NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

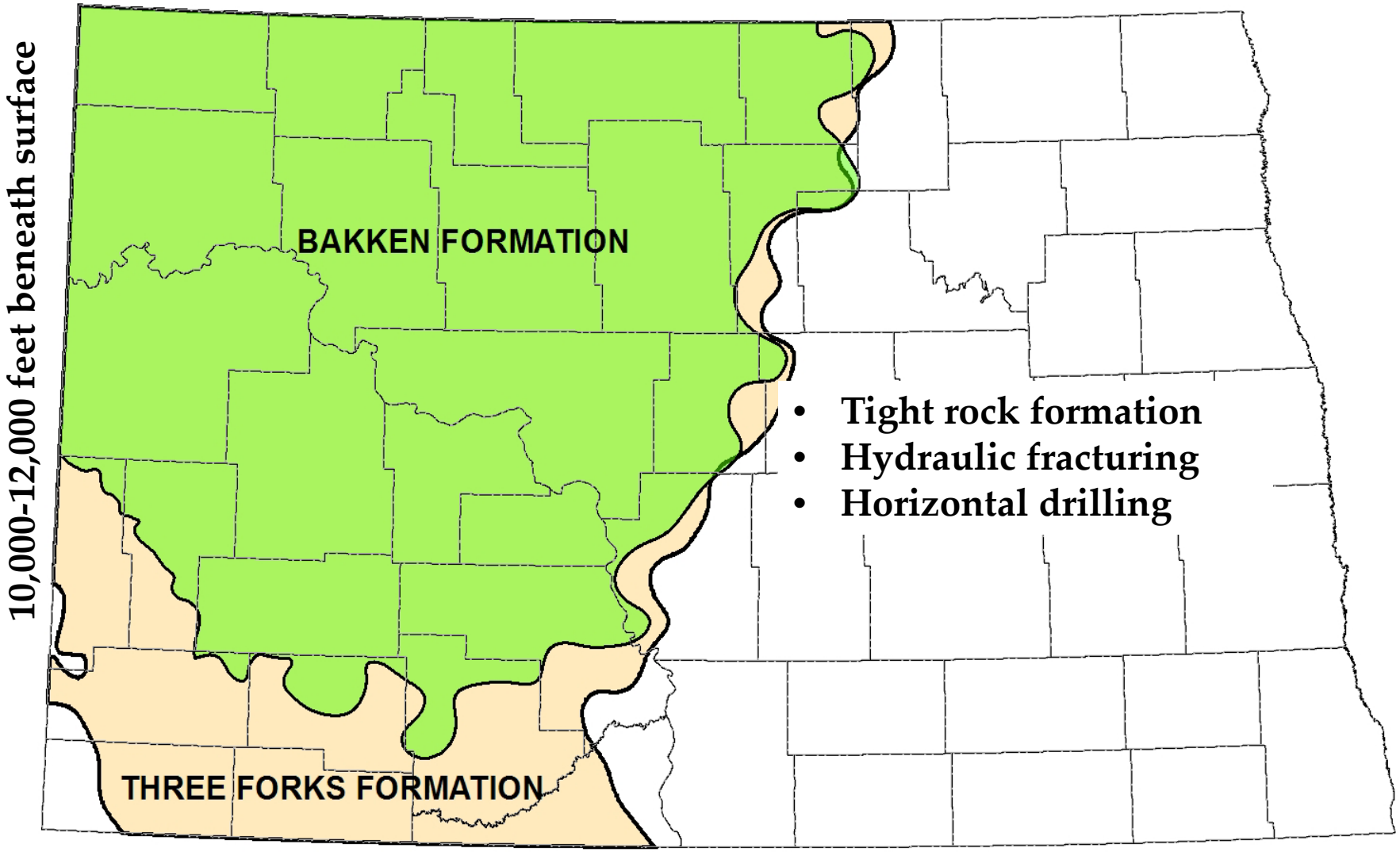
Traffic Growth and Transportation Safety in the Bakken Oil Producing Region

Denver Tolliver
Upper Great Plains Transportation Institute
North Dakota State University

