North Dakota Strategic Freight Planning Analysis
Phase II: 2006-2008

Prepared for

North Dakota Department of Transportation

Prepared by

Mark Berwick
Mark Lofgren

Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

October 2009

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EXECUTIVE SUMMARY

The Biennial Strategic Freight Analysis Program concentrated on North Dakota‘s freight growth and freight system over the last biennium. The goal of this study was to provide information pertaining to freight and freight growth as it has occurred over the past 50 or 60 years. The highway system that exists in North Dakota was developed long ago for lower freight volumes moving in smaller vehicles over short distances. A system of freight transportation and logistics that provides for the efficient movements of goods is the key to the economic health of the world, our nation, regions within the country, individual states, and communities and rural areas.

North Dakota‘s inflation adjusted Gross State Product more than tripled from 1963 to 2005. Many sectors of the economy contributed to the increase in GSP. This dramatic growth in the economy results in large increases in freight. Tonnage of agriculture production more than tripled from the 1940s to present on a decade average annual basis. Factors contributing to the increases in tonnage include inputs that contribute to higher crop yields. Crop choices also contributed to higher tonnages. Changes from small grains to sugarbeets, potatoes, or even corn change the tonnage coming off the land. For instance 50 bu. wheat nets about 3,000 lb. per acre, but sugarbeets can produce 20 tons per acre or more, equating to 40,000 lb. Higher production has led to larger and heavier trucks on all roads, and these trucks may travel longer distances per trip. However, it should be pointed out that larger, heavier trucks may do less damage than smaller trucks hauling the same amount of product over a fixed network.

Changes have also occurred in the manufacturing sector. From the 1960s to the present, the state grew manufacturing employment by 144%. While it is easy to quantify agricultural tonnage, it is more difficult to equate manufacturing in terms of tonnage. Commodity flow and FAF provide estimates on the state level, but county level data is elusive. It can easily be seen that because the manufacturing sector nearly tripled employee numbers statewide, the tonnage of freight moving over the transportation system would have more than tripled.

The mining industry in the state is made up of mostly coal mining and oil and gas production. Coal is a relative constant as the demand for electricity is increasing and regulated and the price for the product is relatively constant. Therefore, coal-fired energy plants mine the coal and turn it into electricity.

Oil and gas exploration is a volatile industry. Oil was first discovered in Williams County in western North Dakota in the early 1950s, and that discovery provided incentive for the first oil boom in the state. Beginning in the early 2000s, oil exploration and production is again on the rise in North Dakota as energy prices have increased to all time record highs. Technology and innovation have provided for oil extraction in the Bakken formation using horizontal drilling and production techniques that were unavailable in the past. This drilling and production technique has provided successful well completion at a pace that was previously unachievable. Oil exploration and production is mostly in western North Dakota, which is the deepest part of the Williston Basin. Coal mining is mostly in the central part of the state. Where coal mining has a low impact on the highway system, the oil industry has a large impact on the highway system.

This study provided information about the increases in freight over time. The data reveal the needs for the infrastructure that was developed some 50 to 80 years ago. As freight traffic increases so does the need for infrastructure. Transportation is the core of many of the businesses in the state, and without improving the infrastructure future growth may be hampered. The agricultural sector will continue to grow along with the oil and gas and mining. As these sectors grow so will all aspects of the economy.

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A system of freight transportation and logistics that provides for the efficient movements of goods is the key to the economic health of the world, our nation, regions within the country, individual states, and communities and rural areas.

Freight and freight growth over time is known because of data collected by different agencies at the local, state, and federal government. Even though those data are collected, it is not always reported in a way that the ordinary citizen can understand. It is important that citizens and policy makers for funding the maintenance and upgrading of our transportation infrastructure understand that, in many cases, the infrastructure was designed for the economy of 50 or 60 years ago.

It is important for North Dakota to have a safe and efficient freight system. It is also important that the public and private sector maintain their system. This report provides the information on the growth in the sectors that most affect the highway system or that part of the transportation infrastructure that is owned, maintained, and upgraded through public funds.

1.1 North Dakota Freight Analysis Phases

The information in this report is Phase 2 of a 3-phase study which provides for identification and discussion of North Dakota‘s direction for state freight planning, important freight gateways, and relationships that are instrumental in the state‘s economic productivity.

Phase 1 examines freight flows, discusses known freight capacity issues and impediments, and identifies major freight generators. Phase I also identifies key freight system players and their roles and responsibilities. Phase 2 will examine the current freight system, economic trends, and issues affecting freight movements and identify projected capacity shortfalls and freight impediments. Phase 3 will incorporate the information and findings developed in the first two phases of the Biennial Strategic Transportation Analysis to create a state freight plan. Planning and improvements will be developed along with recommendations for regulatory changes and multi-state proposals. Phase 3 will entail the development of a freight strategy. In Phase 3, the NDDOT will incorporate the information and findings developed in the first two phases of the Biennial Strategic Transportation Analysis to create a state freight plan.

1.2 Phase 2 Overview

This paper is the product of Phase 2 of the North Dakota Strategic Freight Planning Analysis. This part of the project builds on Phase 1 findings and provides an overview and modal snapshot of North Dakota‘s freight system. This overview will go beyond freight and include the state‘s economic trends and relate these trends to the future freight system. Phase 2 examines major freight issues facing the state including regional, national, and global issues that will directly impact the movement of freight flowing through, leaving, entering, and circulating within North Dakota. Phase 2 will also identify how freight movements are changing and what factors are influencing these changes, such as international trade agreements and protocols and cross border issues and programs.

Important North Dakota freight gateways are identified using data from Phase 1. In addition, the data from Phase 1 are used for identification of capacity constraints and other problems associated with freight corridors and flow to transportation centers. These elements have important implications for North Dakota freight movements now and into the future.

This section will also examine technology applications and what the future holds for increased efficiencies and improvements in safety and security. Phase 2 explores the possibilities and needs for freight movements for the next 20 years.

2. NORTH DAKOTA TRANSPORTATION INFRASTRUCTURE

North Dakota's transportation system includes: local and rural roads, and county and state highways; oil, gas, and water pipelines, local, regional, and national railroads; and airports. The state is land-locked with no direct access to water transportation. The closest sea port is at Duluth, Minnesota, which provides access to the eastern seaports and areas beyond.

North Dakota is crossed by three congressionally designated highway corridors, several other highway routes, three main rail routes, and national and international pipeline connections that connect North Dakota with the rest of the country and the world. The three congressionally designated highway corridors include the I-35 corridor,[1] the Theodore Roosevelt Expressway,[2] and the Central North American Trade Corridor.[3] Even though these routes are part of nationally declared corridors, many other highways play a major role in transporting freight out of, through, and within North Dakota.

2.1 Highways

Two Interstates cross through the state. Interstate 29, which is part of the I-35 corridor, runs in a north-south direction on the eastern edge of the state; while I-94 traverses the state from east to west connecting the West Coast to points east, including the twin cities of Minneapolis/St. Paul, Minnesota, and Chicago, Illinois. U.S. 2 is an important east/west route that parallels I-94 and the Canadian border. Highway 2 is a four-lane highway from the eastern border of North Dakota to Minot. Construction is underway to complete four laning to Williston, which is located on the western side of the state. U.S. highways 83 and 85, both with federally designated corridor status, are north/south routes. Highway 83 is a north/south route in the geographic center of North Dakota. Highway 85 skirts the west side of the state, has a Federal Corridor Designation as the Theodore Roosevelt Expressway, and provides connectivity from Canada to other federally designated north-south corridors serving the increased transportation demand brought about by the North American Free Trade Agreement (NAFTA). These north/south highways have become increasingly important, connecting the Great Plains with Canada and Mexico. Highway 52 provides access from Canada's western provinces and serves the trucking industry, allowing southeast diagonal travel from Regina, Saskatchewan, in the northwest through North Dakota to locations in the eastern United States.

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[1] The Interstate Route 35 Corridor from Laredo, Texas, through Oklahoma City, Oklahoma, to Wichita, Kansas, to Kansas City, Kansas/ Missouri, to Des Moines, Iowa, to Minneapolis, Minnesota, to Duluth, Minnesota, including I-29 between Kansas City and the Canadian border and the connection from Wichita, Kansas, to Sioux City, Iowa, which includes I-135 from Wichita, Kansas to Salina, Kansas, United States Route 81 from Salina, Kansas, to Norfolk, Nebraska, Nebraska State Route 35 from Norfolk, Nebraska, to South Sioux City, Nebraska, and the connection to I-29 in Sioux City, Iowa. http://www.fhwa.dot.gov/planning/nhs/hipricorridors/hpcor.html#l59

[2] The Theodore Roosevelt Expressway from Rapid City, South Dakota, north on United States Route 85 to Williston, North Dakota, west on United States Route 2 to Culbertson, Montana, and north on Montana Highway 16 to the international border with Canada at the port of Raymond, Montana. http://www.fhwa.dot.gov/planning/nhs/hipricorridors/hpcor.html#l59

[3] The Central North American Trade Corridor from the border between North Dakota and South Dakota, north on United States Route 83 through Bismarck and Minot, North Dakota, to the international border with Canada. http://www.fhwa.dot.gov/planning/nhs/hipricorridors/hpcor.html#l59

In 2002, NDDOT embarked on classifying its highway system with the goal of better management for maintenance and upgrading. Like many states, prior to a hierarchical classification system, roadways were upgraded or maintained based on time. Prior to the Highway Performance Classification System (HPCS), resource allocation may have been less than optimal. [4]

The HPCS has five levels based on traffic volume, capacity, safety, reliability, travel speeds, and convertibility of major traffic generators. The five levels are the Interstate System, Interregional System, State Corridor, District Corridor, and District Collector. Particularly, Interstate and Interregional systems play an important role for efficient freight movement and a competitive regional economy largely due to traffic volumes. The efficient Interstate and Interregional systems can reduce freight travel time, bring major cities closer together, and increase the robustness of the regional economy. According to the description of the HPCS, both Interstate and Interregional systems maintain a high degree of reliability and mobility. They also support international, national, regional, and statewide trade and economic activity. They generally serve long-distance, interstate, and intrastate traffic for freight movement.

[4] The HPCS includes separate investment strategies and performance guidelines for District Corridor mileage that is on the National Highway System. The National Highway System includes160,000 miles (256,000 kilometers) of roadway important to the nation's economy, defense, and mobility. The National Highway System (NHS) includes the following subsystems of roadways (note that a specific highway route may be on more than one subsystem):

- **Interstate:** The Eisenhower Interstate System of highways retains its separate identitywithin the NHS.
- **Other Principal Arterials:** These are highways in rural and urban areas which provide access between an arterial and a major port, airport, public transportation facility, or other intermodal transportation facility.
- **Strategic Highway Network(STRAHNET):** This is a network of highways which are important to the United States' strategic defense policy and which provide defense access, continuity, and emergency capabilities for defense purposes.
- **Major Strategic Highway Network Connectors:** These are highways which provide access between major military installations and highways which are part of the Strategic Highway Network.
- **Intermodal Connectors:** These highways provide access between major intermodal facilities and the other four subsystems making up the National Highway System. A listing of all official NHS Intermodal Connectors is available: http://www.fhwa.dot.gov/planning/nhs/intermodalconnectors/index.html

The National Highway System (NHS) includes the Interstate Highway System as well as other roads important to the nation's economy, defense, and mobility. The NHS was developed by the Department of Transportation (DOT) in cooperation with the states, local officials, and metropolitan planning organizations (MPOs).

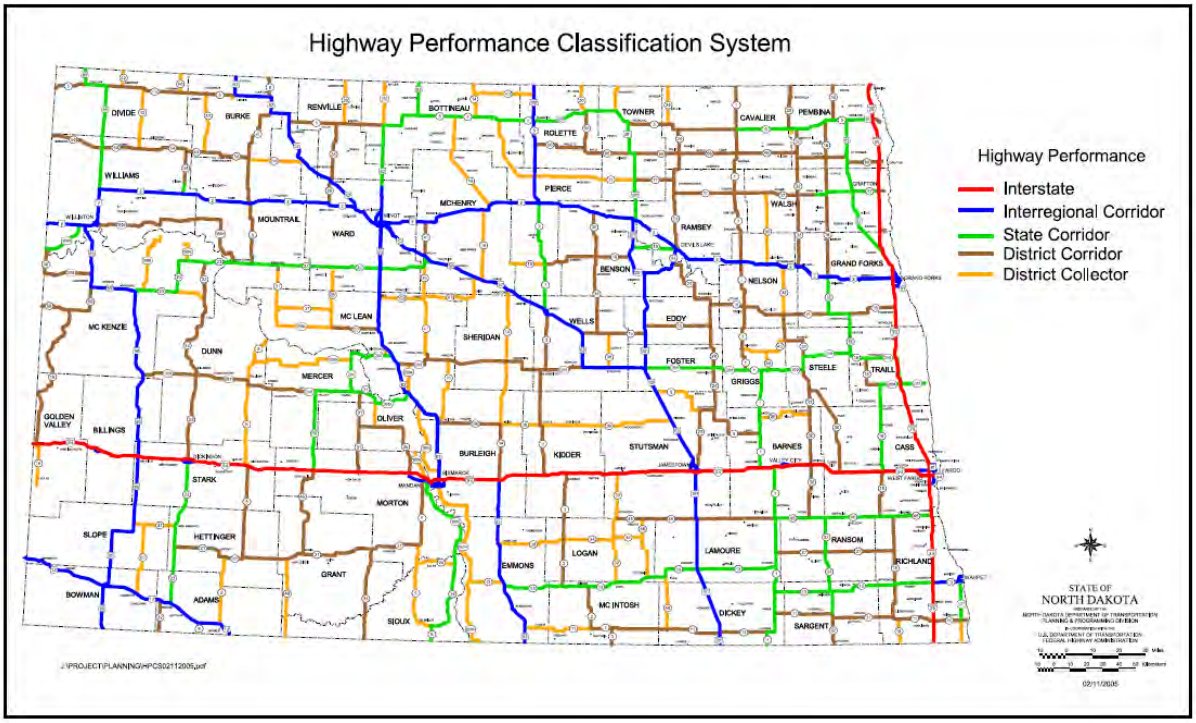

Figure 2.1 Highway Performance Classification System

NDDOT established the goal of seasonally unrestricted (restricted by legal load) and height restriction free to 16 ft. on the Interstate and Interregional systems. This allows efficient freight flow on North Dakota highways. According to the 2006 HPCS report, the system consists of 8,411.6 RM (roadway miles). The eight designated highway districts include: Bismarck 1,383.9 RM, Minot 1,142.2 RM, Devils Lake 1,136.3 RM, Valley City 1,078.4 RM, Dickinson 984.1 RM, Grand Forks 928.5 RM, Fargo 878.4 RM, and Williston 879.8 RM. The Interstate consists of 1,141.8 RM or 13.6% of the state's highway network. Rural Interstate accounts for 1,023.1 RM or 89.6% of the Interstate in North Dakota, and the rest is urban.

Interregional Corridors account for 1,829.8 RM or 21.8% of the state highway network. The rural Interregional Corridors account for 1,589.9 RM or 86.9% and urban Interregional Corridors account for 239.8 RM, or 13.1%.

There are 1,402.1 RM of State Corridors on the state highway network making up 16.7% of the total network. Rural State Corridors make up 1,375.2 RM, or 98.1%. Urban State Corridors account for 26.9 RM, or 1.9%.

District Corridors are the largest HPCS category with 2,568.7 RM or 30.6% of the state highway network. Less than one percent of the District Corridors are located in urban areas. A little less than 6%, or 147.3 RM of District Corridor roadways are on the NHS (National Highway System).[5]

District Collectors represent 17.4%, or 1,469.2 RM of the state highway system. Less than 1% of the District Collectors are in urban areas.

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[5] The HPCS includes separate investment strategies and performance guidelines for District Corridor mileage that is on the NHS.

The above dialogue includes state highways their classifications. These freight movements that originate and terminate at North Dakota businesses, farms, and residences are also moving on county, city, and township roads. Within North Dakota there is 3,860 miles of city streets, 19,043 miles of county roads, and 56,509 miles of township roads. The county and township roads are the origin for the farm products produced in North Dakota. There are also 19,827 miles of trails which follow section and township lines and, in some cases, provide access to land not accessible by any other roadway.

2.2 Railroads

As of the writing of this report, North Dakota is served by seven railroad companies operating 3,609 miles of road. Two are Class I carriers, three are regional railroads, and two are local railroads. The Surface Transportation Board (STB) classifies railroads as Class I, II, or III based on annual revenue.[6] Miles of rail are not considered in STB classification. The Association of American Railroads (AAR) has a classification system that considers both annual revenue and miles of track. AAR classifies railroads as Class I, Regional Railroad, and Local Railroad. The seven railroads operating in North Dakota, with classification, are named below.

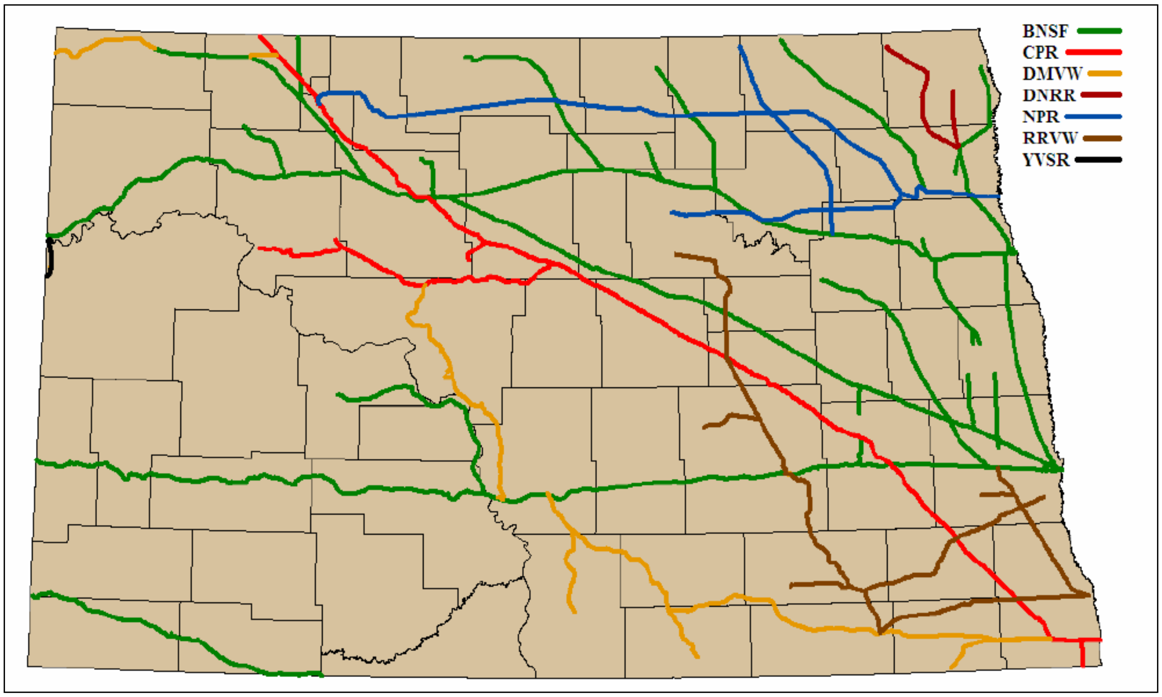

Figure 2.2 North Dakota Rail Map

Burlington Northern Sante Fe railway (BNSF) and Canadian Pacific Railway (CPR) are Class I railroads by both AAR and STB classification standards. The Dakota, Missouri Valley & Western Railroad (DMVW), the Northern Plains Railroad (NPR), and the Red River Valley & Western Railroad (RRVW) are defined as regional railroads by AAR classification standards because they operate more than 350 miles of rail. The Yellowstone Valley Railroad (YSVR) and Dakota Northern Railroad (DNRR) are both

[6] Class I: =>$250 million adjusted annual operating revenue for three consecutive years
Class II: $20 million - $249,999,999.99
Class III: <$20 million

local railroads because they fall below the AAR regional railroad criteria.[7] Table 2.1 lists the miles of main line and branch line track in North Dakota by operating railroad. BNSF miles of rail are about 62% main line, while CPR has about 79% main line. The Class I carriers operate 62% of the total track mileage in North Dakota.

Table 2.1 North Dakota Railroad System Mileage (2005)[8]

Railroad	Main line	Branch Line	Total Miles
Burlington Northern Sante Fe Railway (BNSF)	1,107	683	**1,790**
Canadian Pacific Railway (CPR)	353	92	**445**
Red River Valley & Western Railroad (RRVW)	-	428	**428**
Northern Plains Railroad (NPR)	-	436	**436**
Dakota, Missouri Valley & Western Railroad (DMVW)	-	431	**431**
Yellowstone Valley Railroad (YSVR)	-	9	**9**
Dakota Northern Railroad (DNRR)	-	70	**70**
TOTAL	**1,460**	**2,149**	**3,609**

The BNSF has two main lines that move through the state. The northern line is a direct route from the Seattle/Tacoma area and the Pacific Northwest to Chicago and all points east. This route is a designated COFC/TOFC (container on flatcar/trailer on flatcar) intermodal route and moves consumer goods from the West Coast to all points east in the United States. The rail terminals in Chicago provide for transload and car switching among railroads and distribution and termination of much of the freight imported from sea ports. It is estimated that 54 trains a day move across the northern BN line that runs through North Dakota. The more southern BNSF route is an east/west route, and follows I-94, serving the coal industry of North Dakota, and also brings coal from Montana and Wyoming. This line serves Bismarck/Mandan and Dickinson and merges with the northern line at Fargo. More than 20 trains a day move on the Southern BNSF line. Both lines serve the grain industry and other general freight movements.

The CPR also serves the state, and the main line follows a similar route as the Highway 52 corridor as it passes thru Minot to Valley City. Four short lines do the gathering for the Class I railroads. The RRVW, DMVW, NPR, and DNRR do most of the gathering and connect with the Class Is to receive and hand off rail freight.

2.3 Air

North Dakota has eight commercial service airports located in Fargo, Grand Forks, Devils Lake, Jamestown, Minot, Bismarck, Williston, and Dickinson. According to the North Dakota Aeronautics Commission, the Fargo, Grand Forks, Bismarck, and Minot airports generate approximately 10,000 tons of air freight annually. The major air cargo carriers that operate within North Dakota airspace include DHL, Federal Express (FedEx), United Parcel Service (UPS), and the United States Postal Service (USPS). Cargo that is conducive to air is usually small time-sensitive packages. UPS flies packages to six airports, while Fed-Ex and DHL rely on ground delivery of packages from the major airports in North Dakota. Figure 2.3 shows the locations of the eight commercial and 82 general aviation airports.

[7] A regional railroad is defined by the Association of American Railroads as a company that operates 350 miles of railroad and/or earns $40 million in annual revenues. Mileage is based on total system miles, which may include track in more than one state. A local railroad is one that falls below regional railroad criteria.

