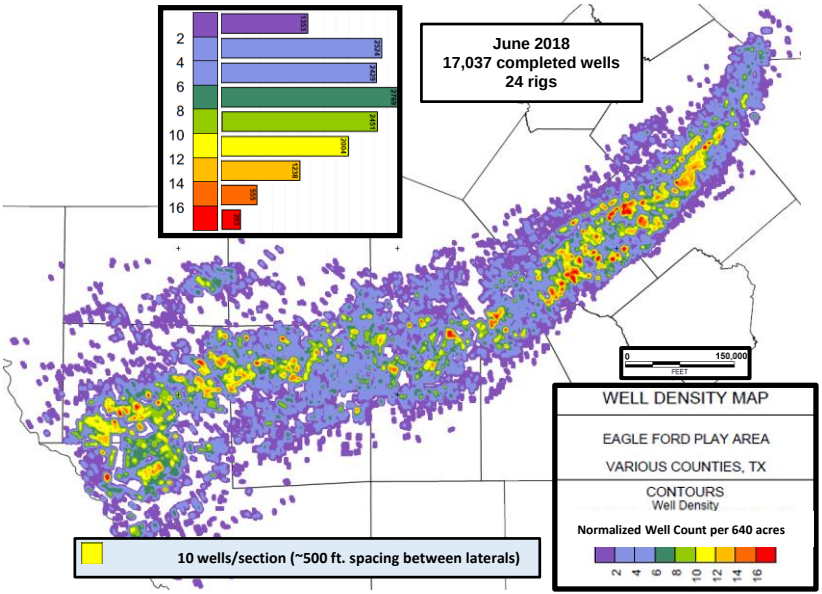
Excerpt from Goodrich 2017 Investor Presentation



Microseismic Case Study: Confirming Near-Wellbore Stimulation

Excerpts from RSP Permian 2Q17 Investor Presentation

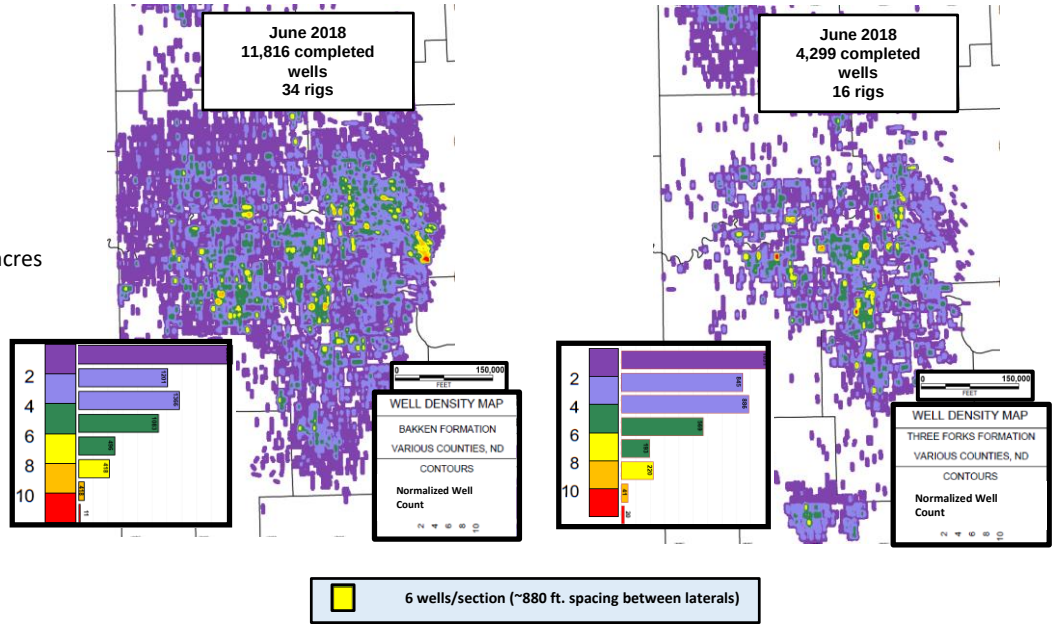
Well Spacing - Eagle Ford Well Density Map