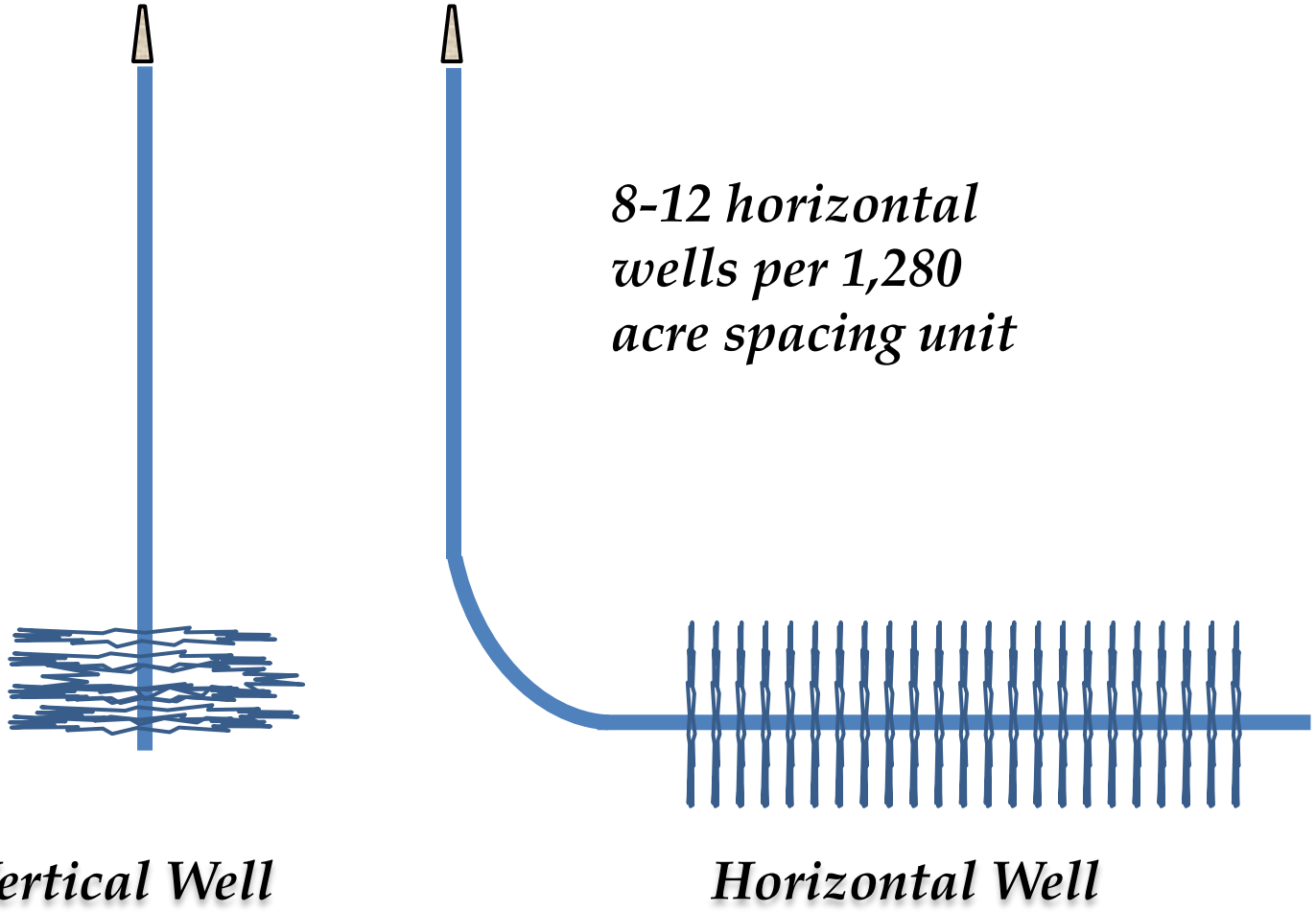
Introduction

- Director: Upper Great Plains Transportation Institute (UGPTI), North Dakota State University
- Director: Mountain-Plains Consortium (MPC), Region 8 University Transportation Center (NDSU)
- Consortium member: Small Urban & Rural Livability UTC (Montana State U.); NTI
- UGPTI's Lakewood CO center develops/updates FMCSA software: (1) *inspection apps*: e.g., Aspen, ISS, QC; (2) *investigative apps*: e.g. , CAPRI, CDLIS Access, UFA, CaseRite