[8] Source: North Dakota Public Service Commission, December 2005, and website information

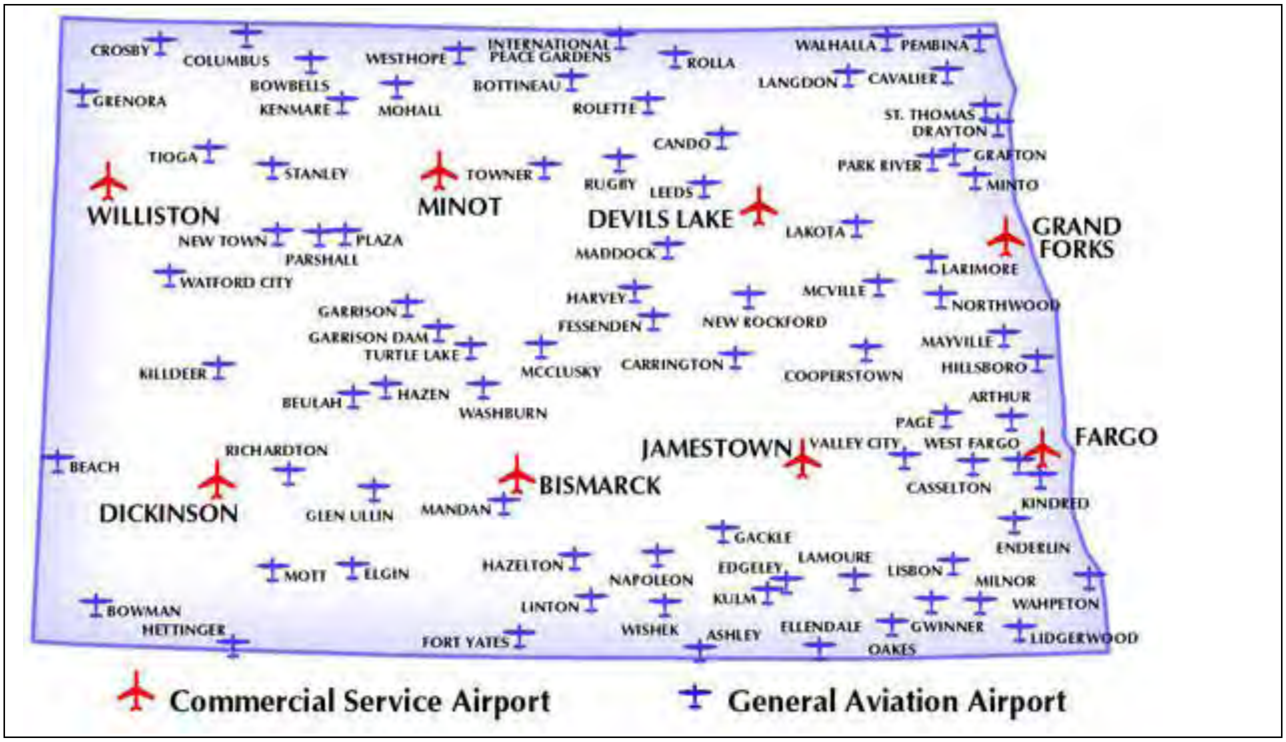

Figure 2.3 Map of North Dakota Commercial and General Aviation Airports
(Source: North Dakota Aeronautics Commission 2007)

2.4 Pipelines

Pipelines move oil and gas into, out of, and through North Dakota. Since the terrorist attack of September 11, 2001, the level of detail about all pipelines is more closely held. Throughout North Dakota there are water, gas, and oil pipelines. There is a significant fresh water system that brings quality water to rural areas. The most extensive system is in southwestern North Dakota where water is piped from the Missouri River. Prior to the pipeline, the citizens struggled to find quality water and, in some cases, the water quality was blamed for health problems.

3. NORTH DAKOTA ECONOMIC GROWTH

The North Dakota economy has been expanding over the last 20 years and all sectors have participated in the growth. Mobility of people and freight is the backbone of a strong economy and without transportation a vibrant economy does not exist. Transportation infrastructure, which includes highways and bridges, has an impact on industry if that infrastructure is incapable of handling the load or the volume. Transportation infrastructure, and mostly the public highway system, is affected by freight transportation or truck traffic. Truck volume, weather, and age are prime contributors to pavement deterioration. In North Dakota truck traffic demand is derived mostly from the natural resource based industry sectors of mining, oil, and gas extraction and agriculture. Manufacturing, wholesale trade, and retail trade produce freight in large quantities.

North Dakota‘s Gross State Product (GSP) reached 26.4 billion in 2006, an almost 6% increase over 2005, following a 9% increase from 2004 to 2005. Inflation adjusted the results to 3.1% and 6.6% growth, respectively.

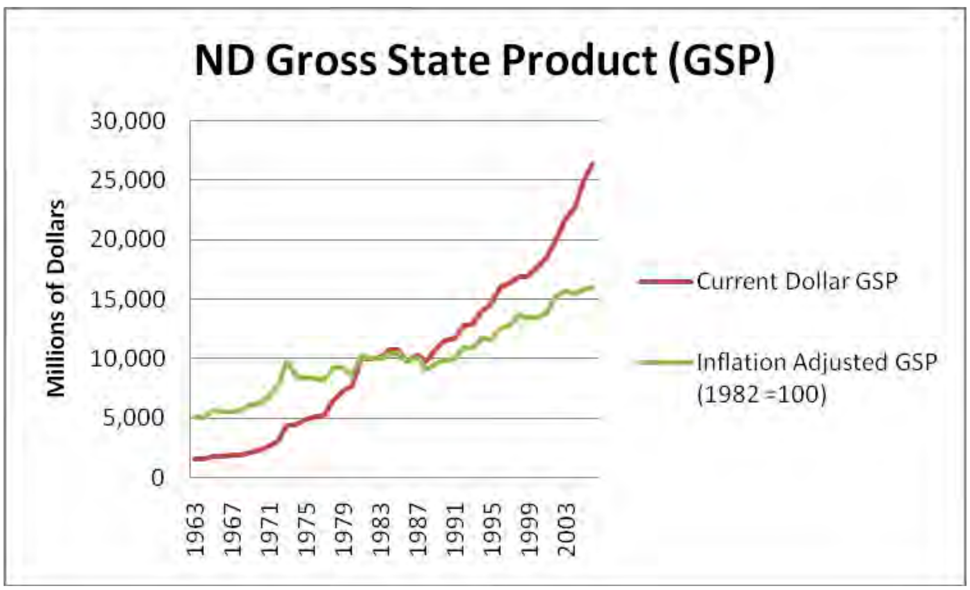

Figure 3.1 ND Gross State Product (1982 =100) (Derived From BEA 2008)
Source: Bureau of Economic Analysis PPI Adjusted Data

A quote by Richard Rathge of the North Dakota State Data Center sums up the growth and changes occurring in North Dakota‘s economy. He states, ―Our state‘s economy has diversified greatly over the past 20 years. The best sign of that change is the shifting make-up of our GDP. With the expansion of the service sector along with new and advanced technologies, former service sector components such as information, professional and technical services, and health care and social assistance are now viewed independently. This demonstrates the new economic era we are entering."

Even though North Dakota's economy is diversifying, some of the newly recognized sectors have relatively small impact on freight transportation[9]. Businesses related to information, professional and technical services, and health care and social assistance may provide significant contributions to the North Dakota economy, but have little or no impact on freight moving over the highways or rail lines in North Dakota.

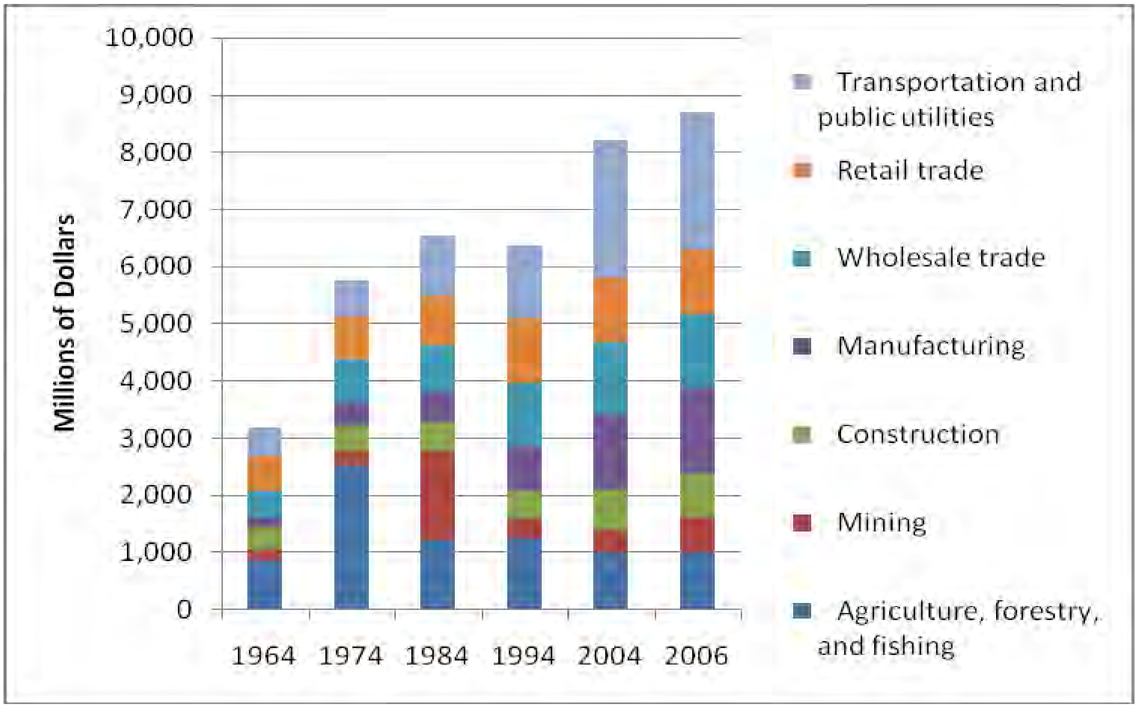

Figure 3.2 Inflation Adjusted GSP of Industries Producing Transportation Demand (1982 =100) (BEA 2008)

The data reveals that the agriculture sector makes up a much smaller portion of the overall economy than in the past. This is not because the agricultural economy is shrinking (Figure 3.2, Table 3.1). Agriculture has grown dramatically over time, but other industries have grown faster, contributing relatively more to the state's gross domestic product. The structure of the natural resource based economy in North Dakota is that agricultural producers are price takers and have little control over the prices they receive for their product; and even though tons have grown, overall revenue has not grown at the same pace as other industries.

[9] Cautionary note:
There is a discontinuity in the GDP by state time series at 1997, where the data change from Standard Industrial Classification (SIC) industry definitions to North American Industry Classification System (NAICS) industry definitions The NAICS system replaced the 1987 SIC system, which was used in the U.S. since the 1930s to present various statistics. The NAICS is a uniform system for the countries that comprise North America (http://www.census.gov/epcd/www/naicssvc.html). This discontinuity results from many sources, including differences in source data and different estimation methodologies. In addition, the NAICS based GDP by state estimates are consistent with U.S. gross domestic product (GDP) while the SIC based GDP by state estimates are consistent with U.S. gross domestic income (GDI). This data discontinuity may affect both the levels and the growth rates of the GDP by state estimates. Users of the GDO by state estimates are strongly cautioned against appending the two data series in an attempt to construct a single time series of GDP by state estimates for 1963 to 2006.

Table 3.1 Sector Contribution to Gross State Product (BEA 2008)

Industry	1964	1974	1984	1994	2004	2006
Agriculture, forestry, and fishing	17%	30%	12%	11%	6%	6%
Mining	4%	3%	15%	3%	3%	4%
Construction	8%	5%	5%	4%	5%	5%
Manufacturing	3%	5%	5%	7%	9%	9%
Wholesale trade	9%	9%	8%	9%	8%	8%
Retail trade	12%	9%	8%	10%	7%	7%
Transportation and public utilities	10%	8%	10%	11%	15%	15%

Currently, prices for commodities have increased dramatically. From mid to late 2007, most commodity prices have soared to new records. Prices of wheat, soybeans, and corn are either at, or close to, all time record highs. Other natural resource based products have also reached historic levels. The prices of gold, silver, coal, steel, oil, and all commodity-based products have increased as the value of the dollar has plummeted. Foreign demand for food and fuel has increased, and investors seek returns in rising or asset based investments.

Table 3.2 Year Over Year Sector Growth (BEA 2008)

Industry	2001	2002	2003	2004	2005	2006
Agriculture, forestry, fishing, and hunting	-5.01%	24.62%	48.92%	-15.01%	8.38%	4.09%
Mining	6.46%	-4.13%	20.00%	23.42%	49.23%	16.84%
Utilities	11.06%	7.71%	1.57%	4.98%	9.17%	1.80%
Construction	0.12%	0.23%	7.13%	15.05%	10.05%	7.67%
Manufacturing	8.19%	8.90%	7.51%	0.00%	21.62%	6.25%
Wholesale trade	3.48%	3.29%	11.59%	10.75%	8.39%	5.06%
Retail trade	3.21%	3.79%	5.94%	3.14%	6.21%	5.85%
Transportation and warehousing, excluding Postal Service	-4.80%	-4.79%	10.06%	6.45%	9.91%	6.51%
Information	8.79%	9.37%	8.71%	13.72%	5.85%	2.03%
Finance and insurance	2.36%	12.14%	3.73%	6.54%	0.97%	7.04%
Real estate and rental and leasing	9.49%	14.61%	0.05%	6.89%	9.79%	8.47%
Professional and technical services	10.33%	4.38%	-3.62%	9.46%	12.89%	13.37%
Management of companies and enterprises	-15.68%	4.49%	6.75%	9.77%	7.85%	19.90%
Administrative and waste services	9.33%	3.96%	1.47%	6.94%	12.43%	8.65%
Educational services	1.30%	11.54%	2.30%	10.11%	7.14%	10.48%
Health care and social assistance	7.18%	5.58%	6.79%	7.03%	6.72%	2.10%
Arts, entertainment, and recreation	8.70%	12.00%	3.57%	-2.59%	4.42%	3.39%
Accommodation and food services	-1.19%	1.81%	4.35%	5.11%	5.59%	4.95%
Other services, except government	4.42%	3.81%	8.57%	0.38%	3.93%	1.62%
Government	5.19%	8.38%	9.69%	4.01%	7.21%	3.11%
Total Gross Domestic Product by State	4.37%	7.30%	9.01%	4.81%	9.77%	5.82%

Year over year data reveal that all sectors have experienced growth. Sector growth compares the industry to itself year over year without regard to the entire economy. This reveals the health of the individual sector and provides insight. Table 4 reveals that the mining sector has the largest growth rate because of the increases in prices for oil, gas, and coal and increased extraction efforts because of those prices.

Demand for many commodities has increased as worldwide economic expansion is occurring and some formerly impoverished nations are having dramatic gains in their standard of living. The economic expansion in countries, especially those with large populations, such as China and India, demand more oil, steel, copper, coal, and food commodities, such as grains and meat products and other commodity-based products, to fuel their expansion.

North Dakota's 2007/2008 budget surplus provides further evidence of a robust economy. Because of North Dakota's abundant natural resources and higher prices for many of the natural resource-based products, such as coal, oil, and agricultural products, the state's economy has enjoyed extraordinary economic growth. The state's growth is also due to its diversification and manufacturing. The extraction tax levied on the mining industry, based on higher prices and volumes, have greatly increased revenues for North Dakota. The increased production activity provides economic stimulus to communities of western and central North Dakota because of the demand for services and increased disposable income from better salaries and increased number of good jobs or jobs providing a living wage. North Dakota's economy grew 9.7% from 2004 to 2005 and 5.8% from 2005 to 2006 in current dollars (Table 3.3).

Manufacturing in North Dakota has outperformed the national trend and has become a much larger part of the North Dakota economy, growing from 3% in 1964, to almost 10% in 2006. While manufacturing is losing GSP share in most of the rest of the country, it is gaining GSP share in North Dakota. This is due in part to North Dakota's machinery manufacturers and the food processing industry which grew out of the value-added push of the 1990s.

Agriculture's share of GSP slipped from 17% in the 1960s to about 6% currently. Even though production of agricultural products has increased in volume, the overall growth in the economy has risen at a faster pace than the returns for agricultural commodities (Table 3.2). The high prices of late 2007 increased agriculture's share of the GSP pie.

Mining as a percentage of GSP has maintained an estimated 3 to 4 percent. However, growth in the sector from 2003 to 2004 was 23% from 2004 to 2005 was almost 50%, and 2005 to 2006 was 16% (Table 3.3). This growth has been spurred by higher oil and coal prices, encouraging investment in existing oil and gas wells to increase production and increased exploration. Innovation in drilling and recovery techniques, such as horizontal drilling, have allowed oil companies to produce relatively large quantities of oil from geological formations that were previously not economically viable.

The agricultural sector uses transportation to move product from areas of production to places of demand. This includes moving crops to primary on-farm storage for later shipment. Some crops such as feed grain or silage or hay, are fed to livestock and then the livestock is moved to market. When crops are stored for sale at a later date, they are moved to market in a secondary movement from on-farm storage into the marketing channel.

Mining operations in North Dakota are mostly limited to coal mining and oil and gas extraction. The majority of coal mining activity in the state is consumption-based, and the coal is turned into electricity and transported out of state as electricity through transmission lines. Most other coal movements are rail movements. However, there are instances where coal moves in trucks. The transload facility at Ardoch is an example of coal moving by truck. Coal is brought into the state by rail transloaded to truck and delivered to American Crystal Sugar's five processing plants throughout the Red River Valley.

Oil and gas exploration has a dramatic localized effect. During the drilling process, large numbers of heavy trucks bring equipment and inputs (such as drilling fluid, cement, and nitrogen pressurized hydraulic fluid) to the location (OSHA). Once a well is brought into production, oil is trucked unless economics dictates installation of a pipeline. The largest impact is when the well needs repair or maintenance performed by a workover rig. The three products produced by most oil wells include oil, natural gas, and salt water.

Table 3.3 Sector Share of Total GSP (BEA 2008)

Industry	2000	2001	2002	2003	2004	2005	2006
Agriculture, forestry, fishing, and hunting	5.51%	5.02%	5.83%	7.96%	6.46%	6.38%	6.27%
Mining	2.18%	2.22%	1.99%	2.19%	2.58%	3.50%	3.87%
Utilities	2.70%	2.87%	2.88%	2.69%	2.69%	2.67%	2.57%
Construction	4.81%	4.61%	4.31%	4.23%	4.64%	4.66%	4.74%
Manufacturing	8.60%	8.91%	9.04%	8.92%	8.51%	9.43%	9.47%
Wholesale trade	7.77%	7.71%	7.42%	7.60%	8.03%	7.92%	7.87%
Retail trade	8.06%	7.97%	7.71%	7.49%	7.37%	7.13%	7.14%
Transportation and warehousing, excluding Postal Service	4.82%	4.39%	3.90%	3.94%	4.00%	4.00%	4.03%
Information	3.21%	3.34%	3.41%	3.40%	3.68%	3.55%	3.43%
Finance and insurance	6.44%	6.32%	6.60%	6.28%	6.38%	5.87%	5.94%
Real estate and rental and leasing	8.66%	9.09%	9.71%	8.91%	9.09%	9.09%	9.32%
Professional and technical services	3.38%	3.57%	3.48%	3.07%	3.21%	3.30%	3.54%
Management of companies and enterprises	1.04%	0.84%	0.82%	0.80%	0.84%	0.83%	0.94%
Administrative and waste services	1.69%	1.77%	1.72%	1.60%	1.63%	1.67%	1.71%
Educational services	0.43%	0.42%	0.44%	0.41%	0.43%	0.42%	0.44%
Health care and social assistance	8.95%	9.19%	9.04%	8.85%	9.04%	8.79%	8.48%
Arts, entertainment, and recreation	0.52%	0.54%	0.56%	0.54%	0.50%	0.47%	0.46%
Accommodation and food services	2.83%	2.68%	2.55%	2.44%	2.44%	2.35%	2.33%
Other services, except government	2.55%	2.55%	2.46%	2.45%	2.35%	2.23%	2.14%
Government	15.85%	15.98%	16.14%	16.24%	16.11%	15.74%	15.33%

Most oil transported long distances is moved in pipelines. Natural gas is all moved via pipeline. Drilling for oil, however, requires movements of large equipment over the state and local road systems. Moving a drilling rig to a site designated for drilling requires many truckloads that must be permitted for being overlength and over-width. In addition to the equipment, water and drilling mud must be transported to the rig during the drilling operation. It takes several hundred truckloads of a combination of inputs and equipment movements prior to the well being put into production. This heavy truck traffic has negative impacts on roads and bridges that were not designed for heavy trucks or increased truck traffic. Wells are also serviced by equipment after the drilling process is completed by a workover rig, which is a mobile unit that requires special permitting because of weight and width. This rig will visit a well three to four times the first year and approximately once every four to five years thereafter.

After a well is put into production, pipelines will be built if economically feasible to retrieve the oil and gas and wastewater that is produced. However, this may take some time before these pipelines are constructed. During this timeframe, oil is trucked to the pipeline transfer station and most saltwater is trucked to disposal wells.

4. AGRICULTURE PRODUCTION

Crop production reported at the state level may not consider the infrastructure effects that increased agricultural production has on the local, regional, and state infrastructure. Agricultural production is sourced at the county level, and what happens at the county level affects townships, counties, state, and national road infrastructure. As crop production has changed over time some infrastructure has not been upgraded to serve the increased loads and larger trucks and equipment using that infrastructure. The production capabilities of an acre of land have, in most instances, doubled and, in some cases, tripled since the 1940s and 1950s. Agricultural practices have increased production over time. These practices include irrigation, increased fertilizer use, advances in pesticide technology, and crop genetics. Crop choice has increased production. North Dakota 2007 corn production was an increase of 75% over the 2006 record crop (NASS 2007). Corn production for grain increases tonnage by as much as three times over wheat production. For example, an acre of wheat producing 35 bu. at 2,100 lb. to the acre compares with 120 bu. of corn at 6,720 lb. to the acre. Harvesting and marketing the corn requires more than three times the truck trips.

There are various options from getting crops from the field to the end market. The various options are illustrated in Figure 4.1. The typical trucking scenario from field to market would include:

- gravel township or county road to farm storage
- from farm storage, including a trip on a gravel or township road, to a state highway
- from the state highway to the national highway system to a grain elevator.

