Drilling and Completions Changes from Conventional to Unconventional Developments – Part Three

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Drilling and Completions Changes from Conventional to Unconventional Developments – Part Three

Part One – Conventional Well Design

- Targets permeable reservoirs with technologies of the day
- Within a traditional mineral leasing structure
- To develop a conventional field, vertically or directionally

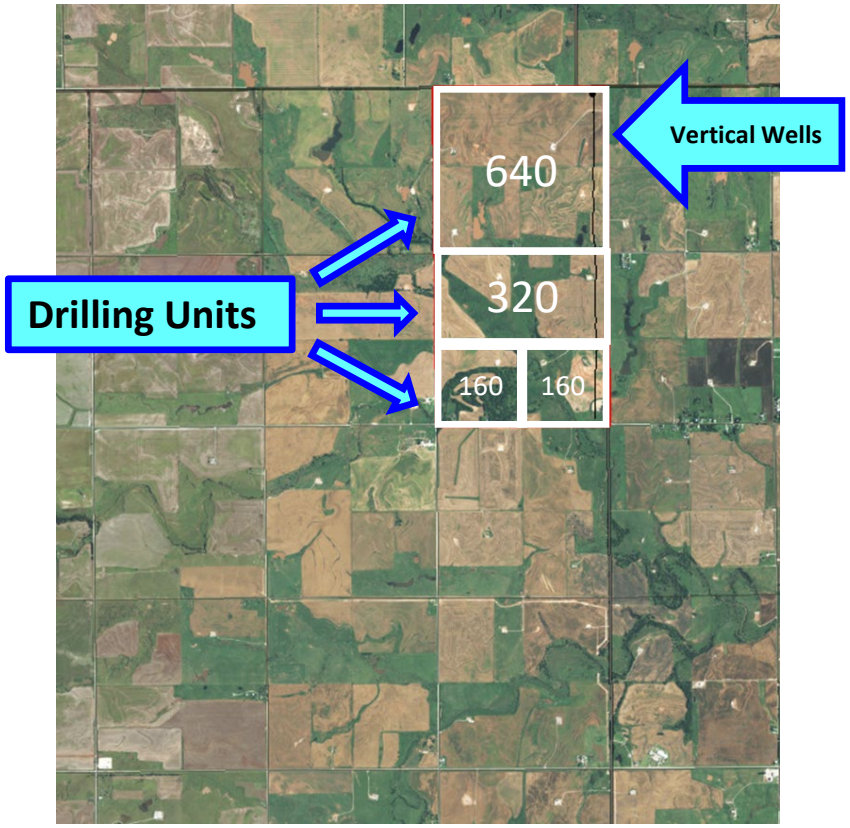
Part Two – Unconventional Well Design

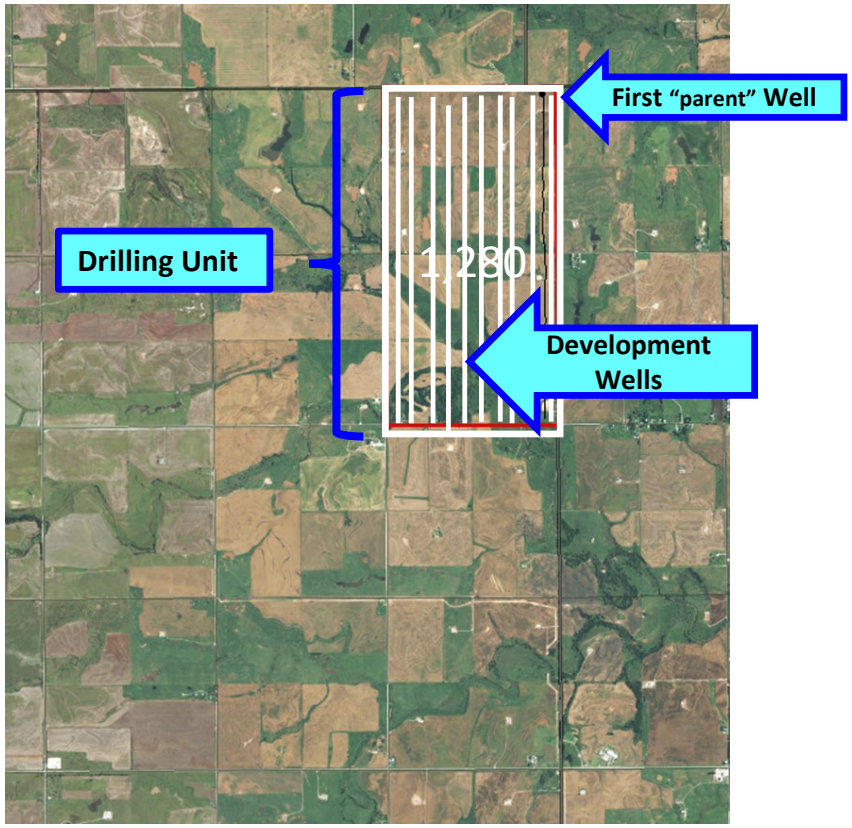
- Targets very low permeability rock with new technologies
- Within a relatively new mineral leasing structure
- To develop an unconventional field, horizontally