Shale Oil Formations in North Dakota



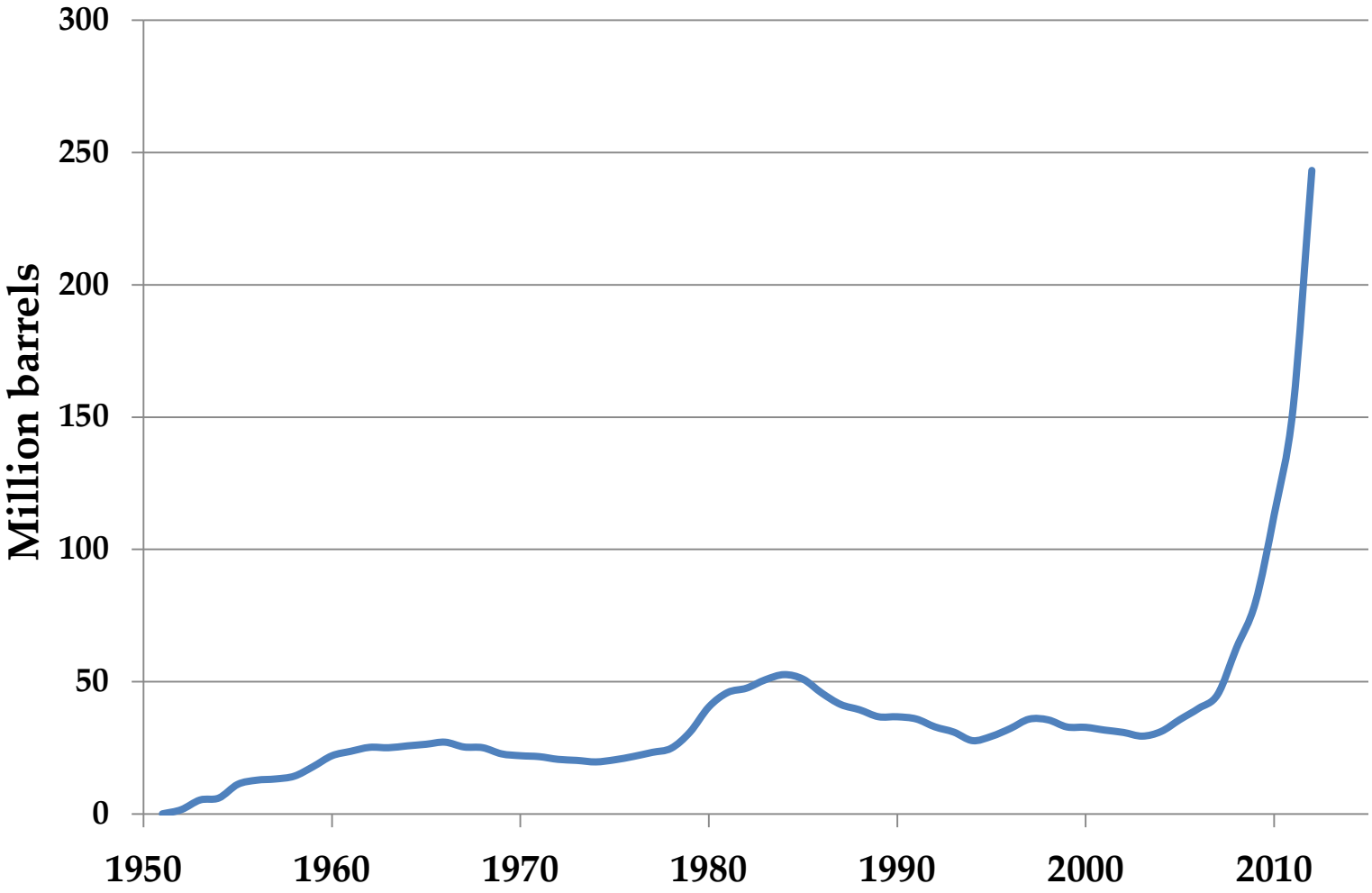
Horizontal versus Vertical Wells



Production Trends and Potential

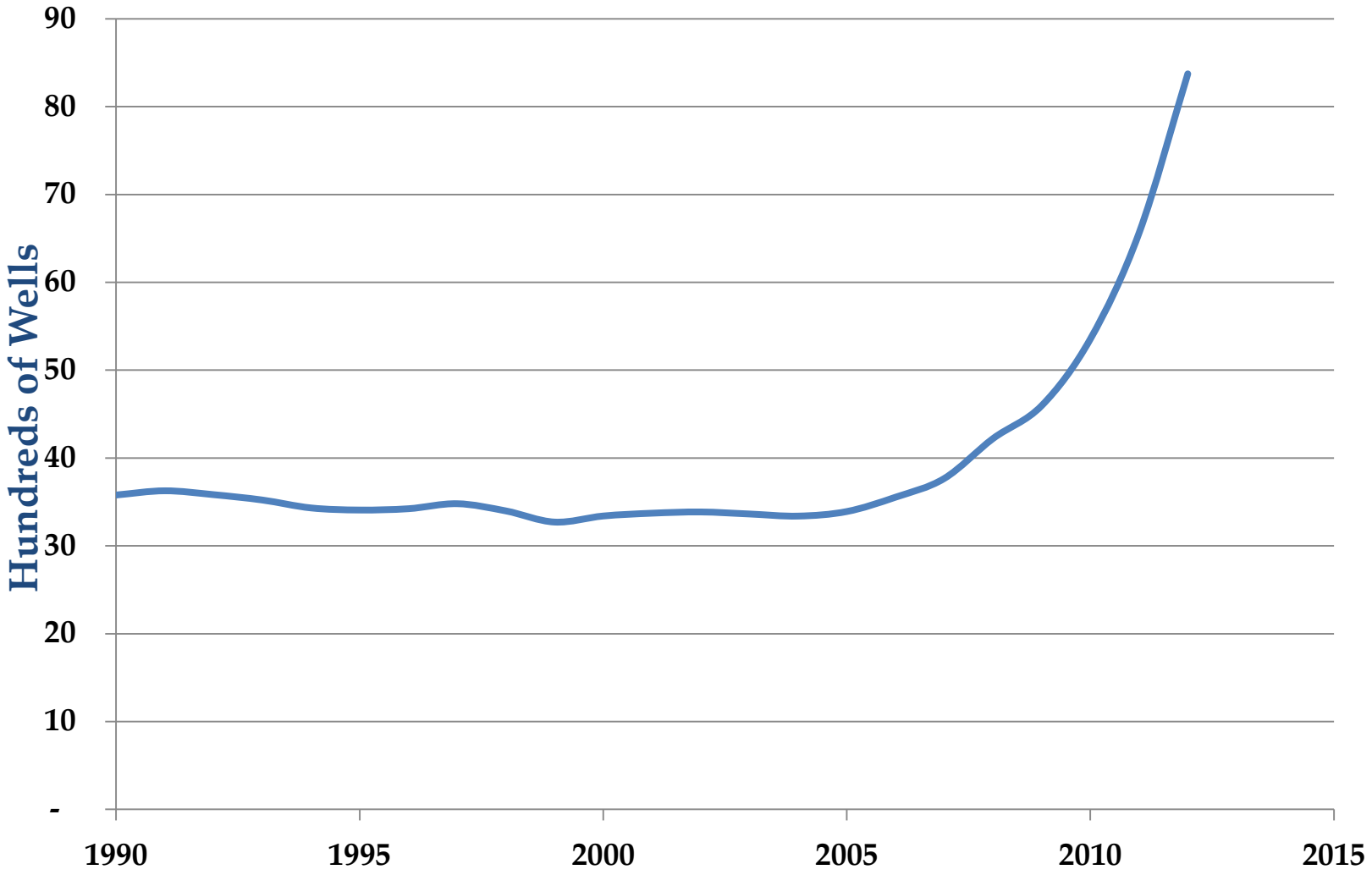
- ND is producing roughly 1 million barrels of oil per day (BOPD)
- Production may increase to 1.6 million BOPD
- Dept. of Mineral Resources projects 10-14 billion barrels of ***technically recoverable reserves***
- Industry projections (e.g., Continental Resources) are much higher—e.g., 20+ billion barrels
- Continental Resources estimates in-place oil reserves of 900 billion barrels
- 60,000 new wells will be drilled over next 20-30 years
- See following production charts

