Road Infrastructure to Support Oil Development

Gene Griffin
Upper Great Plains Transportation Institute
North Dakota State University
Points Covered

• Impact of oil development on roads
• Additional factors
• Long term implications
• Political considerations
• Potential solutions
• Expected long-term investments
Road Impacts
Will take 10,000 – 20,000 to fully develop the Bakken – Three Forks

<table>
<thead>
<tr>
<th>Year</th>
<th>well cost</th>
<th>oil price</th>
<th>IP</th>
<th>stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>$5,651,771</td>
<td>$60</td>
<td>725+</td>
<td>15-28+</td>
</tr>
<tr>
<td>2009</td>
<td>$5,413,471</td>
<td>$81</td>
<td>654</td>
<td>10-20</td>
</tr>
<tr>
<td>2008</td>
<td>$4,386,927</td>
<td>$54</td>
<td>576</td>
<td>6-10</td>
</tr>
<tr>
<td>2007</td>
<td>$4,089,715</td>
<td>$52</td>
<td>326</td>
<td>2-6</td>
</tr>
<tr>
<td>2006</td>
<td>$4,089,715</td>
<td>$52</td>
<td>195</td>
<td>1-2</td>
</tr>
</tbody>
</table>
Road Impacts

• An sample Bakken horizontal well requires 2,024 truck trips during the drilling phase

<table>
<thead>
<tr>
<th>Rig Related Movements</th>
<th>Number of Trucks</th>
<th>Inbound/Outbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>80</td>
<td>Inbound</td>
</tr>
<tr>
<td>Water (Fresh)</td>
<td>400</td>
<td>Inbound</td>
</tr>
<tr>
<td>Water (Waste)</td>
<td>200</td>
<td>Outbound</td>
</tr>
<tr>
<td>Frac Tanks</td>
<td>100</td>
<td>Inbound/Outbound</td>
</tr>
<tr>
<td>Rig Equipment</td>
<td>50</td>
<td>Inbound/Outbound</td>
</tr>
<tr>
<td>Drilling Mud</td>
<td>50</td>
<td>Inbound</td>
</tr>
<tr>
<td>Chemical</td>
<td>4</td>
<td>Inbound</td>
</tr>
<tr>
<td>Cement</td>
<td>15</td>
<td>Inbound</td>
</tr>
<tr>
<td>Pipe</td>
<td>10</td>
<td>Inbound</td>
</tr>
<tr>
<td>Scoria/Gravel</td>
<td>80</td>
<td>Inbound</td>
</tr>
<tr>
<td>Fuel trucks</td>
<td>7</td>
<td>Inbound</td>
</tr>
<tr>
<td>Frac/cement pumper trucks</td>
<td>15</td>
<td>Inbound</td>
</tr>
<tr>
<td>Workover rigs</td>
<td>1</td>
<td>Inbound</td>
</tr>
<tr>
<td>Total - One Direction</td>
<td>1012</td>
<td></td>
</tr>
<tr>
<td>Total Trucks</td>
<td>2024</td>
<td></td>
</tr>
</tbody>
</table>
Impacts are Localized
Production by County (Barrels)
Road Impacts

• The number of outbound trucks during the production phase depends on initial production rate and pipeline access

• In North Dakota, 96% of well locations are located more than ¼ mile from the state system, thus requiring the use of local road systems designed for low traffic volumes
Existing Road Conditions

• Resurface vs. Reconstruction
  – Roadway Width – practice of thin-lift overlays maintains surface condition but reduces roadway width
  – Existing condition
  – Is resurfacing feasible?
Improvement Responses to Impacts

• Gravel Roads
  – Increase blading frequency (low impact)
  – Increase gravel application frequency (medium impact)
  – Upgrade to a paved surface type (high impact)

• Paved Roads
  – Increased ESALs decrease pavement life
  – Structural Overlays
  – Reconstruction
    • Insufficient roadway width
    • Existing condition poor
Additional Factors

Agriculture
Changing Agriculture

• Farm Size Increasing
• Acres Increased by 2,000,000 Since 1997
• More Tons/Acre
• More Inputs (fertilizer, chemicals)
• Larger Equipment
• Larger Trucks (Semis)
• Reduced Grain Elevator Numbers (Shuttles)
  – From 1029 in 1950 to 402 today
  – Capacity increased from 60 million bu to 288 million b
  – From 10 miles to market in 1950 to 30 miles today
North Dakota Decade Average Annual Crop Production (NASS)
North Dakota Wheat versus Corn Bushels (NASS)

Decade Average Annual Production

Bushels Thousands

- Wheat All
- Corn For Grain
Decade Average Annual Corn Production and Acres in North (NASS)
Irrigated Acres

