North Dakota Industrial Commission

Justin J Kringstad
Geological Engineer
Director
North Dakota Pipeline Authority
• Economics
  • Understanding current and future oil production
    • Pricing update
    • Activity
    • Oil forecasts
  • North Dakota natural gas production
    • Flaring and gas capture
    • Interstate Transmission
  • Pipeline construction update
Understanding North Dakota’s Bakken/Three Forks Potential*

*Version 1.1
Updates & Modifications to Follow

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.

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**Key Assumptions & Considerations**

- Two mile production zone buffers are set by an individual well’s “peak month minimum” performance. Not all existing wells within a production zone have performed at the zone's “peak month minimum” for a variety of reasons.

- High degree of uncertainty surrounding the future development patterns of the middle and lower Three Forks “Benches”.

- High degree of economic uncertainty as infill development intensifies and deeper Three Forks benches are developed.

- This work will be updated as new information becomes available.
Past Well Performance – Bakken Formation

Production Zone

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<th>Existing Wells</th>
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<table>
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<th>Area, SqMi</th>
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<table>
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<th>1280 Spacing Units (Est.)</th>
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Legend:
- 100-200 bopd Bakken Fm.
- 200-300 bopd Bakken Fm.
- 300-400 bopd Bakken Fm.
- 400-500 bopd Bakken Fm.
- 500-600 bopd Bakken Fm.
- 600-700 bopd Bakken Fm.
- 700-800 bopd Bakken Fm.
- 800-900 bopd Bakken Fm.
- 900-1000 bopd Bakken Fm.
- 1000-1250 bopd Bakken Fm.
- 1250-1500 bopd Bakken Fm.
- 1500 PLUS bopd Bakken Fm.
Remaining Wells* – Bakken Formation

*Well Density Assumptions
Low Case = 4 Wells In Bakken Formation
High Case = 8 Wells In Bakken Formation
Past Well Performance – Three Forks Formation

Production Zone

- Existing Wells
- Area, SqMi
- 12B9 Spacing Units (Est.)

Legend:
- 100-200 bopd Three Forks
- 200-300 bopd Three Forks
- 300-400 bopd Three Forks
- 400-500 bopd Three Forks
- 500-600 bopd Three Forks
- 600-700 bopd Three Forks
- 700-800 bopd Three Forks
- 800-900 bopd Three Forks
- 900-1000 bopd Three Forks
- 1000-1250 bopd Three Forks
- 1250-1500 bopd Three Forks
- 1500 PLUS bopd Three Forks

JJ Kringstad - North Dakota Pipeline Authority
Tim Nesheim (NDGS) Three Forks Work
Past Well Performance – Three Forks Tier 2

Production Zone

Existing Wells

Area, SqMi

1280 Spacing Units (Est.)

- 100-200 bopd Three Forks
- 200-300 bopd Three Forks
- 300-400 bopd Three Forks
- 400-500 bopd Three Forks
- 500-600 bopd Three Forks
- 600-700 bopd Three Forks
- 700-800 bopd Three Forks
- 800-900 bopd Three Forks
- 900-1000 bopd Three Forks
- 1000-1250 bopd Three Forks
- 1250-1500 bopd Three Forks
- 1500 PLUS bopd Three Forks

JJ Kringstad - North Dakota Pipeline Authority
Past Well Performance – Three Forks Tier 3

Production Zone

- Existing Wells
- Area, SqMi
- 1280 Spacing Units (Est.)

 JJ Kringstad - North Dakota Pipeline Authority
“Empty” Three Forks Tier 1 & 2

All Empty Regions Were Removed From Estimates/Calculations
Remaining Wells* – Three Forks Tier 1

*Well Density Assumptions
Low Case = 4 Three Forks Wells Per DSU
High Case = 10 Three Forks Wells Per DSU
Remaining Wells* – Three Forks Tier 2

*Well Density Assumptions
Low Case = 2 Three Forks Wells Per DSU
High Case = 6 Three Forks Wells Per DSU
Remaining Wells* – Three Forks Tier 3

*Well Density Assumptions

Low Case = 0 Three Forks Wells Per DSU
High Case = 4 Three Forks Wells Per DSU
Remaining Wells – All Bakken and Three Forks Tiers