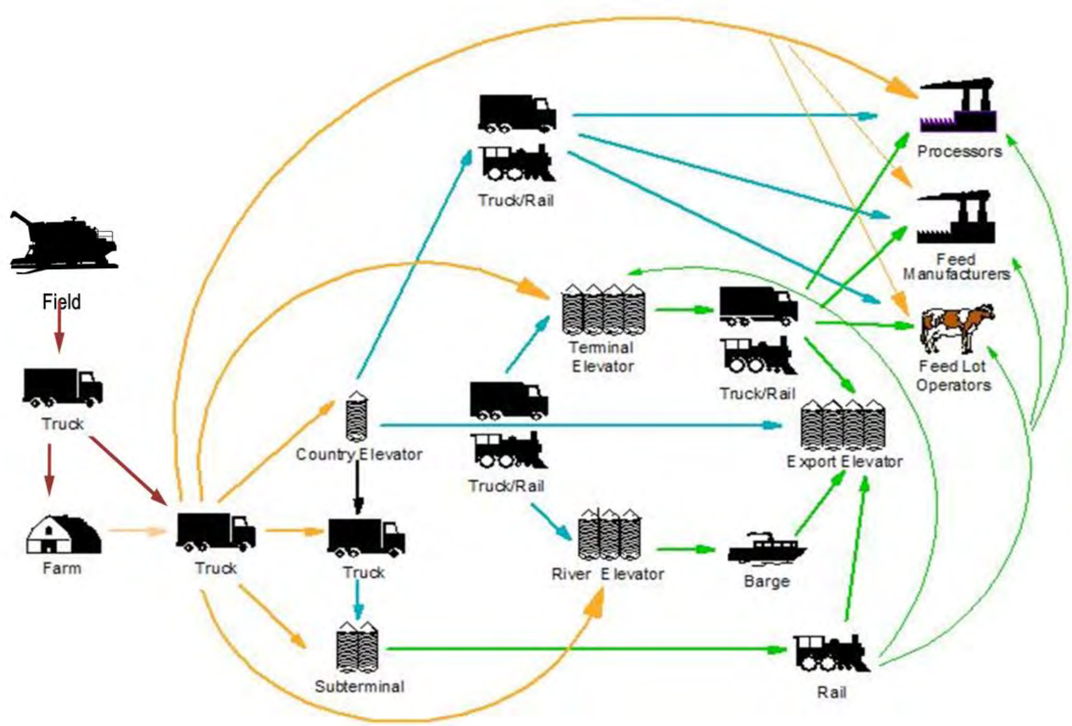

Figure 4.1 Crop Transport Options, from Field to Market

To illustrate the increased production in North Dakota agriculture, data from the National Agricultural Statistics Service (NASS) were compiled, including the top commodities of small grains and oil seeds, peas and lentils, beans, potato production, sugar beets, and all hay. Those data were collected by county and year then averaged by decade to estimate production increases over time. State level data were compiled and Figure 4.2 illustrates the dramatic increase in production over the last 60-plus years in the state. Production on a statewide level has more than tripled from the 1940s' average annual tonnage to the 2000s' average annual tonnage (Figure 4.2).

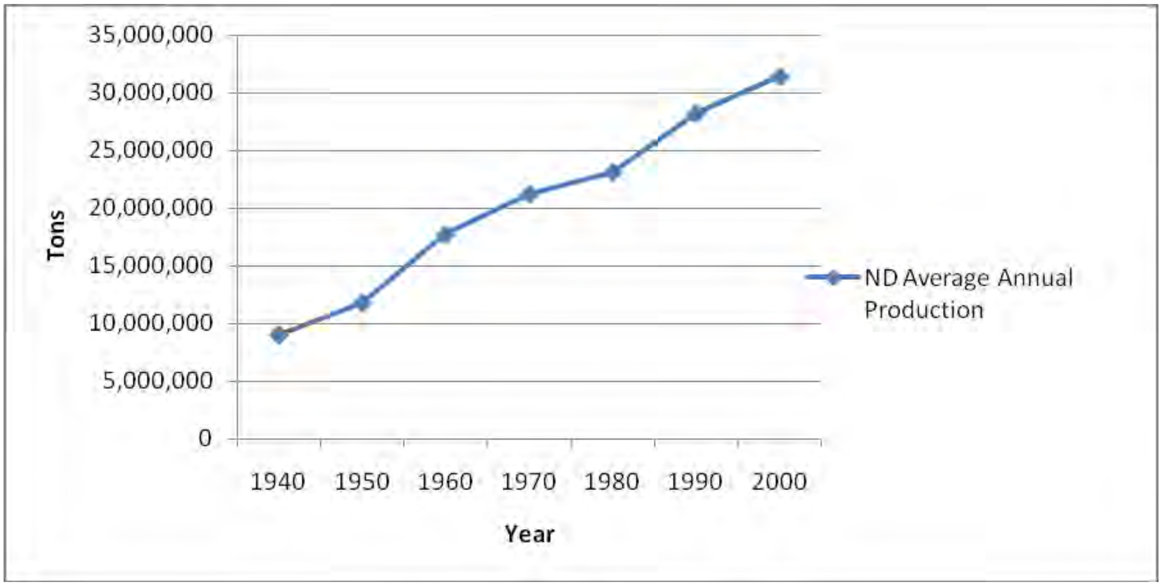

Figure 4.2 North Dakota Decade Average Annual Production

North Dakota is first in the nation when it comes to the production of many agricultural crops. In 2006 North Dakota was number one in the production of durum, hard red spring wheat, barley, flaxseed, dry edible beans, dry edible peas, lentils, sunflowers, canola, and honey. North Dakota was second in production of all wheat and sugarbeets. From a freight perspective, agricultural product movements statewide have the greatest overall impact on local, county, and state highways. To gauge the significance of the impact agriculture has on North Dakota roads and highways it is important to look at county level production.

4.1 County Level Production

As was illustrated above, production across North Dakota has increased dramatically over time. Table 4.1 shows the tonnage growth at the county level and shows the growth in percentage terms.

The county in the state with the largest gains in production from the decade annual average production of the 1940s to the average annual production of the 2000s is Richland, with a 580% increase in total decade average annual tonnage. Other counties with large percent tonnage increases include Kidder, Dickey, Sargent, and Traill.

Table 4.1 Growth in North Dakota Crop Production by County 1940s to 2000s (Average Annual Decade Tonnage, NASS 2008)

Richland	580%	Stutsman	260%	McIntosh	213%	Wells	180%	Bottineau	138%
Kidder	505%	Burleigh	247%	McHenry	209%	Sioux	174%	Sheridan	137%
Dickey	416%	Bowman	246%	Stark	207%	McLean	172%	Adams	126%
Sargent	387%	Morton	232%	Griggs	205%	Slope	171%	Grant	124%
Traill	379%	Emmons	228%	Ward	203%	Williams	152%	Nelson	121%
Pembina	377%	Barnes	226%	Walsh	201%	Steele	152%	Ramsey	118%
Ransom	336%	Oliver	225%	Grand Forks	189%	Pierce	149%	Divide	104%
La Moure	331%	Renville	219%	Rolette	189%	Mercer	145%	Burke	99%
McKenzie	305%	Logan	219%	Hettinger	188%	Benson	143%	Golden Valley	72%
Cass	282%	Foster	217%	Eddy	185%	Mountrail	140%		
Billings	262%	Dunn	215%	Cavalier	181%	Towner	140%	**State**	**288%**

Many crops in North Dakota yield significant tonnage, including wheat, corn for grain, soybeans, sugarbeets, hay, corn silage, and a combination of many other crops. All counties showed significant gains or growth in production. The eastern counties have the highest production tonnage because of the better soils and higher annual precipitation. Historically, Walsh, Pembina, Cass, Grand Forks, and Richland are the top tonnage producers in the state. Table 4.2 shows the tonnages from production agriculture and the changes over time. Technological changes in seed, machinery, nutrient application, pesticides, and farming practices have all played a part in the growth in production agriculture. Economics, crop genetics, technological advances, advances in farming practices, input prices, and changes in consumer demand have encouraged North Dakota producers to add to or change their crop rotations, and some of these crops, such as sugarbeets and potatoes increase tonnage per acre significantly. Continued technological gains will provide continued growth in production tonnage for agriculture.

Valuable insight can be gained by examining the data. Using the past as a proxy estimate of the future growth may or may not provide accurate measures for future production. Many variables weigh into accurately forecasting growth in production agriculture. These include genetic modification potential, fertility management potential and affordability, weather or climate, pesticides or other management of weeds and insects and disease, economics of agriculture, and other unforeseen variables.
The average annual compounded gain in production tonnage from the 1950s though 2006 is a factor of approximately 2.8% annually. This equates to a 228% increase in tonnage over the period from the decade average annual production in the 1940s to the decade average annual production in 2000s. Table 4.1 shows the gains in tonnage by county and every county gained significantly in average annual tonnage (NASS 2008). These tonnage increases are substantial despite the growth farm acres placed into the Conservation Reserve Program (CRP) since 1986.[10] Under the CRP program, farmers voluntarily take crop acres, which are highly erodible or sensitive, out of production for 10 to 15 years. The Census of Agriculture indicates that North Dakota‘s CRP acreage increased from 2.7 billion acres in 1997 to more than 3.0 billion acres in 2002.

[10] CRP is a provision of the U.S. Food Security act of 1985 and extended under the Food, Agriculture, Conservation and Trade Act The first year acres were enrolled was 1986. http://www.ers.usda.gov/publications/aer834/aer834.pdf

Table 4.2 County Production of Top Crops, Annual Decade Average Production Tons (NASS 2007)

County	1940's	1950's	1960's	1970's	1980's	1990's	2000's
Adams	97,994	118,232	184,367	202,968	201,853	242,881	221,697
Barnes	245,125	335,623	501,232	583,674	615,134	733,639	798,637
Benson	190,126	239,770	332,165	372,677	383,498	474,531	462,671
Billings	32,768	51,411	72,111	77,177	95,333	130,361	118,742
Bottineau	255,298	278,890	378,586	441,958	514,735	586,746	608,505
Bowman	69,687	95,092	157,303	181,824	158,491	201,606	240,838
Burke	121,827	136,942	185,459	214,915	201,703	279,409	242,034
Burleigh	121,338	235,830	354,921	371,739	355,704	388,900	421,454
Cass	414,123	526,361	835,469	1,071,731	1,285,954	1,565,302	1,580,396
Cavalier	250,865	313,504	408,229	491,259	617,066	662,471	704,610
Dickey	131,786	230,500	375,434	432,053	435,794	534,818	680,582
Divide	139,661	140,502	190,882	256,383	210,246	302,570	285,593
Dunn	138,273	176,701	335,205	340,920	347,839	402,200	435,898
Eddy	68,090	123,359	164,218	174,824	213,067	221,273	194,164
Emmons	158,895	236,621	384,014	383,060	382,212	506,773	521,787
Foster	90,102	141,779	224,860	228,404	246,475	291,422	285,251
Golden Valley	73,927	72,175	93,904	127,711	94,023	143,586	127,105
Grand Forks	477,692	515,087	758,620	1,010,767	1,073,346	1,374,814	1,382,086
Grant	125,811	188,656	305,364	335,948	319,330	365,447	282,424
Griggs	94,340	142,943	207,573	240,573	275,456	311,249	287,944
Hettinger	141,733	170,848	246,835	285,635	290,412	372,820	408,758
Kidder	91,834	205,516	288,967	307,221	342,632	433,576	555,270
La Moure	166,688	251,536	409,440	453,668	450,025	561,673	719,221
Logan	99,144	159,755	240,980	245,624	275,630	311,910	316,102
McHenry	209,004	330,156	421,027	459,081	486,557	544,447	645,984
McIntosh	107,194	164,558	258,698	274,126	263,839	308,277	335,067
McKenzie	143,884	189,729	316,479	405,607	405,427	543,110	583,247
McLean	259,814	318,286	491,952	502,129	507,655	623,409	707,579
Mercer	102,595	142,585	242,988	234,415	217,879	247,131	251,727
Morton	171,095	241,397	411,180	451,846	460,536	586,350	568,783
Mountrail	167,451	197,382	285,968	330,668	313,200	432,142	402,660
Nelson	139,276	201,690	273,203	296,325	362,599	372,877	307,866
Oliver	69,123	106,742	170,018	192,417	181,651	208,810	224,564
Pembina	425,996	427,443	625,889	986,486	1,275,696	1,782,827	2,030,645
Pierce	141,628	184,358	258,385	277,217	284,191	339,704	352,736
Ramsey	196,781	240,624	321,308	352,189	393,597	433,174	429,473
Ransom	122,953	191,673	307,955	360,442	408,910	489,778	536,484
Renville	123,078	139,568	194,410	232,936	277,574	374,463	393,229
Richland	275,051	415,977	619,405	964,871	1,303,266	1,554,715	1,869,457
Rolette	97,382	140,295	183,658	223,775	248,243	284,138	281,431
Sargent	124,034	198,876	306,511	356,117	363,846	461,379	603,437
Sheridan	103,945	139,915	228,411	215,451	210,356	250,562	246,647
Sioux	41,723	74,577	101,368	103,555	116,377	157,633	114,400
Slope	64,767	85,785	128,200	150,710	155,815	192,011	175,397
Stark	149,777	180,927	319,672	345,737	311,690	427,307	459,533
Steele	146,900	179,967	231,342	287,912	334,211	401,556	370,568
Stutsman	248,711	406,528	624,955	676,680	717,691	797,061	894,567

County	1940's	1950's	1960's	1970's	1980's	1990's	2000's
Towner	164,958	215,660	281,977	334,628	360,322	389,372	395,123
Traill	246,725	293,002	464,482	726,223	977,106	1,122,712	1,180,640
Walsh	536,830	542,090	834,422	1,234,357	1,431,222	1,659,418	1,615,329
Ward	256,478	319,606	468,869	518,710	560,705	711,673	776,873
Wells	194,680	250,440	382,029	403,474	420,144	516,436	545,780
Williams	209,963	216,569	334,443	429,217	377,774	532,338	529,724
State Total	**9,038,921**	**11,824,204**	**17,737,321**	**21,214,015**	**23,142,408**	**28,227,333**	**31,413,047**

Pembina County has the highest average annual tonnage with over two million tons in the 2000s. Richland, Pembina, Walsh, Traill, Cass, and Grand Forks counties all had tonnages over one million. The eastern part of the state's sugarbeet crop, along with higher yields for all crops, provide for large tonnages.

Wheat is still king in many North Dakota counties. However, counties that produce sugarbeets have different truck movements due to tonnage differences. These areas where sugarbeets are grown, like Pembina county, experience large tonnage and movements from the field to the storage pile, and the secondary movement from storage area to the factory provides for significant truck numbers. Most of these sugarbeet movements are concentrated in the Red River Valley in eastern North Dakota. However, because of irrigation acres, McKenzie County's number one crop is sugarbeets. Irrigation has made it possible for sugarbeets and other row crop production in western North Dakota. Irrigated acres are increasing in western North Dakota as irrigation provides water to the arid landscape, increasing production and providing opportunity for raising potatoes, corn, and sugarbeets, which are all high tonnage crops.

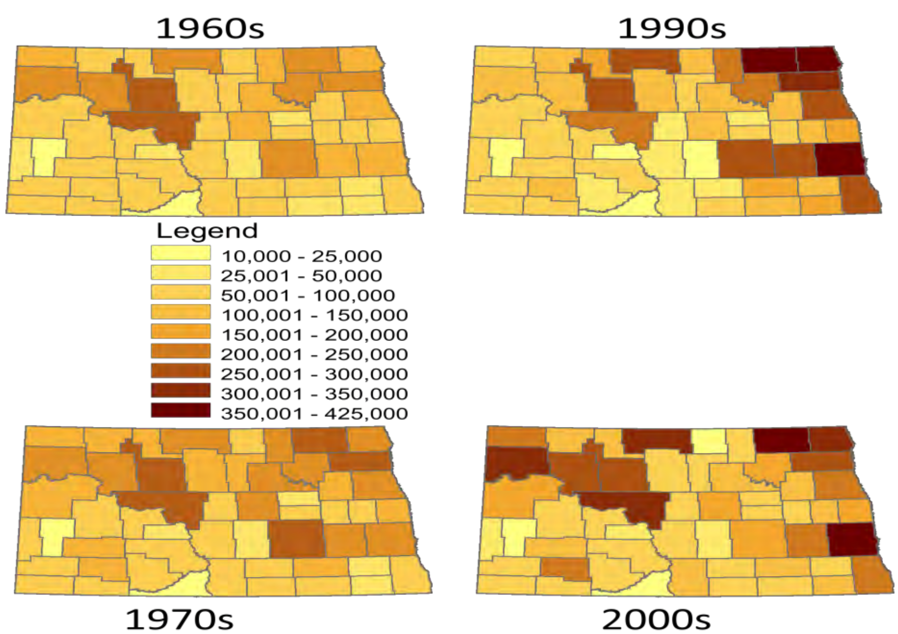

Figure 4.3 Wheat Tonnage Over Time (NASS 2007)

Hay is also a major commodity, although it is mostly consumed locally. However, in times of drought, hay is moved a considerable distance within the state from the area of surplus to drought stricken areas.[11] Although not quantifiable, quality hay is also moving farther. Quality hay can be raised in North Dakota because the semi-arid climate of western North Dakota allows farmers to harvest the hay without it being damaged by rainfall. This hay may move long distances to dairy operations in the Midwest, East Coast, Texas, or California. Hay also moves to places in the country that have localized feed shortages.

Table 4.3 Top Crop by County and Tonnage, 2000s average annual production (NASS 2007)

Pembina	Sugarbeet	1,430,214	McHenry	Hay All	235,371	Logan	Hay All	113,057
Walsh	Sugarbeet	890,857	Morton	Hay All	229,857	McIntosh	Hay All	108,714
Richland	CornGrain	767,610	Kidder	Hay All	213,429	Steele	Soybeans	105,840
Grand Forks	Sugarbeet	663,857	Stark	Wheat All	212,889	Pierce	Wheat All	105,347
Traill	Sugarbeet	583,286	Eddy	Hay All	210,157	Mercer	Hay All	105,214
Cass	Soybeans	466,787	Wells	Wheat All	209,803	Nelson	Wheat All	103,530
Cavalier	Wheat All	400,054	Ransom	CornGrain	206,018	Bowman	Hay All	100,400
Ward	Wheat All	381,603	Stutsman	Wheat All	200,318	Adams	Wheat All	99,125
McLean	Wheat All	357,815	Towner	Wheat All	194,500	Billings	Hay All	98,029
Dickey	CornGrain	322,537	Dunn	Hay All	186,380	Sioux	Hay All	86,700
Divide	Wheat All	322,537	Burleigh	Hay All	178,786	Oliver	Hay All	82,143
Hettinger	Wheat All	276,468	Renville	Wheat All	178,033	Slope	Wheat All	79,011
Sargent	CornGrain	271,793	Mountrail	Wheat All	175,363	Sheridan	Wheat All	77,524
Barnes	Wheat All	244,762	Foster	Wheat All	158,514	Griggs	Wheat All	64,723
Williams	Wheat All	243,647	Grant	Hay All	142,143	Golden Valley	Wheat All	61,761
La Moure	CornGrain	242,632	Ramsey	Wheat All	138,333	Emmons	Hay All	55,143
Bottineau	Wheat All	239,106	Benson	Wheat All	128,263	Rolette	Canola	32,589
McKenzie	Sugarbeet	236,857	Burke	Wheat All	124,198			

4.2 High Tonnage Crops

As stated in the previous section, some crops naturally produce more tons per acre than others. Crops grown under irrigation or crops such as potatoes, sugarbeets, or even corn produce more tonnage. Forage crops also produce more tons per acre than traditional small grain crops such as wheat or barley. Land quality and water are the drivers for tonnage under most conditions. Irrigation may have the greatest impact on production, especially in the more arid western part of the state. For instance, irrigation provides producers in McKenzie County the ability to raise sugarbeets, making it the highest tonnage crop in the county. Irrigation also provides producers in Williams County the water needed to raise sugarbeets, corn, and potatoes. NASS reports that crop acreage under irrigation varies from year to year. However, over time NASS has reported dramatic increases in irrigated acres.

The data reveal as irrigation acres increase, a shift from small grains to row crops occurs as producers attempt to maximize return. Irrigated acres in 1980 were dominated by small grains, but by 2000 most irrigated acres were row crops.

[11] NDDOT has committed resources to remove height obstructions within the state. The goal is to increase the height of bridges and overpasses to allow for the free flow of freight.

North Dakota irrigated acres have continued to increase over time, with acres almost tripling from the 1980s to 2000s. Irrigation provides producers with options for growing high tonnage crops that would not be available without consistent water availability. Some counties reported a reduction in irrigated acres and others a dramatic increase (Table 4.4).

Table 4.4 Irrigated Acres by County (NASS 2007)

County	1980	1990	2000	County	1980	1990	2000	County	1980	1990	2000
Barnes	1,400	2,300	900	Griggs	1,900	2,200	4,200	Pierce		200	
Benson	2,100	2,500	2,800	Kidder	1,200	6,000	16,500	Ransom	400	12,700	16,400
Burleigh	8,000	2,700	1,500	La Moure	1,000	4,400	4,400	Richland		1,200	3,400
Cass	2,200	9,700	6,800	Logan		1,100		Rolette		300	
Dickey	1,900	10,600	11,300	McHenry	800	1,000	7,100	Sargent		6,500	6,000
Divide	1,400	2,400	2,200	McKenzie	8,200	13,900	16,600	Sioux	500	1,200	900
Eddy		1,000		McLean	5,000	4,300	2,500	Steele		1,500	1,400
Emmons	400	3,300	3,700	Mercer	5,200	1,200	2,300	Stutsman	400	2,300	5,400
Foster	2,400	1,800	2,800	Morton	300	3,000	2,500	Traill	700	200	
Golden Valley		800		Nelson		300	600	Walsh		200	1,000
Grand Forks	600	3,100	17,400	Oliver	100	1,700	1,300	Ward	1,000	600	
Grant	200	1,300	1,200	Pembina	400		1,300	Williams	6,600	9,000	13,200
								StateTotal	**54,300**	**116,500**	**157,600**

Advances in production technology and irrigation result in average annual tonnage of crops increasing over time. Again, as shown in previous section, Pembina County leads the state with production tons of over two million tons annually. Eastern counties dominate tonnage as soil quality and annual rainfall allow for different cropping options and generally better conditions for all crops.

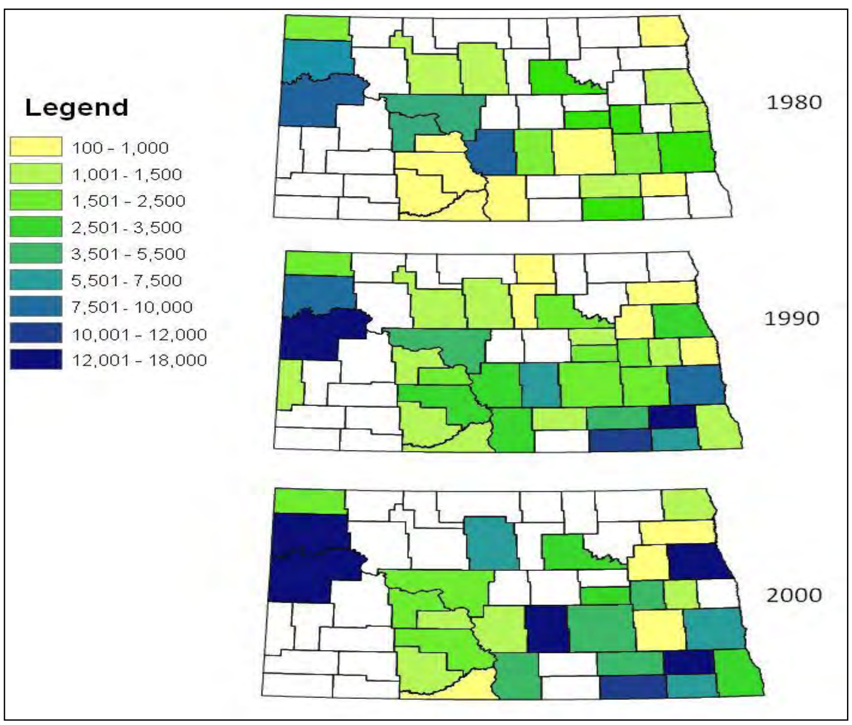

Figure 4.4 Irrigation Acres by County (NASS 2008)

Table 4.5 2000s Average Annual Tonnage and Rank for Top Crops (Tons) (NASS 2008)

Pembina	Sugarbeet	1,430,214	McHenry	Hay All	235,371	Logan	Hay All	113,057
Walsh	Sugarbeet	890,857	Morton	Hay All	229,857	McIntosh	Hay All	108,714
Richland	CornGrain	767,610	Kidder	Hay All	213,429	Steele	Soybeans	105,840
Grand Forks	Sugarbeet	663,857	Stark	Wheat All	212,889	Pierce	Wheat All	105,347
Traill	Sugarbeet	583,286	Eddy	Hay All	210,157	Mercer	Hay All	105,214
Cass	Soybeans	466,787	Wells	Wheat All	209,803	Nelson	Wheat All	103,530
Cavalier	Wheat All	400,054	Ransom	CornGrain	206,018	Bowman	Hay All	100,400
Ward	Wheat All	381,603	Stutsman	Wheat All	200,318	Adams	Wheat All	99,125
McLean	Wheat All	357,815	Towner	Wheat All	194,500	Billings	Hay All	98,029
Dickey	CornGrain	322,537	Dunn	Hay All	186,380	Sioux	Hay All	86,700
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Hettinger	Wheat All	276,468	Renville	Wheat All	178,033	Slope	Wheat All	79,011
Sargent	CornGrain	271,793	Mountrail	Wheat All	175,363	Sheridan	Wheat All	77,524
Barnes	Wheat All	244,762	Foster	Wheat All	158,514	Griggs	Wheat All	64,723
Williams	Wheat All	243,647	Grant	Hay All	142,143	Golden Valley	Wheat All	61,761
La Moure	CornGrain	242,632	Ramsey	Wheat All	138,333	Emmons	Hay All	55,143
Bottineau	Wheat All	239,106	Benson	Wheat All	128,263	Rolette	Canola	32,589
McKenzie	Sugarbeet	236,857	Burke	Wheat All	124,198			

4.2.1 Corn

Corn plantings and production declined from the peak acres of the 1930s through the 1980s. However, since then, technological advances in genetics and new farming practices have been implemented, increasing corn acres and production per acre. Comparing North Dakota production of wheat and corn, corn production has increased since the mid 1990s. As of 2005, federal mandates and the price of corn have encouraged increased plantings and production (Figure 4.5).

