Road Infrastructure to Support Oil Development

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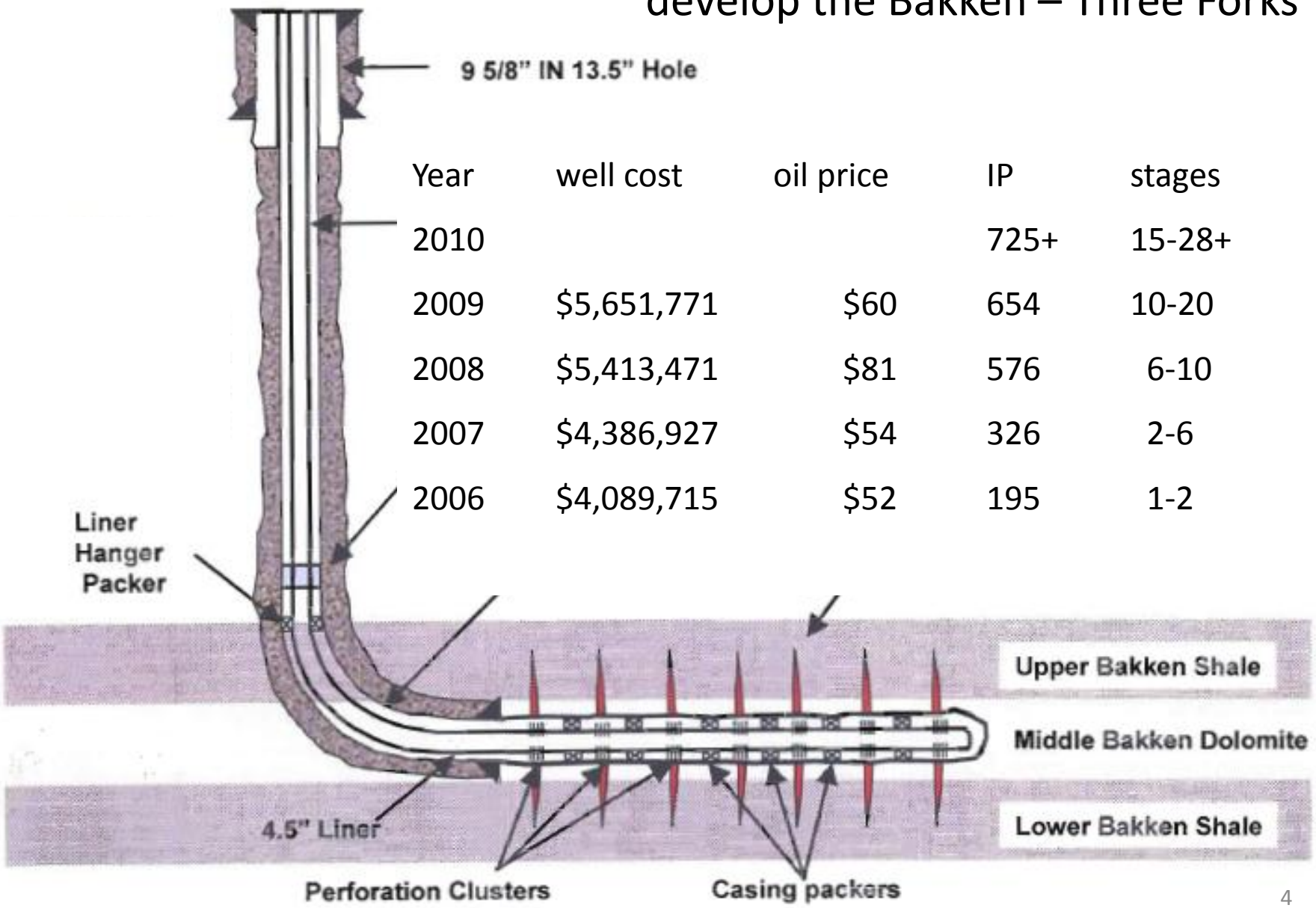
Points Covered

- 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

Year	well cost	oil price	IP	stages
2010			725+	15-28+
2009	$5,651,771	$60	654	10-20
2008	$5,413,471	$81	576	6-10
2007	$4,386,927	$54	326	2-6
2006	$4,089,715	$52	195	1-2

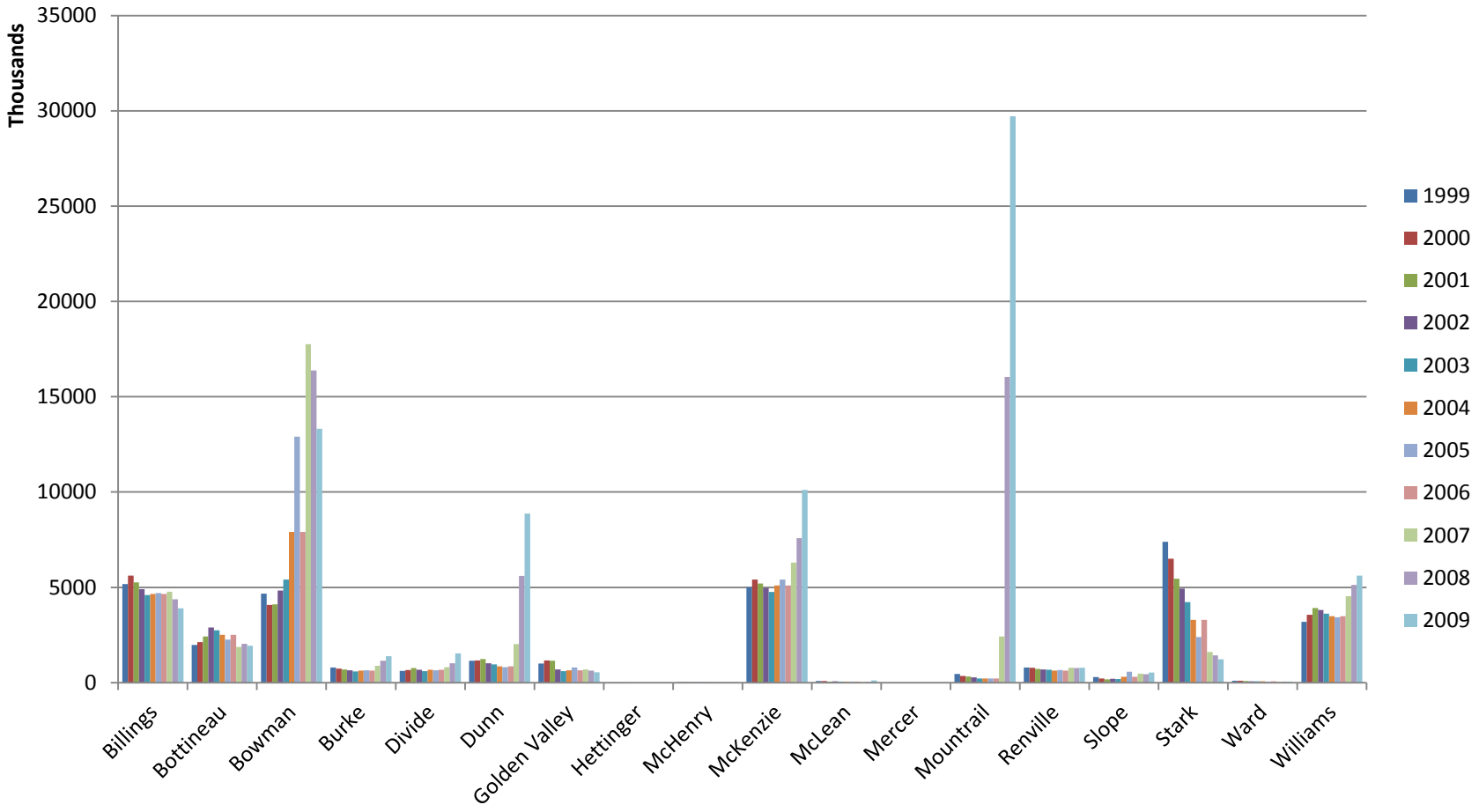


Road Impacts

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

Rig Related Movements		
Item	Number of Trucks	Inbound/Outbound
Sand	80	Inbound
Water (Fresh)	400	Inbound
Water (Waste)	200	Outbound
Frac Tanks	100	Inbound/Outbound
Rig Equipment	50	Inbound/Outbound
Drilling Mud	50	Inbound
Chemical	4	Inbound
Cement	15	Inbound
Pipe	10	Inbound
Scoria/Gravel	80	Inbound
Fuel trucks	7	Inbound
Frac/cement pumper trucks	15	Inbound
Workover rigs	1	Inbound
Total - One Direction	1012	
Total Trucks	2024	

Impacts are Localized
Production by County (Barrels)