Part Three – Regulatory Response to Unconventionals

- **Increased focus on protection of workers, public health, the environment**
- **Maintain protection of mineral ownership and prevents waste**
- **Adapting or replacing older paradigms to embrace new technology**

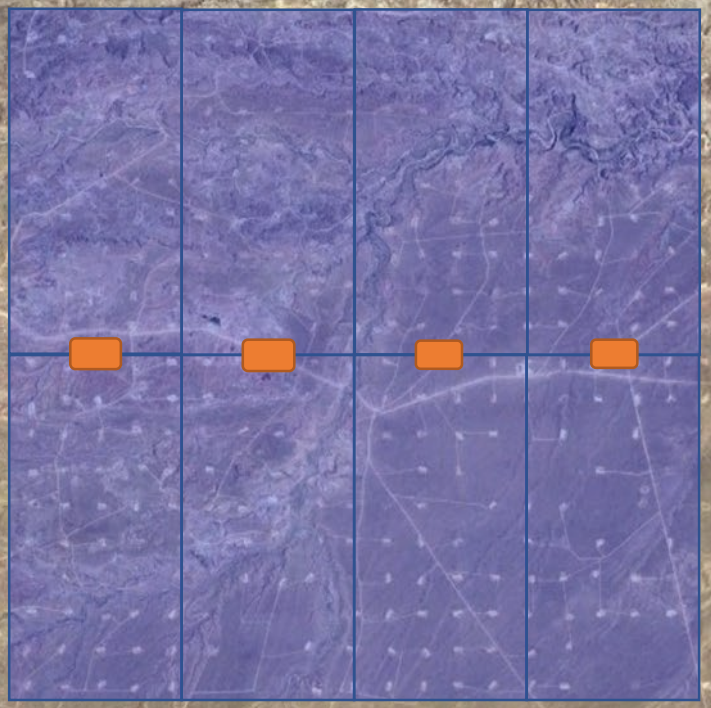
Conventional vs. Unconventional





Conventional vs. Unconventional

- Reduced Surface Area of Operations
- More efficient use of resources and facility design
- Cost effective for well maintenance over time



Opportunities and Challenges

Opportunities:

- Smaller footprint
- Centralized facilities
- Longer wellbores
- More surface area covered
- Local revenue increases
- Increased efficiency

