



## Barriers and Mining-Induced Ground Movements near Gas Wells

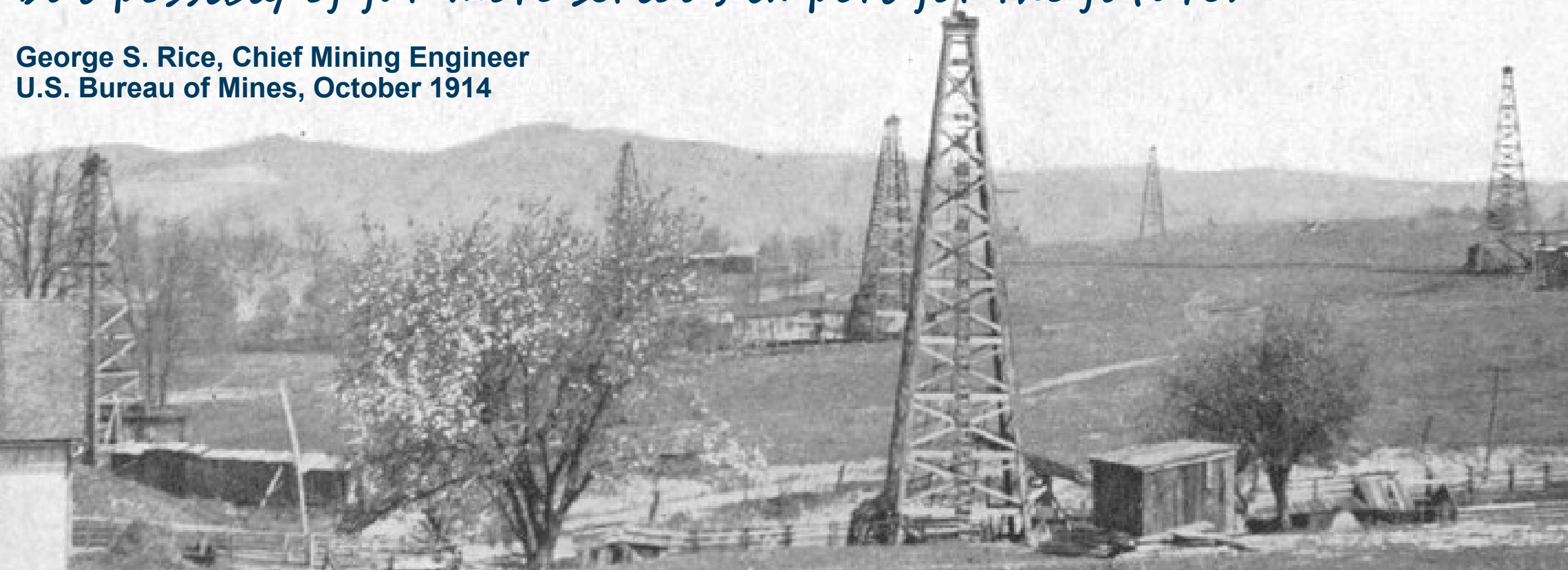
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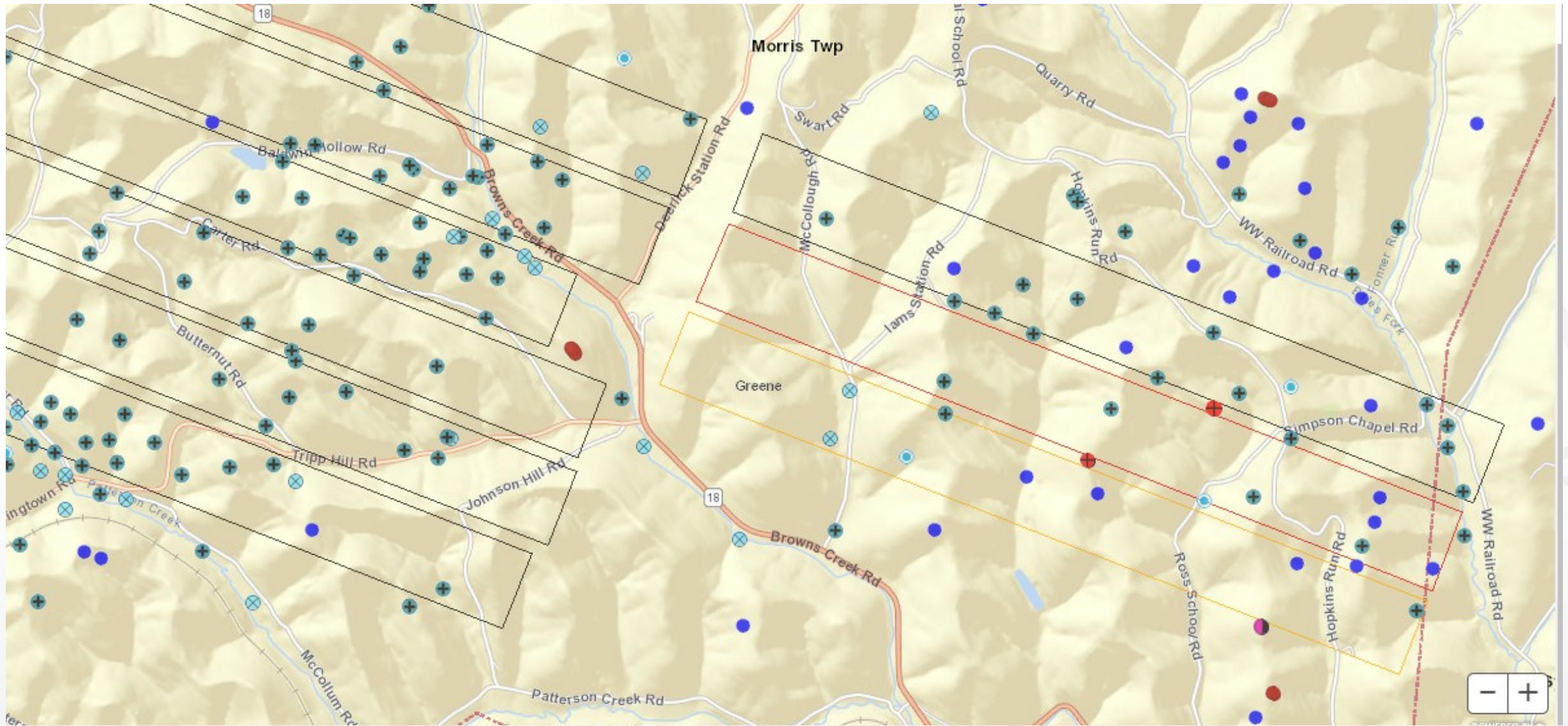
**Gregory M. Rumbaugh, P.E.**  
Chief, Roof Control Division