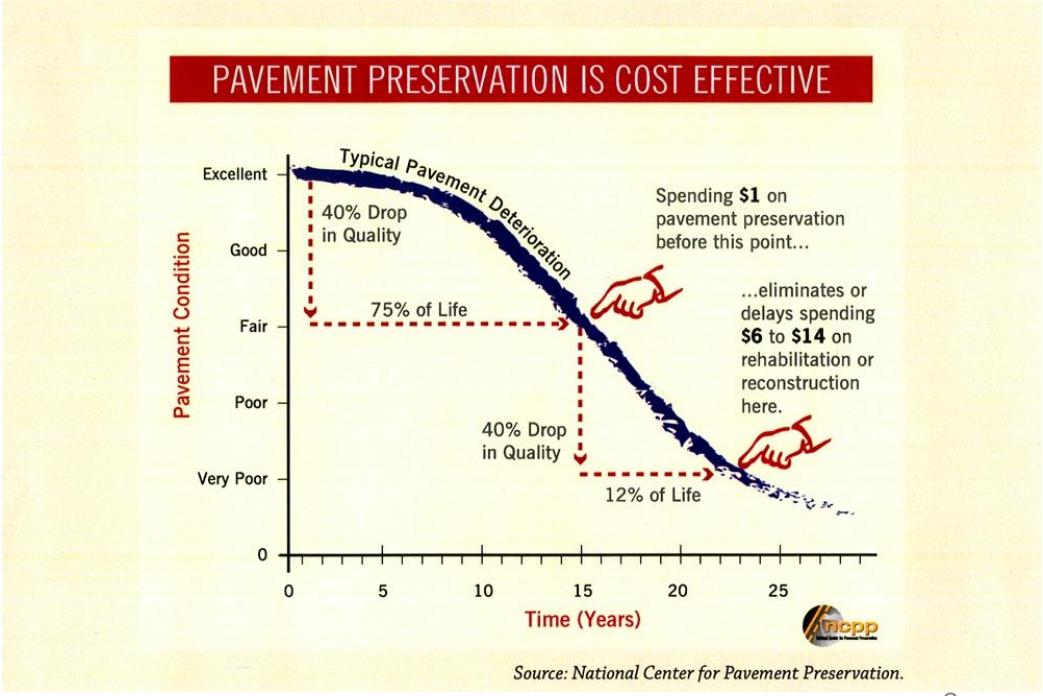


Road Impacts

- 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

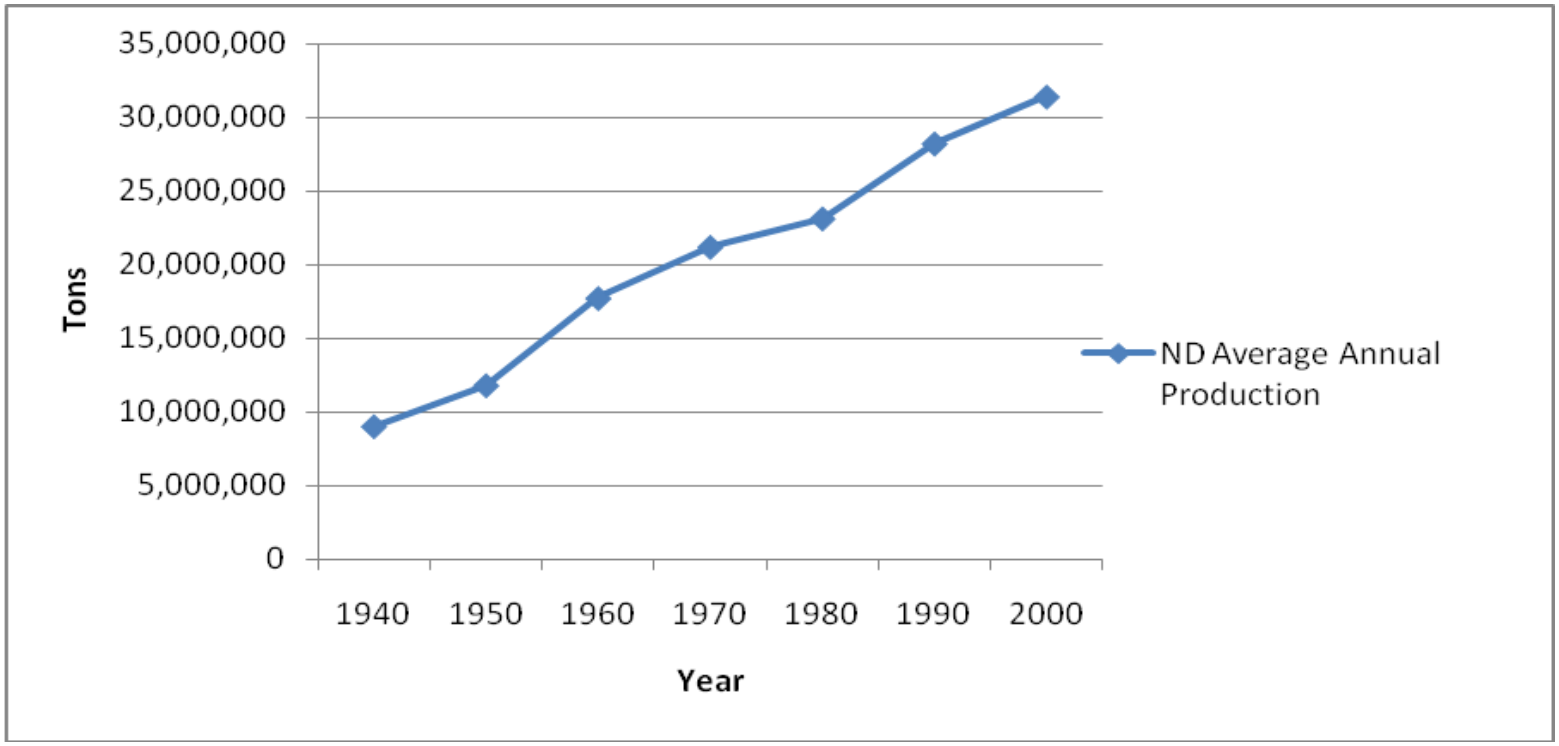
- Gravel Roads
  - Increase blading frequency (low impact)
  - Increase gravel application frequency (medium impact)
  - Upgrade to a paved surface type (high impact)
- Paved Roads
  - Increased ESALs decrease pavement life
  - Structural Overlays
  - Reconstruction
    - Insufficient roadway width
    - Existing condition poor

Additional Factors
Agriculture

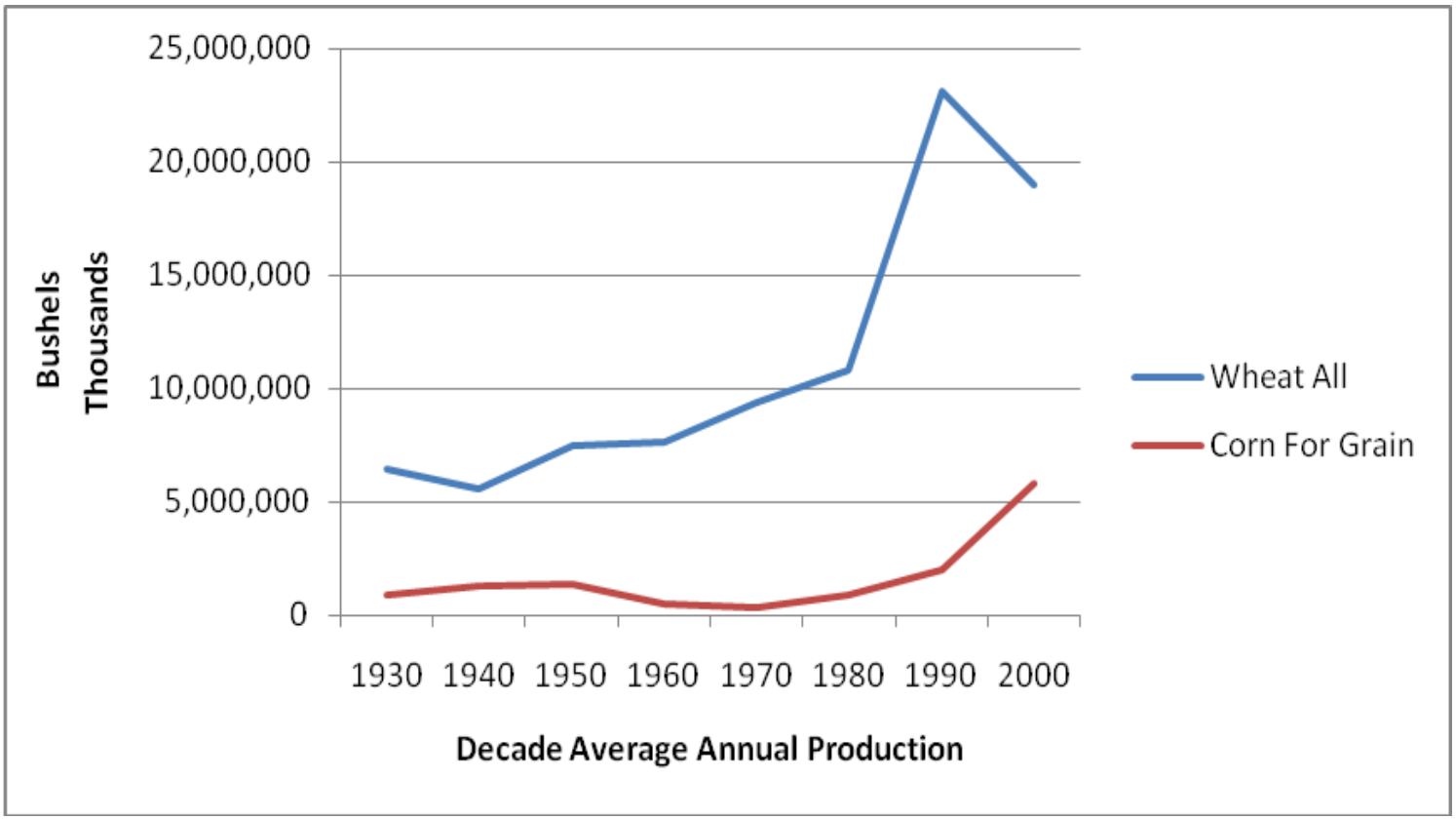
Changing Agriculture

- 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

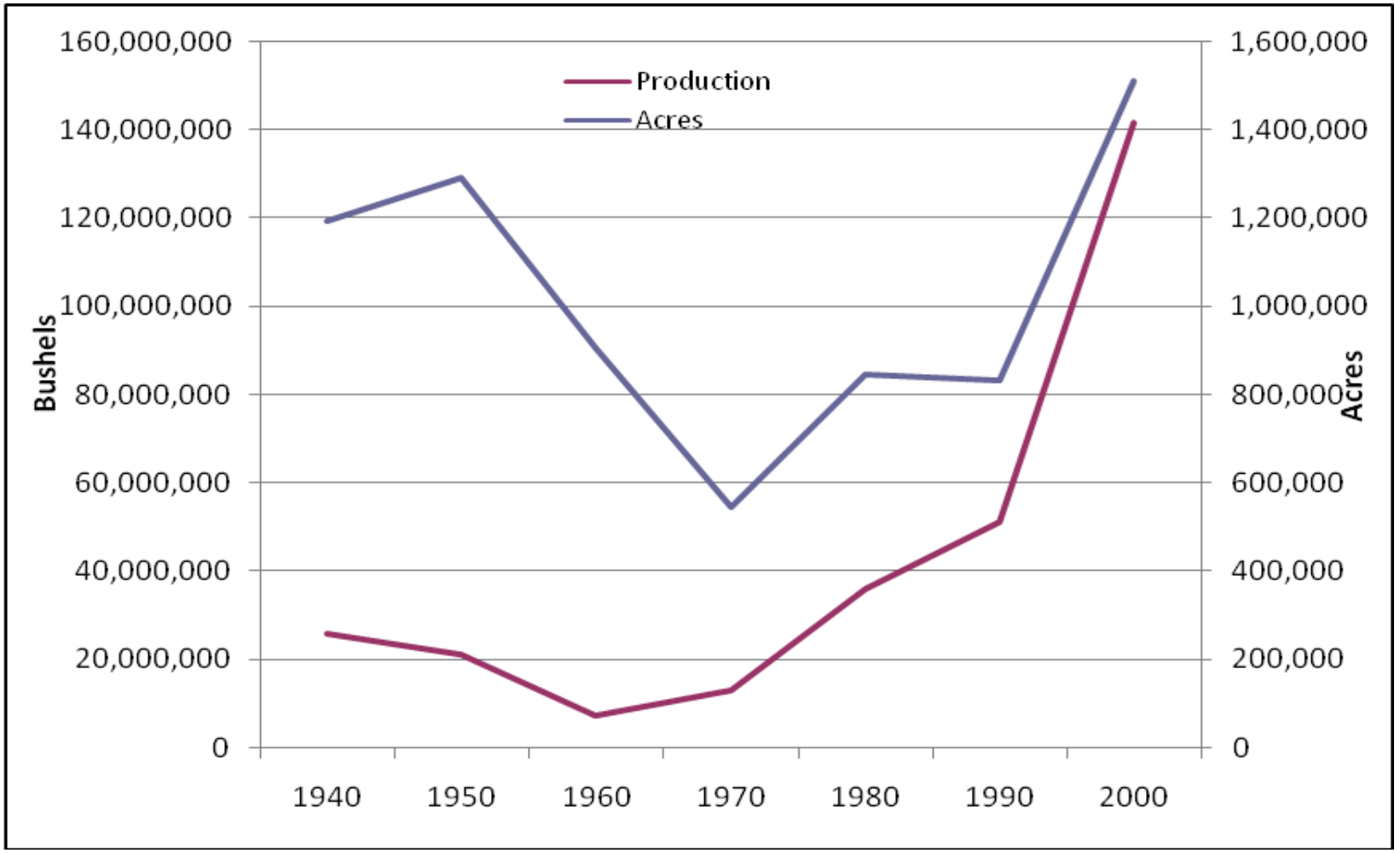
North Dakota Decade Average Annual Crop Production (NASS)