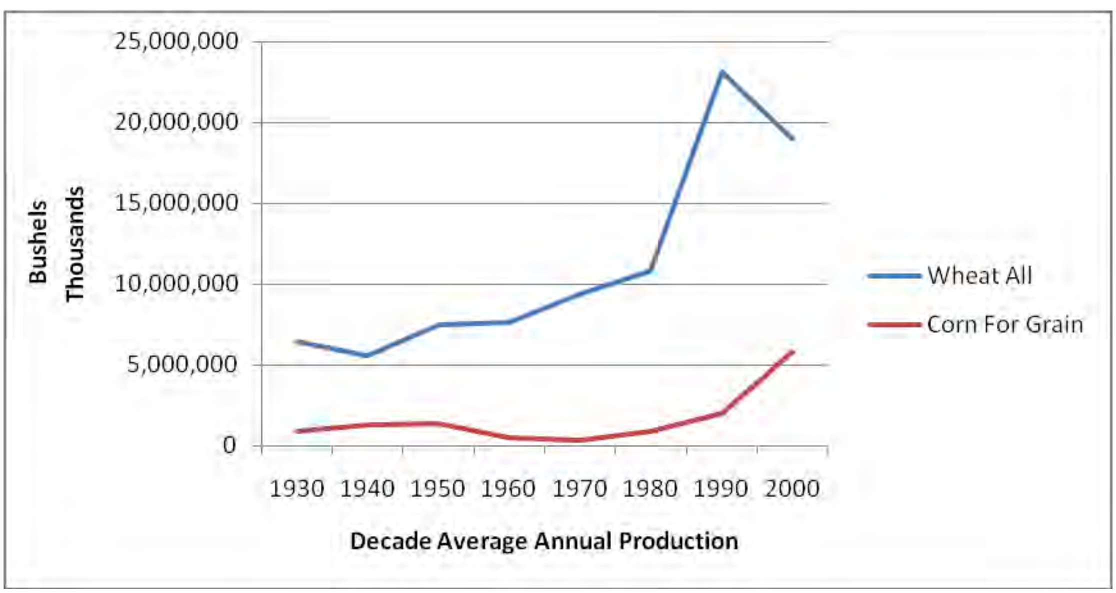

Figure 4.5 Comparison of North Dakota Wheat & Corn Production (NASS 2007)

There are reported corn acres in every county in North Dakota. Producers have planted corn either for on-farm feed or a cash crop since records have been kept in every county in North Dakota. During the 50s, 60s, and 70s, corn production declined as producers sought crops with less risk and better return. The short growing season and lack of precipitation in North Dakota makes corn production a risky venture as corn may not mature, leaving producers with just the stocks. Corn stocks can be used for cattle feed; however, without corn grain, feed value is low. New shorter maturation, drought resistant varieties have lessened the risk and corn production has increased dramatically and, as a result, corn production is being grown further north and west (Figure 4.6).

The push for ethanol has led to a demand for corn within the state as construction of plants is underway. Currently, there are five operating ethanol plants in the state.

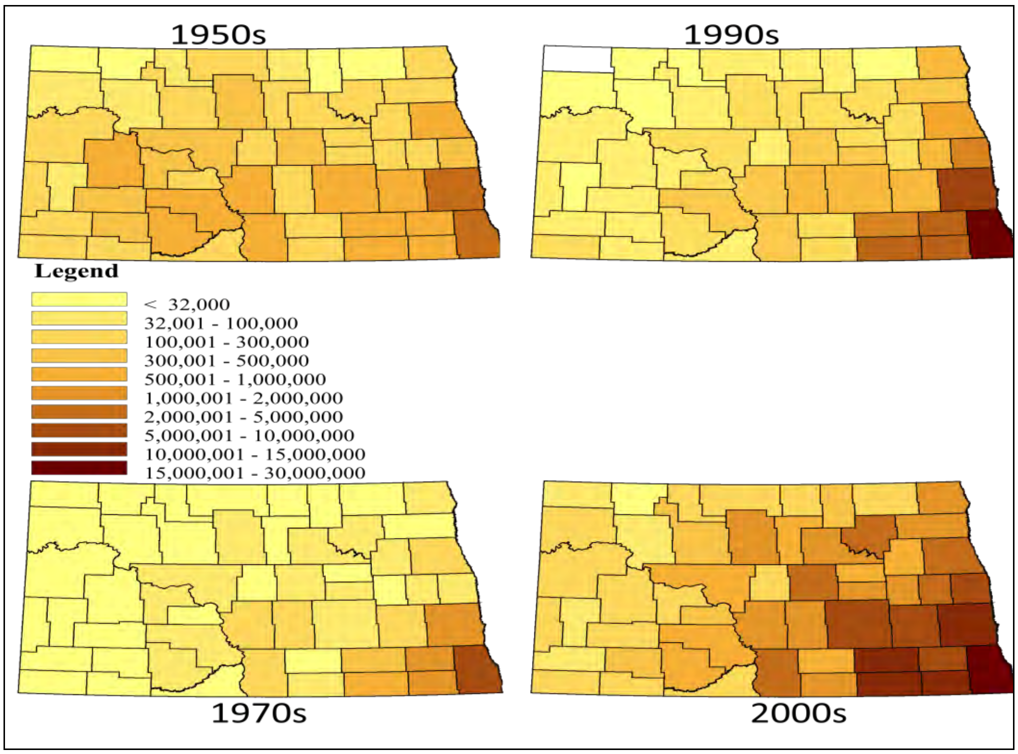

Figure 4.6 Decade Average Annual Corn Production (Bushels) (NASS 2007)

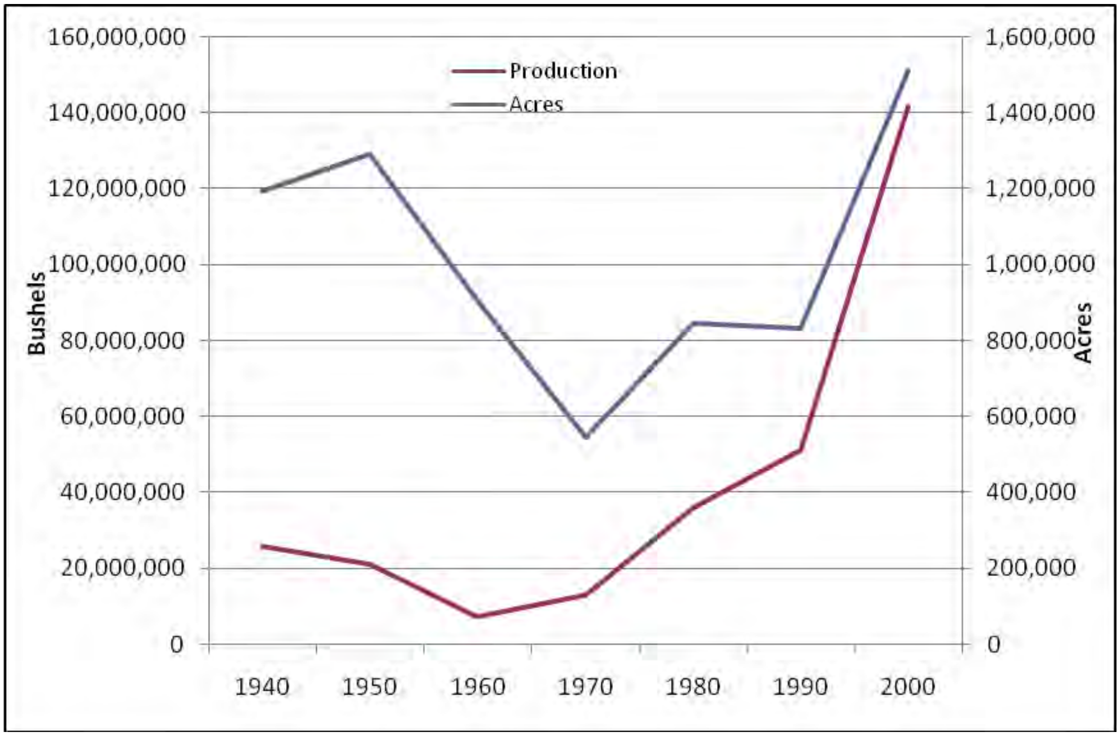

Figure 4.7 Corn Production and Acres in North Dakota (NASS 2008)

4.2.2 Sugarbeets

Tonnage of sugarbeet production has also grown over time. Sugarbeets are grown mostly in the eastern counties of North Dakota and Williams and McKenzie Counties in western North Dakota. Sugarbeets are harvested and moved to outside storage piles. Sugarbeets are susceptible to decay, therefore, without proper temperature control, quality declines rapidly and sugar content is lost. From these piles, these beets are moved to the factory. These beets are moved to processing facilities throughout the winter with the end of processing sometime in the spring of the year.

Sugarbeet production has increased in the northern Red River Valley as sugarbeets are susceptible to disease and the soil is the carrier, therefore, sugarbeet production is most prolific on ground that has not produced them in the past or only on a limited basis. Crop rotation minimizes the adverse effects of disease but does not eliminate it. Because of this susceptibility, producers weigh transportation costs of longer hauls against the potential increase in tonnage that comes with producing sugarbeets on new ground.

American Crystal operates six factories, two are located in North Dakota: Drayton and Hillsboro. These factories have a capacity of 1.675 million tons and two million tons, respectively. Other American Crystal factory locations in Minnesota include East Grand Forks, Crookston, and Moorhead. These factories have a capaciy of 2.3, 1.5, and 1.5 million tons, respectively. The factory at Sidney, Montana, has an estimated capacity of .85 million tons.[12]

[12] http://www.crystalsugar.com/coopprofile/factor/factories.asp

To supply these factories, several piling stations are located throughout the Red River Valley (Figure 4.8). Piling stations are also located on the western edge of North Dakota to serve the Sidney, Montana, factory. These piling stations represent seasonal freight generators.

Table 4.6 Sugarbeet Decade Average Annual Production Tons by County (NASS 2007)

	1960s	1970s	1980s	1990s	2000s
Cass	94,802	222,760	206,290	408,480	501,900
Grand Forks	133,480	173,290	281,380	481,430	663,857
McKenzie	76,627	117,160	159,130	207,570	236,857
Pembina	162,305	362,720	539,080	992,720	1,430,214
Richland	24,464	230,800	377,500	499,440	650,417
Steele	1,100		4,500	18,000	6,625
Traill	82,179	282,000	487,200	581,900	583,286
Walsh	173,888	356,480	473,580	722,740	890,857
Williams	30,545	54,330	68,980	88,820	99,429
State Total	779,390	1,799,540	2,597,640	4,001,100	5,063,442

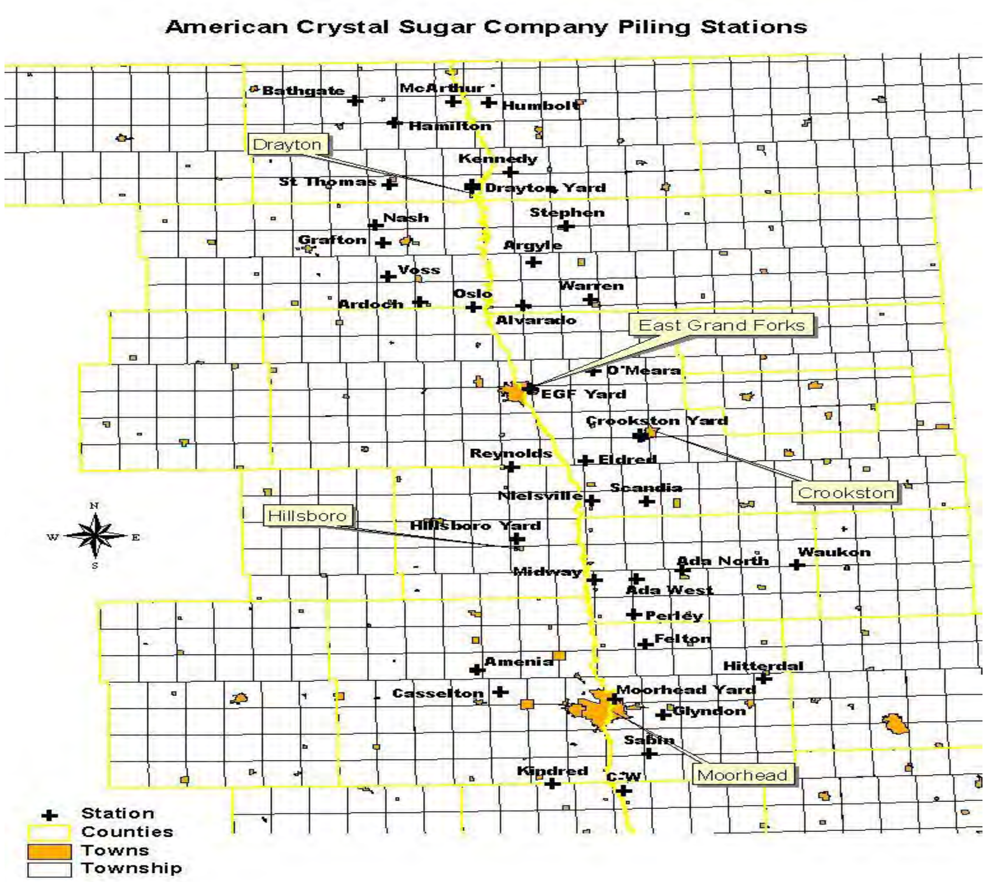

Figure 4.8 American Crystal Sugar Company Red River Valley Piling Stations and Factory Locations

In years of ideal production conditions, sugarbeets are produced at a level higher than factory capacity. Other times, beets yield more in one area of the Red River Valley, providing for a localized surplus in one area and a deficit in another. When this occurs, the company may order a percentage of beets to be moved from one factory territory to another. This requires a transportation of beets from one growing region to another, allowing the company to process more beets.

Although some information about American Crystal production is closely held, according to Richard C. Parton of the North Dakota Department of Transportation, ―The piling station at Ardoch, North Dakota, is near a storage facility for coal. The Ardoch beet piling station is a ‗deep freeze' location. It draws beets from 10,000 acres of land, averaging 20 tons per acre. That is 200,000 tons going in, and with ‗shrinkage' of 8%, the average going out is about 184,000 tons.

―Ardoch coal facility averages 85 to 95 loads going out per day during the peak processing time. The lowest time is through the summer and is 13 to 15 loads per day, of various tonnages. The coal comes in by rail, but is hauled to the processing plants on highways. The actual tonnage hauled beginning August 15, 2006 (beginning processing), was 714,000 tons of coal for the record harvest. 2005's estimated total was 650,000 tons of coal."

Figure 4.9 Ardoch Beet Station and Coal Facility Locations (NDDOT 2008)

Another sugar factory constructed in the early 1970s is located north of Wahpeton, North Dakota. The Minn-Dak Cooperative also has several piling stations that supply the factory during the fall and winter. The factory north of Wahpeton has an annual processing capacity of 2.3 million tons. Five of the seven piling stations are in Minnesota, but the beets are delivered to the factory north of Wahpeton.

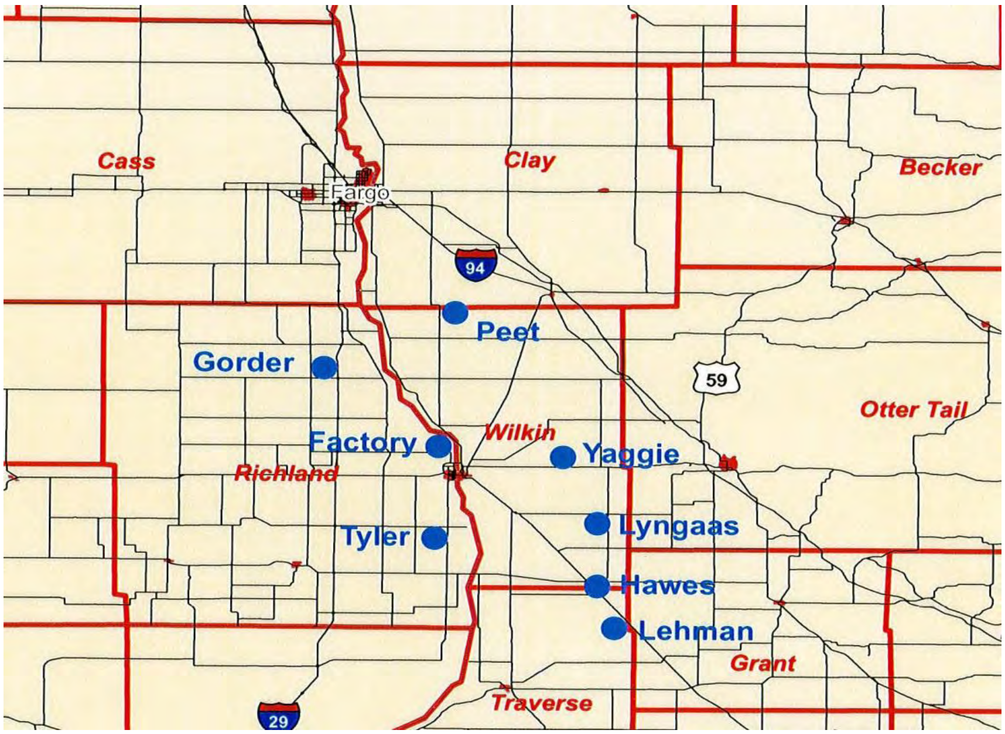

Figure 4.10 Minn-Dak Farmers Cooperative Piling Stations and Factory Location

Sugarbeet production has been increasing over time. Crop genetics, technological gains, and improved farming practices, along with more acres, have provided for increased production. Sugarbeets and potatoes provide large tonnages per acre compared to small grains. This tonnage has implications for local, county, and state roadways and bridges. Again, an acre of beets can easily achieve 20 tons, while an acre of wheat, even under ideal growing conditions, will produce only two tons of grain and one to two tons of straw.

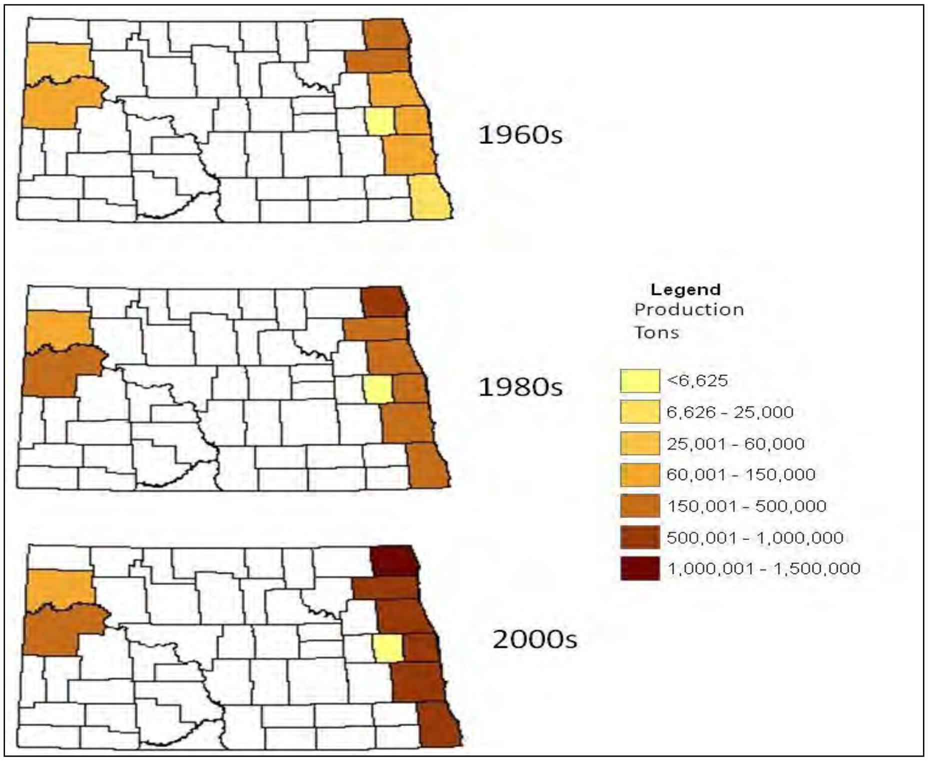

Figure 4.11 Decade Annual Average Sugarbeet Production (NASS 2007)

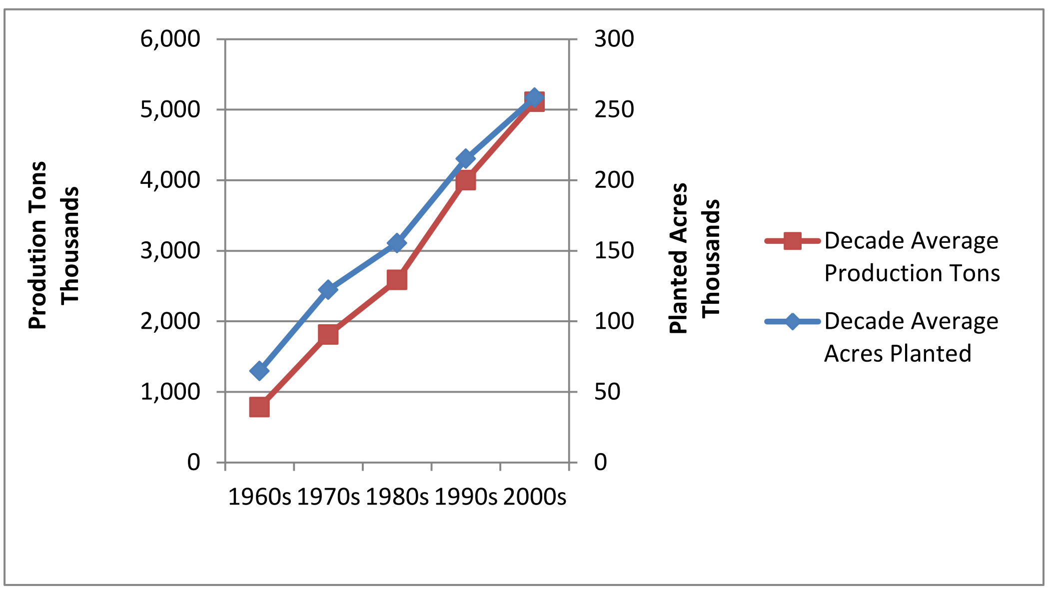

Figure 4.12 Decade Average Annual Sugarbeet Production Tons and Planted Acres (NASS 2007)

4.2.3 Potatoes

According to NASS, North Dakota produced potatoes commercially in every county during the 1960s.[13] Potatoes, like corn, were seen by farmers as a staple and may have been raised because of local marketing potential and consumption. Potatoes, like sugarbeets, provide large tonnages per acre. Potatoes are stored in cold storage warehouses until they are demanded by the market. Potatoes produced in North Dakota are used as seed, fresh or tablestock, frozen products, and until recently, potato flakes.[14] These warehouses are scattered mostly throughout northeast North Dakota, with the exception of potato production around the Aviko french-fry plant at Jamestown and production in Williams County for both seed and supply for the frozen processing facilities in Grand Forks and Jamestown. The frozen potato processing facility at Jamestown promoted potatoes under irrigation as the demand for fast food French fries became increasingly popular. The industry demanded a uniform product for French fries and irrigation can provide that uniform potato product. Controlling the application of water is essential in producing a uniform potato product. Potatoes are processed into fries and other frozen products at Aviko in Jamestown and JR Simplot in Grand Forks.