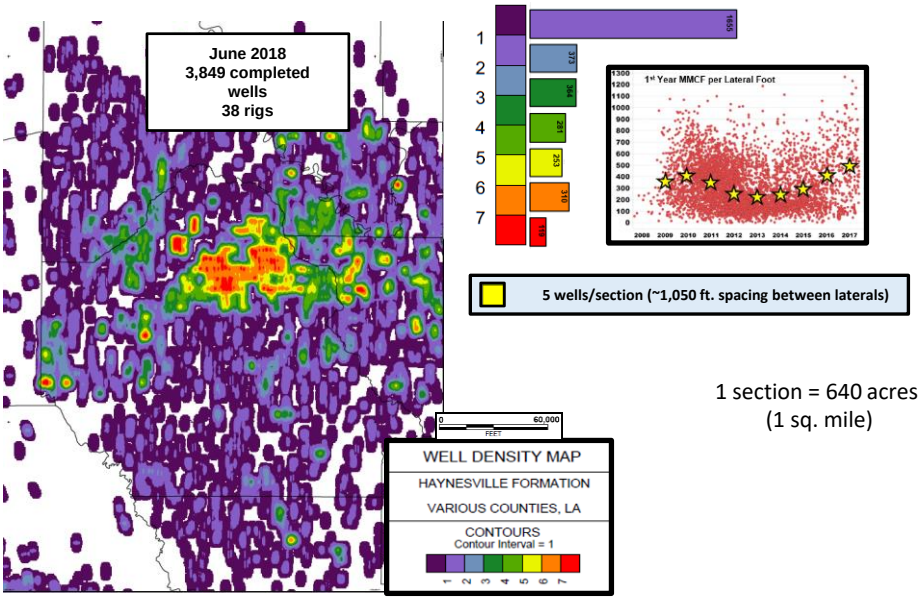
1 section = 640 acres
(1 sq. mile)

Well Spacing - Bakken and Three Forks Well Density Maps

1 section = 640 acres
(1 sq. mile)