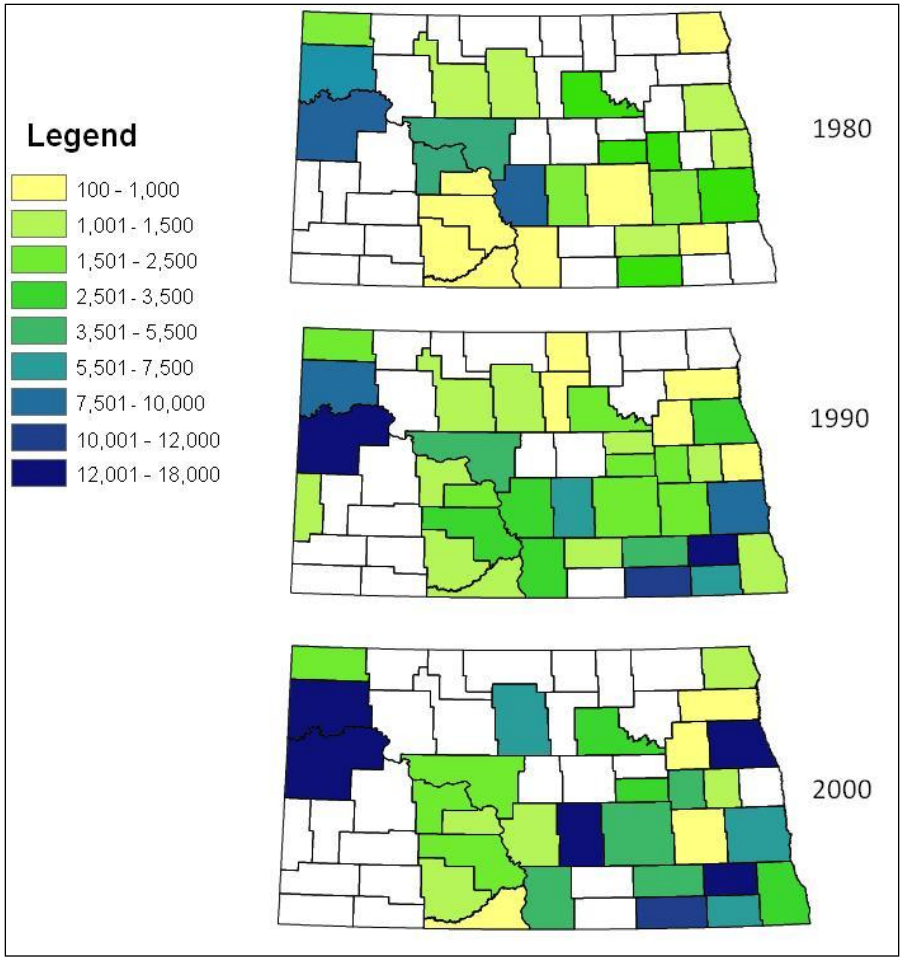
North Dakota Wheat versus Corn Bushels (NASS)



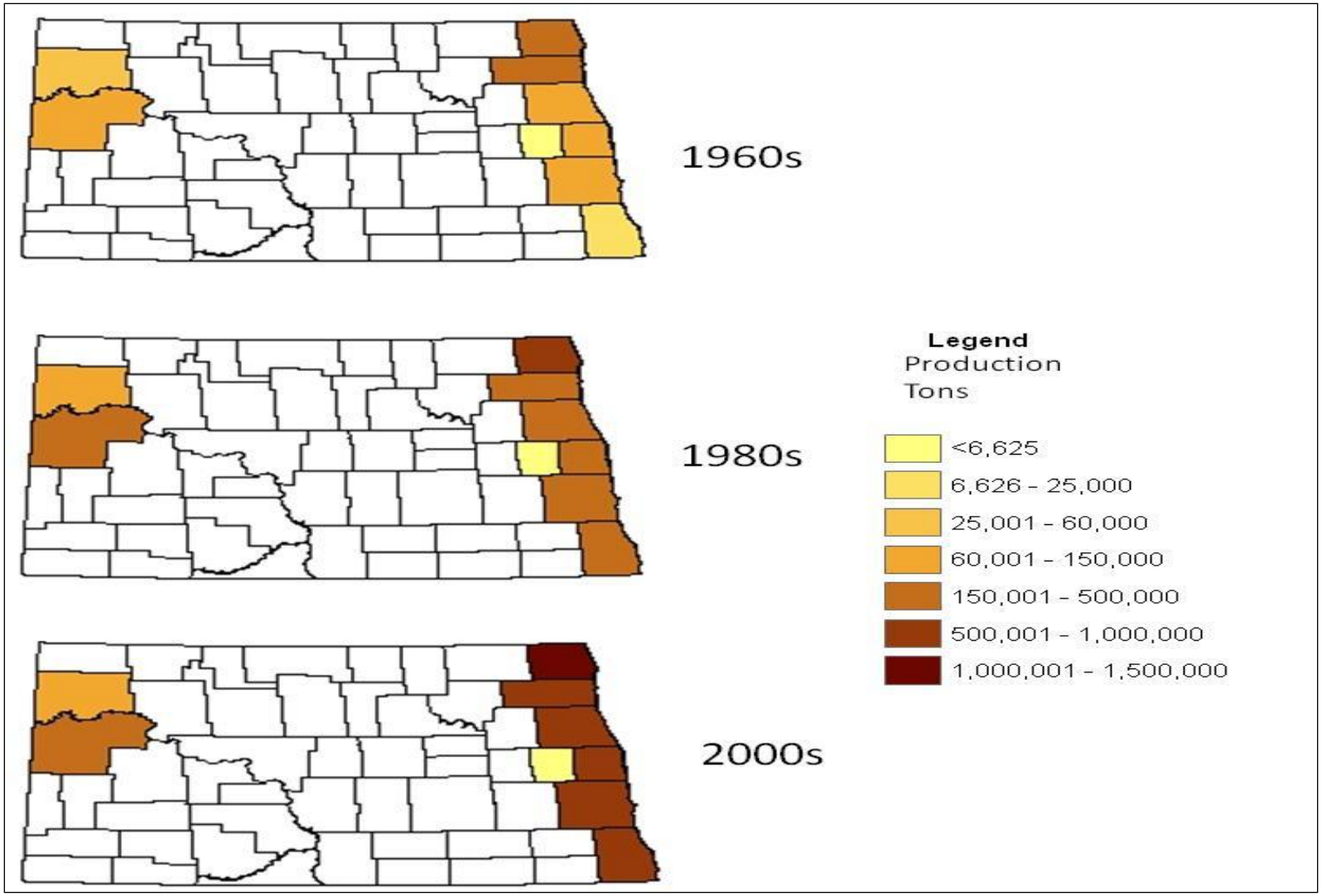
Decade Average Annual Corn Production and Acres in North (NASS)