Production Zone

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<th>Remaining Wells Low Case</th>
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Cumulative Remaining Wells – Peak Month Minimum BOPD

Production Zone

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Years Remaining* / Minimum Wellhead Oil Price

*Assumes 1,200 Completions Per Year and $7MM Well Costs (20% After Tax IRR)
Presentation Outline

• Economics
• Understanding current and future oil production
  • Pricing update
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  • Oil forecasts
• North Dakota natural gas production
  • Flaring and gas capture
  • Interstate Transmission
• Pipeline construction update
Crude Oil Prices – Sep 13, 2018

Cushing $69.39
Brent $79.08
WTI + $9.69

Pricing Data:
Bloomberg & CME (LLS-Argus)

Brent $79.08
WTI + $9.69

LLS (Argus)
WTI + $7.35
North Dakota Oil Differential to WTI

- ND Wellhead Discount to WTI
- ND Wellhead Discount %

Year: 2014, 2015, 2016, 2017, 2018

(JJ Kringstad - North Dakota Pipeline Authority)
North Dakota Drilling Activity
Statewide Oil Performance

~13% Improvement Over 2017

Average BKN/TF Well Performance Statewide
DOE-EIA Forecasted Oil Price

- EIA Forecast
- Historical
Williston Basin Oil Production & Export Capacity, BOPD

Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.
Presentation Outline

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Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
- Natural Gas Liquids
Statewide Gas Performance

~16% Improvement Over 2017
NDPA North Dakota Gas Production Forecast

- ND Gas Case 1 - MMCFD
- ND Gas Case 2 - MMCFD
Natural Gas Update

- Production
  - Technology
  - Markets

- Gathering
  - Capacity
  - Connections

- Processing
  - Capacity
  - Location

- Transmission
  - Dry Gas
  - Natural Gas Liquids
Solving the Flaring Challenge

GREEN – % of gas captured and sold
Blue – % flared from zero sales wells
Orange – % flared from wells with at least one mcf sold.

Simple Terms
Blue – Lack of pipelines
Orange – Challenges on existing infrastructure

Statewide

83%

14%

3%

June 2018 Data – Non-Confidential Wells
Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
- Natural Gas Liquids
Solving the Flaring Challenge
Solving the Flaring Challenge
Upcoming Expansion

No

Yes
Upcoming Expansion

MMCFD
## Natural Gas Processing Capacity, Million Cubic Feet Per Day

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<td><strong>Total, MMCFD</strong></td>
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<td>355.0</td>
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Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
- Natural Gas Liquids
Major Gas Pipeline and Processing Infrastructure

[Map showing gas pipeline and processing infrastructure in North Dakota]
Northern Border Pipeline

- 42” Pipeline
- Carries Canadian (Port of Morgan) and Domestic Gas
- Receives Gas From ND Plants, WBI Transmission Interconnections, and WY Pipelines (Bison & Grasslands)
- Midcontinent Deliveries

*Data Source: Northern Border IPS*
Northern Border Pipeline

*Data Source: Northern Border IPS*
Conclusion: **IF** no other gas export options open and all other deliveries on other pipelines stay static, ND gas production could increase 1.38-1.68 BCFD (from June-18) before Northern Border is 100% Bakken production. **BTU management becomes increasingly important for Bakken residue gas.**
Now What?
LNG Exports to Benefit ND by Shifting Gas Flow
LNG Exports to Benefit ND by Shifting Gas Flow
Existing Global LNG Facilities

Global LNG

billion cubic feet per day

billion cubic feet per day
Presentation Outline

• Economics
• Understanding current and future oil production
  • Pricing update
  • Activity
  • Oil forecasts
• North Dakota natural gas production
  • Flaring and gas capture
  • Interstate Transmission
• Pipeline construction update
North Dakota Pipeline Construction

- New Miles
- Year End Miles

Sources: NDIC & PHMSA

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<th>Year</th>
<th>New Miles of Pipe</th>
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<td>673</td>
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<td>2009</td>
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<td>914</td>
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<td>2017</td>
<td>996</td>
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Total Miles of Pipe

Sources: NDIC & PHMSA
Contact Information

Justin J. Kringstad, Director
North Dakota Pipeline Authority

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

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E-mail: jjkringstad@ndpipelines.com

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