Multilateral Wells in Southeastern Ohio
Targeting the Marcellus and Utica from a Single Vertical Wellbore
Multilateral well introduction

Junctions: Drilling and construction procedures

Case Study: Granite Wash Formation in the Anadarko Basin

Economic analysis of Utica/Marcellus multilaterals

Conclusions
Advantages of multilateral wells

- Reduction in tangible/intangible costs
  - Reduced surface and intermediate drilling/casing
  - Less cementing
  - Fewer wellheads and gathering lines
  - Smaller pads
  - Less man-hours on location
  - Operational efficiencies
Advantages of multilateral wells cont’d
- Larger reservoir drainage volume
- Quicker payout period

Challenges of multilateral wells
- Construction and installation of junction
- Selective stimulation of individual laterals
Junctions

Wellbore Geometries

- Multibranched
- Forked
- Laterals into horizontal hole
- Laterals into vertical hole
- Stacked laterals
- Dual opposing laterals

TAML Classifications

- 1
- 2
- 3
- 4
- 5
- 6
Junctions
Junctions
Junctions

JIS Installation for Lower Lateral

- Eleven frac stages (Plug and Perf method)
Junctions

JIS Installation for Upper Lateral
- Ten frac stages (Plug and Perf method)
2013 Case Study

- Stacked multilateral in Anadarko Basin targeting Granite Wash
- Temporary TAML 5 junction installed at 12,500’
- Each lateral selectively fractured

Results
- Double the production of individual horizontal well
- $2MM savings compared to 2 individual horizontal wells
In 2012 Apache Corporation spent $5MM to $7.5MM per well in the Granite wash.

On first attempt at multilateral, operator reduced D&C costs by ~15 to 20%.
Utica/Marcellus Multilateral
Utica/Marcellus Multilateral
Utica/Marcellus Multilateral

- EUR
- 13.9 Bcfe
- 30-day IP
- 11.7 MMcfe/d
- 50% volume reduction
Utica/Marcellus Multilateral

- EUR
- 16.0 Bcfe
- 30 Day IP
- 23.0 MMcfe/d
- 50% volume reduction
Utica/Marcellus Multilateral

- 3-month exponential decline
- Harmonic decline thereafter
- EUR
  - ~18.7 Bcfe
- 30-Day IP
  - ~24.5 MMcfe/d

Eclipse Resources Dry Utica Type Curve (8,000' lateral)
### Economic Analysis

<table>
<thead>
<tr>
<th>Company</th>
<th>Source</th>
<th>Formation</th>
<th>Development Cost</th>
<th>Well Cost/1000’</th>
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</thead>
<tbody>
<tr>
<td>Antero</td>
<td>2015 Co. presentation</td>
<td>Marcellus (Dry)</td>
<td>$10.6MM</td>
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<td>EQT Corp.</td>
<td>Co. website</td>
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- Average Marcellus drilling and completion costs
- $9.57 MM
### Economic Analysis

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<th>Company</th>
<th>Source</th>
<th>Utica Well Costs Formation</th>
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<th>Well Cost/1000'</th>
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- Average Utica drilling and completion costs
- $11.3 MM
Assumptions

- Operating costs
  - Fixed: $60,000/year
  - Variable: $0.23/mcfe
- Wellhead gas price based on 3-year NYMEX strip and 3-year transportation basis strip
- NGL separation neglected; Gas price adjusted for BTU content
- Cost reduction of 15% for multilateral wells
Economic Analysis

ROR Sensitivity to Wellhead Gas Price

- Marcellus Dry
- Marcellus Wet
- Utica Dry
- Marcellus Dry/Utica Dry
- Marcellus Wet/Utica Dry

Before Tax ROI (%) vs. Gas Price

$2.00 - $4.00
Economic Analysis

Development Cost of Economic Viability for Multilaterals

- Utica Dry/Marcellus Wet
- Utica Dry
- Utica Dry/Marcellus Dry

Reduction in Development Cost vs. IRR (internal rate of return)
Conclusions

- Multilateral wells in southeastern Ohio require a 22% reduction in D&C costs for wet Marcellus areas and a 32% reduction for dry Marcellus areas.
- Multilaterals in PA and WV stand a better chance of being economically viable because the Marcellus is thicker.
- Economics of 2 laterals into the Utica should be analyzed.
Sources

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- Utica Shale: The Natural Gas Giant Below the Marcellus. Figure 5a. [www.geology.com](http://www.geology.com). Accessed January 2015.