The Horseshoe Canyon Coals of Central Alberta — A Dry CBM Play*

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Abstract

Alberta’s first commercial production of CBM was established in 2002 from the Horseshoe Canyon Formation. The coal stratigraphy consists of multiple thin, 1- to 10-foot seams with net coal thicknesses of 25 to 80 feet, occurring at a depth of 1000 to 3000 feet. The play trend covers an area of at least 90 x 300 miles with an estimated initial gas in-place of 147.0 TCF. Currently an estimated 7000+ wells produce from the Horseshoe Canyon, with initial production rates across the trend averaging 100 mcf/d. This “dry CBM” play requires little to no pumping of water before production.

From the inception of commercial drilling, this play has faced significant challenges, both operational and regulatory. Early drilling and completion techniques were sub-optimal, causing severe damage to the dry coals and associated sediments. There has been continuous improvement in technology leading to increased production rates and reduced capital costs.

Many conventional gas pools in the trend are marginally economic when produced separately. Recent regulatory changes have increased well density and allowed commingling of CBM with conventional gas pools; this will ultimately enhance gas recovery and reduce the need to duplicate well locations. Shallow-rights reversion implemented in 2009 by the regulatory board will push the boundaries of the trend, as established deeper plays will no longer retain mineral rights on a section.
The Horseshoe Canyon Coals of Central Alberta: A “Dry” CBM Play

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Acknowledgments

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Where are we?
Geology
Lithology of Horseshoe Canyon

Coal

Silt

Sand

Shale
Lithology of Horseshoe Canyon

Shale

Sand

425 ft
Stratigraphic Trapping of HSCN Coals
Alberta’s 1st commercial production of CBM
Coal Isopach

- Producing Fairway
- Sweet Spot
2002

- Handful of purpose drilled HSCN wells
2005

- 2,500 HSCN Drills
- 1,800 HSCN re-completions
2006
2007
2008
Present

- 15,850 Producing HSCN wells (source: ST109)
- Ultimate HSCN CBM gas-in-place 147 Tcf (source: ST98-2009)
- 440 Bcf remaining established reserves (source: ST98-2009)
- Trident Exploration well count = 750 producing wells
Horseshoe Canyon Production
Horseshoe Canyon Daily Production
Coal Isopach

- Initial average daily rate 53-92 mcf/d across the producing fairway (source: ST98-2009)

- Producing Fairway
- Sweet Spot
Horseshoe Canyon Daily Rate

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<tr>
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<th>Producing Fairway</th>
<th>Sweet Spot</th>
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<tr>
<td>HSCN Average</td>
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<tr>
<td>(Operated)</td>
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Average Gas Rate (mcf/d)
Typical Wet CBM - Mannville

North Well Production

- Gas Rate (mcf/d)
- Water Rate (bbl/d)

Date

Gas Production (mcf/d)

Water Production (bbl/d)
Typical Dry CBM - HSCN

Well Production

Gas Production (mcf/d)

Pressure (psi)

Date

June 08 Aug. 08 Oct. 08 Dec. 08 Feb. 09 May 09 July 09

Gas Rate (mcf/d)
Pressure (psi)
Excellent Dry CBM - HSCN
Unlocking the Horseshoe Canyon Coals
Early Resource Assessment: Core Area

- Suite of nine cores were taken early to establish gas contents
- Gas content ranged between 4 – 40 scf/t
- Mineralogy from core samples establish bentonitic and other swelling clays
Dry Coals - Drilling Challenges

- Horseshoe Canyon coals and associated sediments have essentially no water-filled porosity
- Drilling fluids easily invaded low-pressured lithologies – reservoir unable to clean-up on completion
- Swelling clays present in all lithologies – can reduce permeability
Dry Coals - Drilling Solutions

- Drilled first ~40 wells into the fairway underbalanced with air
- Good production results
- Poor hole conditions
- Moved to coil-tubing drilling with inhibited mud minimizing fluid contact with formation
- Moved to cased hole logging to further reduce time of fluid on formation
Drill Spacing Density Evaluation

16 Section Model Area

4 Section Pilot Area

Monitoring Well
Completions and Production

- Coals unable to produce on perforation alone
- Stimulation program needs to take into account water-sensitive nature of all lithologies and low formation pressure
- Early low-rate $N_2$ stimulations showed reasonable success
- $N_2$ pumping rates and volumes have evolved specific to depth and thickness of individual coal seams
Gathering System Compression

Well Production

- Free flowing well @ 20 psi
- Non optimal compression @ 10 psi
- Optimized compression @ 4 psi

Avg. Daily Raw Gas Production Gross (mcf/d)

Upstream Pressure (psi)
Trident’s Keys to HSCN production

- Minimize fluid exposure on formation
- Cased-hole log
- High rate $\text{N}_2$ fracture of each seam
- Low-pressure gathering system
Government Initiatives and Regulations
Development Entity 1
2006

- 4 wells / section
- No set back from the north and east edges
- Commingling of sand, shale, and coal
Edmonton Sand Commingling
2006
Control Wells Implemented
2006

- Desorption
  3.10 mile radius
  = 19,397 acres

- Pressure and Flow
  1.85 mile radius
  = 6,983 acres
Control Wells - Theoretical

- 3 Pressure and Flow wells ≠ 1 Desorption well
Control Wells - Theoretical

- 6 Pressure and Flow wells = 1 Desorption well
Compliance - Desorption

- Apparent full coverage?
Compliance - Pressure and Flow

- Same example – large gaps in pressure and flow coverage.
Compliance - Missing Compliance

- 22 Desorption
- 34 Pressure and Flow control wells
- Still missing compliance
Shallow Rights Reversion
2009

- ~6 Townships held by a deep-production unit with little HSCN development
- Numerous other units in a similar position
Where are we going?
Future Plans

- 8 wells / section
- Horizontal target
- Slant drilling program
Slant Drilling

2 Miles
Summary
Summary

- Immediate gas production at 100+ mcf/d
- Produces 240 Bcf / year
- Ultimate gas-in-place 147 Tcf
Thank you.