Annual Oil Production: North Dakota



North Dakota is second leading state in oil production

Number of Oil Wells: North Dakota

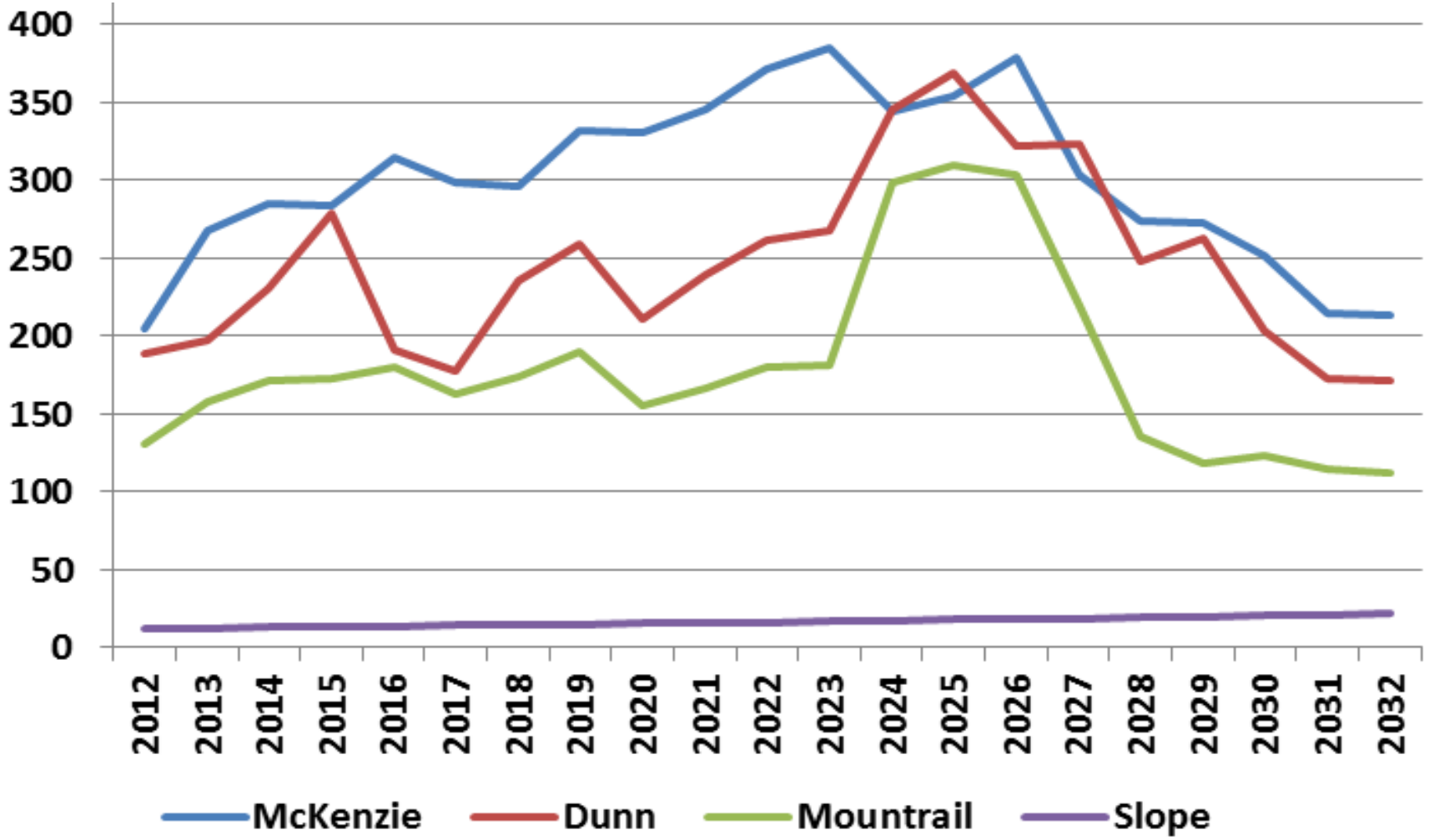


Currently: 10,000+ producing wells

Critical Highway Transportation Issues

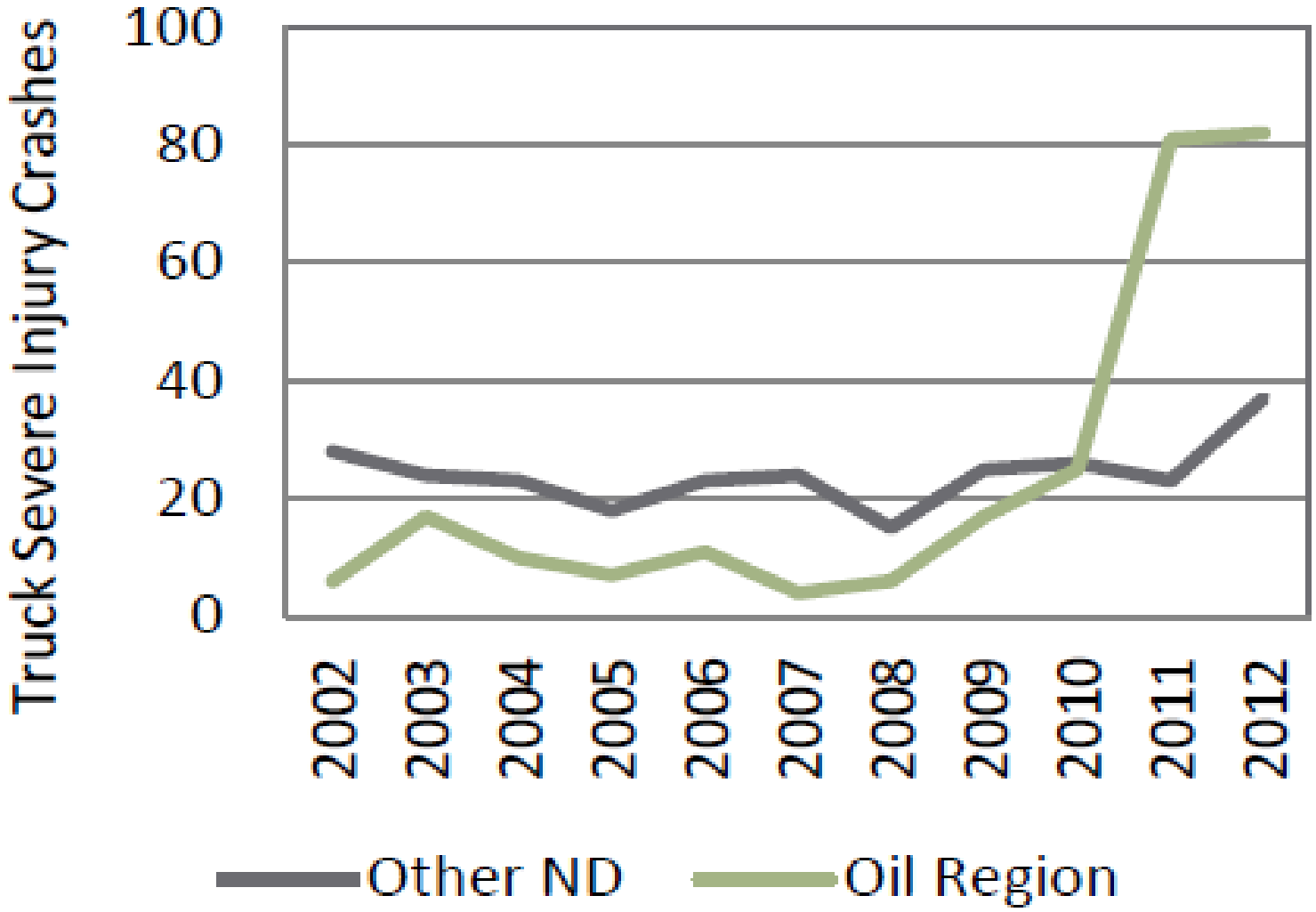
- Unprecedented heavy truck traffic levels on two-lane rural roads
- 1st slide following: shows truck ADT projections on oil routes vs. traditional farm-to-market roads
- Percent trucks 40% to 50% in many cases
- Highways deteriorate quickly under heavy loads; insufficient roadway widths result in narrow shoulders
- Truck severe injury crashes in oil region increased by 1200% from 2008 to 2012, vs. 147% increase for remainder of the state over the same period
- See trend (2nd slide following) and map of crashes (3rd slide following)

Avg. Projected Truck ADT on County Roads for Three Heavily Impacted Oil Counties (with Control Case)