*“Undoubtedly there is a serious problem through the juxtaposition of gas and oil wells and coal mines, not only at the present time, but possibly of far more serious import for the future.”*

**George S. Rice, Chief Mining Engineer  
U.S. Bureau of Mines, October 1914**



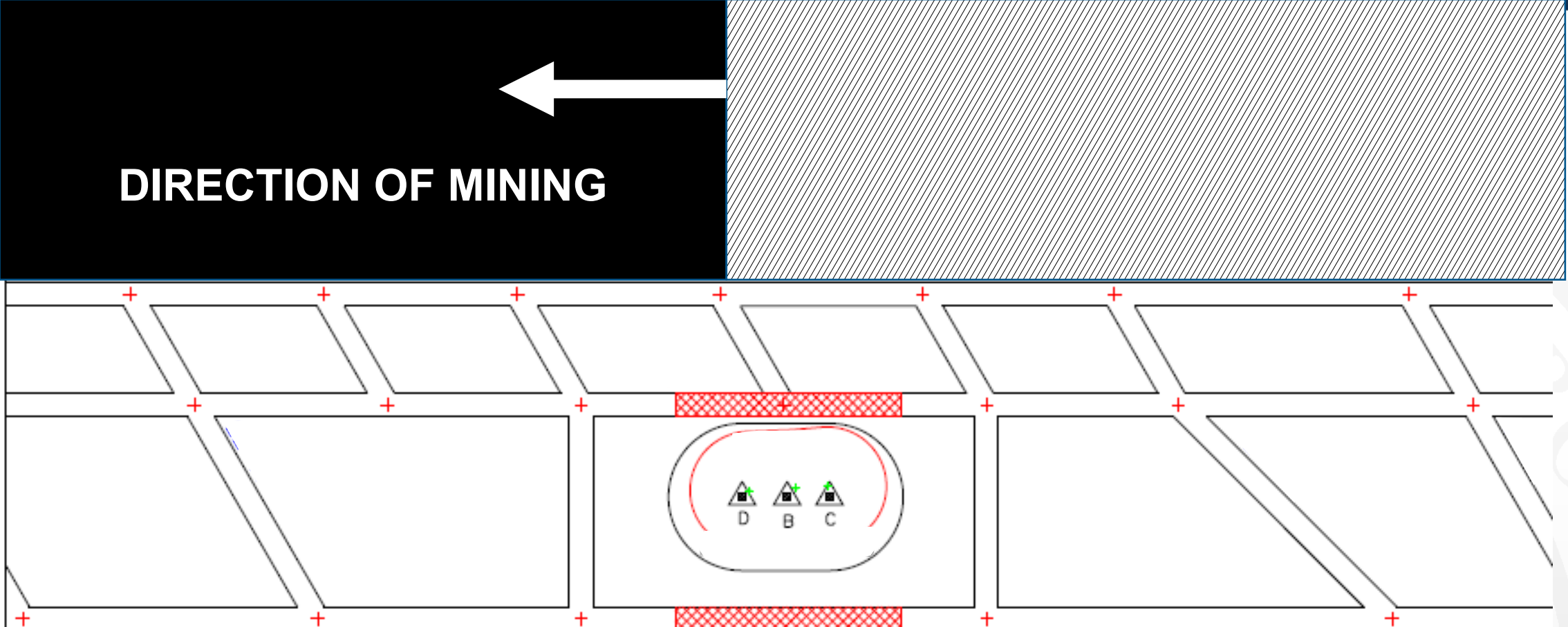




# Agenda

- Background on Gas Wells
  - Conventional (shallow, vertical)
  - Unconventional (deep, horizontal)
- Pennsylvania 1957 Study
- Subsidence caused longwall and retreat mining
  - Ground movement is both vertical and horizontal
- Other considerations to determine Barrier Width







**DEPARTMENT OF ENVIRONMENTAL PROTECTION**  
**Office of Oil and Gas Management**

**DOCUMENT NUMBER:** 800-0810-004

**TITLE:** Guidelines for Chain Pillar Development and Longwall Mining Adjacent to Unconventional Wells

**EFFECTIVE DATE:** August 28, 2021

**APPLICABILITY:** This guidance applies to coal operators and unconventional well operators conducting operations in areas where workable coal seams are being developed using longwall mining techniques.