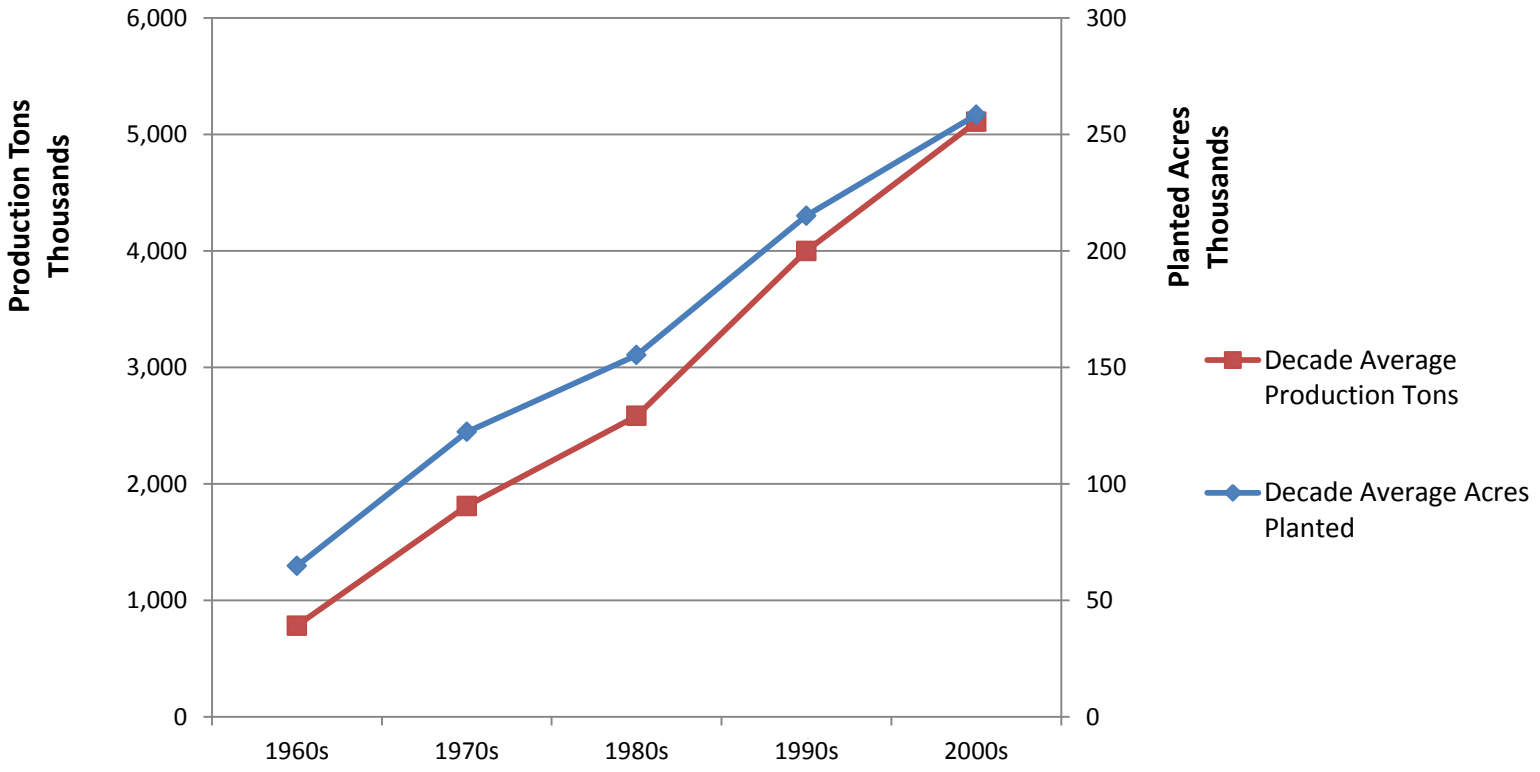
Irrigated Acres



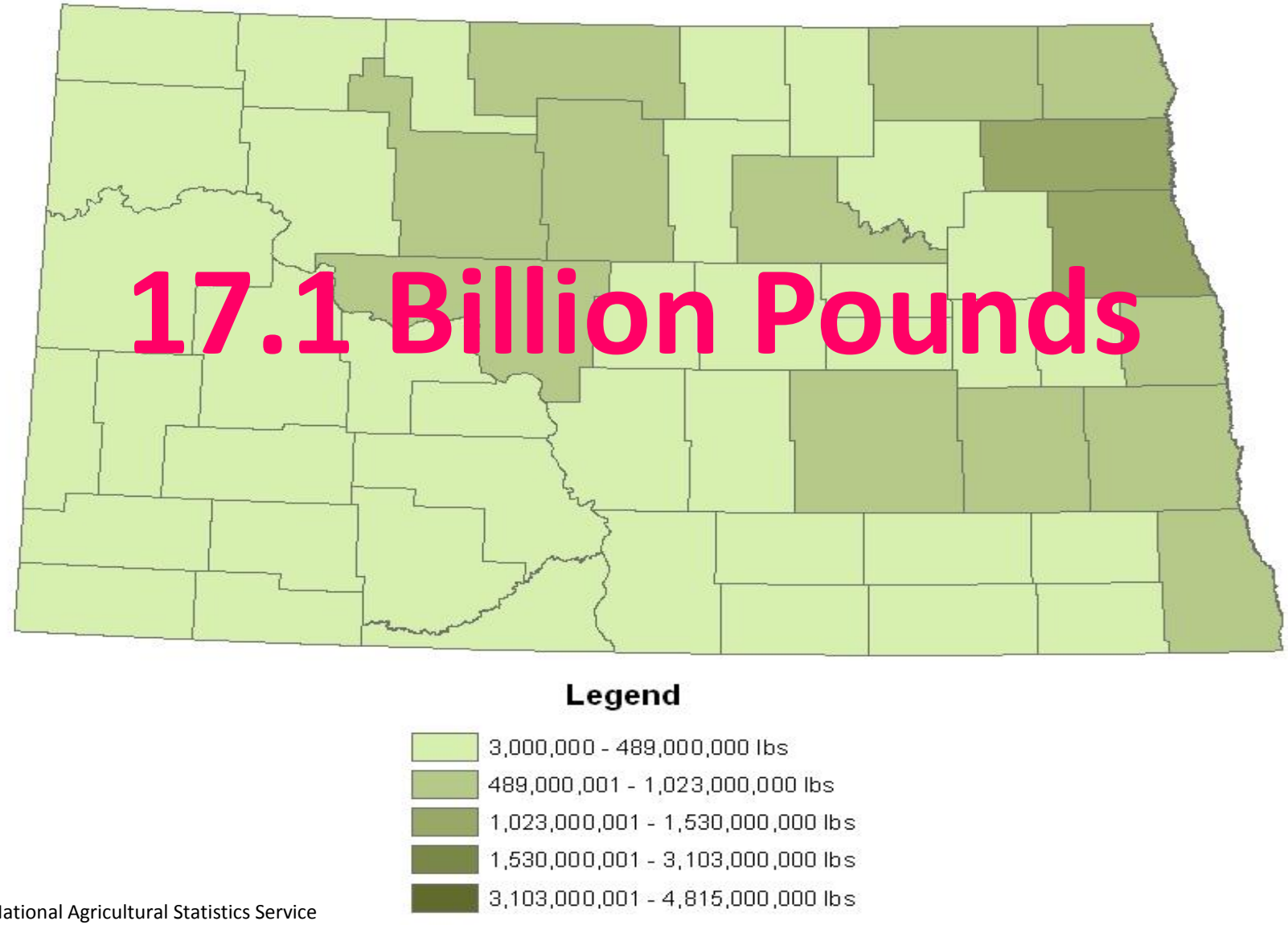
Decade Annual Average Sugarbeet Production (NASS)



Sugarbeet Production Tons and Planted Acres (NASS)