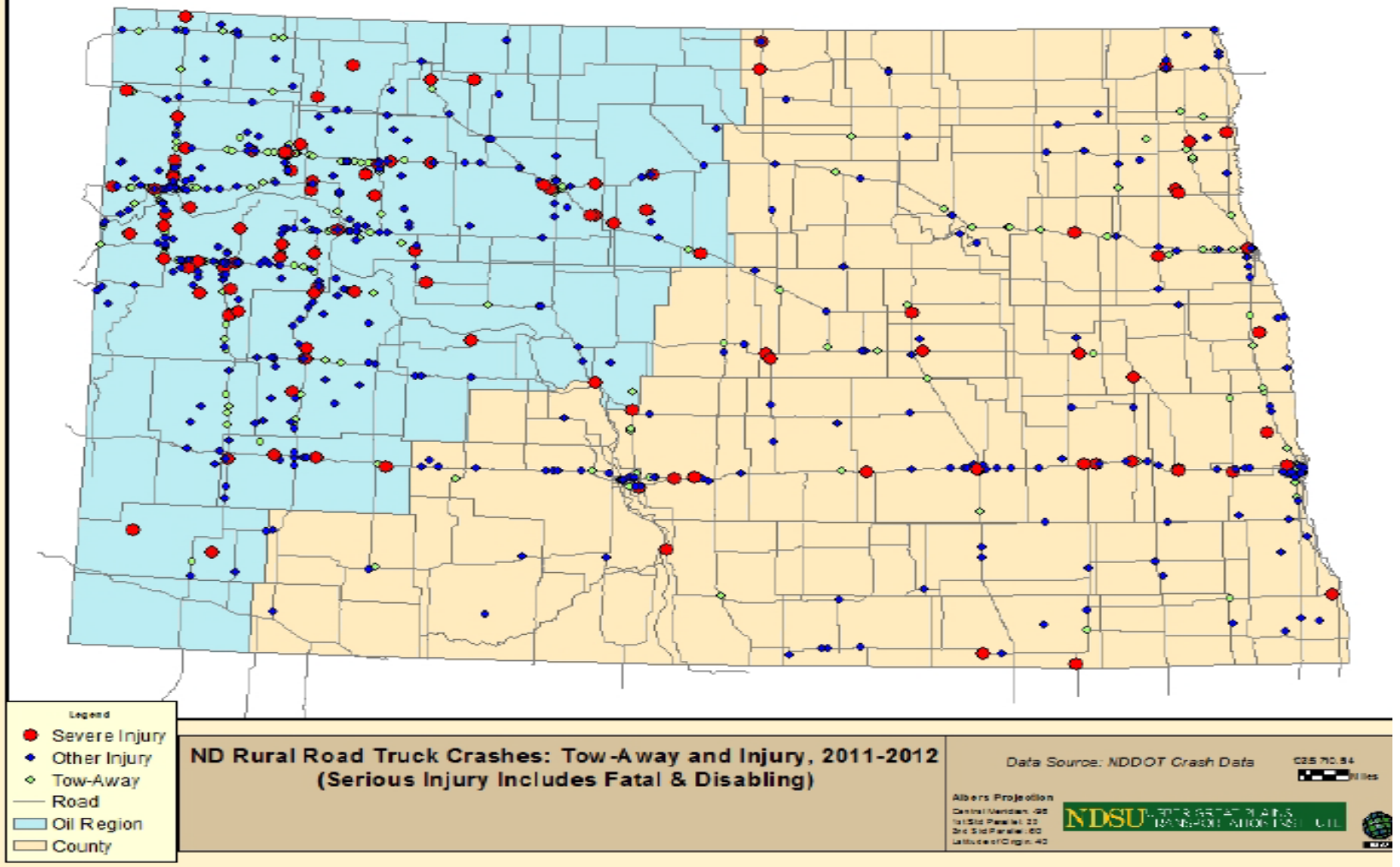


Slope County (not impacted by oil production) illustrates traditional truck traffic levels

Motor Carrier Crashes in North Dakota



Bakken Shale Region (Blue)



Materials and Product Flows

- Inputs (e.g., sand, water, chemicals) move to well site for hydraulic fracturing and production
- Specialized equipment (drilling and workover rigs) move to and from well site
- 1st slide following shows 2,300 drilling-related truck trips per well
- Outbound crude initially moves by truck to pipeline or rail transfer location (2nd slide following); may shift to small diameter pipe later in production cycle
- Outbound byproducts: e.g., salt water

Drilling Related Truck Movements per Well

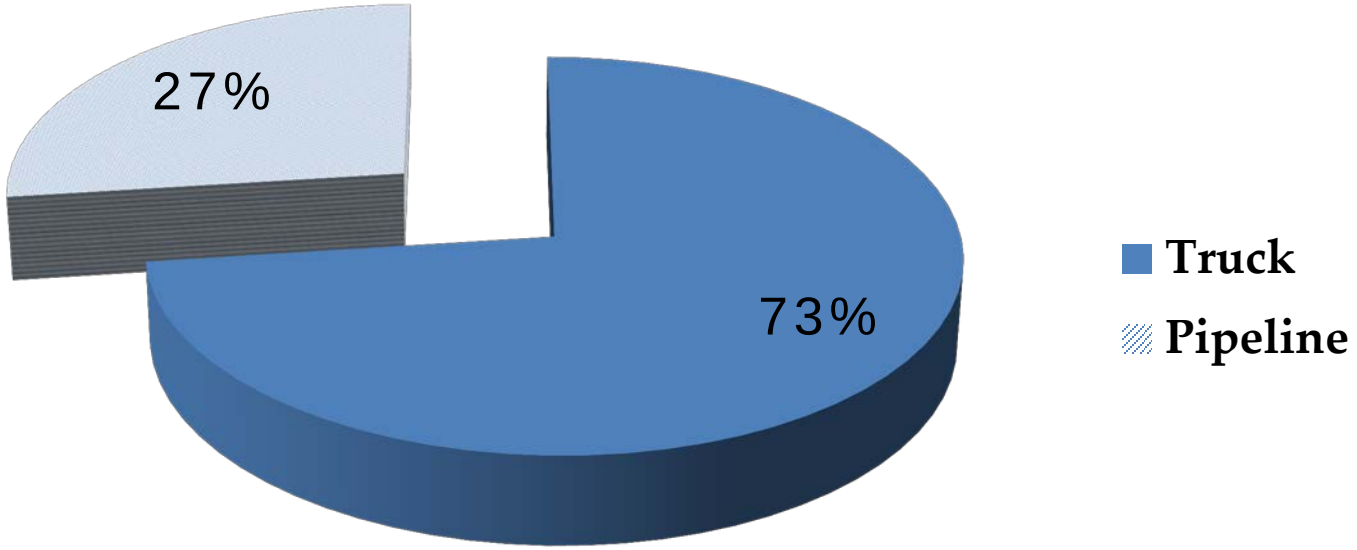
Input or Byproduct	Loaded Trucks
Water (Fresh)	450
Water (Waste): Out	225
Frac Tanks	115
Sand	100
Scoria/Gravel	80
Rig Equipment	65
Drilling Mud	50
Cement	20
Pipe	15
Other	30