**PAGE LENGTH:** 31 pages



# Barrier between two Longwall Districts

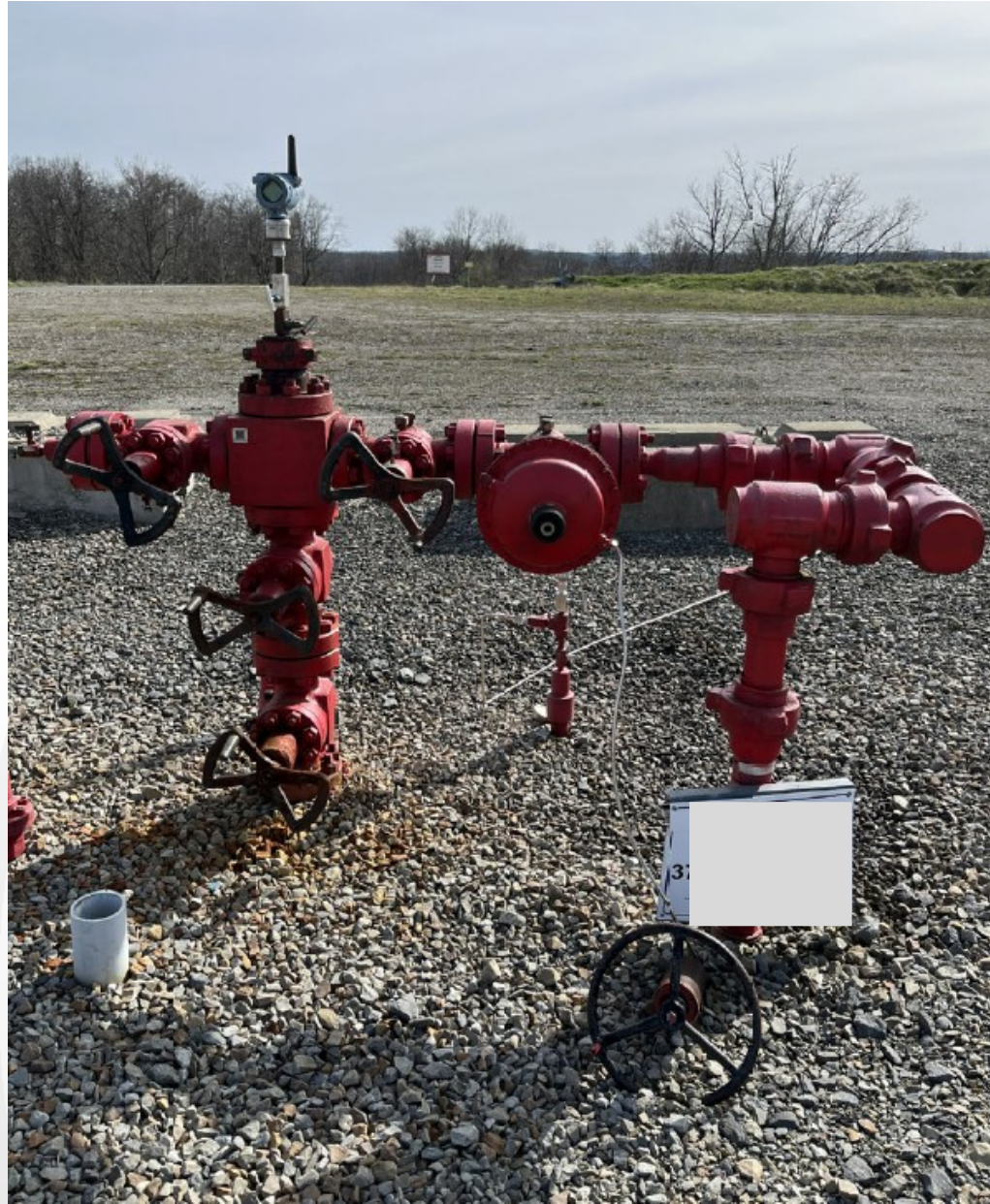


**FUTURE  
LW  
PANEL**











## Typical Unconventional Well Construction in Active Coal Regions:

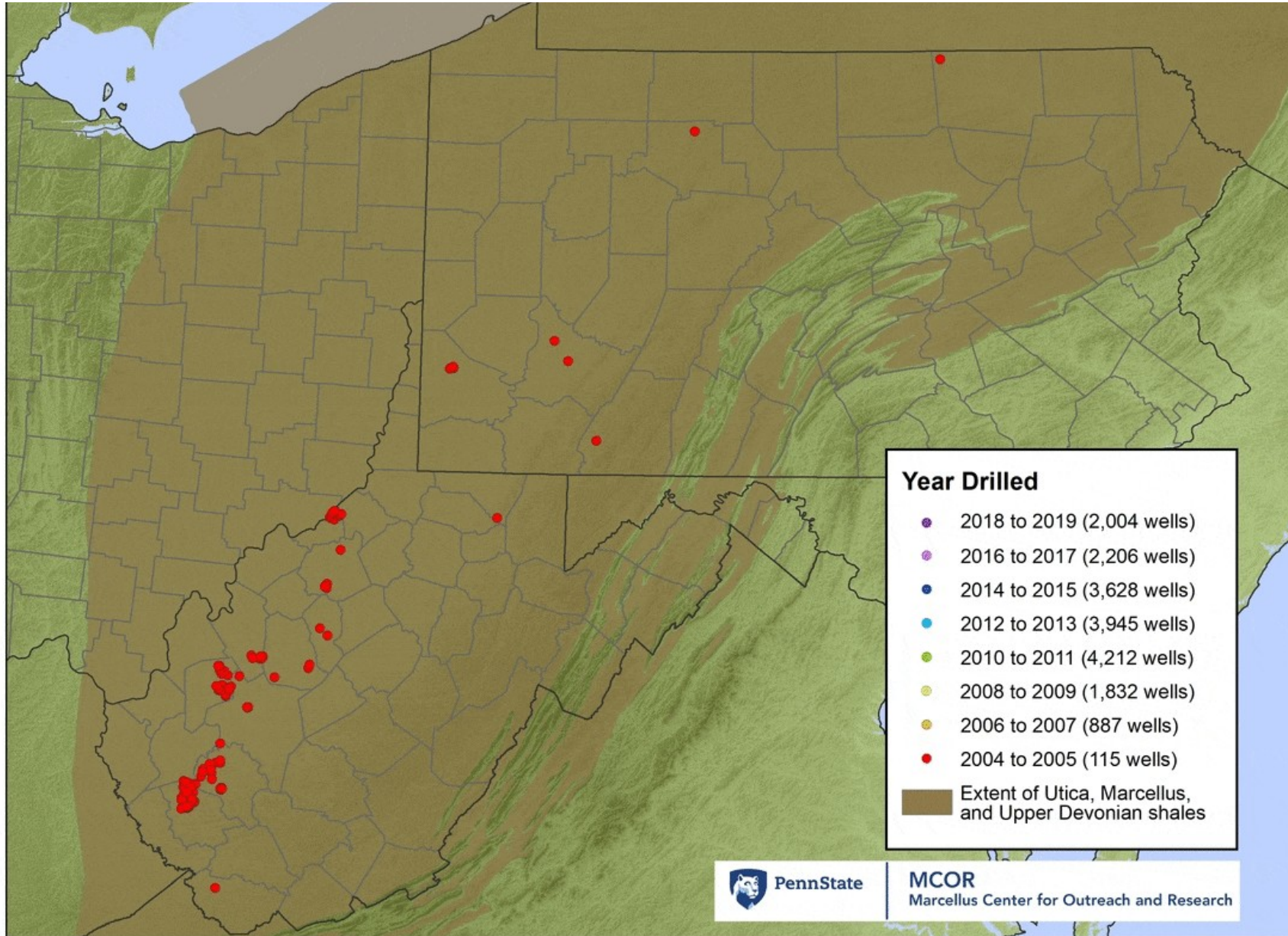
- Conductor (24" dia.)
- Surface (20" dia.)
- Coal Protection (13 3/8" dia.)
- Intermediate (9 5/8" dia.)
- Production (5 1/2" dia.)