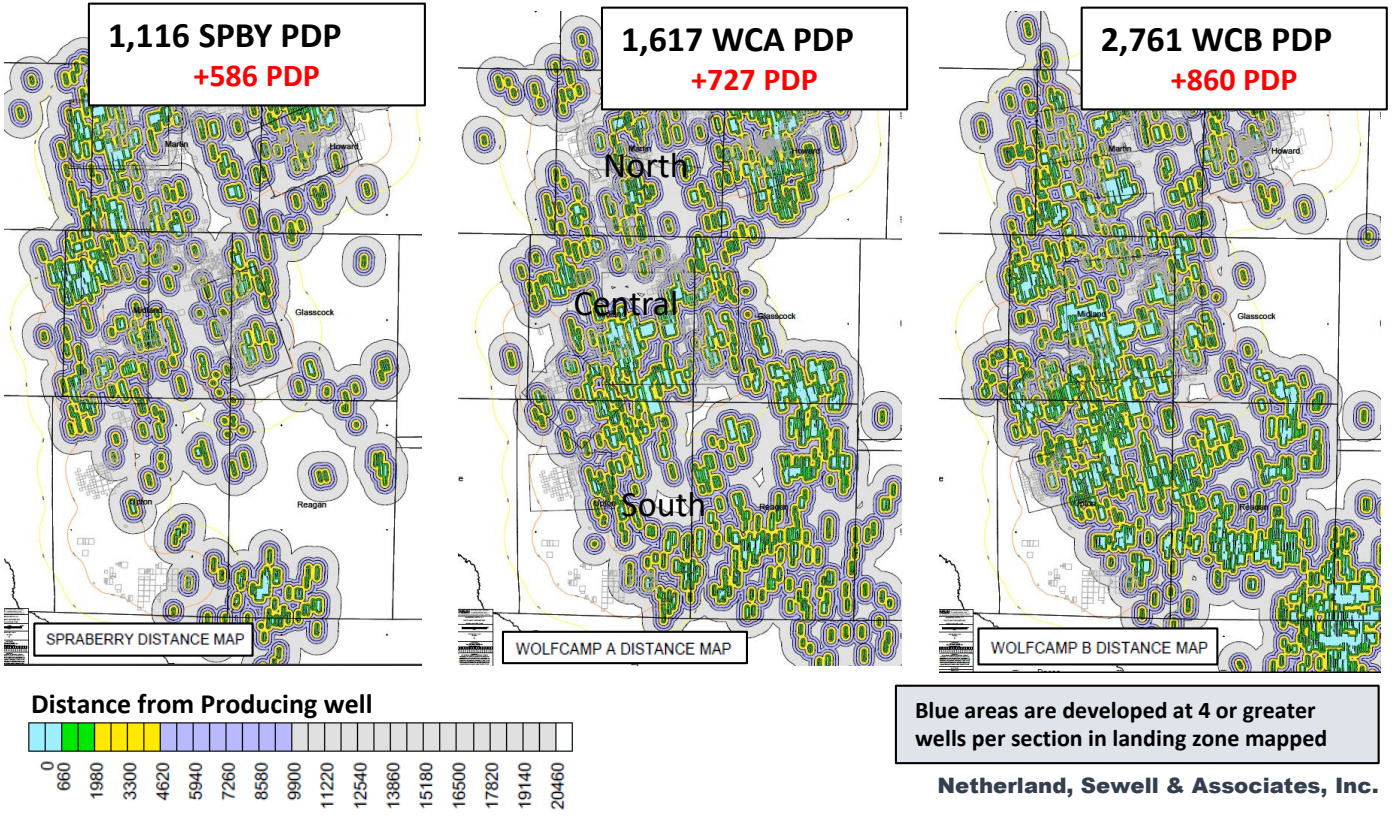


Well Spacing - Haynesville Well Density Map

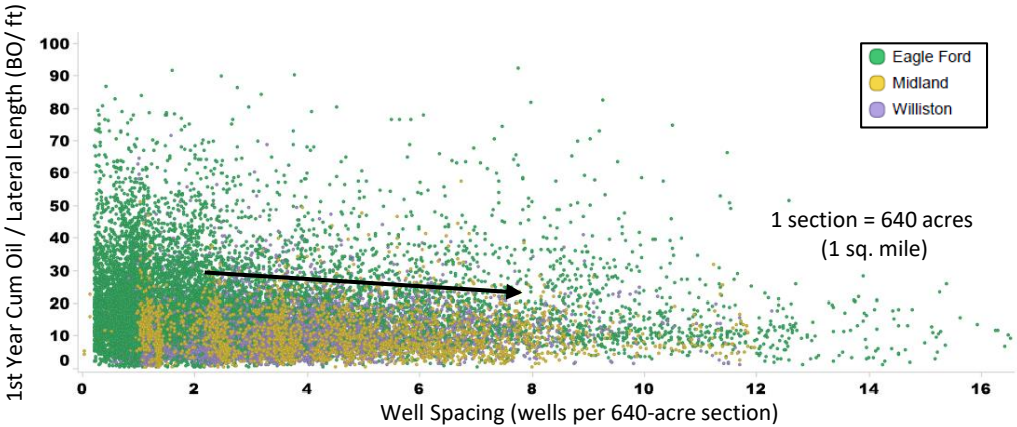


1 section = 640 acres
(1 sq. mile)