1,150 Loaded Trucks

2,300 Loaded and Empty Trucks

Current Mode Share Crude Oil
Gathering Movement

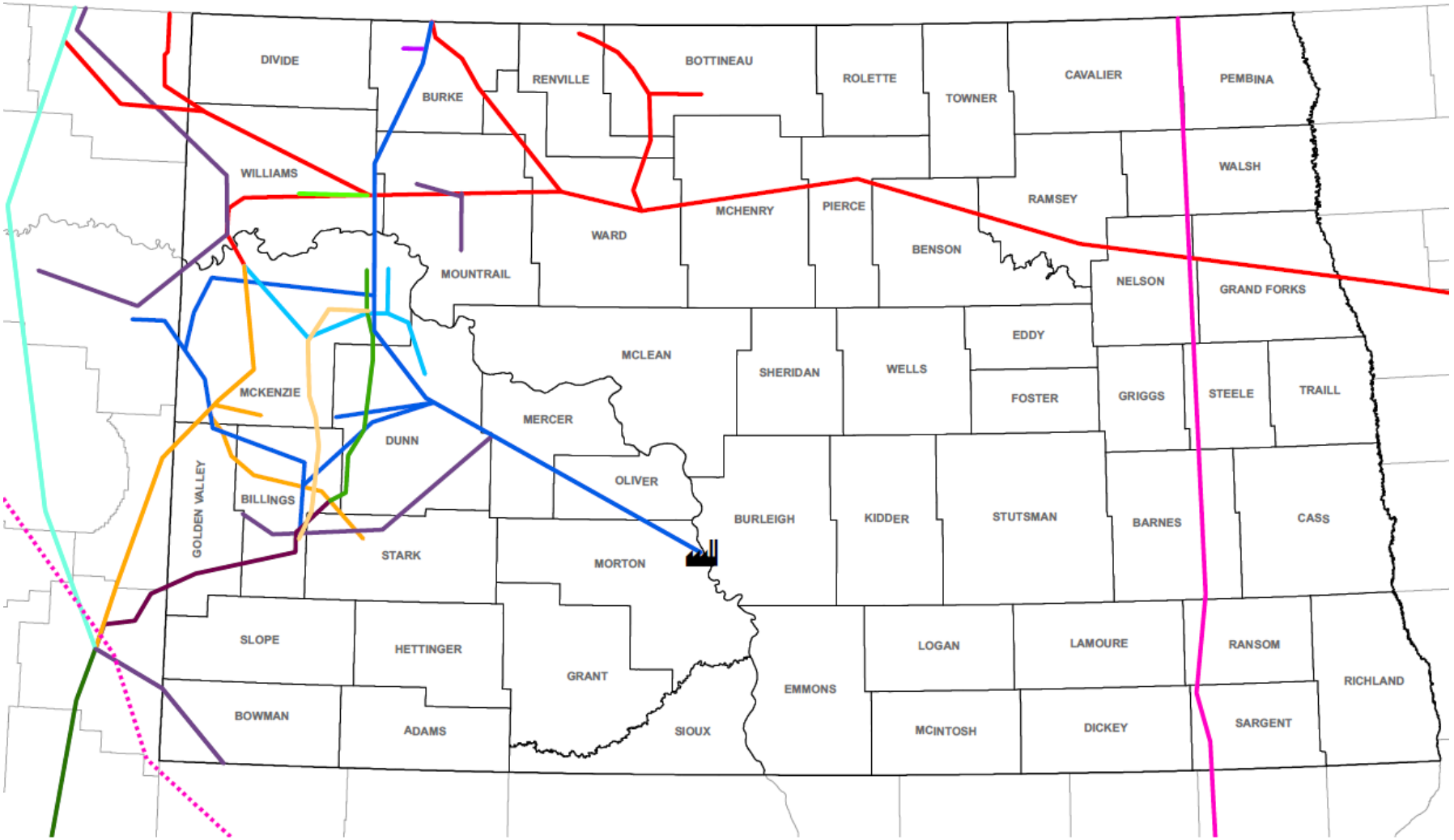
Movements from Wells to Transfer Locations