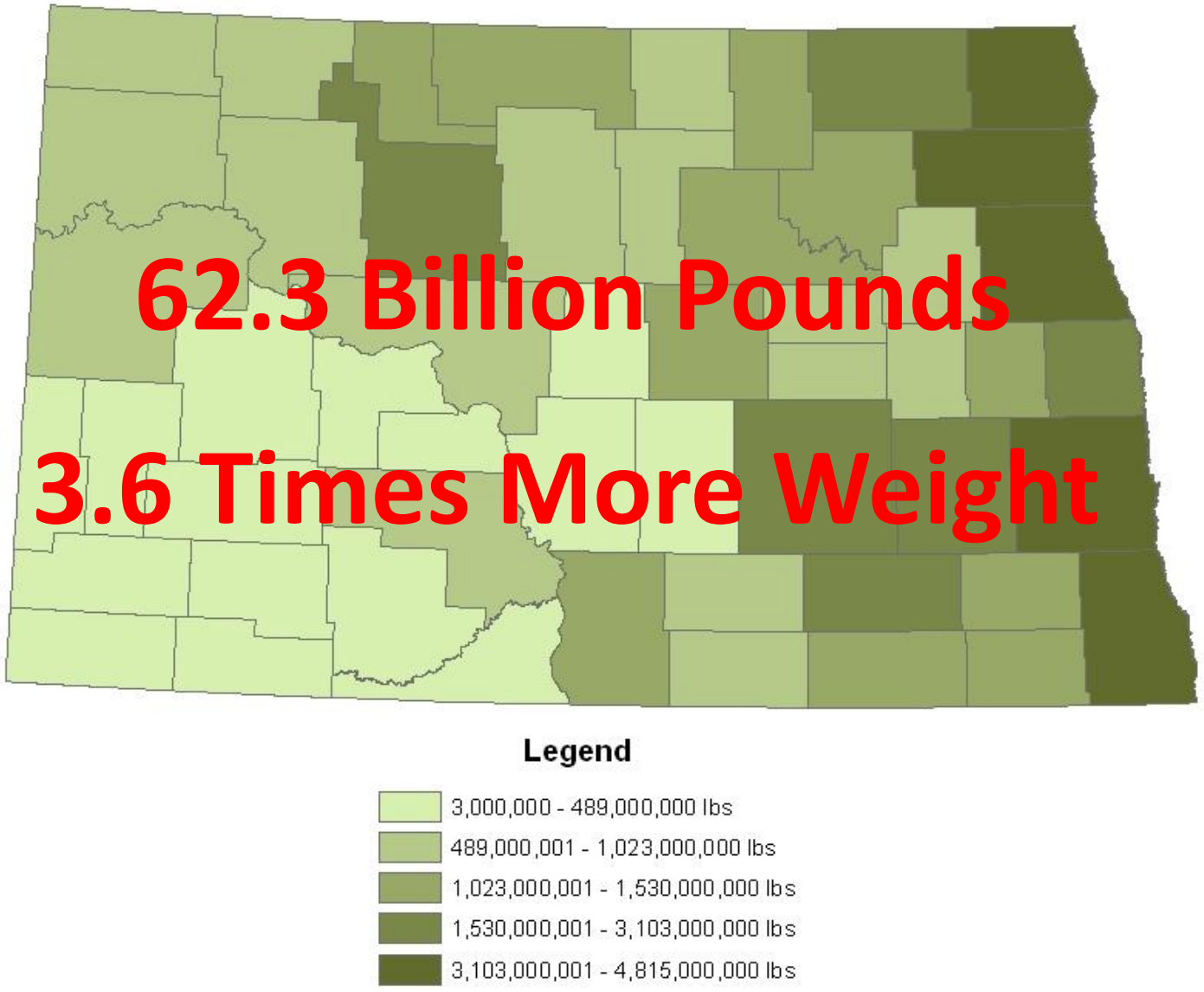


All Crops in Pounds
1950

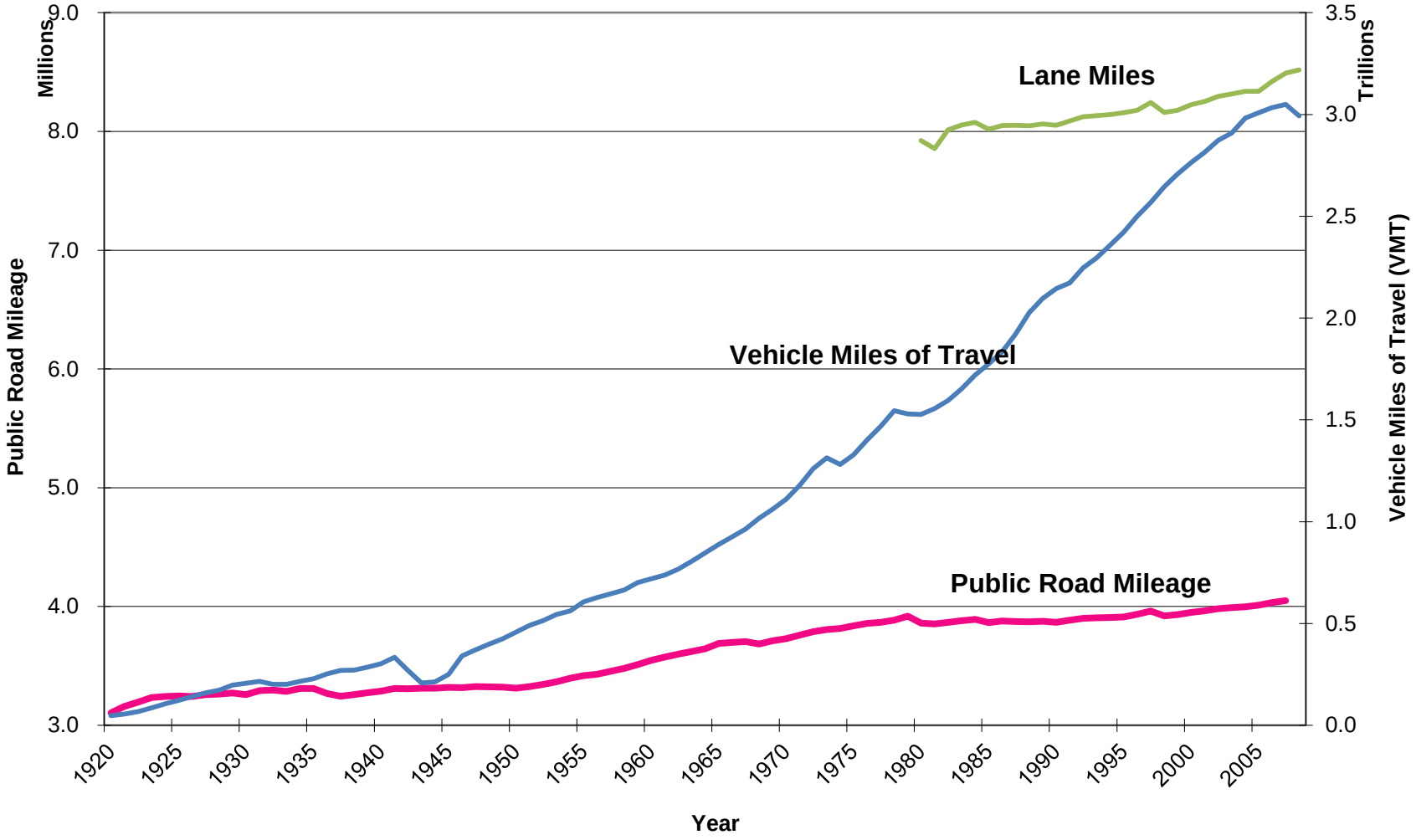


Source: National Agricultural Statistics Service

All Crops in Pounds
2008



Public Road Mileage - VMT - Lane Miles
1920 – 2008 (FHWA)



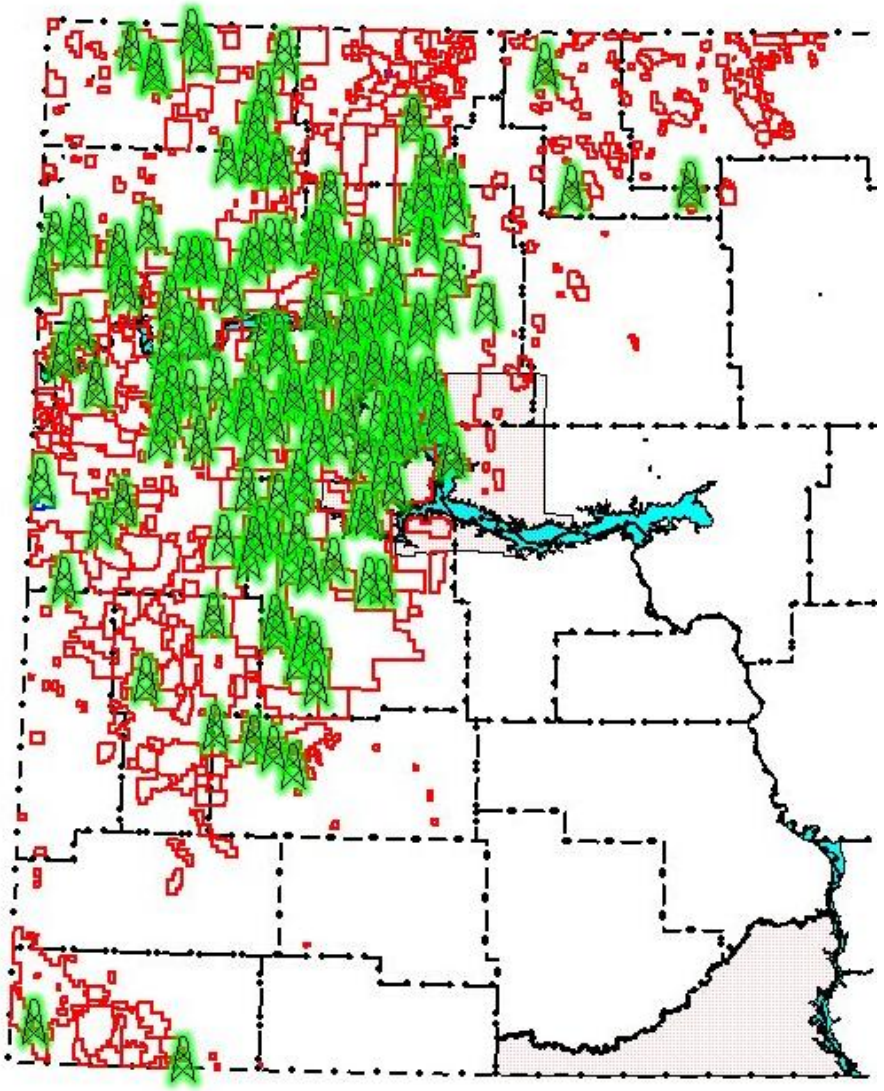
Long Term Implications

Several Factors

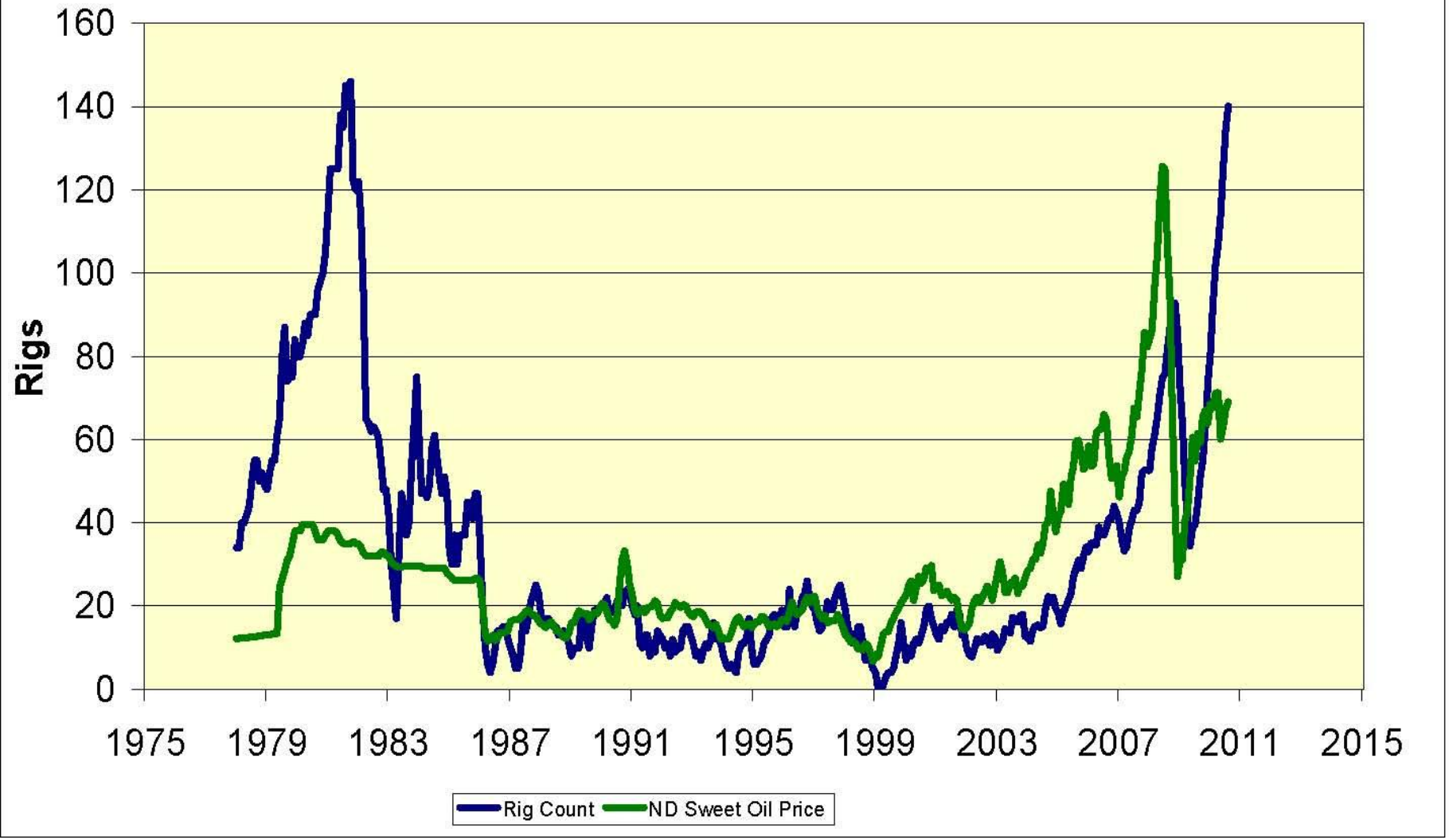
- Future of the carbon based economy
- Global growth of the middle class
  - China, India, Brazil, and others
- Drilling technology
- Other sources of oil