Potato production has been and still is concentrated in northeast North Dakota. Wash plants for table potatoes are also concentrated in the northeast. Potatoes are stored in warehouses and delivered to washplants throughout the year. Most potatoes processed through wash plants are marketed to super market chains across the country (Table 4.7).

Table 4.7 Potato Wash Plant Locations (Northern Plains Potato Growers 2007)

Wash Plant	Location
Associated Potato	Grand Forks
Associated Potato	Grafton
Associated Potato	Drayton
Lone Wolf Farms	Minto
J.G. Hall and Sons	Edinburg
J.G. Hall and Sons	Hoople
Northern Valley Growers	Hoople
Aaland Potato Company	Hoople
NoKota Packers	Buxton
Potato Sales Inc.	Park River
Tri-Campbell Farms	Grafton

Walsh County growers reported the largest tonnage of potatoes with average annual production at over 316 thousand tons (NASS 2007). Second is Pembina County followed by Grand Forks County. These three counties make up about 60% of potato production in North Dakota.

Potato production per acre has increased because of better genetics, increased irrigation acres, and better pesticides. The potato market has experienced volatility over the last decade. Demand for frozen products grew at an unprecedented pace during the 1990s, keeping prices and demand relatively strong. The low-carb diet craze of 2003-2007 reduced demand and prices as consumer choices and health consciousness did not include potatoes at the same level as in the past.

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[13] Methods of reporting data has changed therefore NASS does not show acreages of less than 400 per county or reveal data that may breach confidentiality.
[14] North American Foods (RDO) closed its Plant in Grand Forks winter 2007/08.

Table 4.8 Potato Production Tons by County (NASS 2007)

County	Average 1970s	Average 1980s	Average 1990s	Average 2000s
Benson			15,750	21,550
Cass			18,367	15,950
Dickey			31,106	31,936
Eddy				8,450
Emmons			28,270	25,580
Foster			18,979	16,617
Grand Forks	276,048	216,830	233,455	189,593
Griggs			17,275	17,375
Kidder			82,130	156,450
La Moure			20,500	19,850
McHenry			32,925	41,619
Nelson				7,350
Pembina	227,539	249,036	289,305	241,936
Ransom			45,644	32,679
Sargent			30,889	24,571
Steele			16,775	
Stutsman			26,250	27,300
Towner	19,683	19,550	29,195	12,813
Traill	55,344	35,270	26,680	18,821
Walsh	381,937	428,973	388,230	316,992
Williams				17,250
State Total	**960,550**	**949,659**	**1,351,725**	**1,244,680**

Potato production provides for large tonnage from an acre of land similar to sugarbeets. Potatoes may produce between 10 and 20 tons per acre. These tonnages from potatoes and sugarbeets provide for localized impacts on county, township, and state roadways.

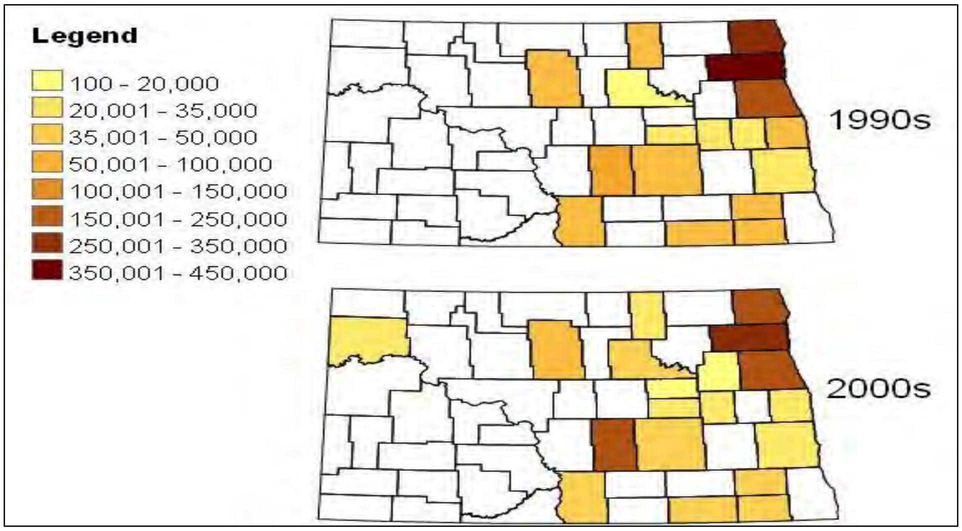

Figure 4.13 Decade Average Annual Potato Production Tons (NASS 2007)

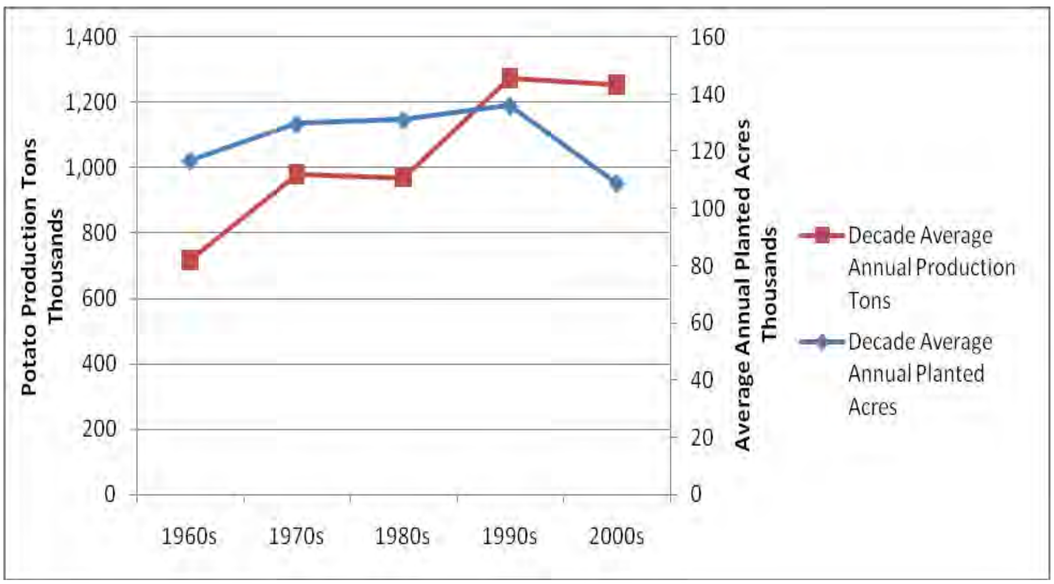

Figure 4.14 Average Annual Potato Production Tons and Planted Acres (NASS 2007)

4.3 Farm Inputs

As farm production has increased over time so has farm inputs. Increased fertilizer applications have the direct result of increased crop production. Some crops or legume crops require smaller amounts or no fertilizer inputs, such as dry edible beans and peas, lentils, or soybeans. Other crops, such as corn, wheat, and sugarbeets, require larger amounts of fertilizer to varying degrees. Irrigated crops also require large fertilizer applications to achieve desired yields and adequate return on investment. Producers generally enter into a crop rotation scheme to maximize return and to minimize investment in commercial fertilizer. The same would apply to herbicide, insecticide, and fungicide.

Changes in farming practices have increased the need for crop rotations as the practice of summer-fallowing has declined. Summer-fallowing is the practice of leaving the land fallow or unplanted during the growing season to preserve moisture and increase fertility for the following growing season. This practice became popular before the widespread use of commercial fertilizer and after the ―Dust Bowl" era of the 1930s when the land was plowed and seeded. The Dust Bowl was created by the early farming practice of the moldboard plow along with continuous cropping which depleted the land of nutrients and moisture and leading to wind and water erosion. The federal government stepped in and paid farmers to leave land fallow to stop the erosion and increase production. Using the summer-fallow method during the year a crop was raised on the land, enough organic matter would be introduced into the soil, and the results were reduced erosion and increased production. Economics, no-till and minimum-till farming methods, and the use of commercial fertilizer and other chemicals and technological improvements have led to less summer fallow and more continuous cropping over time. This has increased the need for farm inputs to make up for nutrient losses that were gained through the practice of summer-fallow. Plant nutrients can be added though a combination of crop rotations and the use of commercial fertilizer. Seeding legumes or nitrogen fixating plants, such as dry edible beans, soybeans, peas, lentils, alfalfa, or clover, provide some of the nitrogen needed to raise small grains, corn, sugarbeets, or other non-legume crops. Commercial fertilizer needs are reduced when these legume crops are introduced into the crop rotation.

Fertilizer consumption data are available on a limited basis. Data are not available on a county level, but fertilizer and chemicals as inputs for specific crops is available at the state level. Fertilizer data are available on the state level annually from 2001 to 2006. Data are available sporadically from NASS on fertilizer and chemical applications since 1990. Because the data are incomplete, assumptions will be made to estimate chemical and fertilizer use over time.

As mentioned above, proper rotation may reduce the need for commercial fertilizer, and this is the case for wheat. Wheat production has increased over time even though fertilizer applications have been reduced (Figure 4.15).

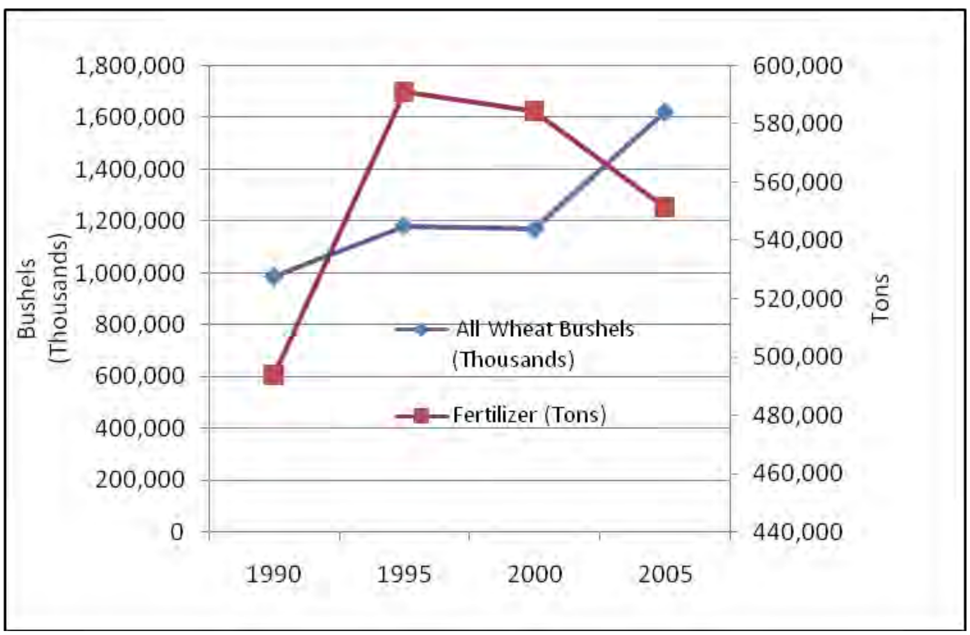

Figure 4.15 Wheat Production & Fertilizer Inputs (NASS 2008)

Table 4.9 Total Inputs of All Wheat (NASS 2008)

Year	Pounds of Inputs Per Durum Acre	Durum Acres	Total Pound of Inputs	Pounds of Inputs Per Other Wheat Acre	Other Wheat Acres	Total Pounds of Inputs	Total Tonnage of Inputs
1991	85	2,900,000	246,621,800	92	7,000,000	644,749,000	445,685
1992	92	2,150,000	197,537,700	99	9,200,000	911,057,600	554,298
1993	101	1,950,000	197,332,200	109	9,600,000	1,048,195,200	622,764
1994	203	2,450,000	496,191,150	136	9,100,000	1,238,928,600	867,560
1995	106	2,950,000	312,995,000	107	8,300,000	885,004,100	599,000
1996	NA	3,000,000	NA	121	9,600,000	1,157,251,200	583,034
1997	104	2,700,000	280,092,600	125	8,800,000	1,097,694,400	688,894
1998	65	3,000,000	194,478,000	103	6,700,000	689,738,200	442,108
2000	101	3,250,000	329,140,500	124	6,800,000	845,648,000	587,394
2002	112	2,100,000	234,288,600	136	6,900,000	936,647,400	585,468
2006	88	1,300,000	114,153,000	117	7,300,000	851,187,300	482,670

Because the data are available per acre, it can then be assumed that the inputs were somewhat uniformly distributed across the state. Tables 4.10 through 4.16 show county distribution of different farm inputs. Inputs for wheat include nitrogen fertilizer either as urea or anhydrous ammonia, phosphorus, potassium, and herbicides and fungicides. Phosphorus and potassium are usually applied in a dry state during planting, while urea can be spread on the field dry or applied during the seeding operation and mostly depends on a farmer‘s equipment, rates applied, and other factors. Nitrogen can also be applied in a liquid form with some type of liquid applicator, and it can be at times of planting or after the seeding operation.

Except for 1993, input tonnage for all wheat has fluctuated with wheat acres. Decisions on inputs are based on price of the inputs and what a producer can receive for the crop. If crop market prices are low, some farmers will conserve on inputs, while still others will try to make up for low prices by increasing volume or yield.

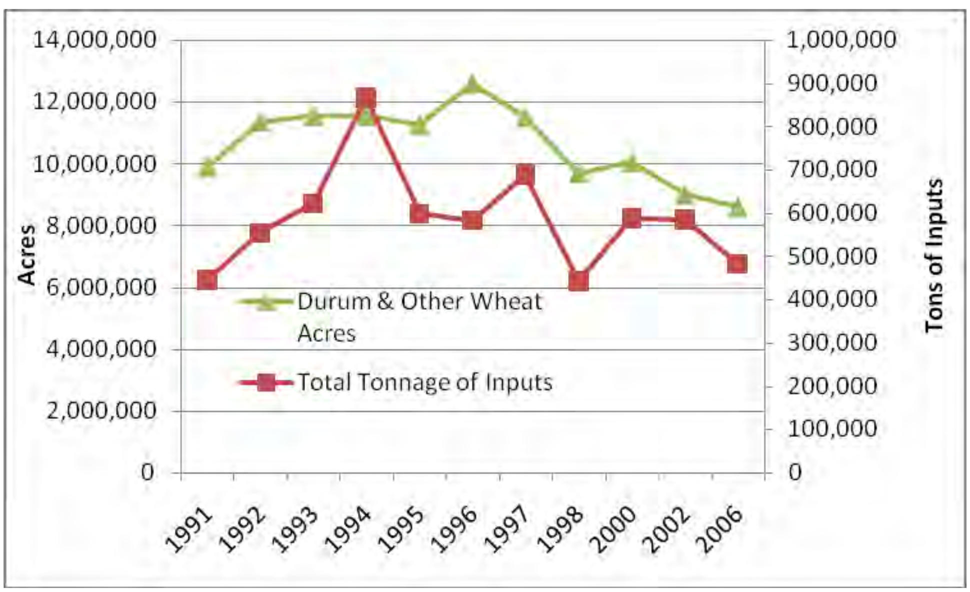

Figure 4.16 All Wheat Acres & Input Tonnage for ND (NASS 2008)

Table 4.10 Input Tons for Durum (NASS 2008)

County	2002	2004	2006	County	2004	2006	2002	County	2002	2004	2006
Adams	1,458	1,591	749	Griggs	80	417		Ramsey	1,106	603	159
Barnes	146			Hettinger	4,727	60		Renville	3,269	1,481	1,208
Benson	1,308	357		Kidder	80	5,704	1,982	Rolette	1,006	686	130
Billings	302	384	300	La Moure		82		Sheridan	241	329	155
Bottineau	2,766	1,810	749	Logan	156	192		Sioux		181	
Bowman	2,766	3,291	1,788	McHenry	603	603		Slope	2,464	2,962	1,450
Burke	7,041	3,291		McIntosh	302	247	275	Stark	2,213	2,688	1,692
Burleigh	568	680	275	McKenzie	5,532	6,198		Stutsman	553	148	
Cavalier	1,609	960	63	McLean	7,544	7,679	3,770	Towner	1,986	1,152	188
Dickey		27		Mercer	1,458	1,426	4,108	Walsh	156	143	
Divide	12,824	10,696	11,358	Morton	981	702	870	Ward	7,041	5,650	3,383
Dunn	855	987		Mountrail	11,064	10,970	179	Wells	337	527	106
Eddy	111	66		Nelson	80	77	7,974	Williams	17,099	18,375	14,016
Foster	85	104		Oliver	201	165		**State Total**	**105,609**	**95,988**	**62,829**
Golden Valley	1,660	49		Pembina	50	55					
Grand Forks	40	1,481	498	Pierce	603	384					
Grant	779	27									

Table 4.11 Input Tons for Spring Wheat (NASS 2008)

County	2002	2004	2006	County	2002	2004	2006
Adams	8,409	12,541	8,772	McLean	14,800	20,744	15,900
Barnes	16,482	16,501	8,224	Mercer	4,507	5,940	4,551
Benson	9,755	12,541	8,224	Morton	11,437	18,858	12,062
Billings	1,076	1,509	1,261	Mountrail	4,373	9,052	6,853
Bottineau	10,764	10,372	15,351	Nelson	8,073	9,240	6,305
Bowman	4,844	6,600	5,483	Oliver	3,835	6,035	3,947
Burke	4,777	5,280	6,579	Pembina	16,819	21,215	12,884
Burleigh	7,064	10,183	6,305	Pierce	7,737	10,560	7,127
Cass	18,837	21,215	10,417	Ramsey	9,082	8,769	6,853
Cavalier	23,546	30,173	20,834	Ransom	5,853	6,129	2,961
Dickey	5,718	4,054	2,303	Renville	8,409	8,203	10,143
Divide	605	754	1,151	Richland	10,428	12,258	5,757
Dunn	9,217	13,201	9,869	Rolette	4,373	5,657	5,208
Eddy	3,364	3,677	2,741	Sargent	6,122	6,129	2,741
Emmons	8,409	14,144	8,498	Sheridan	6,526	8,580	5,757
Foster	6,055	6,412	3,838	Sioux	1,682	3,206	2,029
Golden Valley	2,422	3,772	2,851	Slope	6,122	9,052	6,305
Grand Forks	16,819	19,329	11,239	Stark	13,119	19,329	13,707
Grant	8,409	13,955	8,388	Steele	8,208	8,486	4,222
Griggs	5,584	6,129	3,838	Stutsman	15,473	15,086	8,224
Hettinger	14,464	20,744	15,900	Towner	10,764	14,521	10,417
Kidder	3,566	4,715	3,015	Traill	9,418	9,429	5,099
La Moure	9,755	7,543	3,947	Walsh	17,155	21,215	13,158
Logan	4,844	7,260	3,947	Ward	15,473	23,101	18,367
McHenry	9,755	13,672	9,595	Wells	14,800	17,161	10,965
McIntosh	5,046	7,543	4,660	Williams	4,709	5,469	5,154
McKenzie	5,315	7,355	6,305	State Total	464,197	584,598	400,230

Table 4.12 Input Tons for Barley, 2003 (NASS 2008)

County		County		County	
Adams	564	Dunn	1,337	Pembina	812
Barnes	2,197	Eddy	1,672	Pierce	2,436
Benson	4,012	Emmons	1,767	Ramsey	4,777
Billings	396	Foster	2,723	Ransom	344
Bottineau	8,216	Golden Valley	425	Renville	5,111
Bowman	1,242	Grand Forks	1,385	Richland	473
Burke	1,672	Grant	874	Rolette	2,197
Burleigh	812	Griggs	2,102	Sargent	177
Cass	1,815	Hettinger	908	Sheridan	2,102
Cavalier	4,060	Kidder	669	Sioux	129
Dickey	439	La Moure	1,672	Slope	669
Divide	1,051	Logan	1,481	Stark	1,003
				State Total	98,014

Table 4.13 Input Tons for Soybeans (NASS 2008)

County	2002	2004	2006	County	2002	2004	2006
Barnes	8,443	17,261	11,422	Mountrail	39		
Benson	766	3,933	2,676	Nelson	1,603	5,829	2,872
Bottineau	217	362	277	Oliver		45	
Burke	32	492	176	Pembina	1,674	5,376	2,937
Burleigh	185	28,580	17,623	Pierce	428	1,641	1,191
Cass	17,207	2,632	946	Ramsey	1,888	6,339	2,937
Cavalier	784	8,206	4,732	Ransom	3,242	6,339	3,753
Dickey	3,527			Renville	118	204	179
Eddy	374	2,094	1,387	Richland	11,079	17,544	10,606
Emmons	588	1,007	587	Rolette	281	204	245
Foster	1,710	5,263	3,851	Sargent	4,988	8,885	4,993
Grand Forks	4,097	10,413	5,287	Sheridan	164	718	1,245
Griggs	1,817	4,811	3,166	Steele	3,919	8,772	5,417
Kidder	192	623	343	Stutsman	6,804	16,865	11,422
La Moure	6,591	14,432	8,648	Towner	748	1,387	979
Logan	392	1,471	914	Traill	6,377	12,451	7,408
McHenry	125	990	408	Walsh	1,496	5,376	2,643
McIntosh	1,532	2,830	1,599	Ward	346	1,783	555
McLean	78	594		Wells	1,087	5,603	4,145
Morton	75			Williams		153	
				State Total	95,119	212,229	127,277

Inputs also increase on acres that are under irrigation. Increased moisture results in possibilities of greater production, but production maximization can only occur if proper fertility exists, and this is introduced through the use of commercial fertilizer. For most crops, other inputs remain relative, comparing dryland and irrigated farming practices. Fertilizer may need to be doubled or more on irrigated acres to reach production goals.