## Typical Unconventional Well Construction in Active Coal Regions:

- 5,000'-10,000' Deep
- 3,000'-20,000' Laterals

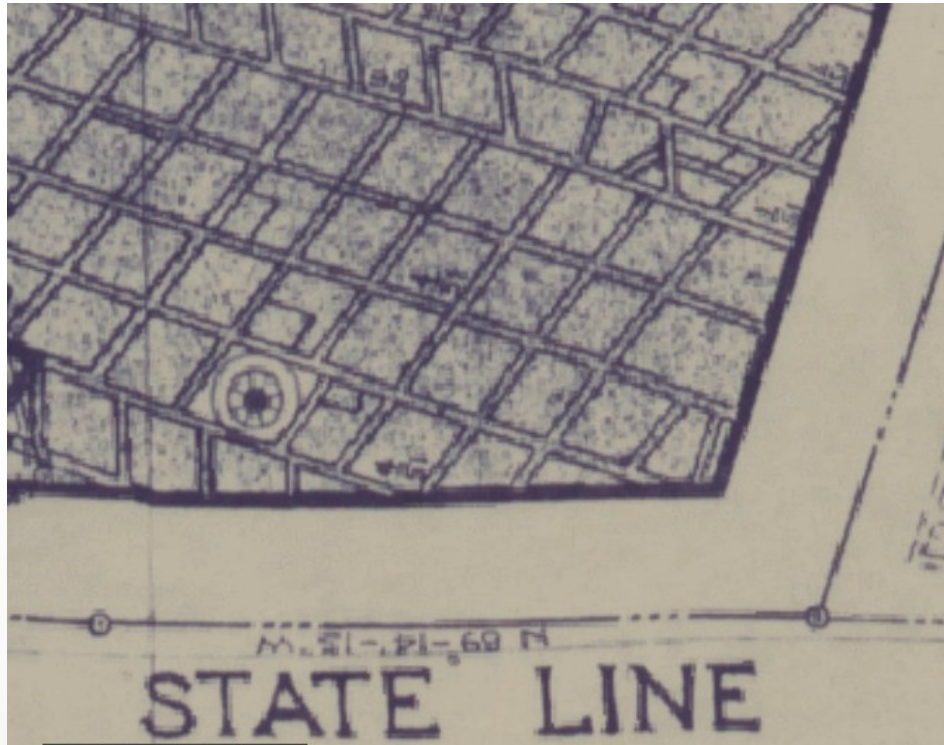