Current Activity

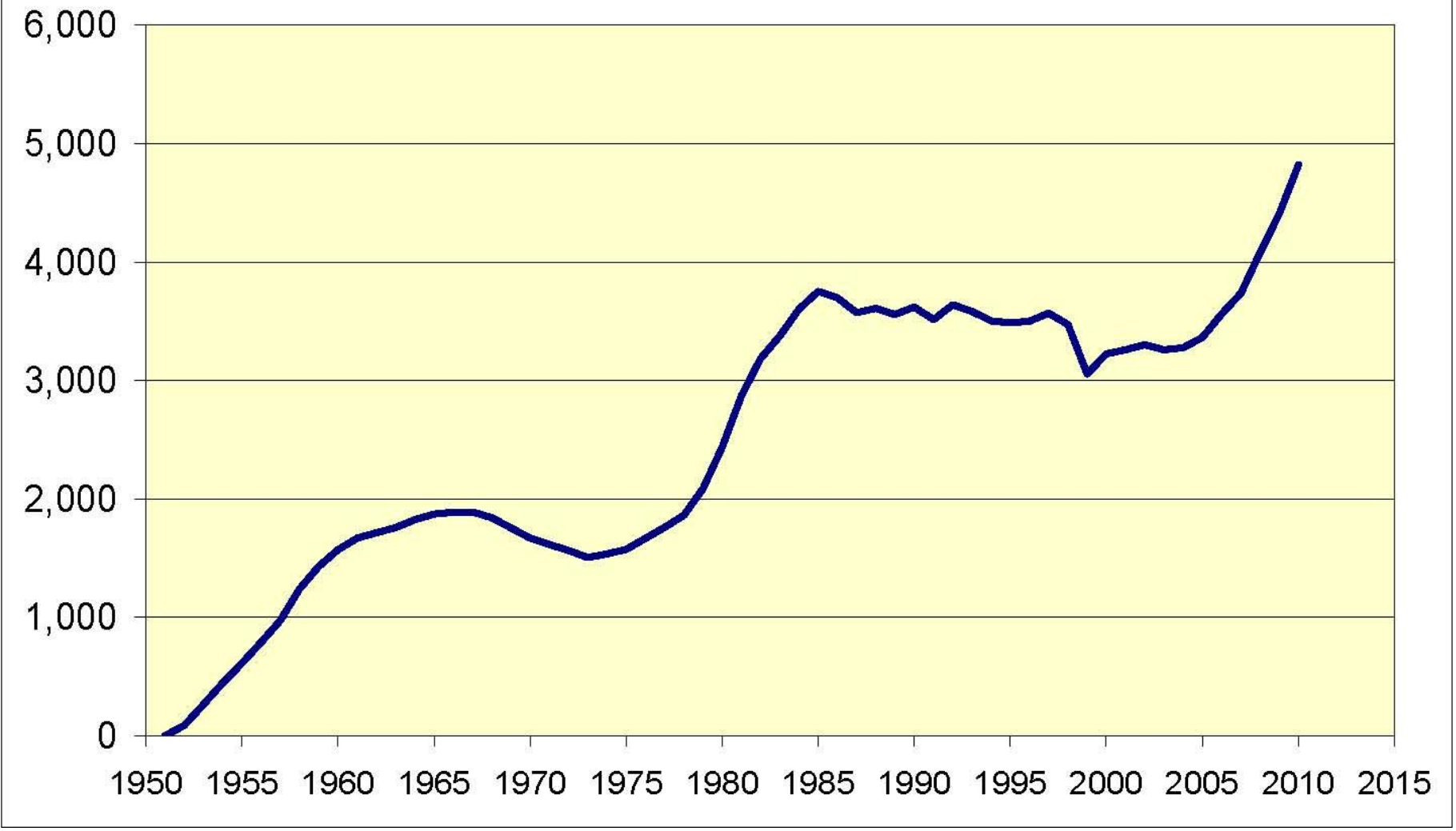
- On 11/2 there were 154 rigs operating in North Dakota
  - (Source: ND Oil & Gas)



North Dakota Average Monthly Rig Count



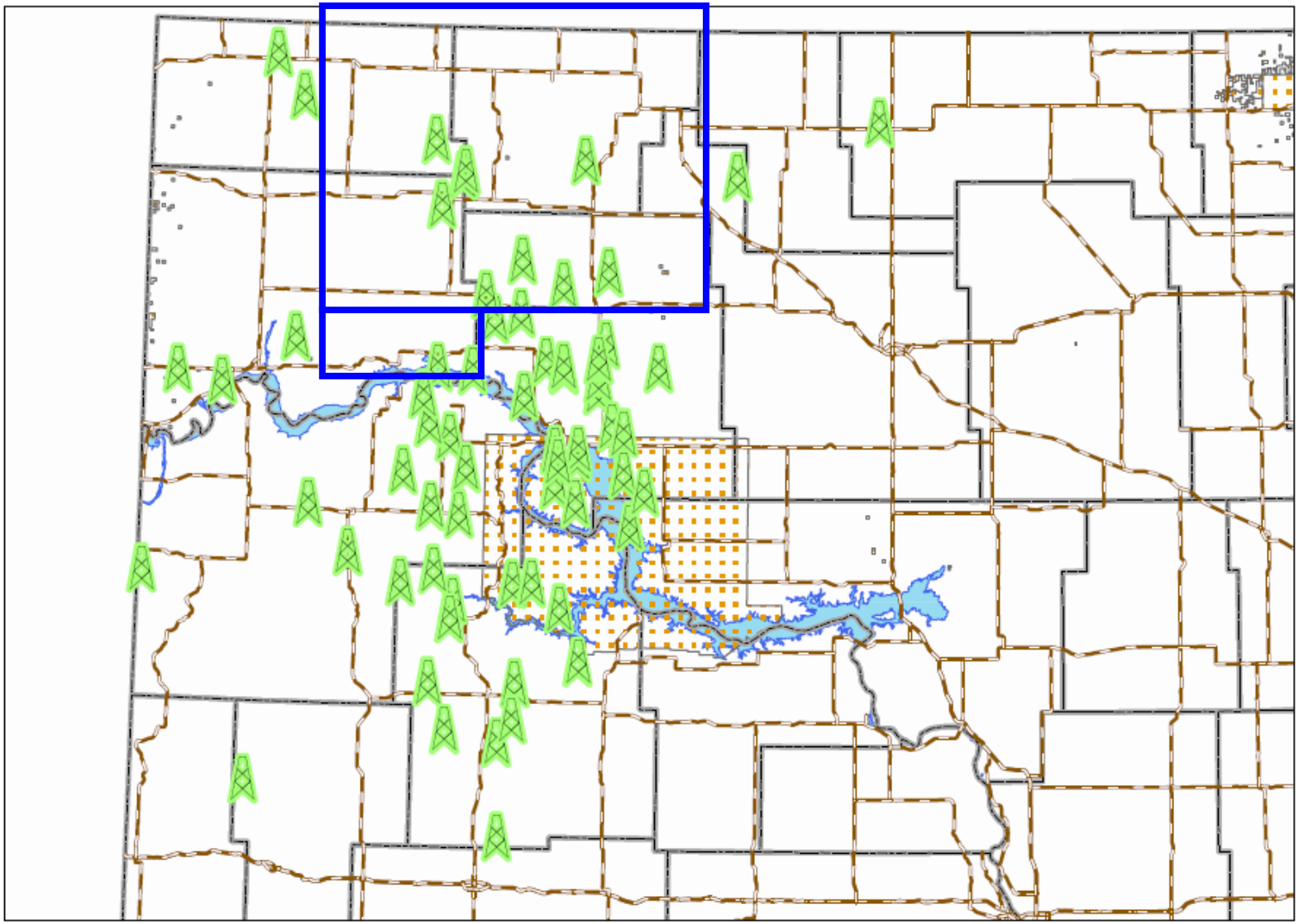
North Dakota Wells Producing Each Year



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



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0 15 30 60 Miles

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DATE : 12/5/2009
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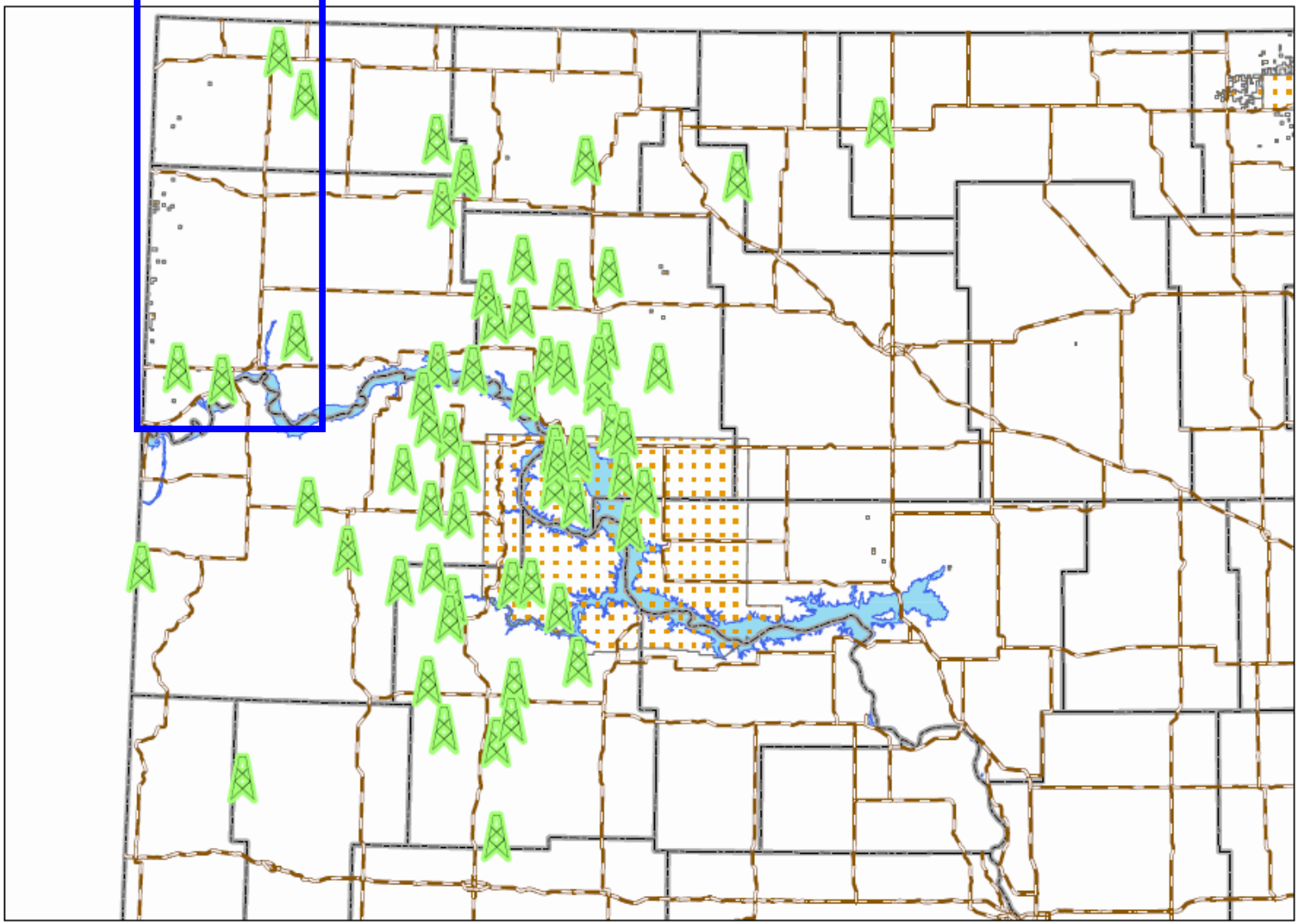
Ray-Tioga Area