Table 4.14 Input Tons for Potatoes (NASS 2008)

County	2003	2005	County	2003	2005
Benson	601	559	Ransom	795	662
Dickey	756	724	Sargent	679	683
Emmons		579	Stutsman	756	
Grand Forks	3,645	2,876	Towner	601	1,159
Griggs	814	2,048	Traill	911	6,166
Kidder	2,075	869	Walsh	8,143	6,745
McHenry	969	5,235	Williams	620	
Pembina	5,313	683	State Total	23,073	19,449

Table 4.15 Input Tons for Corn (NASS 2008)

County	2001	2003	2005	County	2001	2003	2005
Adams	794	975	844	McLean	654	1,244	1,026
Barnes	2,242	4,977	6,137	Mercer	355	647	575
Benson	981	2,488	2,301	Morton	2,289	3,185	2,972
Billings		229	144	Mountrail	140	269	
Bottineau	411	358		Nelson	504	1,244	959
Bowman	654	1,065	652	Oliver	701	1,095	1,103
Burleigh	1,541	2,687	2,062	Pembina	673	1,145	
Cass	5,418	10,650	11,027	Pierce	589	1,393	1,199
Cavalier		129		Ramsey	1,121	2,837	3,596
Dickey	6,446	10,451	10,068	Ransom	4,110	6,768	5,753
Divide		149		Renville	168	289	
Dunn	1,168	1,891	1,457	Richland	17,750	22,893	21,095
Eddy		946	911	Rolette	308	737	
Emmons	2,662	4,778	3,356	Sargent	5,885	8,460	8,246
Foster	813	1,543	1,630	Sheridan		547	527
Golden Valley	374	547	422	Sioux	374		
Grand Forks	1,308	3,086	2,972	Slope		428	249
Grant	1,261			Stark	869	1,244	1,218
Griggs	561	1,393	1,390	Steele	1,401	3,683	3,308
Hettinger	579	985	690	Stutsman	2,102	5,673	5,945
Kidder	1,448	2,040	1,486	Towner		667	
La Moure	4,204	7,764	8,342	Traill	2,709	7,167	7,863
Logan	841	1,792	1,534	Walsh	682	846	959
McHenry	1,074	1,991	1,918	Ward	308	916	518
McIntosh	1,401	2,588	1,534	Wells	841	2,190	2,445
McKenzie	299	597	537	Williams			240
				State Total	144,326	135,198	162,046

Table 4.16 Input Tons for Sugarbeets, 2003 (NASS 2008)

County	2003 Tons
Williams	418
Grand Forks	2,762
Pembina	5,959
Walsh	3,402
McKenzie	813
Cass	1,760
Steele	47
Traill	2,455
Richland	2,731
State Total	20,363

Implications on transportation for crop inputs include fertilizer delivery to producers which provides for localized heavy truck traffic during spring plantings. Due to North Dakota's geographic location and climate, load restrictions during spring thaw are an impediment to freight transportation and increase transportation costs. Load restrictions are necessary to preserve the highway infrastructure during the spring thaw. The spring is the most sensitive time for North Dakota roadways on which load restrictions are enforced. Load restrictions are put in place to preserve the highway during spring thaw when the road infrastructure is most susceptible to damage by heavy trucks, and move based on the projected spring thawing of the road bed. According to industry experts, an estimated 90% of commercial fertilizer is transported to North Dakota via rail. However, once fertilizer is delivered, it is distributed to local co-ops and retailers and farmers by truck. Because the deliveries are mainly in the spring, roadways may be susceptible to damage if spring load restrictions are ignored.

Freight generation for farm inputs nearly mirror elevator locations throughout the state. Even though fertilizer plants may not be located at the exact location of the grain elevator, in many instances the local co-op or Cenex Harvest States CHS[15] operates the farm input business. There are also non-co-op owned input stores, but for the vast majority of farmers it is either the local co-op or CHS that supplies the inputs.

[15] CHS provides a broad array of agricultural services and programs to the backbone of its farm-to-table system: producers and cooperatives. Through a variety of business units, subsidiaries and company-owned locations, CHS strives to be the total solutions provider for crop and livestock producers.

A wide spectrum of products and services support these country locations, including energy, agronomy, animal nutrition and grain marketing—delivered locally to producers, but backed by the efficiency and scope of the CHS system. In addition, producers and local co-ops have system-backed programs such as transportation, insurance, risk management, financing and training from trusted experts located in their own communities.

5. LIVESTOCK

Livestock also adds to the mix, and North Dakota's primary commodity is cattle. Cattle are moved from pasture to pasture, to other geographic areas in times of drought, and to market. Cattle, sheep, and hogs are moved in many different configurations of vehicles, from tandem axle livestock trailers to cattle pods pulled by a semi-tractor.

5.1 Cattle

Disposition of the cattle herd has changed somewhat over time as there has been a liquidation of the dairy herd.

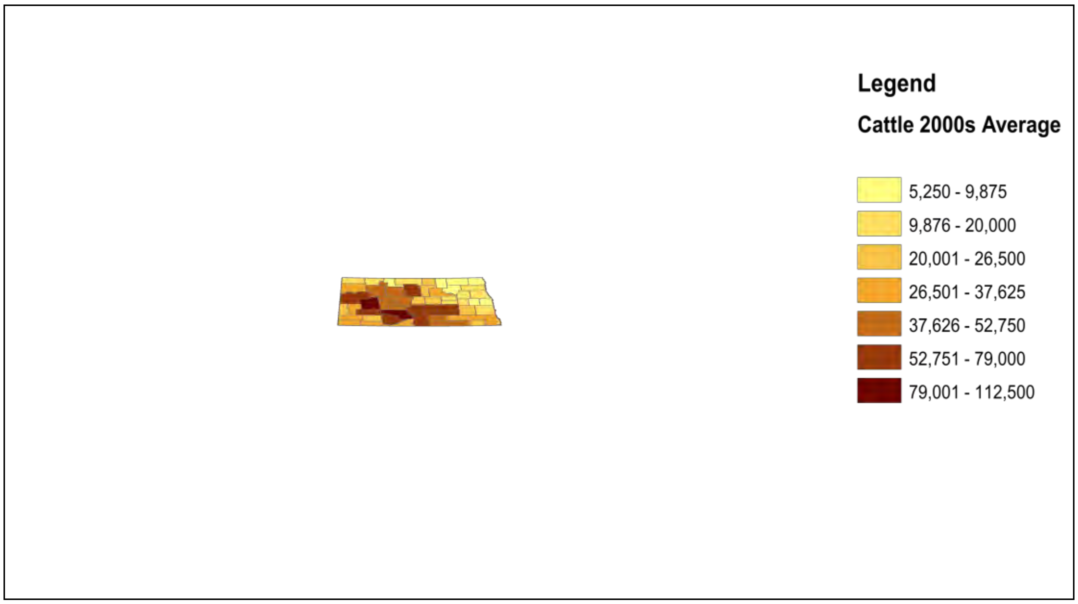

Figure 5.1 Decade Annual Average 2000s All Cattle Distribution by County (NASS 2008)

There is a cycle in the cattle industry which includes times of good prices and expansion and times of low prices and liquidation which historically has followed a 7- to 10-year cycle. Recent history has, however, not exactly followed this pattern. Beef is high on the list for populations moving out of poverty. As world economic conditions have improved, the demand for more protein in diets has increased.

The problems associated with BSE (bovine spongiform encephalopathy) have dampened demand for U.S. beef in some countries in Asia, such as Japan and Korea. However, overall beef demand has been increasing and the historical cattle cycle has been interrupted.

North Dakota's beef cattle are more concentrated in central and western counties as these counties make up the largest percentage of land either seeded to forage or grass or native range. The land in southwest and west central North Dakota is more suited to livestock or cattle production than crop production.

Table 5.1 Percentage Change in Cow Numbers by County (Decade Annual Average from 1940s to 2000s) (NASS 2008)

County	Percent Change	County	Percent Change	County	Percent Change	County	Percent Change	County	Percent Change
Sioux	136%	Logan	58%	Mercer	23%	Foster	-6%	Grand Forks	-50%
Bowman	119%	Burleigh	54%	Williams	12%	McLean	-7%	Nelson	-53%
Morton	107%	Slope	51%	Steele	11%	Sheridan	-9%	Renville	-55%
Kidder	89%	McKenzie	49%	Ransom	5%	Benson	-13%	Pembina	-59%
Oliver	85%	Dickey	47%	Rolette	4%	Sargent	-14%	Cass	-65%
Golden Valley	84%	McIntosh	46%	Walsh	1%	Griggs	-15%	Stutsman	-65%
Billings	83%	McHenry	43%	La Moure	-4%	Ward	-32%	Ramsey	-73%
Dunn	79%	Mountrail	38%	Eddy	-5%	Richland	-35%	Cavalier	-79%
Stark	69%	Emmons	34%	Pierce	-5%	Barnes	-44%	Towner	-79%
Grant	69%	Wells	24%	Burke	-6%	Bottineau	-45%		
Adams	67%	Divide	23%	Hettinger	-6%	Traill	-48%	State Total	-58%

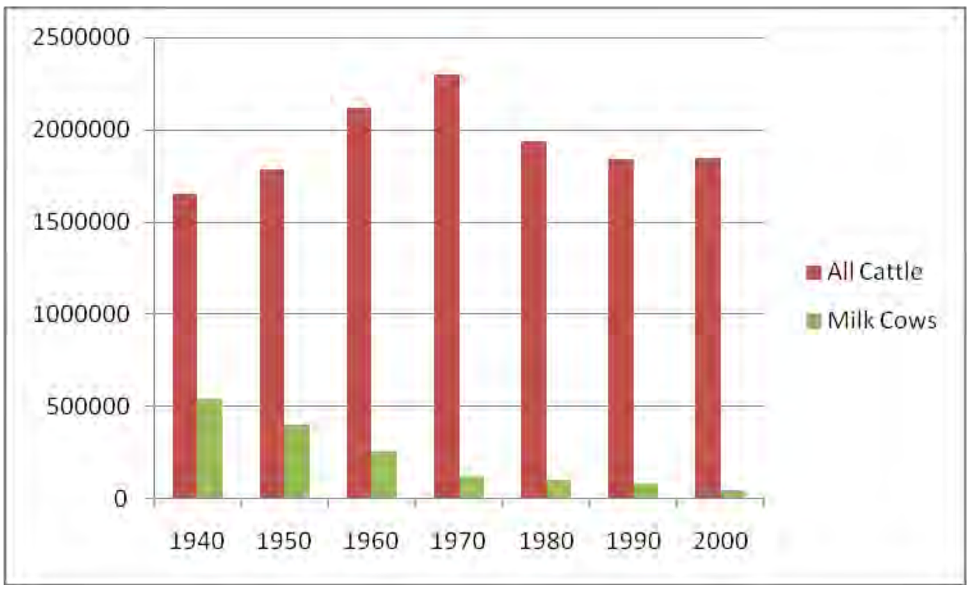

Figure 5.2 Changes in ND Cattle Herd Over Time (Decade Annual Average All Cattle Numbers) (ND NASS 2007)

All Cattle numbers have remained relatively constant from the average annual numbers of the 1980s and 1990s to the average annual numbers of the 2000s. This reflects a relatively healthy cattle industry.

Table 5.2 North Dakota All Cattle Numbers by County, 2000-2007 Annual Average Count (ND NASS 2007)

County	Cow Numbers	County	Cow Numbers	County	Cow Numbers	County	Cow Numbers	County	Cow Numbers
Morton	112,500	Dickey	48,000	Adams	35,000	Sheridan	23,500	Walsh	14,500
Dunn	92,750	McIntosh	46,250	La Moure	33,500	Sargent	23,125	Nelson	12,375
McHenry	79,000	McLean	45,250	Ransom	31,875	Hettinger	21,375	Pembina	9875
Kidder	70,125	Ward	42,500	Richland	31,625	Bottineau	20,000	Steele	7750
McKenzie	69,875	Mercer	41,375	Slope	30,375	Divide	19,000	Ramsey	6875
Grant	68,500	Oliver	41,375	Benson	29,750	Eddy	18,875	Towner	6875
Burleigh	64,125	Mountrail	40,625	Pierce	26,500	Cass	18,375	Renville	6625
Emmons	63,000	Billings	37,625	Barnes	24,500	Grand Forks	17,875	Cavalier	6000
Stutsman	61,000	Bowman	36,750	Wells	24,125	Griggs	17,875	Traill	5250
Stark	56,500	Sioux	35,625	Golden Valley	23,625	Foster	16,750		
Logan	52,750	Williams	35,250	Rolette	23,500	Burke	14,500	State Total	1,842,500

Logically, marketing of cattle is relative to the cattle numbers that exist in each county. The typical cow/calf operator produces a crop of calves in the spring and markets them in October or November. These calves are typically purchased by feeders in more southern climates where feed such as corn is readily available. This is typically Kansas, Nebraska, or Colorado. The calves weigh between 550 and 600 pounds when sold to these feeder operations.

Typically cow/calf operations sell or replace a portion of their stock cows each year because of old age or lack of production, which they replace by purchasing or raising replacements. A portion of the cattle are also bulls used for breeding purposes. In the ―cattle all" number supplied by NASS, this includes breeding stock, cattle on feed, and cattle that are being fed for market.

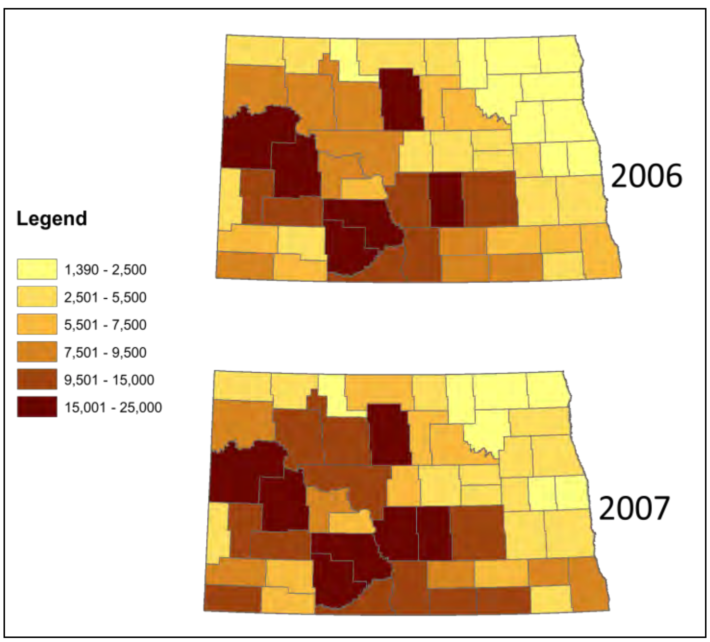

Figure 5.3 Marketing Tons of Beef (NASS 2008)

Table 5.3 Estimated Beef Cattle 2006 Marketing Tons by County (NASS 2008)

County	Marketing Tons		Marketing Tons		Marketing Tons		Marketing Tons		Marketing Tons
Adams	6,810	Divide	4,006	La Moure	6,009	Pembina	1,202	Stark	10,015
Barnes	4,807	Dunn	17,226	Logan	8,813	Pierce	5,609	Steele	1,202
Benson	6,410	Eddy	4,206	McHenry	15,624	Ramsey	1,202	Stutsman	11,417
Billings	9,615	Emmons	13,220	McIntosh	9,214	Ransom	7,211	Towner	1,402
Bottineau	5,208	Foster	3,205	McKenzie	15,223	Renville	1,602	Traill	801
Bowman	8,813	Golden Valley	3,605	McLean	8,413	Richland	7,011	Walsh	2,203
Burke	4,006	Grand Forks	2,404	Mercer	8,012	Rolette	4,807	Ward	8,813
Burleigh	14,422	Grant	15,223	Morton	20,431	Sargent	3,806	Wells	4,407
Cass	3,405	Griggs	3,806	Mountrail	9,214	Sheridan	4,807	Williams	9,214
Cavalier	1,402	Hettinger	4,807	Nelson	1,803	Sioux	10,816		
Dickey	9,214	Kidder	15,624	Oliver	6,810	Slope	6,810	State Total	375,370

Table 5.4 Disposition of ND Cattle Herd (NASS 2008)

County	2006 Cattle All	2006 Beef Cows	2006 Milk Cows	2007 Cattle All	2007 Beef Cows	2007 Milk Cows
Adams	37,000	17,000		34,000	16,000	
Barnes	19,000	12,000		24,000	11,500	
Benson	26,000	16,000		28,000	16,000	
Billings	40,000	24,000		42,000	25,500	
Bottineau	19,000	13,000		20,000	15,000	
Bowman	45,000	22,000		47,000	25,000	
Burke	14,000	10,000		16,000	9,500	
Burleigh	63,000	36,000		62,000	36,500	
Cass	17,000	8,500		17,000	10,000	
Cavalier	5,000	3,500		7,000	4,000	
Dickey	48,000	23,000	500	53,000	21,000	
Divide	18,000	10,000		18,000	9,000	
Dunn	82,000	43,000		89,000	46,500	500
Eddy	18,000	10,500		17,000	10,500	
Emmons	55,000	33,000	2,700	58,000	31,000	2,600
Foster	15,000	8,000		16,000	11,000	
Golden Valley	20,000	9,000		26,000	10,500	
Grand Forks	17,000	6,000		21,000	8,000	
Grant	58,000	38,000	700	63,000	32,500	700
Griggs	16,000	9,500		18,000	9,000	
Hettinger	19,000	12,000	600	24,000	14,000	700
Kidder	70,000	39,000	500	62,000	38,500	
La Moure	34,000	15,000	1,000	40,000	14,500	800
Logan	51,000	22,000	800	52,000	20,500	900
McHenry	71,000	39,000	1,400	78,000	35,000	1,700
McIntosh	45,000	23,000	1,800	52,000	23,500	1,500
McKenzie	61,000	38,000		61,000	36,000	
McLean	38,000	21,000	700	46,000	21,500	900
Mercer	39,000	20,000		43,000	20,000	
Morton	102,000	51,000	5,500	104,000	46,500	5,600
Mountrail	38,000	23,000	1,000	41,000	26,000	
Nelson	10,000	4,500	1,000	14,000	5,500	1,000
Oliver	45,000	17,000	1,200	51,000	16,000	1,000
Pembina	6,000	3,000		4,000	3,000	
Pierce	23,000	14,000	700	29,000	15,500	700
Ramsey	6,000	3,000		6,000	3,000	
Ransom	34,000	18,000		32,000	18,500	
Renville	6,000	4,000		6,000	4,500	
Richland	32,000	17,500		36,000	18,000	
Rolette	21,000	12,000		20,000	11,500	
Sargent	16,000	9,500	2,000	22,000	10,000	2,100
Sheridan	23,000	12,000	500	25,000	12,500	
Sioux	32,000	27,000		38,000	26,500	
Slope	29,000	17,000		30,000	17,500	
Stark	55,000	25,000	2,500	57,000	25,500	2,500
Steele	7,000	3,000		9,000	3,500	
Stutsman	55,000	28,500	1,700	70,000	31,000	1,700

County	2006 Cattle All	2006 Beef Cows	2006 Milk Cows	2007 Cattle All	2007 Beef Cows	2007 Milk Cows
Towner	7,000	3,500		7,000	4,000	
Traill	6,000	2,000		7,000	3,000	
Walsh	14,000	5,500		16,000	5,500	
Ward	35,000	22,000		41,000	21,500	
Wells	24,000	11,000		20,000	11,500	
Williams	34,000	23,000		31,000	17,500	
State Total	**1,720,000**	**937,000**	**33,000**	**1,850,000**	**939,000**	**31,000**

Table 5.5 ND Cattle & Calves: Production & Disposition (NASS 2008)

Year	Cattle & Calves Inventory Jan 1	Calf Crop	In-shipment	Marketing		Farm Slaughter	Deaths		Production	Marketing	Marketing Tons
				Cattle	Calves		Cattle	Calves			
	1,000 Head	1,000 Head	1,000 Head	1,000 Head	1,000 Head	1,000 Head	1,000 Head	1,000 Head	1,000 lbs	1,000 lbs	
2000	1,880	1,000	95	740	186	3	21	45	643,912	614,980	307,490
2001	1,980	1,000	113	866	191	3	19	44	662,659	736,820	368,410
2002	1,970	1,000	112	955	176	3	17	51	686,606	836,925	418,462
2003	1,880	960	85	947	166	2	15	45	745,605	870,000	435,000
2004	1,750	930	85	870	161	2	12	40	763,410	799,250	399,125
2005	1,710	960	115	830	151	2	12	40	748,313	782,250	391,125
2006	1,720		150	805	118.5	1.5	15	40	796,116	750,740	375,370

5.2 Dairy

Milk production has been on the decline in North Dakota and many other agricultural states. Uncertain prices and returns to scale have greatly reduced the dairy herd in North Dakota. The dairy cattle herd has been reduced by 92% statewide from the 1940s to the 2000s.

Table 5.6 Percentage Change in Dairy Cow Herd by County, Decade Average from 1940s to 2000s (NASS 2008)

Adams	-100%	Grand Forks	-100%	Walsh	-100%	Ransom	-93%	Stutsman	-88%
Billings	-100%	Griggs	-100%	Williams	-100%	Pierce	-93%	La Moure	-87%
Bottineau	-100%	McKenzie	-100%	Cass	-97%	Sheridan	-93%	McIntosh	-86%
Bowman	-100%	Mercer	-100%	Barnes	-96%	Logan	-92%	Grant	-86%
Burke	-100%	Pembina	-100%	Benson	-96%	Kidder	-91%	Sargent	-82%
Burleigh	-100%	Renville	-100%	Wells	-96%	Nelson	-91%	Oliver	-81%
Cavalier	-100%	Sioux	-100%	Richland	-95%	Ward	-91%	Stark	-75%
Divide	-100%	Slope	-100%	Ramsey	-95%	Dunn	-91%	Emmons	-74%
Eddy	-100%	Steele	-100%	Rolette	-94%	Mountrail	-91%	Morton	-62%
Foster	-100%	Towner	-100%	Dickey	-94%	Hettinger	-90%		
Golden Valley	-100%	Traill	-100%	McLean	-93%	McHenry	-89%	State Total	-92%

Milk production competitiveness is ruled by economies of scale and proximity to population centers. Transportation minimization is important, however, a balance is needed between the distance to a population center and the social externalities associated with unpleasant odors of livestock production. The dairy industry in North Dakota has been on the decline as market prices and environmental regulations, along with the labor intensity required by the business, have resulted in many producers exiting the business. Economies of scale have dictated that dairies across the country are very large. This is quite the opposite of the dairy industry that existed historically as small milking operations were scattered all across the country and state.