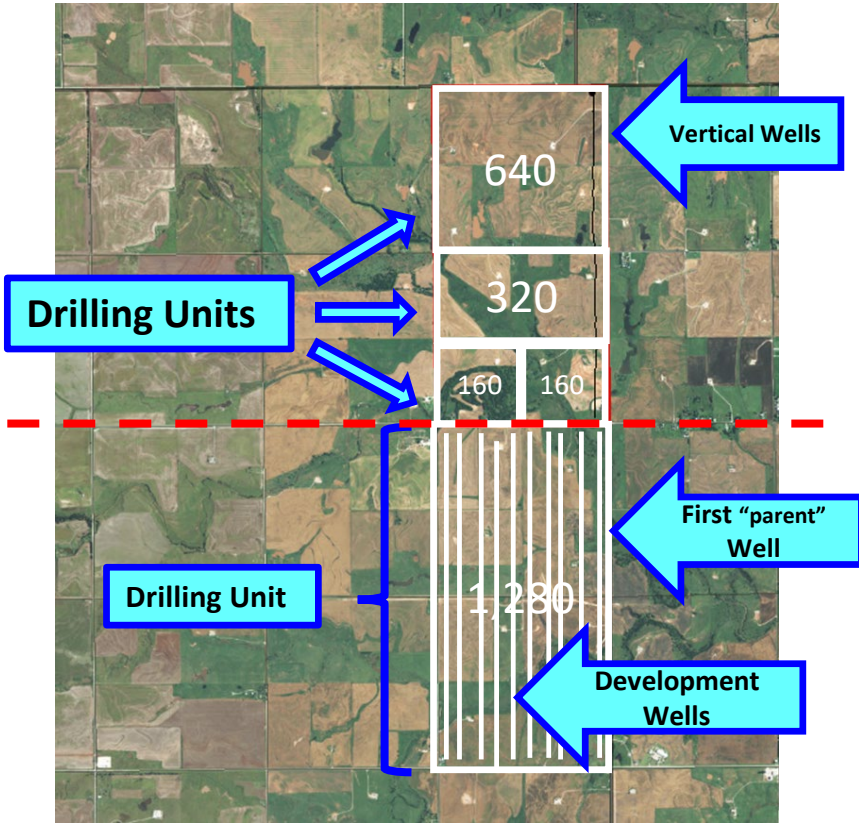
Challenges:

- Development in new areas
- Increased trucking
- Higher production from single facilities
- Increased water use
- High tech operations
- Regulatory legacy

Key Regulatory Considerations

Leasing, Spacing and Unitization:

- Most states leasing framework was not designed with unconventional development in mind.
- Increased surface area requires larger or longer, narrow units.
- More mineral and surface owners requires different pooling determinations.
- Legacy development created challenges in leasehold and mineral rights ownership.