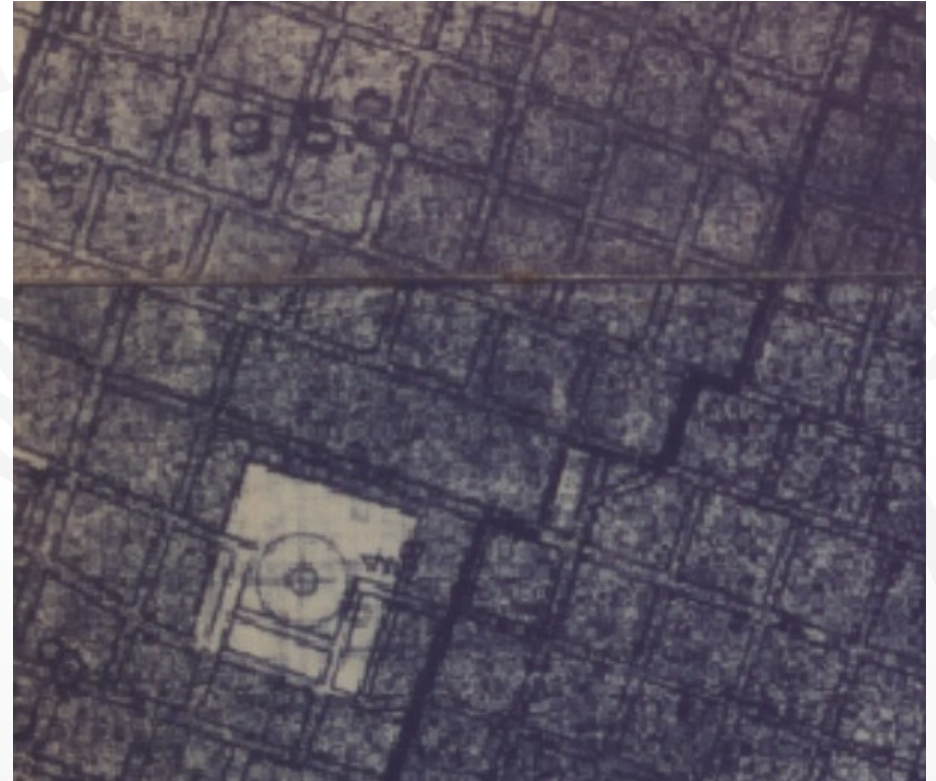


☼ ACTIVE GAS WELL



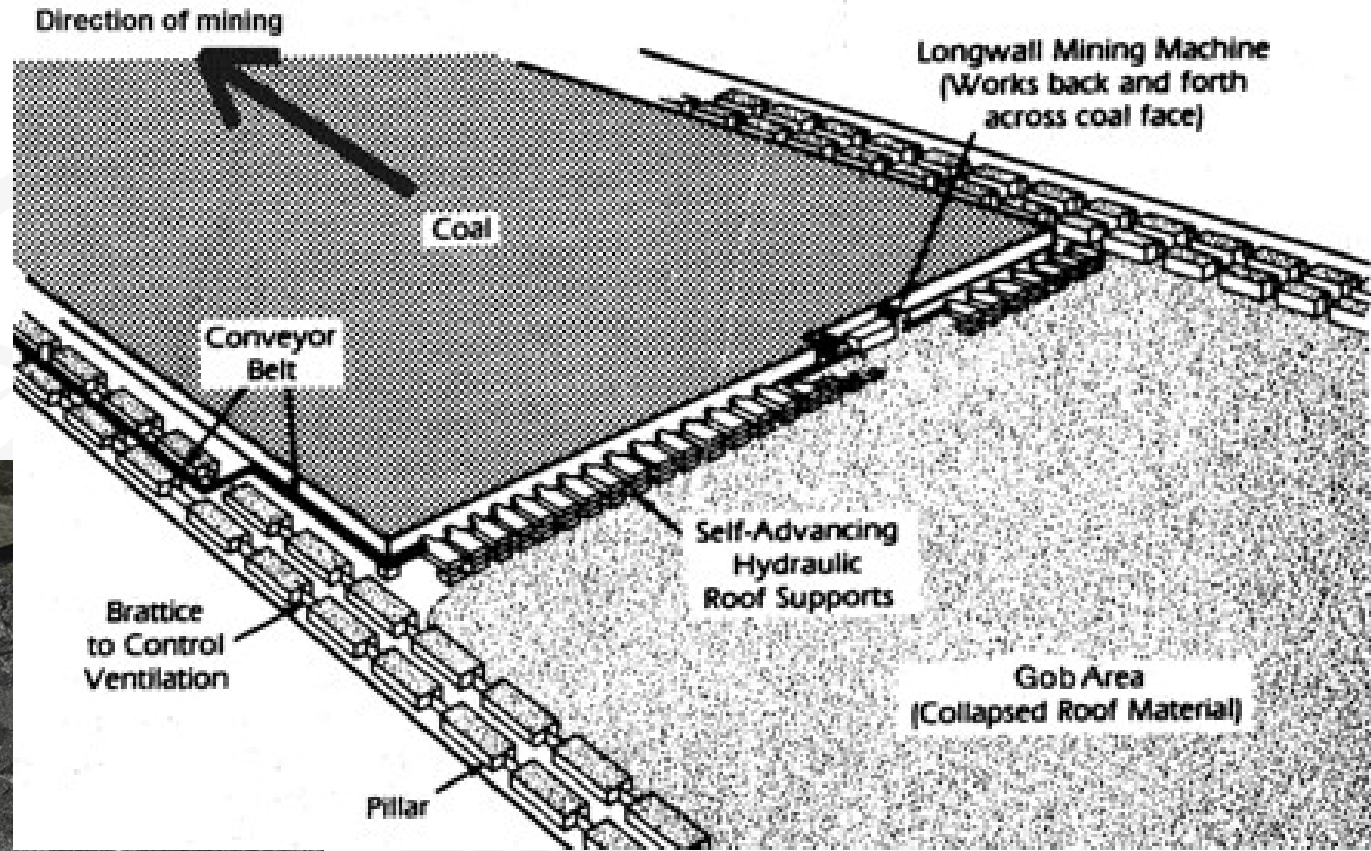
1951 - 50' Radius

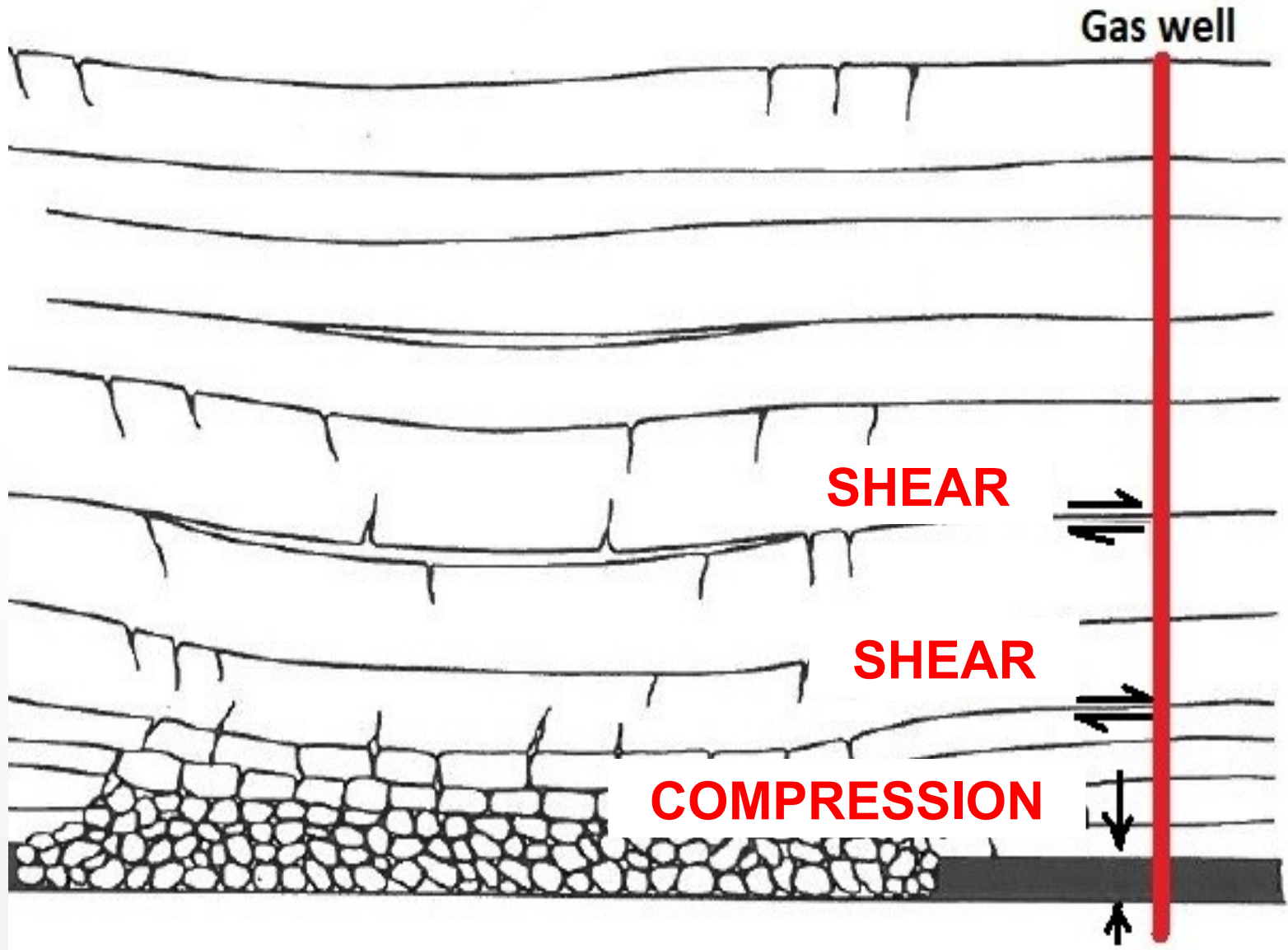
⊕ DRY HOLE