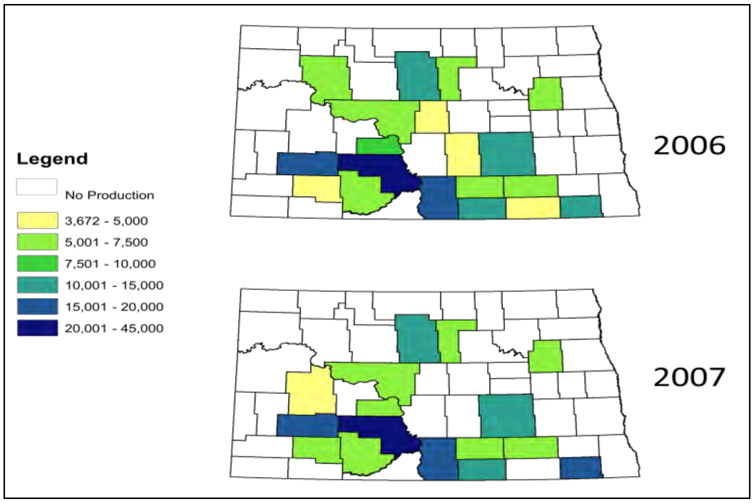

Figure 5.4 Milk Production Tons, (NASS 2008)

Table 5.7 Milk Production Tons by County (NASS 2008)

County	Milk Production 2006 Tons	Milk Production 2007 Tons (est.)	County	Milk Production 2006 Tons	Milk Production 2007 Tons (est.)
Dickey	3,672		McLean	5,141	6,609
Dunn		3,672	Morton	40,391	41,125
Emmons	19,828	19,094	Mountrail	7,344	
Grant	5,141	5,141	Nelson	7,344	7,344
Hettinger	4,406	5,141	Oliver	8,813	7,344
Kidder	3,672		Pierce	5,141	5,141
La Moure	7,344	5,875	Sargent	14,688	15,422
Logan	5,875	6,609	Sheridan	3,672	
McHenry	10,281	12,484	Stark	18,359	18,359
McIntosh	13,219	11,016	Stutsman	12,484	12,484
			State Total	242,344	227,656

5.3 Hogs

Hog numbers have decreased dramatically over time. As with dairy cattle, economies of scale come into play. Throughout the entire United States, consolidation of the hog industry has been the trend. A few very large players control the vast number of sows. Historically, producers would liquidate in times of low prices and get back in the business when the market turned, but as of late not many small producers exist in North Dakota.

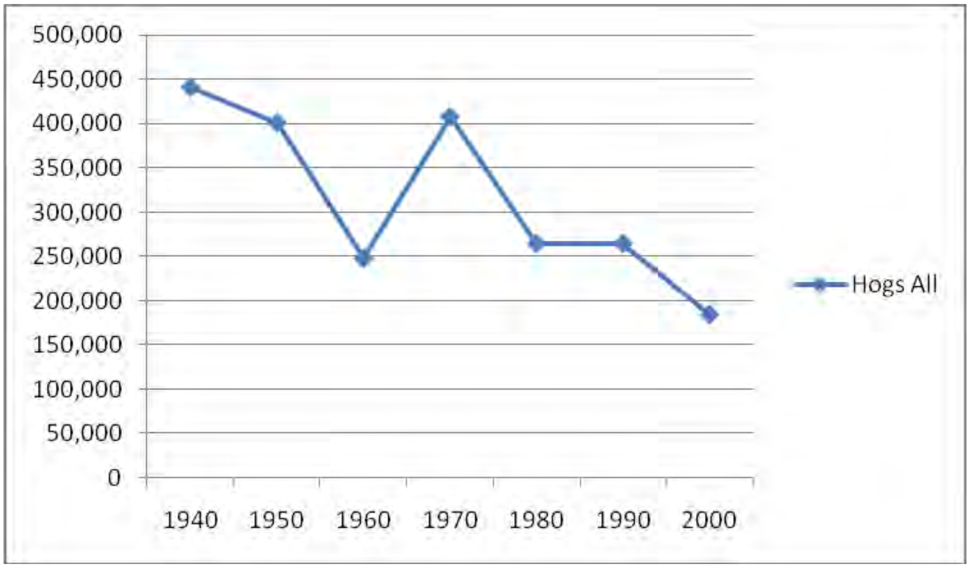

Figure 5.5 Hog Numbers Over Time (NASS 2008)

Since the 1940s hog numbers in North Dakota have been more than cut in half. Historically, many farms were diversified and grew crops, milked cows, and had some chickens and hogs. Agriculture is now specialized and very few producers are diversified into several areas. Producers may still have crops and livestock, but unlike the farms of the past, it is usually only diversified through a couple of enterprises.

Table 5.8 Hog Numbers by County (NASS 2008)

County	Hogs 1990s	Hogs 2000s	County	Hogs 1990s	Hogs 2000s
Adams	1,313	800	McIntosh	2,289	1,700
Barnes	8,860	2,743	McKenzie	2,980	1,750
Benson	1,490	650	McLean	2,200	
Billings	988		Morton	8,330	2,100
Bottineau	950	850	Nelson	1,156	886
Bowman	7,610	14,957	Oliver	3,590	1,443
Burke	2,256		Pembina	8,550	4,060
Burleigh	3,610	800	Ramsey	1,211	
Cass	18,610	8,629	Ransom	25,310	26,543
Cavalier	1,780	1,757	Renville	467	
Dickey	16,190	4,986	Richland	15,950	5,371
Divide	3,490	3,950	Rolette	3,357	
Dunn	4,390	2,300	Sargent	16,022	10,600
Eddy	600		Sheridan	970	633
Emmons	2,744	675	Slope	1,220	920
Foster	2,170	2,516	Stark	6,550	1,450
Golden Valley	3,130	1,700	Steele	1,117	
Grand Forks	8,780	19,157	Stutsman	6,690	1,233
Grant	10,170	1,600	Towner	1,571	20,125
Griggs	1,683		Traill	3,010	600
Hettinger	9,330	2,540	Walsh	4,160	1,275
Kidder	2,260	750	Ward	3,270	2,271
La Moure	11,410	14,514	Wells	3,557	
Logan	1,186	833	Williams	1,420	820
McHenry	1,710	700	**State Total**	**248,500**	**161,143**

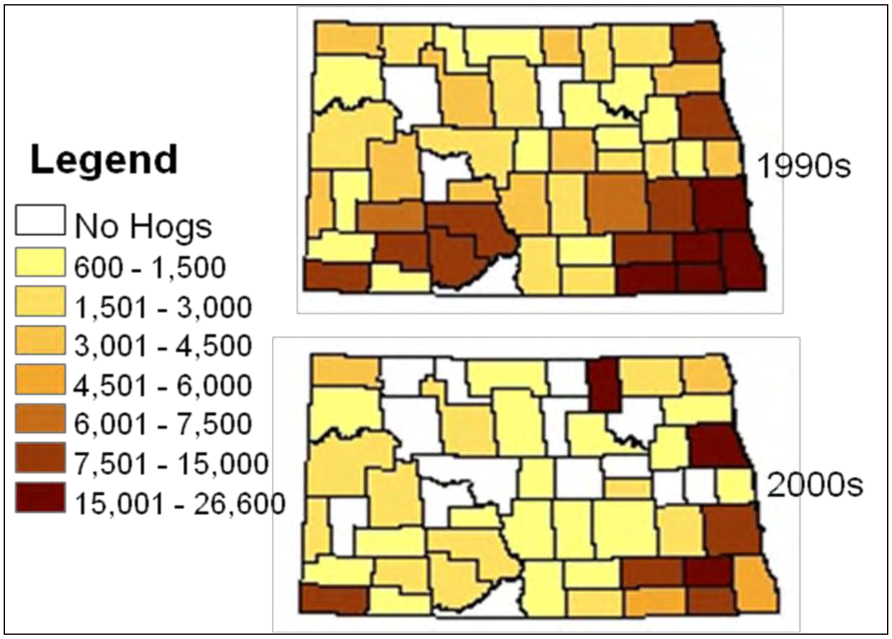

Figure 5.6 North Dakota Decade Average Annual Hog Numbers (NASS 2008)

Table 5.9 Hog Production & Disposition (NASS 2008)

	Unit	2002	2003	2004	2005	2006
Number on Hand at Beginning of Year	1,000 Head	154	144	150	169	157
Pig Crop	1,000 Head	444	429	441	471	530
Inshipments	1,000 Head	20	31	94	91	57
Marketing	1,000 Head	463	445	504	562	562.4
Farm Slaughter	1,000 Head	2	2	2	2	2
Deaths	1,000 Head	9	7	9.4	10	10.6
Number on Hand at End of Year	1,000 Head	144	150	169	157	169
Production	1,000 Pounds	79,018	66,980	66,934	69,670	64,046

Table 5.10 Hog & Pig 2006 Marketing Tons by County (NASS 2008)

Adams	120	McHenry	280
Barnes	340	Morton	340
Bowman	2,458	Nelson	140
Cass	1,239	Oliver	340
Cavalier	200	Pembina	400
Dickey	2,598	Ransom	5,895
Divide	899	Richland	699
Dunn	500	Sargent	1,998
Foster	679	Slope	140
Grand Forks	4,696	Stark	120
Grant	420	Towner	4,596
Hettinger	220	Ward	460
La Moure	2,298	State Total	33,769

5.4 Sheep

Like hogs and dairy cattle, sheep numbers have been on the decline in North Dakota. Sheep numbers are at their lowest level ever recorded in North Dakota's history. The economics and labor demanded in sheep production have driven many producers out of the business. Similar to hogs and dairy cattle, producers concentrate on specialization and are not as diversified into several enterprises. Suspension of the Wool and Mohair program in the 1990s also impacted sheep producers.

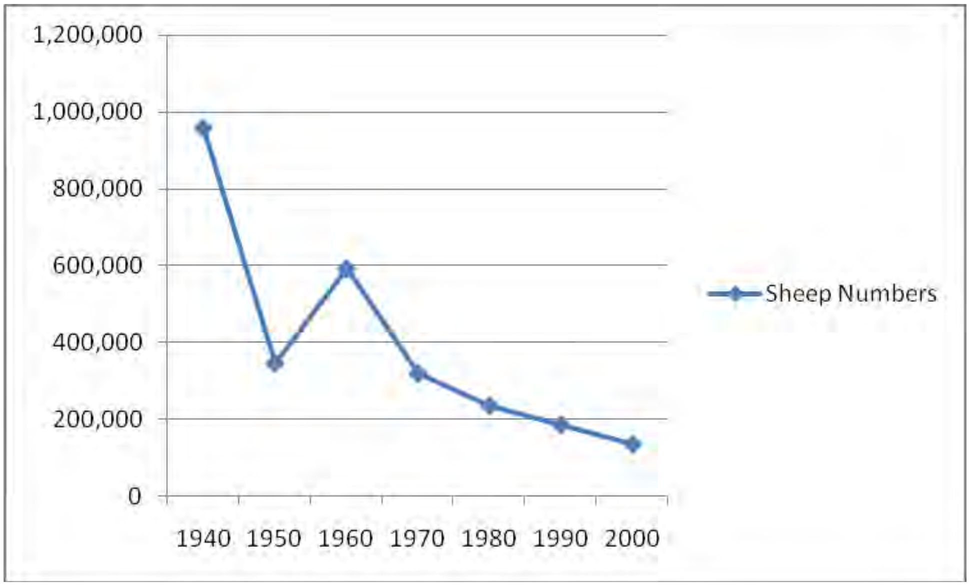

Figure 5.7 Sheep Numbers Over Time (NASS 2008)

Table 5.11 Sheep Numbers by County (NASS 2008)

County	Sheep1990	Sheep2000	Sheep 2006	County	Sheep1990	Sheep2000	Sheep 2006
Adams	10,500	14,300	12,300	McLean	2,300	2,200	1,200
Barnes	7,600	2,300	1,400	Mercer	1,200	600	
Benson	3,400	1,700	1,000	Morton	4,400	5,800	4,500
Billings	700		500	Mountrail	3,200	3,000	1,300
Bottineau	1,700	1,500	800	Nelson	2,000	1,000	700
Bowman	20,000	15,500	7,900	Oliver	2,100	2,600	1,500
Burke	1,800	700	700	Pembina	600		
Burleigh	3,800	4,400	2,400	Pierce	1,300	800	
Cass	10,000	2,100	1,900	Ramsey	1,100	800	700
Cavalier	400	700	1,100	Ransom	1,900	1,000	1,400
Dickey	6,400	3,700	2,100	Renville	500	1,300	
Divide	1,500	900	2,000	Richland	2,700	3,200	8,200
Dunn	4,000	2,800		Rolette	800	1,400	
Eddy	3,100	2,700	1,400	Sargent	2,500	600	800
Emmons	1,300			Sheridan	500	1,000	
Foster	3,400	4,000	2,700	Sioux	1,100		
Golden Valley	3,500	3,300	2,700	Slope	4,400		1,500
Grand Forks	1,800	900	500	Stark	3,700	3,200	2,200
Grant	4,400	2,600	6,000	Steele	1,000	2,700	
Griggs	900	1,100		Stutsman	7,600	3,200	3,400
Hettinger	1,200	2,100	1,400	Towner	1,600	800	
Kidder	9,700	7,800	4,200	Traill	500	1,800	1,800
La Moure	6,500	2,400	1,100	Walsh	1,500	1,900	1,300
Logan	700	1,000	900	Ward	3,100	1,300	
McHenry	3,800	5,000	3,800	Wells	2,700		
McIntosh	1,300	800	1,500	Williams	8,900	1,000	600
McKenzie	9,400	5,800		State Total	186,000	135,000	104,000

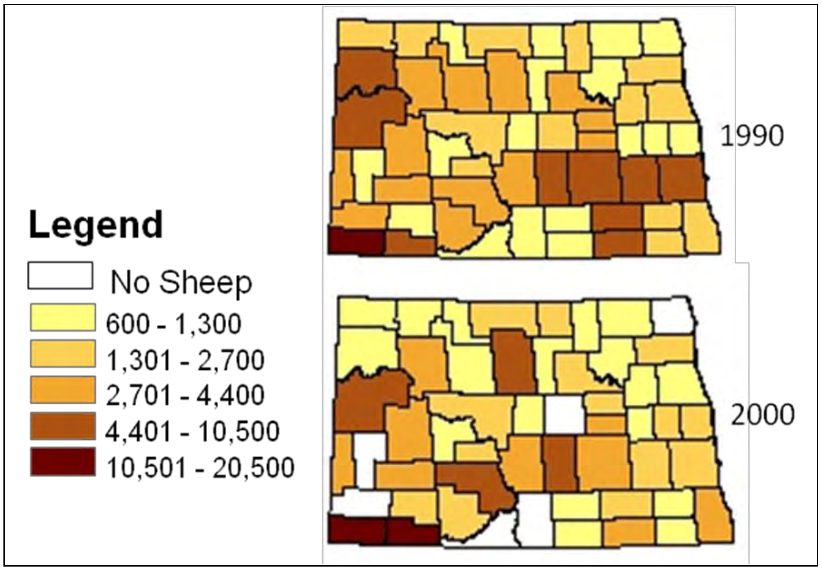

Figure 5.8 Sheep Numbers by County (NASS 2008)

Table 5.12 Sheep 2006 Estimated Marketing Tons By County(NASS 2008)

County	2006 Tons	County	2006 Tons
Adams	442	La Moure	40
Barnes	50	Logan	32
Benson	36	McHenry	137
Billings	18	McIntosh	54
Bottineau	29	McLean	43
Bowman	284	Morton	162
Burke	25	Mountrail	47
Burleigh	86	Nelson	25
Cass	68	Oliver	54
Cavalier	40	Ramsey	25
Dickey	75	Ransom	50
Divide	72	Richland	295
Eddy	50	Sargent	29
Foster	97	Slope	54
Golden Valley	97	Stark	79
Grand Forks	18	Stutsman	122
Grant	216	Traill	65
Hettinger	50	Walsh	47
Kidder	151	Williams	22
		State Total	3,739

6. MANUFACTURING

North Dakota‘s manufacturing sector has been growing over time and has become a larger part of the economy. In 2005, North Dakota was one of only three states in the nation to have experienced an increase in manufacturing jobs (along with Alaska and Nevada) according to the Bureau of Economic Analysis (BEA). From 2001 to 2005, North Dakota added more than 1,900 jobs in the manufacturing industry (BEA). Manufacturing is a value-added process that generates higher returns for raw materials produced or extracted in the state. Some trends that have occurred generally for the state is that many urban counties have gained manufacturing employees at a faster pace than rural counties. This is mainly because of labor and service availability. For instance, Cass County tripled manufacturing employee numbers and Burleigh more than doubled the number from the 1960s to the 2000s. Surprisingly, many rural counties also added an impressive number of employees. Much of this growth can be attributed to the value-added push of the 1990s. Many different entities in the state, including the Governor, Departments of Commerce and Agriculture, and private sector associations and companies, either encouraged, provided support for, or participated in a manufacturing, processing, or other value-added venture. The goal of value-added ventures are to capture more of the finished product dollars and to keep those dollars within North Dakota.

Table 6.1 Change in Decade Annual Average Manufacturing Employees over Time (BEA 2007)

County	1960s	2000s	County	1960s	2000s	County	1960s	2000s
Adams	59	42	McKenzie	22	46	Nelson	35	45
Barnes	114	508	McLean	50	0	Oliver	0	13
Benson	26	22	Grant	21	44	Pembina	404	846
Billings	0	0	Griggs	103	100	Pierce	58	25
Bottineau	55	93	Hettinger	0	8	Ramsey	137	231
Bowman	0	31	Kidder	18	8	Ransom	97	283
Burke	0	9	La Moure	102	90	Renville	20	8
Burleigh	889	2,052	Logan	28	7	Richland	202	2,138
Cass	2,477	7,684	McHenry	69	19	Stark	435	1,007
Cavalier	26	39	McIntosh	40	102	Steele	10	95
Dickey	38	284	Mercer	46	49	Stutsman	264	1,364
Divide	19	0	Morton	429	986	Towner	21	165
Dunn	0	0	Mountrail	22	21	Traill	63	298
Eddy	16	0	Rolette	185	133	Walsh	184	647
Emmons	34	20	Sargent	416	552	Ward	836	777
Foster	25	270	Sheridan	0	0	Wells	42	45
Golden Valley	39	3	Sioux	18	0	Williams	427	258
Grand Forks	1,036	2,088	Slope	0	0	***State Total***	***9,657***	***23,553***

From the 1960s to the present, the state grew manufacturing employment by 144%. While it is easy to quantify agricultural tonnage, it is more difficult to equate manufacturing in terms of tonnage. Commodity flow and FAF provide estimates on the state level, but county level data are elusive. It can easily be seen that because the manufacturing sector nearly tripled employee numbers statewide the tonnage of freight moving over the transportation system would have more than tripled.

Table 6.2 Percentage Change in Manufacturing Employment 1960s to Present

County	Change in Employment	County	Change in Employment	County	Change in Employment	County	Change in Employment
Adams	-29%	Emmons	-41%	Mercer	7%	Sioux	-100%
Barnes	345%	Foster	981%	Morton	130%	Slope	No employ
Benson	-17%	Golden Valley	-94%	Mountrail	-5%	Stark	131%
Billings	No employ	Grand Forks	102%	Nelson	28%	Steele	850%
Bottineau	69%	Grant	111%	Oliver	NA	Stutsman	417%
Bowman	No employ	Griggs	-3%	Pembina	109%	Towner	687%
Burke	No employ	Hettinger	No employ	Pierce	-57%	Traill	373%
Burleigh	131%	Kidder	-56%	Ramsey	68%	Walsh	252%
Cass	210%	La Moure	-12%	Ransom	191%	Ward	-7%
Cavalier	51%	Logan	-76%	Renville	-61%	Wells	6%
Dickey	648%	McHenry	-72%	Richland	958%	Williams	-40%
Divide	-100%	McIntosh	155%	Rolette	-28%		
Dunn	No employ	McKenzie	108%	Sargent	33%		
Eddy	-100%	McLean	-100%	Sheridan	No employ		

As stated previously, manufacturing has grown at an impressive rate in North Dakota compared to many other parts of the country. Again, value-added agricultural products play an important role in the state's manufacturing industry trends. The other part of the manufacturing process is technological innovation, which dramatically improves productivity per employee. Innovation in manufacturing equipment, and methods of manufacturing, such as "lean"[16] and "just-in-time,"[17] have allowed manufacturers to produce more product with less labor. These innovative techniques result in an efficient manufacturing and processing industry. Productivity per employee is tracked by the Bureau of Labor Statistics (BLS) and can provide a better picture of what innovation provides in productivity than looking at employee numbers alone.

[16] **Lean manufacturing** or **lean production**, which is often known simply as "**Lean,**" is the optimal way of producing goods through the removal of waste and implementing flow, as opposed to batch and queue. Lean manufacturing is a generic process management philosophy derived mostly from the Toyota Production System (TPS). http://en.wikipedia.org/wiki/Lean_manufacturing

[17] Just-in-time manufacturing is a strategy used in the business manufacturing process to reduce costs by reducing the in-process inventory level. It is driven by a series of signals that tell the production line to make the next piece for the product as and when it is needed. The signals used are usually simple visual signals, such as the absence or presence of a piece needed in the manufacturing process. http://www.wisegeek.com/what-is-just-in-time-manufacturing.htm

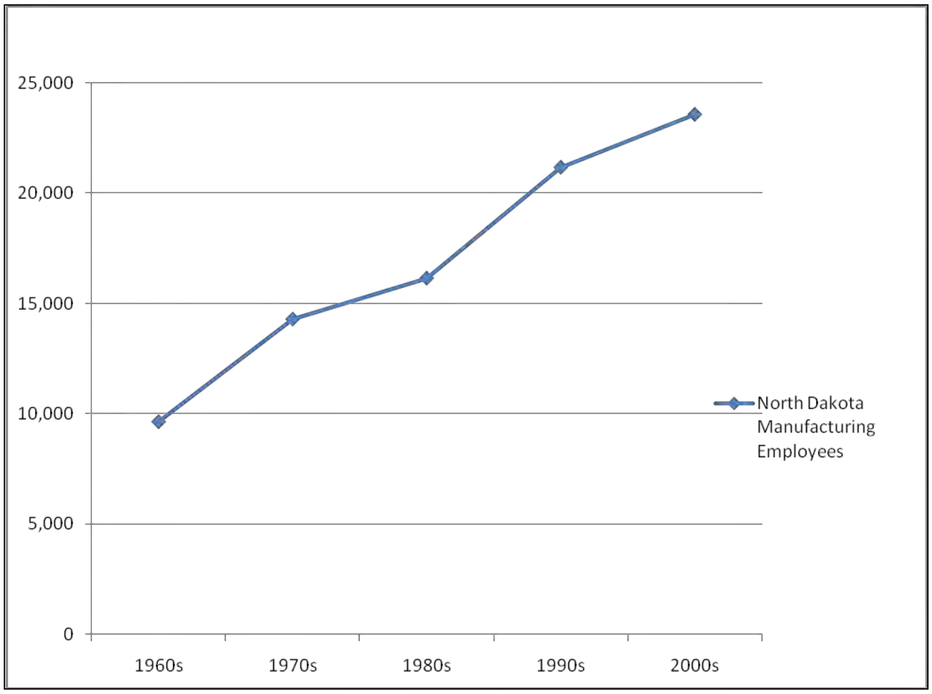

Figure 6.1 Decade Average Annual North Dakota Manufacturing Employees 1960s to 2000s (Bureau of Labor Statistics 2007)

The productivity index for manufacturing is similar to other indices. Indices are based on productivity for a given year, in this case 1992. In looking at the data, and using the productivity index and applying it to employee number growth, it is evident that the manufacturing sector grew at a much faster pace than employee numbers would indicate. Technological innovation increased dramatically from 1992 to present, therefore, the average annual employee numbers of 23,553 equates to over 40,000 1992 equivalents (Figure 6.2).