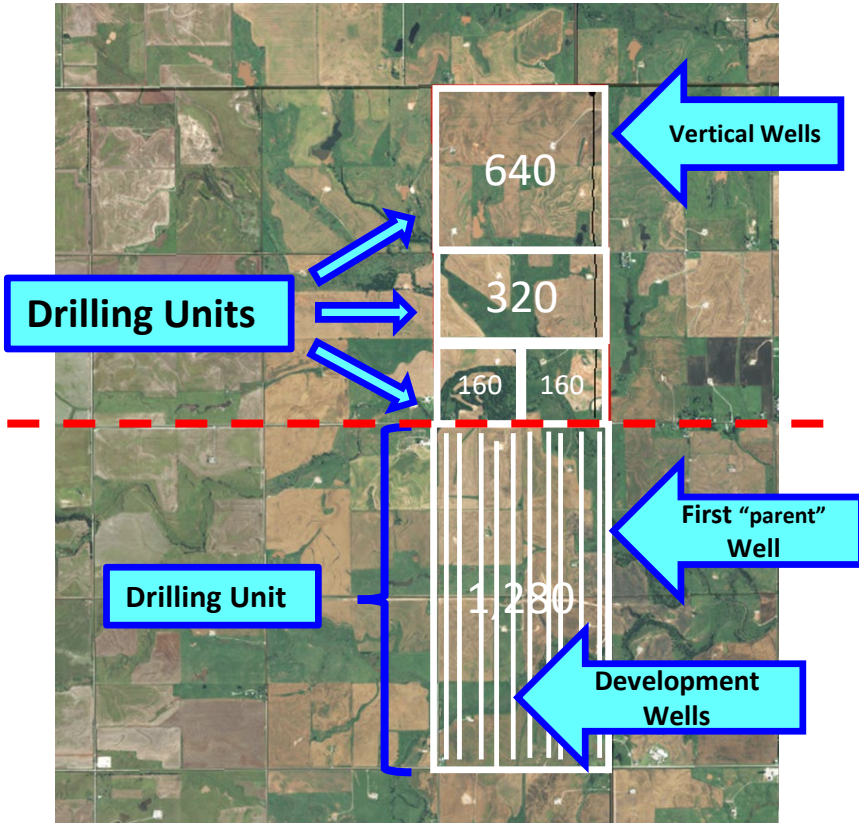


See: *"Horizontal Well Development Pooling, Spacing, and Unitization," June 2015. IOGCC.*

Key Regulatory Considerations

Leasing, Spacing and Unitization:

- Spacing requirements – need to be capable of allowing multi-well units.
- Unit setback requirements may need to be reduced due to elliptical drainage patterns.
- Cross unit wells may share production from more than one unit.
- Operators in some states are required to drill enough wells to drain the entire unit in a predetermined time frame.
- Participation can be a challenge for multi-well developments.



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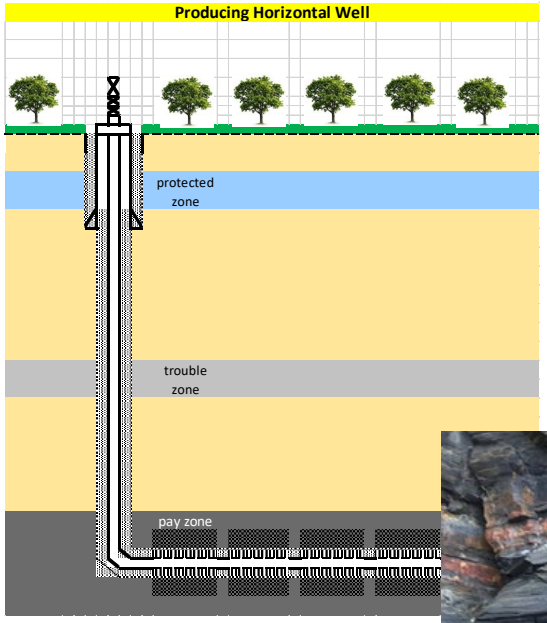
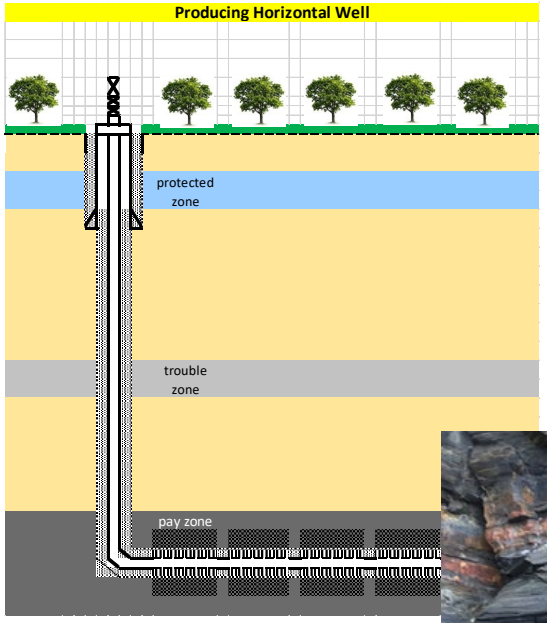
Key Regulatory Considerations



Wellbore Integrity:

- Increased flowrates and pressure in the well bore during completion require more robust isolation.
- Protection of ground water requires proper cementing and casing.
- Pressure gradients from completion activities can interact with other nearby well bores.
- Offset well identification.

Key Regulatory Considerations



The Old:

- USDW protections provided by having leak and spill free operations at the surface.
- Casing and cementing programs across all USDWs.

