Revisiting Bakken Well Economics

Justin J Kringstad
Geological Engineer
Director
North Dakota Pipeline Authority

December 31, 2015
Objective
Define where the Bakken/Three Forks system is economic in a lower oil price environment.

Method
Analyze past well performance across the region and estimate well economics for various production levels.

Disclaimer
The goal of this work is not to imply individual company actions or intentions. All view expressed are strictly that of Justin J. Kringstad.

Neither the State of North Dakota, nor any agency, officer, or employee of the State of North Dakota warrants the accuracy or reliability of this product and shall not be held responsible for any losses related to its use.
North Dakota Oil Differential

Based on EIA Data
Key Economic Assumptions

- $6-$8 Million Well Costs
- $30/BBL & $3.00/MCF Wellhead Pricing
- 1/6 Royalty
- Zero Flaring
- Assumed 10-20% IRR to drill (calculated after production taxes and royalties)
- No Tax Incentives Included
- Production rate is 30-day average
- All Bakken/Three Forks wells drilled in 2008+
Peak Month Minimum 400 BOPD

- Wellhead $30
- Breakeven Wellhead Price (AT IRR of 20%)
Peak Month Minimum 500 BOPD

4,436 Wells

Peak Month Well Production, BOPD

Well Cost

6 MM
7 MM
8 MM

$0 $5 $10 $15 $20 $25 $30 $35 $40 $45 $50 $55 $60

Breakeven Wellhead Price (AT IRR of 20%)

© OpenStreetMap contributors

$30 Wellhead

6 MM
7 MM
8 MM

After Tax IRR

Peak Month BOPD / Well Cost

500
**Peak Month Minimum**

**600 BOPD**

- Peak Month BOPD / Well Cost

<table>
<thead>
<tr>
<th>After Tax IRR</th>
<th>6 MM</th>
<th>7 MM</th>
<th>8 MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- $30 Wellhead

**Peak Month Well Production, BOPD**

- 3,092 Wells

**Brokeven Wellhead Price (AT IRR of 20%)**

- $0 $5 $10 $15 $20 $25 $30 $35 $40 $45 $50 $55

© OpenStreetMap contributors
Peak Month Minimum
700 BOPD

Peak Month BOPD / Well Cost
700

After Tax IRR

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>6 MM</th>
<th>7 MM</th>
<th>8 MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0-$5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$10-$15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$20-$25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$30-$35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$40-$45</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Break Even Wellhead Price (AT IRR of 20%)

$30 Wellhead
Peak Month Minimum 800 BOPD

Peak Month BOPD / Well Cost

$30 Wellhead
Peak Month Minimum
900 BOPD

Peak Month BOPD / Well Cost
900

After Tax IRR

$30 Wellhead

6 MM

7 MM

8 MM

© OpenStreetMap contributors
Peak Month Minimum
1,000 BOPD

Peak Month Well Production, BOPD

Well Cost

6 MM
7 MM
8 MM

0
5
10
15
20
25
30
35

Breakeven Wellhead Price (AT IRR of 20%)

© OpenStreetMap contributors

JJ Kringstad - North Dakota Pipeline Authority
Peak Month Minimum
1,200 BOPD
Peak Month Minimum
1,500 BOPD

Peak Month BOPD / Well Cost
1500

After Tax IRR

$30 Wellhead

6 MM
7 MM
8 MM

Breakeven Wellhead Price (AT IRR of 20%)

© OpenStreetMap contributors
Summary of $30 Wellhead Oil

Assumed Range of Minimum Acceptable Rate of Return

After Tax IRR

Peak Month BOPD / Well Cost

400 500 600 700 800 900 1000 1200 1500

55% 50% 45% 40% 35% 30% 25% 20% 15% 10% 5% 0% -5% -10%

6 7 8 6 7 8 6 7 8 6 7 8 6 7 8 6 7 8
Breakeven Summary

Peak Month Well Production, BOPD / Well Cost

Breakeven Wellhead Price (AT IRR of 20%)
Arguments

• Well economic assumptions too optimistic or conservative
  – Jump to lower or higher well performance footprints

• Some rigs are not drilling Bakken/Three Forks wells
  – No economics were run on wells in other formations
Understanding “The Core” Footprint

Peak Month Minimum: 800 BOPD

Spud 2008-2011

Spud 2012-2015

© OpenStreetMap contributors

© OpenStreetMap contributors
Understanding “The Core” Footprint

Peak Month Minimum: 1,200 BOPD

Spud 2008-2011

Spud 2012-2015

© OpenStreetMap contributors
Contact Information

Justin J. Kringstad, Director
North Dakota Pipeline Authority

600 E. Boulevard Ave. Dept. 405
Bismarck, ND 58505-0840

Phone: (701)220-6227
Fax: (701)328-2820
E-mail: jjkringstad@ndpipelines.com

Websites:
www.pipeline.nd.gov
www.northdakotapielines.com