1958 - 200' x 200'  
Protective Barrier

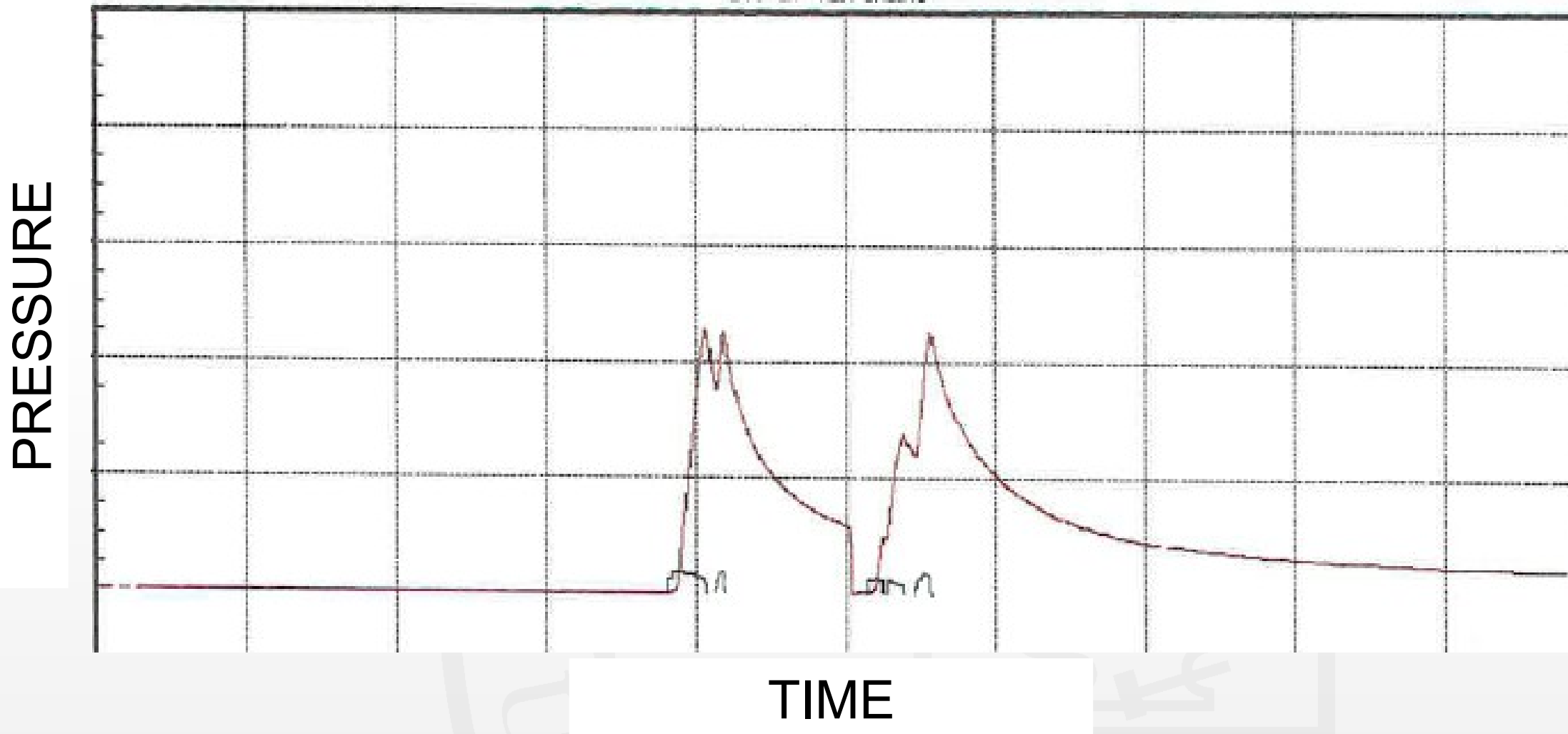




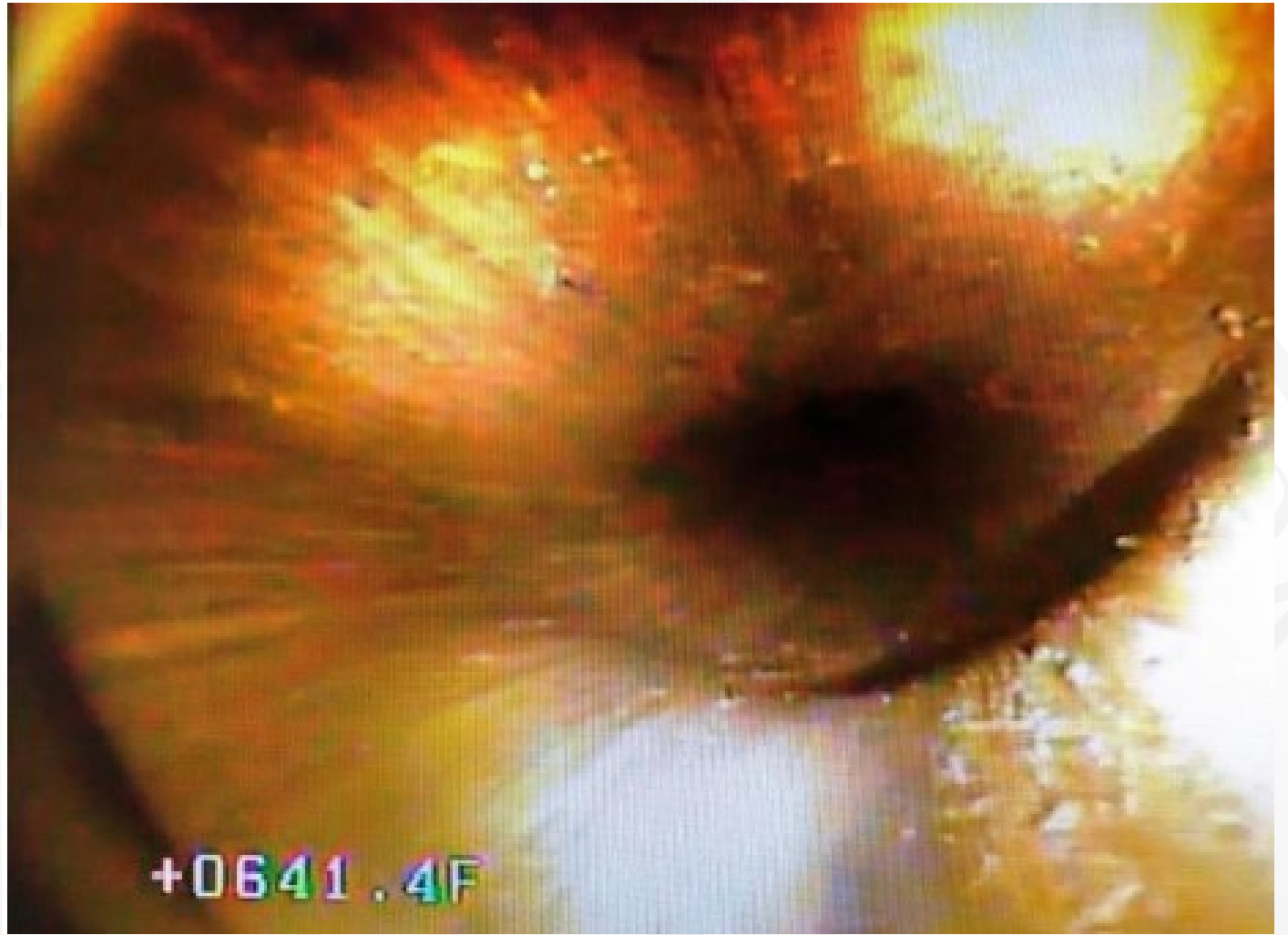
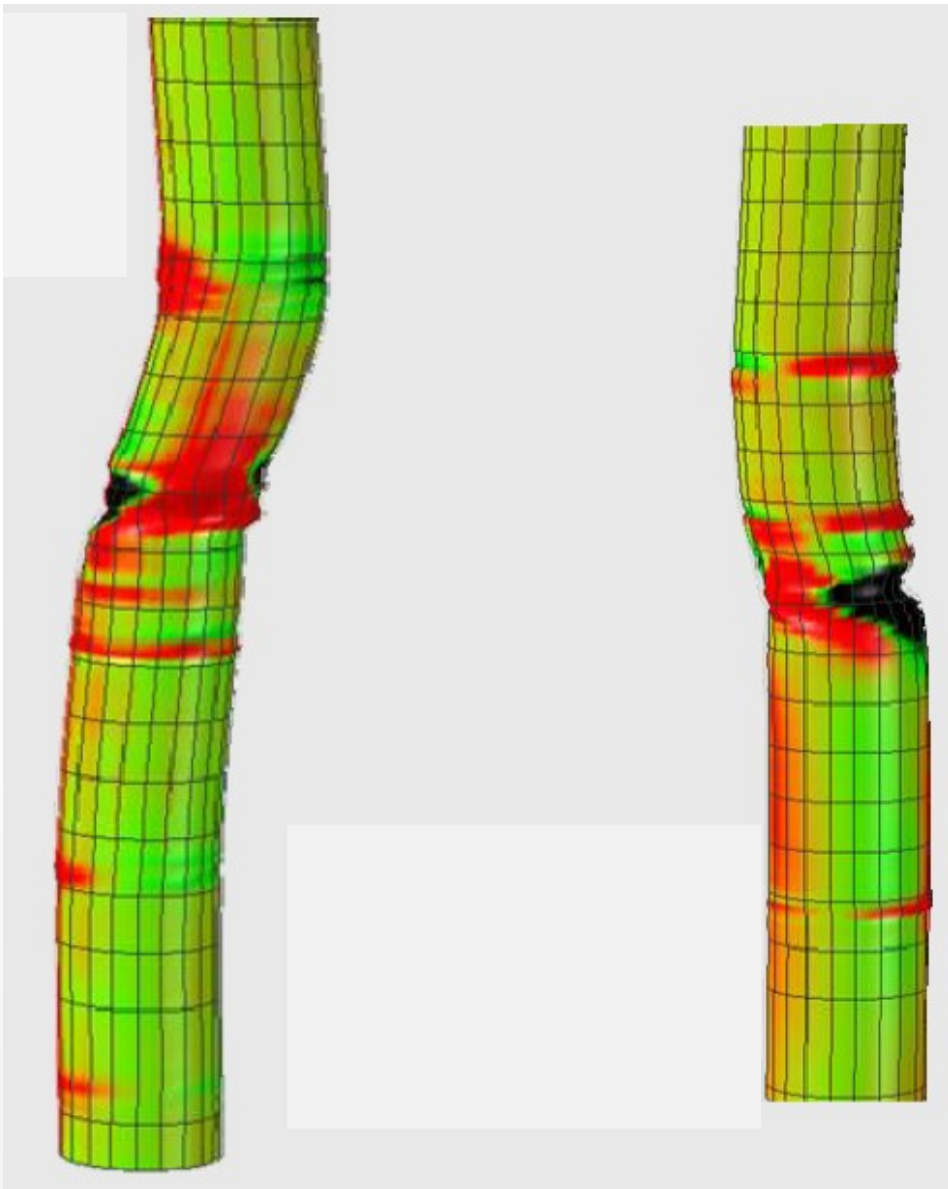