- 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



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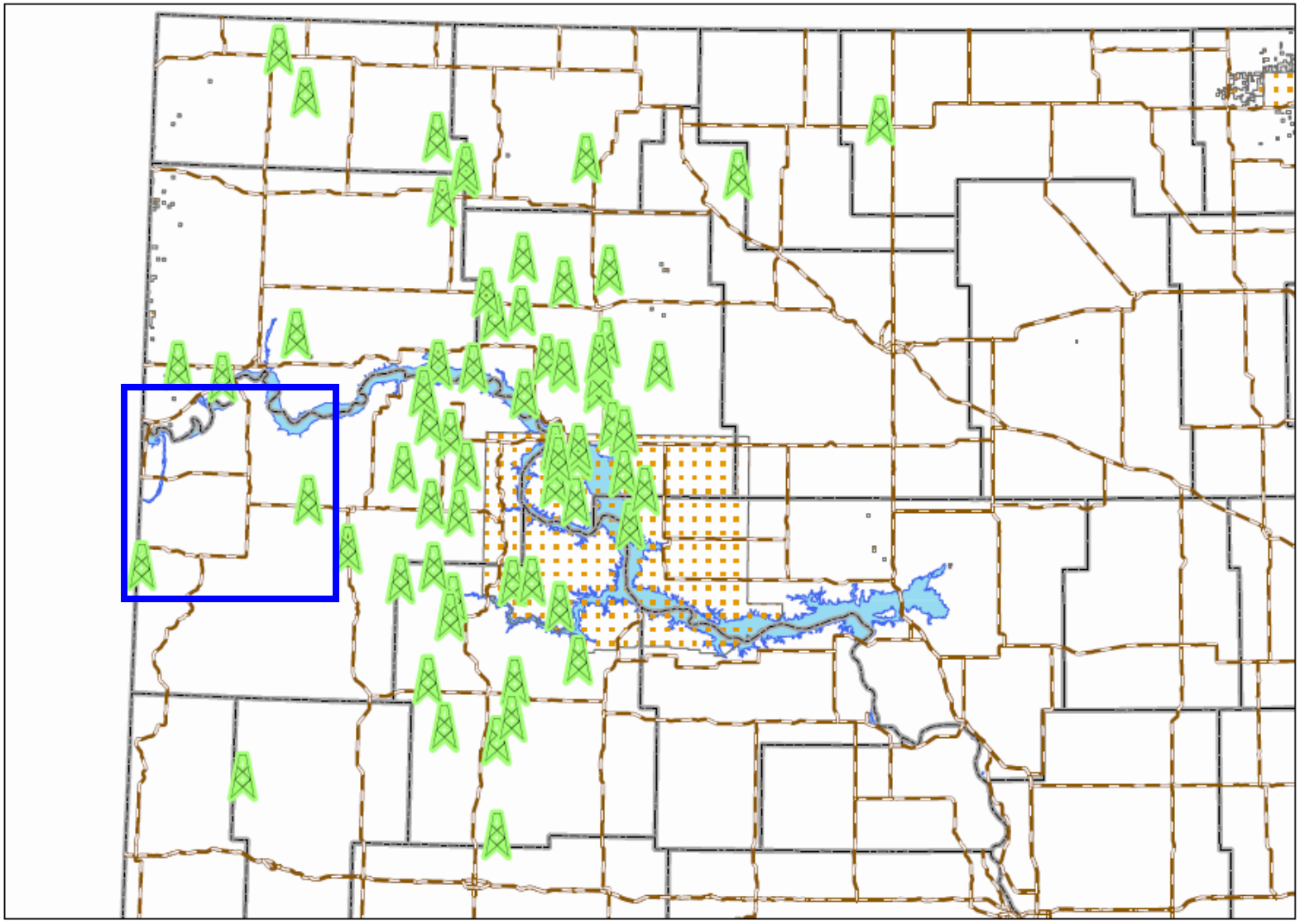
Williston Area

- 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



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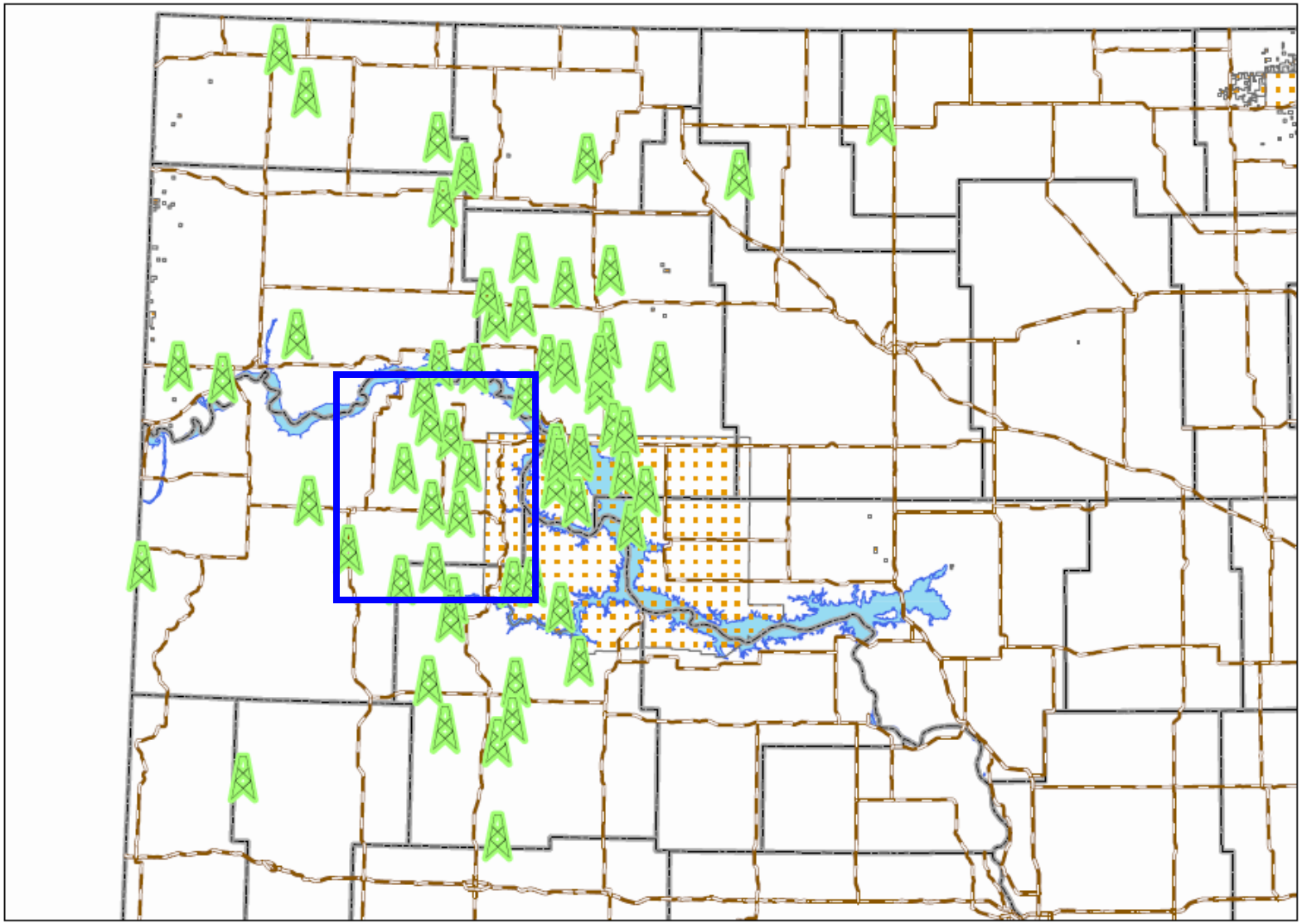
Alexander Area