Crude Oil Mode Shares: Line Haul

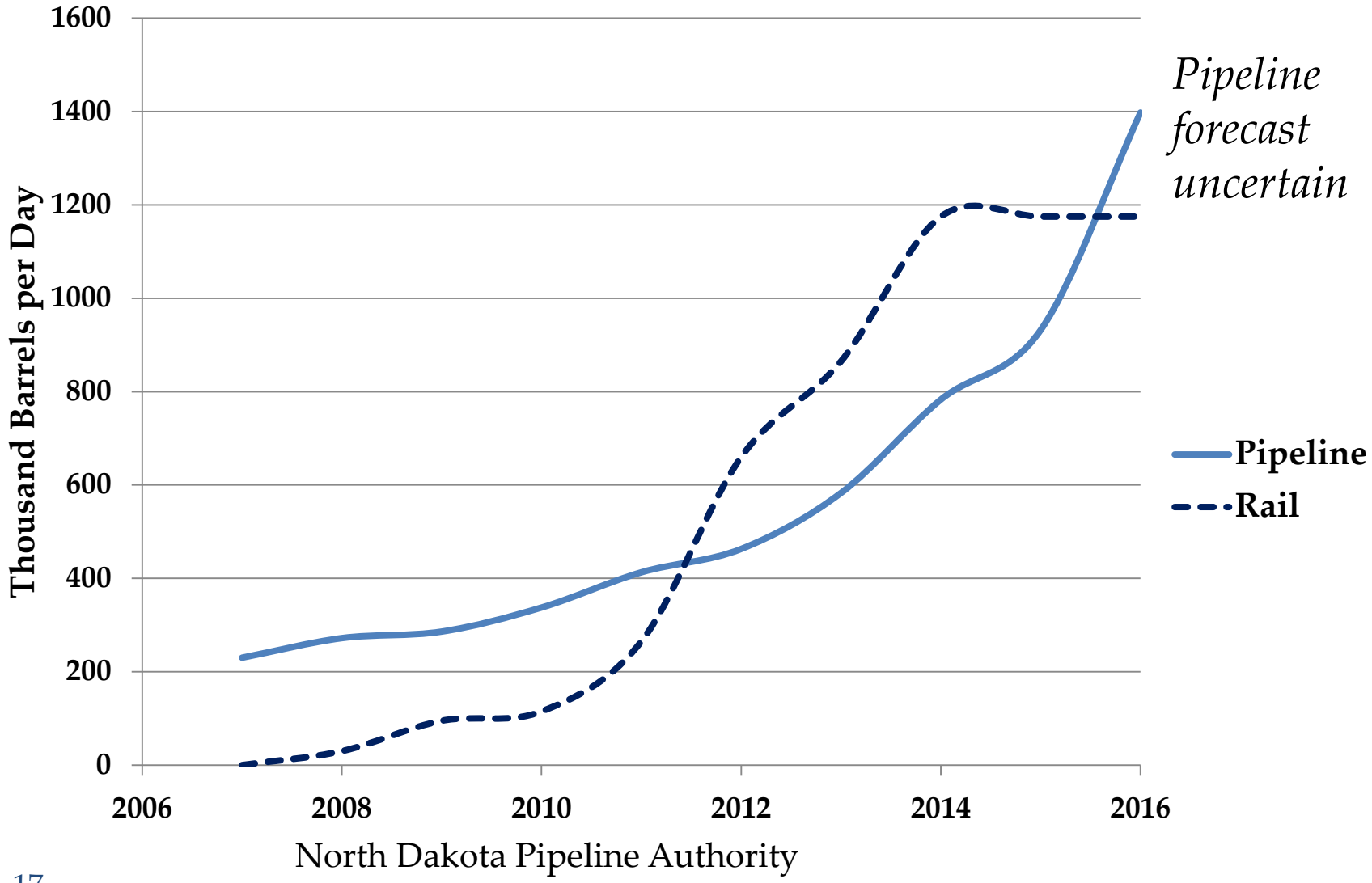
- Currently 69% rail
- Near-term projection: 90% rail
- Reasons for rail dominance
  - Limited pipeline capacity (sized to historical production)
  - Challenges/length of time in siting and constructing new pipelines
  - Greater ease in capacity expansion of railroads
  - Lower cost of rail expansion
  - Rail access to a wider variety of markets → premium prices

North Dakota Crude Oil Pipelines



North Dakota Pipeline Authority – Feb., 2013

System Capacities (Input not Throughput)



Rail Movements

- Shipments in multicar units or trainloads (e.g., 100+ cars)
- Current share in ND ≈ 1,000 railcars per day
- Equivalent to ten 100-car trains/day
- If railroads maintain 70%+ share, could have 16-20 trainloads per day of crude oil at peak
- ***Questions/potential issues***

  - Line capacity: other goods
  - Transload capacity
  - Service levels and priorities
  - Classification/placarding
  - Tankcar standards
  - Accident exposure (train-miles)
  - Grade crossings
  - Risk assessment/routing

Hazmat Concerns

- Bakken light crude: volatility and precise chemical composition
- Disposal of saltwater fracing mix
- Reduction in flaring: leads to more natural gas processing (LNG of CNG transport)
  - Fractionation: (NGLs)
    - Ethane (C_2), Propane (C_3), and Butane (C_4)
- Grade crossings: increasing truck and train traffic at traditional low-volume crossings
- Emergency preparedness and response
  - Pipeline spills
  - Train and truck movements through cities

ND Transportation Safety Advisory Committee

Members

- ND Highway Patrol
- NDDOT
- ND Emergency Services
- FHWA Division
- FMCSA Division
- FRA Division
  - Chief Inspector
  - Grade crossing
- PHMSA Region

Missions

- Gather input
- Fact finding
- Promote safety
- Develop research and technical assistance work plan for MPC/UGPTI
- Leverage industry resources