# Failed Casing Integrity Test after Longwall Mining







# Subsidence Risk Factors

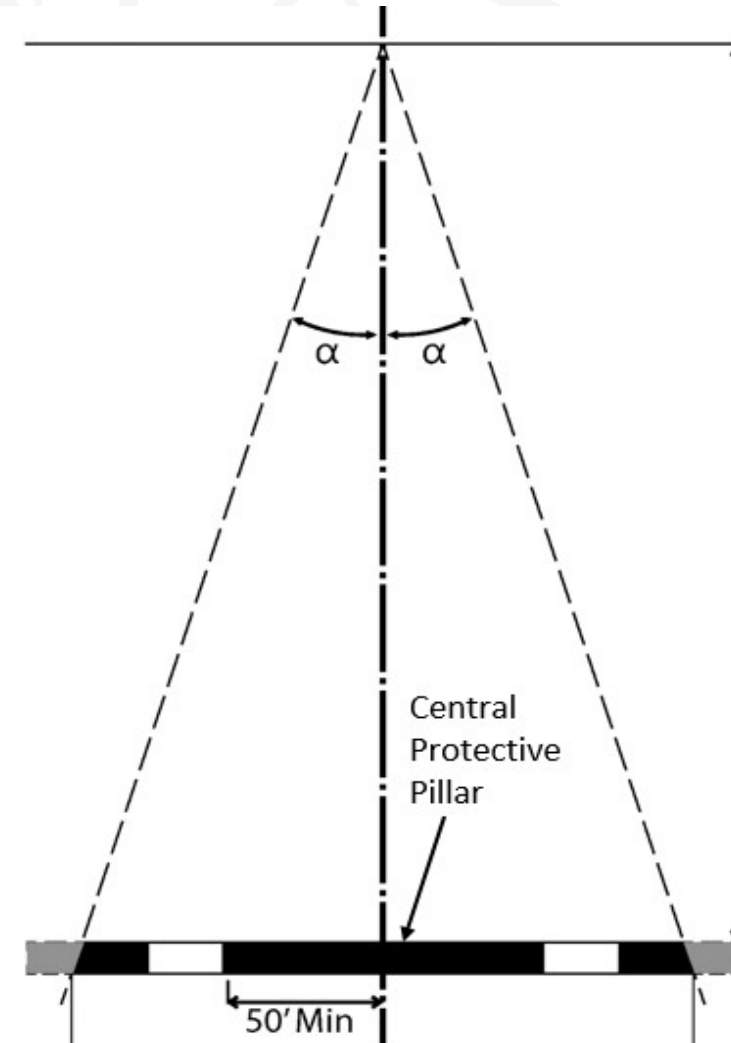
- Well Construction
- Distance to Longwall Gob
- Angle of Support ( $\alpha$ )
- Depth of Coal Seam
- Surface Topographic Location
- Geology