- 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



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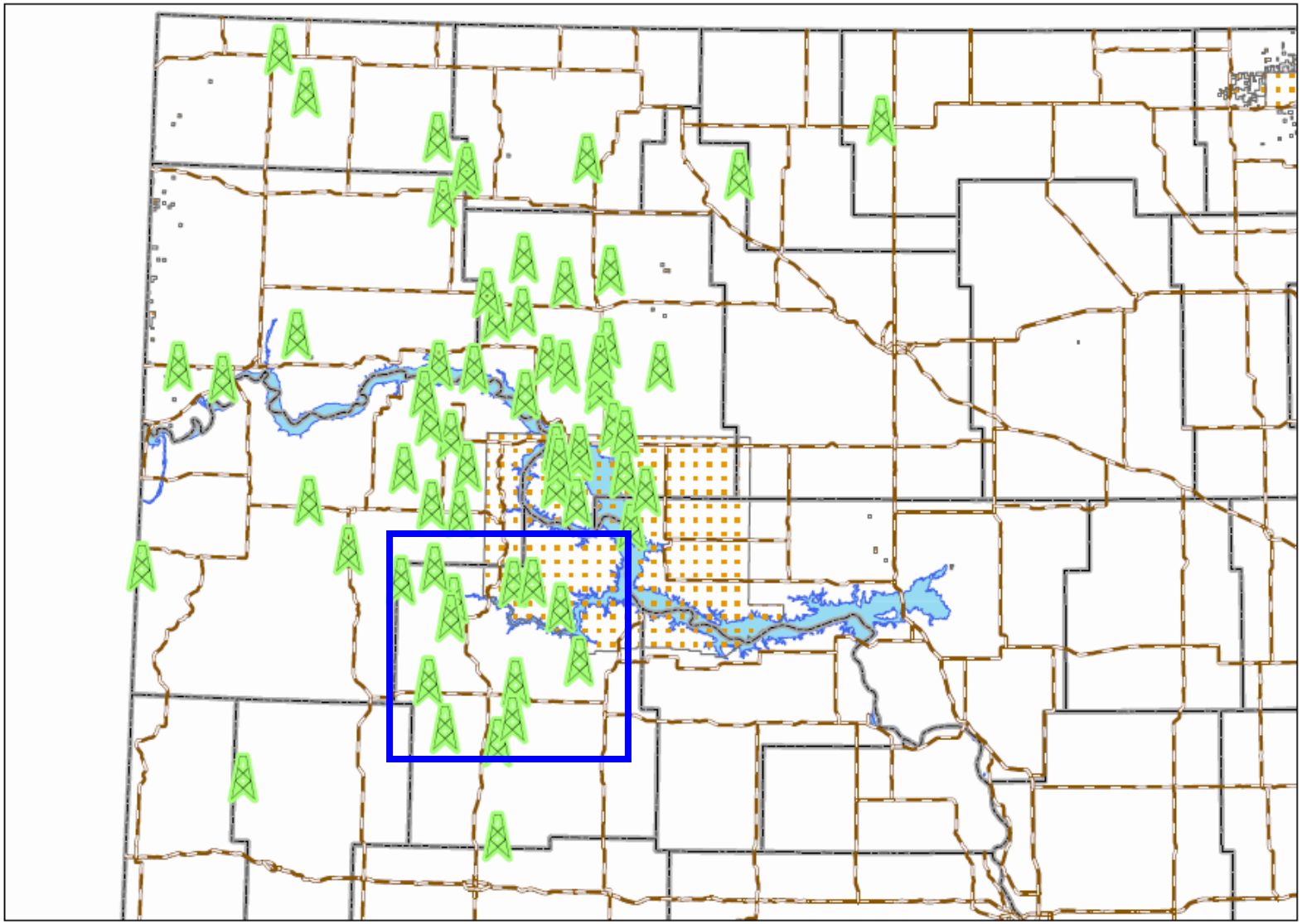
Watford City - Keene Area

- 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



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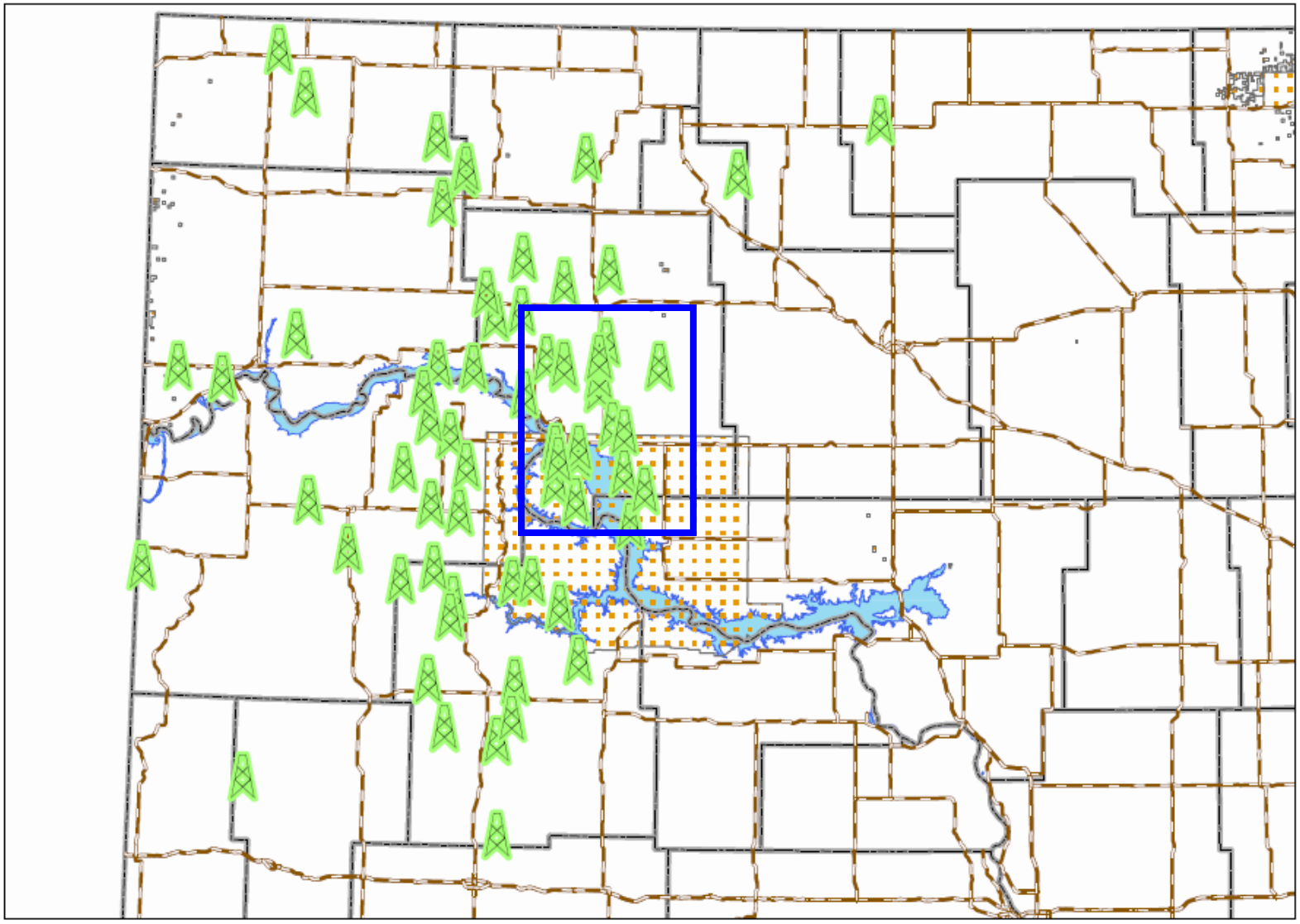
Killdeer Area

- 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



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0 15 30 60 Miles

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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

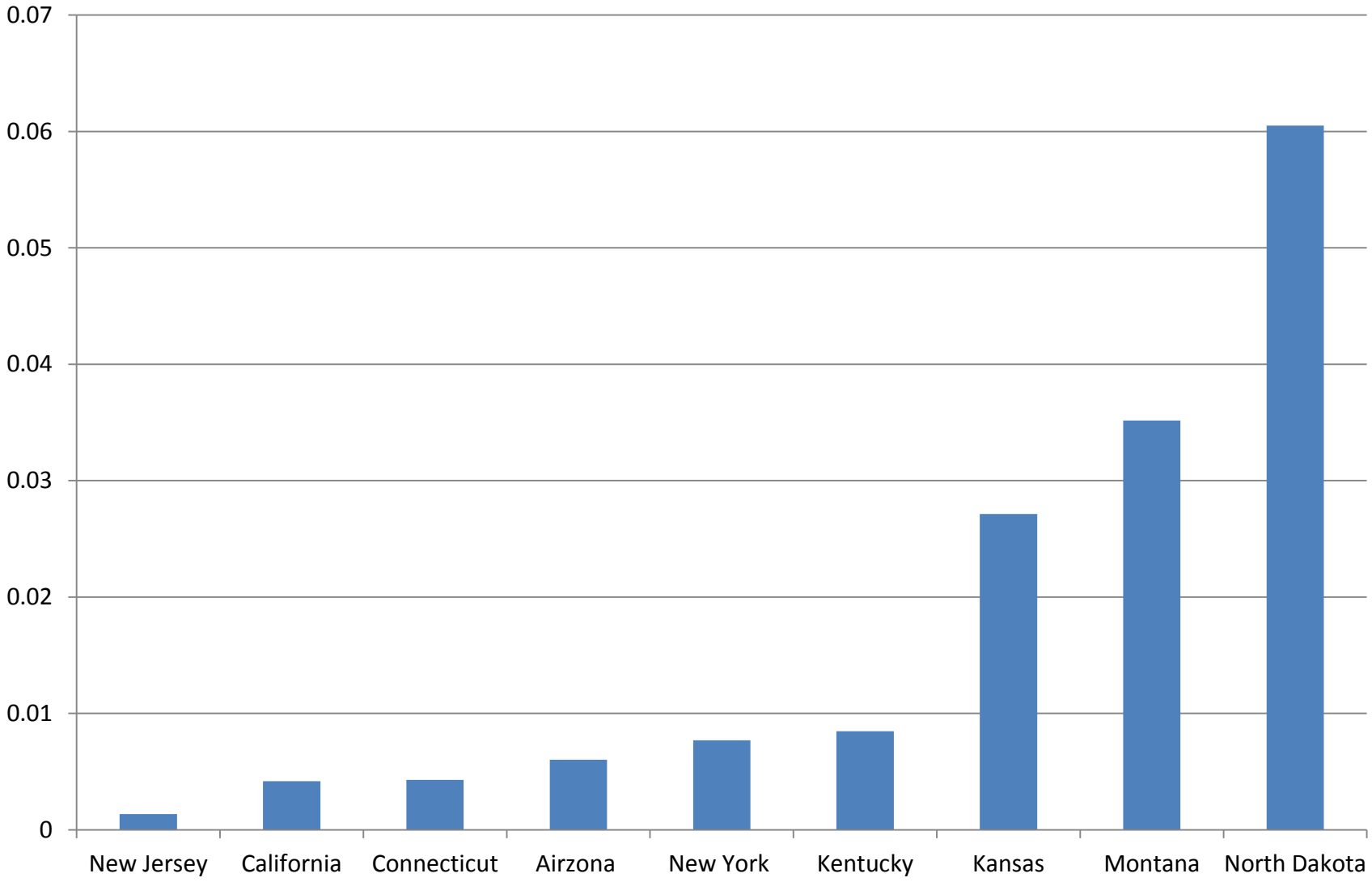
Political Considerations
Small p

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

Lane Miles/Capita

Federal-Aid-Highway Lane Miles



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
- Final Report Release: December 3, 2010
- Contact:
  - Alan Dybing: alan.dybing@ndsu.edu 701.231.5988
  - www.ugpti.org