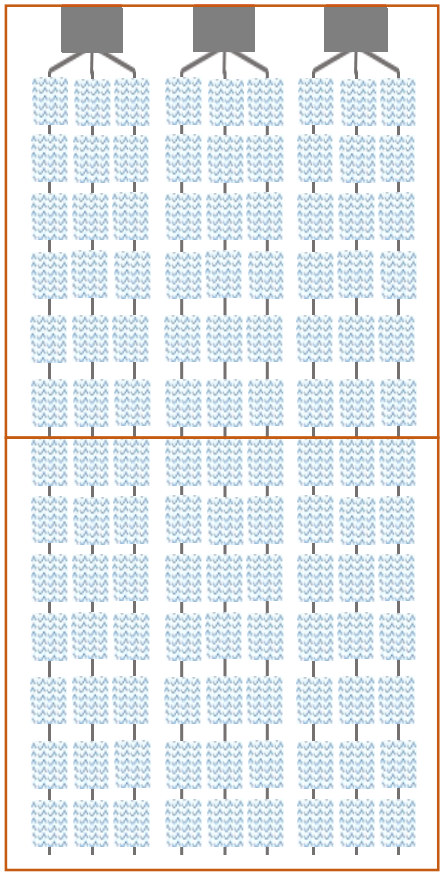
The New:

- Increased engineering concerns for production casing – cyclic loading and temperature effects increase integrity needs.
- Offset well interactions – identification and mitigation
- Hydraulic Fracturing Chemical Disclosure

Key Regulatory Considerations

Water Use and Recycling:

- Moving water requires infrastructure and permitting
- Requires large pits and treatment facilities
- Reuse of water a complex challenge
- Disposal of produced water can overtake local capacity
- Increased use of technology to allow completions chemicals to interact favorably with high-TDS water
- Water injection challenges



Key Regulatory Considerations

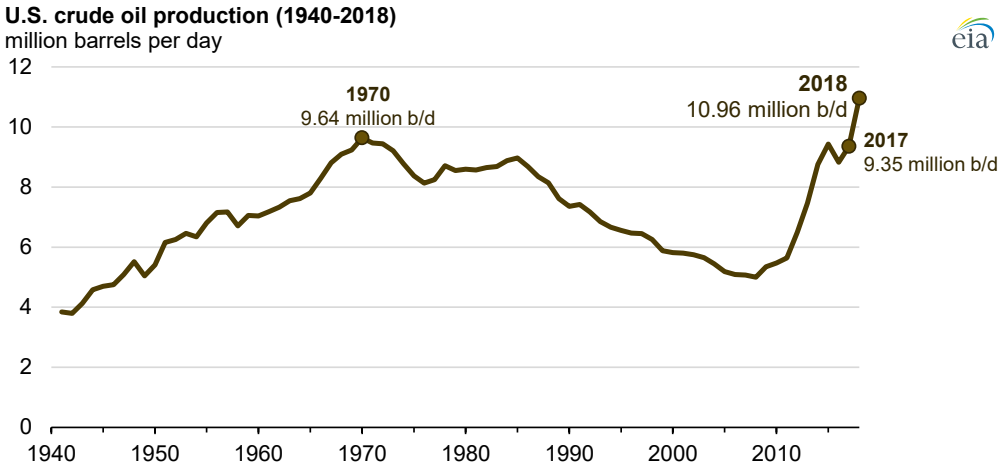
Emissions and Flaring:

- Several wells flowing into one facility multiply the facility potential to emit.
- Increases ability to mitigate emissions through flares, vapor recovery, leak detection and repair.
- Gas takeaway capacity can be limited by right of way issues and permitting delays.
- Trends in emissions monitoring: flyovers, drones, continuous monitoring devices.
- State concerns for methane reductions.

Key Regulatory Considerations

Increase in Production Activity:

- Truck traffic increases
- Noise
- Odor
- Proximity to Homes
- Light pollution
- Worker exposure
- Local emissions



States Working Together

STRONGER
State Review of Oil & Natural Gas Environmental Regulations

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ECOS

INTERSTATE Oil & Gas COMPACT COMMISSION

STATE OIL & GAS REGULATORY EXCHANGE

GROUNDWATER PROTECTION COUNCIL

Thank You

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