Well Spacing – Midland Basin Well Density Maps

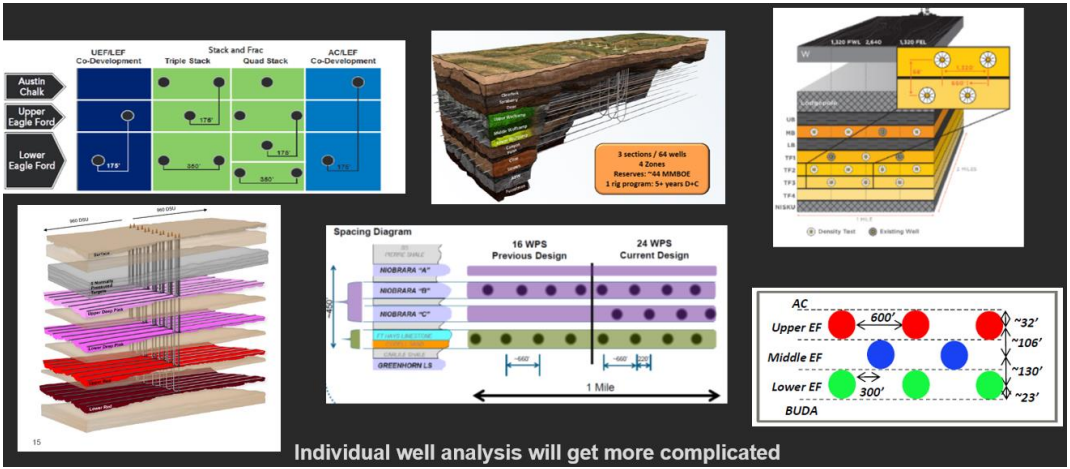


Impact of Well Density on Performance



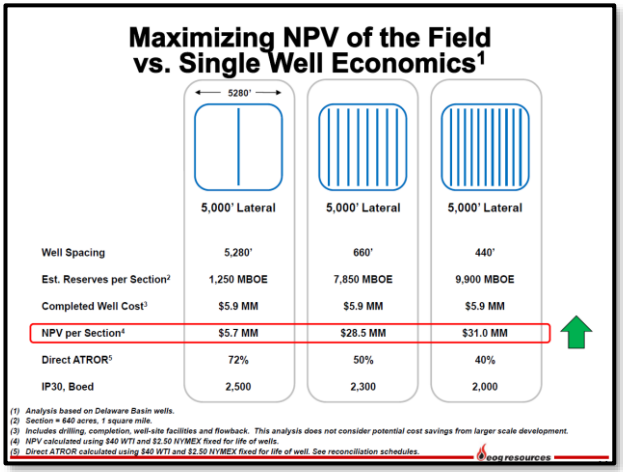
- Increased well density eventually results in interference and decreased well performance for subsequent wells
- Performance for widely spaced initial wells may not be representative of future full-development performance

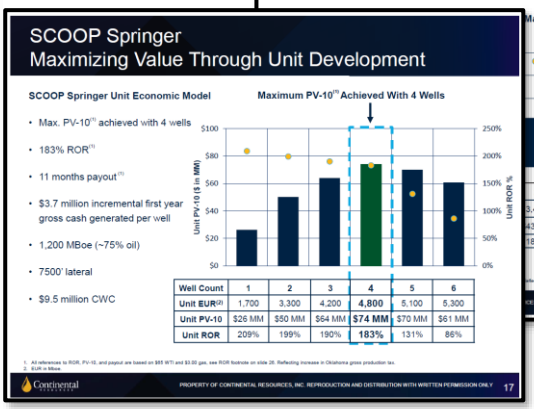
Unconventional Well Development Patterns

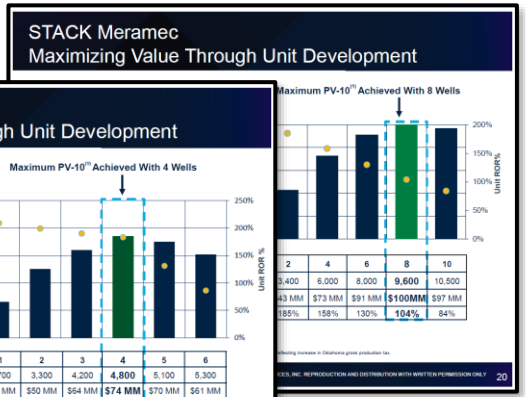


- Well spacing in map view is not the only spacing issue to consider
- Plays in US have multiple productive intervals and consideration should be given to the 3D aspects of the development patterns

Optimizing Well Spacing







- Operators plan to optimize development economics
- Economics dependent on price outlook, well spacing, interference and potential of loss opportunity is not downspaced early

Summary

- Each play and horizon within each play has its own unique characteristics.
- Still improving completion techniques and drilling longer laterals, but…
- Still in early to mid- stages of development in most active basins.
- Many operators seeing necessity of changing completion designs to match with well spacing plans
- Development potential dependent on many variables, including:
  - Ultimate well spacing
  - Price Outlook
  - Economics

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