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- Well Construction
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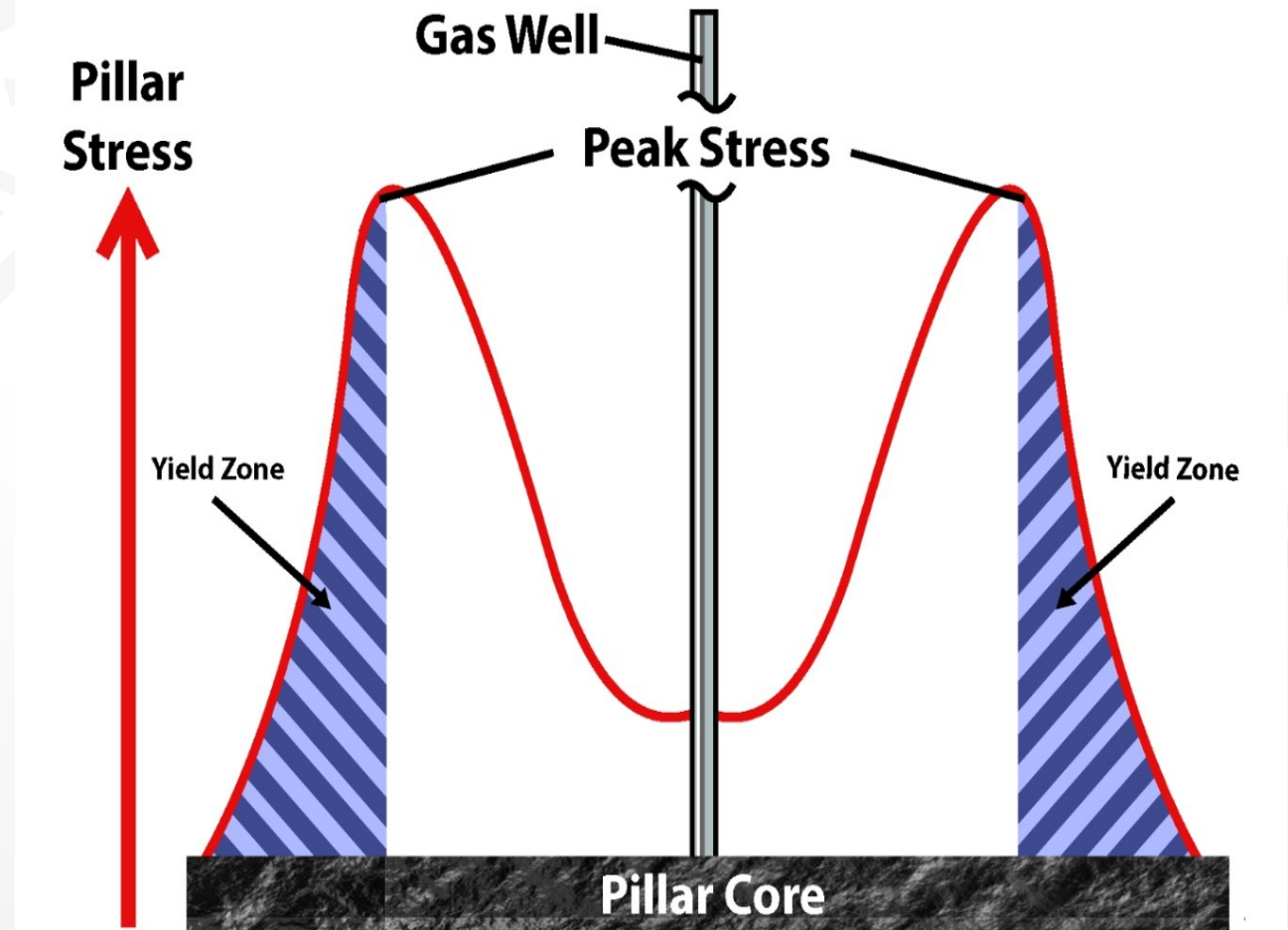
## Angle of Support ( $\alpha$ )





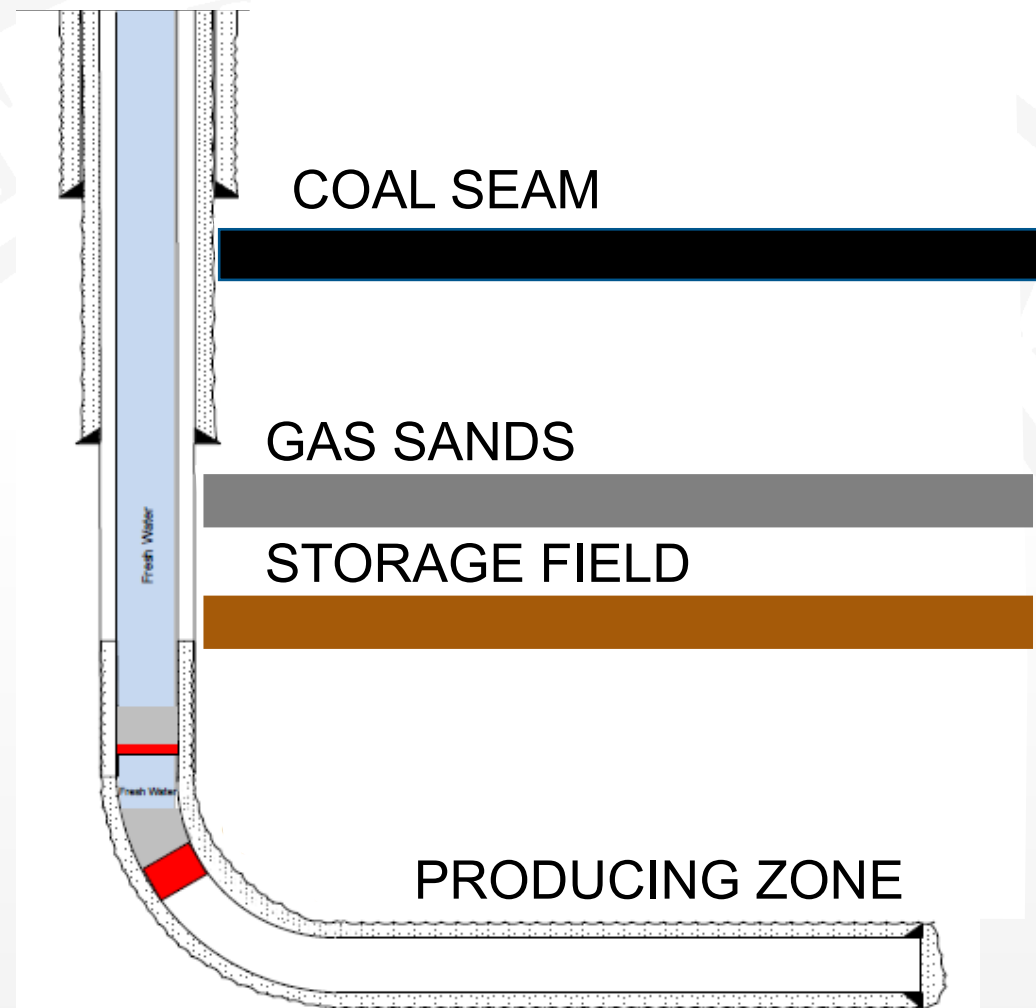
# Pillar Stability Risk Factors

- Pillar System Stability
- Retreat Abutment Loading after Well Installation
- Setback Distance to Rib
- W/H Ratio of Protective Pillar



## Other Barrier Considerations (even if Marcellus is plugged)

- Gas sources other than the producing reservoir.
  - Storage fields
  - Other gas bearing zones
  - Annular Pressure
- Well Construction Information
  - Quality and Consistency of Well Construction Records
  - Large differences even between wells on the same pad!





## Summary

- Determining the correct oil and gas well barrier distance a historical challenge for the mining industry.
- Barrier widths based on:
  - Anticipated Subsidence (horizontal and vertical)
  - Pillar Deformations
- These mechanisms are associated with risk consequence.
- NIOSH is researching other failure mechanisms
- Consider other potential sources and flow paths of gas.





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## Assessing risks from mining-induced ground movements near gas wells

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