Legend
- 100 - 1,000
- 1,001 - 1,500
- 1,501 - 2,500
- 2,501 - 3,500
- 3,501 - 5,500
- 5,501 - 7,500
- 7,501 - 10,000
- 10,001 - 12,000
- 12,001 - 18,000

1980
1990
2000
Decade Annual Average Sugarbeet Production (NASS)
Sugarbeet Production Tons and Planted Acres (NASS)
17.1 Billion Pounds

Source: National Agricultural Statistics Service
All Crops in Pounds
2008

62.3 Billion Pounds
3.6 Times More Weight

Legend
- 3,000,000 - 489,000,000 lbs
- 489,000,001 - 1,023,000,000 lbs
- 1,023,000,001 - 1,530,000,000 lbs
- 1,530,000,001 - 3,103,000,000 lbs
- 3,103,000,001 - 4,815,000,000 lbs
Public Road Mileage - VMT - Lane Miles
1920 – 2008 (FHWA)

- **Public Road Mileage**
- **Vehicle Miles of Travel**
- **Lane Miles**

Year:

Millions:
- 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0

Trillions:
- 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5

Vehicle Miles of Travel (VMT)
Long Term Implications
Several Factors

• Future of the carbon based economy
• Global growth of the middle class
  – China, India, Brazil, and others
• Drilling technology
• Other sources of oil
Current Activity

- On 11/2 there were 154 rigs operating in North Dakota
  - (Source: ND Oil & Gas)
North Dakota Average Monthly Rig Count

Rigs


Rig Count  ND Sweet Oil Price
North Dakota Wells Producing Each Year
Duration of Impacts

• ND Oil & Gas
  – Western North Dakota
    • 1,450 to 2,940 wells/year
    • 10 to 20 years in duration
      – 21,250 new wells
      – If estimate and technology hold, this represents 43 million truck trips for the drilling alone
Ray-Tioga Area

• 430 to 540 wells per year

• 3.5 million – 4.5 million gallons fracturing water per day May through December

• 11 to 14 years
Williston Area

• 70 to 90 wells per year

• 0.9 million – 1.1 million gallons fracturing water per year May through December

• 8 to 20 years
Alexander Area

• 120 to 150 wells per year

• 1.4 million – 1.8 million gallons fracturing water per day May through December

• 12 to 15 years
Watford City - Keene Area

• 250 to 310 wells per year

• 2.0 million – 2.6 million gallons fracturing water per day May through December

• 5 to 7 years
Killdeer Area

• 235 to 290 wells per year

• 1.0 million – 1.2 million gallons fracturing water per day May through December

• 6 to 8 years
Parshall Area

• 375 to 470 wells per year

• 1.5 million – 2.0 million gallons fracturing water per day May through December

• 7 to 8 years
Political Considerations

Small p
Federal Aid and Interstate Highway System

• Highway Trust Fund
• Donor.Donee system
  – Historically, North Dakota received about $2 for every $1 contributed to the Federal Highway Trust Fund
  – Federal Aid makes up about 57% of NDDOT budget
• Long standing battle in Congress over this system
North Dakota Politics, small p

• Not dissimilar from Federal debate
• East versus West
• Agriculture versus Oil
• Water issues
• Flood issues
  – Devils Lake
  – Red River
National Issue

• The culture of free
  – Santa Claus
  – Easter Bunny
  – Tooth Fairy

• Honest discussion
  – What we want from government
  – What we’re willing to pay for
Potential Solutions
State Driven

• Not a Federal issue
• Can’t be solved at the local level
• State Legislature and Executive Branch has to resolve it
  – Extraction taxes go to the state
  – Problem is larger than Western ND
    • Western part most severe
  – Solution needs to be part of a system plan
  – Legislature’s have the responsibility to look after the entire state and solve equity issues
  – Will need to viewed within the context of other major issues such as water supply and flood control
Expected Long Term Investments
Summary

• Impact of oil development on roads
• Additional factors
• Long term implications
• Political considerations
• Potential solutions
• Expected long-term investments
  – Beneficial to the local communities, ND and U.S.
  – Logically one would presume that ND will deal with this effectively and efficiently
UGPTI Oil Impact Study

• Agencies involved: ND Department of Commerce, ND Association of Oil & Gas Producing Counties

• Objectives
  – Estimate the incremental needs for county and local roads due to oil development activity in ND
  – Develop GIS/Cube based traffic flow model
  – Model inbound and outbound rig related movements and outbound oil and saltwater
  – Assign movements to specific routes
  – Estimate the incremental maintenance and improvement needs

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• Contact:
  – Alan Dybing: alan.dybing@ndsu.edu  701.231.5988
  – www.ugpti.org