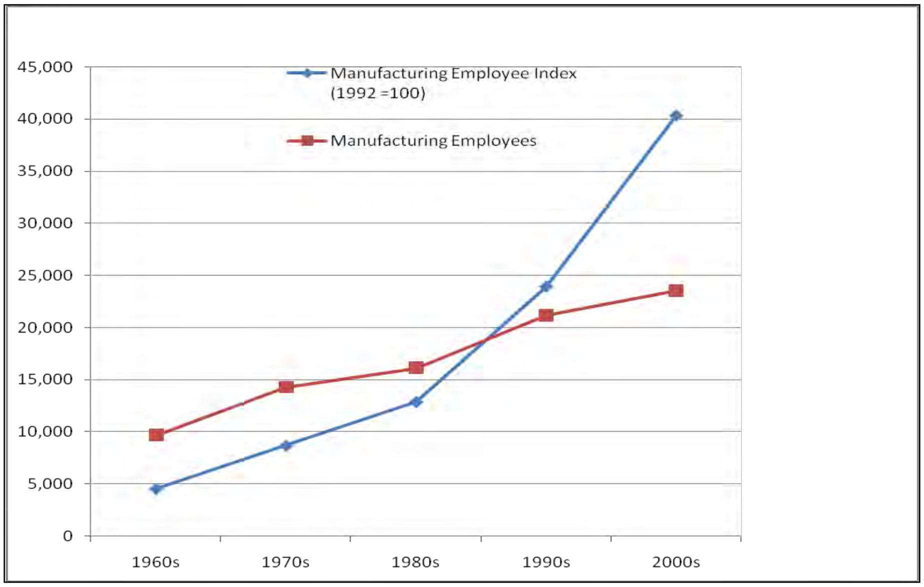

Figure 6.2 Comparison of Manufacturing Employment and Manufacturing Employment Equivalents (Bureau of Labor Statistics 2007)

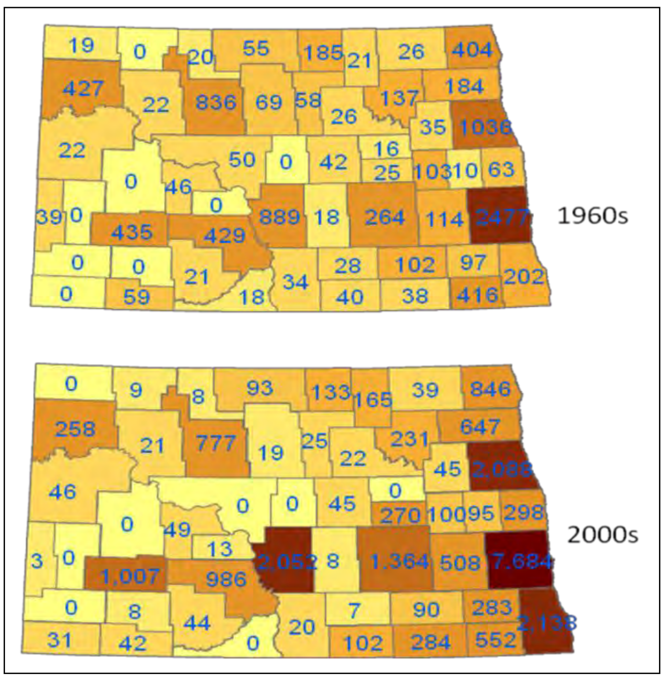

Figure 6.3 Average Annual Manufacturing Employees by County 1960s and 2000s (Bureau of Labor Statistics 2007)

Comparing the statewide distribution of employees, it is evident that employee numbers grew; and the more stark point is the level of increase in urban counties, such as in the eastern part of the state. Looking just at the employee numbers in those urban areas, manufacturing tonnages have doubled and, in some cases, tripled or more over time.

Using the manufacturing index and 1992 as the base year, the associated employee equivalents in many counties have almost doubled from their 2000s average employee numbers and, in the case of Cass County, it is six times the employee numbers of the 1960s.

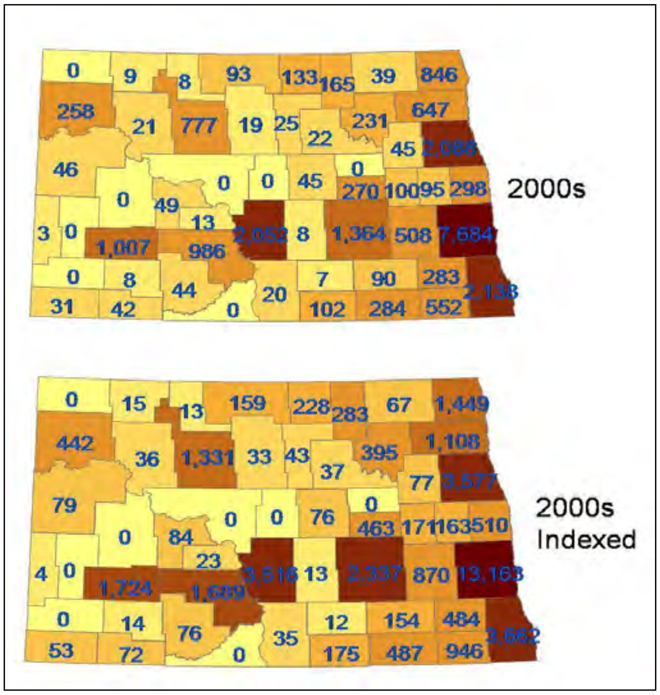

Figure 6.4 Comparison of 2000s Manufacturing Employee Numbers and 2000s Manufacturing Employee Equivalents (Bureau of Labor Statistics 2007)

The Commodity Flow Survey (CFS) estimates that manufacturing tonnage increased 37% from 1993 to 2002 . It is also estimated that 80% of that tonnage moves by truck. Using the employee numbers by county and looking at the estimated increase in tonnage, those counties with the largest concentration of employees and growth in employee numbers also have the greatest proportional share of the tonnage. The CFS estimated tonnage increase was almost six million tons annually, and if 80% moved in trucks it equates to an increase of more than 225,000 5-axle semi trucks annually. Looking at Figure 6.4, it is clear that the increases in truckloads are concentrated on the I-29 and I-94 corridors.

7. MINING

The mining industry in the state is made up of mostly coal mining and oil and gas production. Coal is a relative constant as the demand for electricity is increasing and regulated and the price for the product is relatively constant. Therefore, coal-fired energy plants mine the coal and turn it into electricity. Oil and gas exploration is a volatile industry. Oil was first discovered in Williams County in western North Dakota in the early 1950s and that discovery provided incentive for the first oil boom in the state. The second oil boom was a result of the Arab oil embargo of the 1970s, which promoted exploration and expansion in the oil and gas industry leading to a boom in the 1970s and early 1980s. A dramatic decline in the industry, resulting in a so-called ―bust,‖ occurred beginning in the early to mid 1980s. As oil prices increased in the 1970s, exploration increased dramatically followed by the bust created by plentiful world-wide supply resulting in much lower prices. Beginning in the early 2000s, oil exploration and production was again on the rise in North Dakota as energy prices increased to all time record highs. Technology and innovation have provided for oil extraction in the Bakken formation using horizontal drilling and production techniques that were unavailable in the past. This drilling and production technique has provided successful well completion at a pace that was previously unachievable. Oil exploration and production is mostly in western North Dakota, which is the deepest part of the Williston Basin.[18] Coal mining is mostly in the central part of the state. Where coal mining has a low impact on the highway system, the oil industry has a large impact on the highway and local road system.

Much of the coal produced in North Dakota is supply for the coal fired power plants. There are seven coal fired power plants in North Dakota, all in the central parts of the state. There are four plants in Mercer county, one each in Oliver, McLean, and Morton counties. There is some coal exported from the state and is transported by rail. As previously stated, the coal mining industry has only a small impact on the highways. Some large equipment for both the mines and power plants is moved over the highway system as indivisible loads however the coal itself is almost exclusively moved by rail. Locally, the coal is moved in large trucks and on conveyors.

In looking at the decade average annual mining employees over time, employee numbers outline the boom and bust of the 1970s and 1980s (Figure 7.1). After the collapse of the oil industry in the 1980s, many communities languished as businesses failed, house and property values fell, and North Dakota‘s western communities and counties fought to revitalize their economies.

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[18] "The Williston Basin is a structural-sedimentary intracratonic basin located on the western shelf of the Paleozoic North American craton. The present-day basin occupies a large segment of the northern Great Plains and extends northward into Canada. The basin region is a generally flat lying, moderately dissected plain with minimum topographic relief. The basin is bordered on the east and southeast by the Canadian Shield and the Sioux Uplift. The western and southwestern borders are defined by the Black Hills Uplift, Miles City Arch, Porcupine Dome, and Bowdoin Dome. The United States part of the basin covers approximately 143,000 sq mi with a total sedimentary rock volume of approximately 202,000 sq. mi. Sedimentary rocks of Cambrian through Holocene age are present in the basin. Maximum thickness of Phanerozoic rocks is greater than 16,000 ft. in North Dakota. The basin began subsiding during Late Cambrian or Early Ordovician time and has continued to subside through the remainder of geologic time, with the subsiding center remaining approximately in the same position in northwestern North Dakota throughout that time." http://certmapper.cr.usgs.gov/data/noga95/prov31/text/prov31.pdf

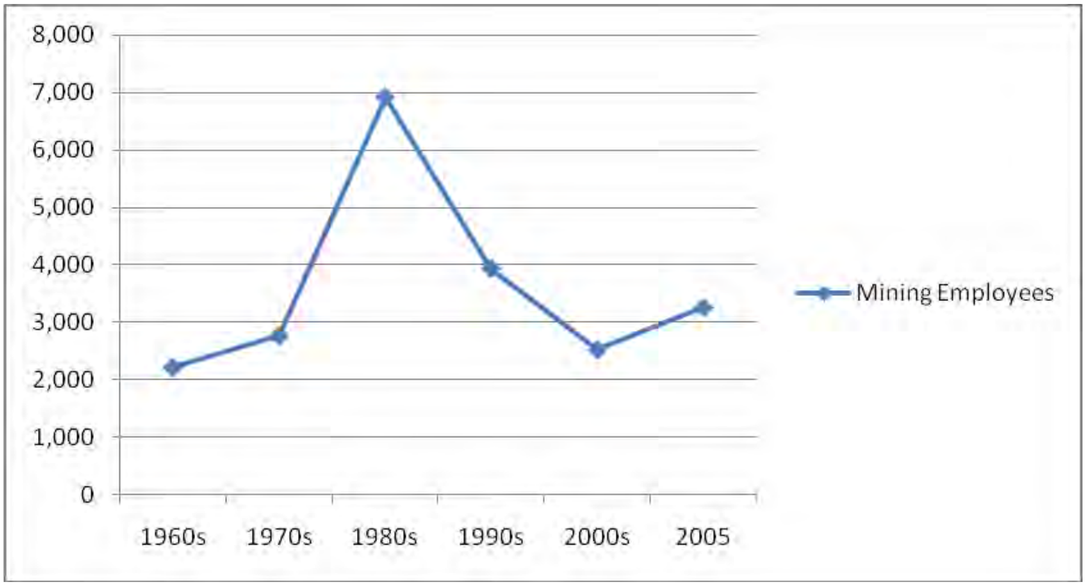

Figure 7.1 Mining Employees Over Time (Bureau of Labor Statistics 2007)

With the increases in oil prices to record levels in 2007 and 2008, along with technological advances in drilling techniques, the oil industry is again booming. Drilling activities have been on the increase. From 2003 to 2007, Bowman County led the way in both exploration and production with the most oil wells drilled at 523 followed by McKenzie at 230. With the new push because of the prolific Bakken formation discovery in North Dakota, the new hot spot is between Parshall and Stanley in eastern Williams and Mountrail counties. Horizontal drilling in the Bakken formation was first prevalent in eastern Montana, but has now moved to mostly North Dakota. As of June 2008, some 73 rigs are actively drilling in North Dakota. Oil companies many times congregate in the same general area trying to exploit the opportunities. Mineral leases are let by mineral owners giving oil companies the right to drill. Most leases are short term often between two and five years. Once there is production on the mineral acres, unless otherwise stipulated, it secures the mineral acres for the oil company, or operator, for the life of the well.

At the county level, Bowman County produced more oil, and the production has been growing at a faster pace than any other county in North Dakota. Bowman County produced almost 18 million barrels in 2007, which was about 40% of North Dakota's production and 3 times as much as the next highest producing county, which is McKenzie at 6 million barrels. Mountrail County now has over 600,000 barrels of production per month and climbing as new wells come into production almost daily.

Table 7.1 Wells Drilled by County (ND Oil & Gas Division 2008)

County	2003	2004	2005	2006	2007	State Total
Barnes					1	1
Billings	24	26	40	54	33	177
Bottineau	18	18	15	15	11	77
Bowman	133	90	132	112	56	523
Burke	5	6	15	17	24	67
Burleigh				1		1
Divide	4	7	15	14	16	56
Dunn	5	1	5	22	62	95
Emmons	1			2	1	4
Golden Valley	4	8	13	14	5	44
McHenry			1			1
McKenzie	22	38	50	66	54	230
McLean		1	3		1	5
Mountrail		2	7	18	60	87
Renville	2	10	8	20	17	57
Rolette				1		1
Slope			2	2		4
Stark	4	5	6	1	4	20
Stutsman				1		1
Ward		4	1	2	2	9
Wells					1	1
Williams	19	18	20	57	61	175
Total	**241**	**235**	**333**	**419**	**409**	**1,637**

Table 7.2 Oil Production Per County By Year (Barrels) (ND Oil & Gas Commission 2008)[19]

	Billings	Bottineau	Bowman	Divide	Dunn	Golden Valley	McKenzie	Mountrail	Renville	Stark	Williams
1999	5,164,895	1,988,396	4,666,112	619,806	1,145,821	997,687	5,023,653	451,708	790,403	7,385,660	3,190,111
2000	5,596,164	2,130,551	4,084,932	668,663	1,168,168	1,157,783	5,414,392	354,445	772,927	6,507,280	3,510,753
2001	5,243,827	2,426,401	4,096,517	760,757	1,236,807	1,144,408	5,217,399	328,994	715,328	5,456,907	3,822,660
2002	4,887,036	2,896,983	4,824,196	669,996	1,016,025	706,260	4,975,379	273,104	689,545	4,938,613	3,672,923
2003	4,580,207	2,745,062	5,405,375	607,638	960,016	611,180	4,756,428	217,490	670,808	4,225,998	3,553,714
2004	4,637,454	2,512,668	7,904,781	681,550	848,124	644,786	5,109,235	220,247	639,365	3,298,402	3,455,840
2005	4,692,404	2,261,030	12,883,175	651,978	814,042	794,993	5,413,570	223,220	655,076	2,390,117	3,403,021
2006	4,695,207	2,095,112	16,546,950	756,590	984,863	808,954	5,564,495	440,565	714,934	1,884,611	3,668,776
2007	4,752,674	1,864,545	17,454,182	790,970	1,891,497	687,056	6,182,480	1,763,959	773,315	1,613,941	4,428,320

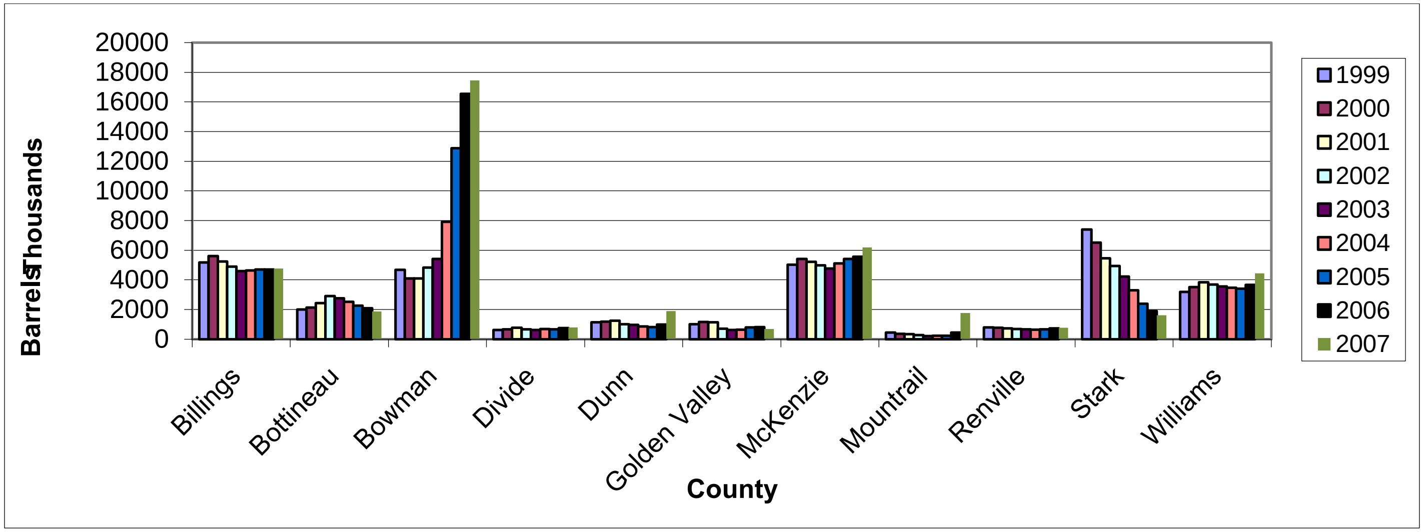

Figure 7.2 North Dakota Oil Production by County (ND Oil & Gas Commission 2008)

[19] North Dakota Oil & Gas Commission. https://www.dmr.nd.gov/oilgas/

Oil discovery and development impacts transportation infrastructure as wells are often drilled in places where the infrastructure is not adequate to support heavy trucks and the volume of heavy truck traffic. All roads and bridges in an area of heavy exploration face an accelerated maintenance schedule. Some of the rural state highways affected are not built to handle the heavy truck traffic and many county and township roads are affected as well. A typical horizontal well, from the beginning of the drilling process until the well is brought into production, uses an estimated 600 to 1000 truckloads of equipment and supplies. After the well is brought into production, it will need additional servicing from trucks to haul oil and saltwater away, which may or may not be permanent. Pipelines may be installed to service a well, and the oil, gas, and saltwater are piped to central tank batteries, the main pipeline, and/or saltwater disposal site. All variations exist, however the goal of the oil company is to minimize transportation costs in moving product to market or disposing of the saltwater waste product.[20]

Oil exploration and production has had and will have the greatest impacts on the road system near the oil fields of western North Dakota. Maintenance of roads and bridges will lag behind the oil industries‘ push into new development areas as the extent and concentration of the exploration and production of an area are unknown until the development is well underway or nearly completed.

[20] More oil statistics in Appendix A.

8. SUMMARY

The Biennial Strategic Freight Analysis Program concentrated on North Dakota‘s freight growth and freight system over the last biennium. The goal of this study was to provide information pertaining to freight and freight growth as it has occurred over the past 50 or 60 years. The highway system that exists in North Dakota was developed long ago for lower freight volumes moving in smaller vehicles over short distances.

A system of freight transportation and logistics that provides for the efficient movements of goods is the key to the economic health of the world, our nation, regions within the country, individual states, and communities and rural areas.

Freight and freight growth over time is known because of data collected by different agencies at the local, state, and federal government. Even though this data are collected, it is not always reported in a way that the ordinary citizen can understand. It is important that citizens and policy makers understand that, in many cases, the infrastructure was designed for an economy that was present 50 or 60 years ago.

Highlights of the study include that the North Dakota inflation adjusted Gross State Product more than tripled from 1963 to 2005. Tonnage of agriculture production also more than tripled from the 1940s to the present on a decade average annual basis. Contributing to the increases in tonnage are the inputs that contribute to the increases along with the crop genetics. Changes in cropping choices also contributed to higher tonnages. Changes from small grains to sugarbeets, potatoes or even corn change the tonnage coming off the land. For instance, 50 bu. wheat nets about 3000 lb. per acre, but sugarbeets can produce 20 tons per acre or more, equating to 40,000 lb. Higher production has led to larger and heavier trucks on all roads, and these trucks may travel longer distances per trip. However, it should be pointed out that larger heavier trucks may do less damage than smaller trucks hauling the same amount of product over a fixed network.

Changes have also occurred in the manufacturing sector. From the 1960s to the present the state grew manufacturing employment by 144%. While it is easy to quantify agricultural tonnage, it is more difficult to equate manufacturing in terms of tonnage. Commodity flow and FAF provide estimates on the state level, but county level data are elusive. It can easily be seen that because the manufacturing sector nearly tripled employee numbers statewide, the tonnage of freight moving over the transportation system would have more than tripled.
As stated previously, manufacturing has grown at an impressive rate in North Dakota compared to many other parts of the country. Again, value-added agricultural products play an important role in the state‘s manufacturing industry trends. The other part of the manufacturing process is technological innovation which dramatically improves productivity per employee. Innovation in manufacturing equipment, and methods of manufacturing, such as ―lean” and ―just-in-time,” have allowed manufacturers to produce more product with less labor. These innovative techniques result in an efficient manufacturing and processing industry. Productivity per employee is tracked by the Bureau of Labor Statistics (BLS) and can provide a better picture of what innovation provides in productivity than looking at employee numbers alone.

The productivity index for manufacturing is similar to other indices. Indices are based on productivity for a given year, in this case 1992. In looking at the data, and using the productivity index and applying it to employee number growth, it is evident that the manufacturing sector grew at a much faster pace than employee numbers would indicate. Technological innovation increased dramatically from 1992 to the present, therefore, the average annual employee numbers of 23,553 equates to over 40,000 in 1992 equivalents. Using the productivity index provided by BLS, a manufacturing employee in 2006 can produce almost twice as much as a worker produced in 1992.

The mining industry in the state is made up of mostly coal mining and oil and gas production. Coal is a relative constant as the demand for electricity is increasing and regulated and the price for the product is relatively constant. Therefore, coal-fired energy plants mine the coal and turn it into electricity. Oil and gas exploration is a volatile industry. Oil was first discovered in Williams County in Western North Dakota in the early 1950s, and that discovery provided incentive for the first oil boom in the state. The second oil boom was a result of the Arab oil embargo of the 1970s, which promoted exploration and expansion in the oil and gas industry leading to a boom in the 1970s and early 1980s. A dramatic decline in the industry, resulting in a so called ―bust” occurred beginning in the early to mid 1980s. As oil prices increased in the 1970s, exploration increased dramatically followed by the bust created by plentiful world-wide supply, resulting in much lower prices. Beginning in the early 2000s, oil exploration and production was again on the rise in North Dakota as energy prices increased to all time record highs. Technology and innovation have provided for oil extraction in the Bakken formation using horizontal drilling and production techniques that were unavailable in the past. This drilling and production technique has provided successful well completion at a pace that was previously unachievable. Oil exploration and production is mostly in western North Dakota, which is the deepest part of the Williston Basin. Coal mining is mostly in the central part of the state. Where coal mining has a low impact on the highway system, the oil industry has a large impact on the highway system.

Oil discovery and development impacts transportation infrastructure as wells are often drilled in places where the infrastructure is not adequate to support heavy trucks and the volume of heavy truck traffic. All roads and bridges in an area of heavy exploration face an accelerated maintenance schedule. Some of the rural state highways affected are not built to handle the heavy truck traffic, and many county and township roads are affected as well. A typical horizontal well, from the beginning of the drilling process until the well is brought into production, uses an estimated 600 to 1000 truckloads of equipment and supplies. After the well is brought into production, it will need additional servicing from trucks to haul oil and saltwater away, which may or may not be permanent. Pipelines may be installed to service a well, and the oil, gas, and saltwater are piped to central tank batteries, the main pipeline, and/or saltwater disposal site. All variations exist, however, the goal of the oil company is to minimize transportation costs in moving product to market or disposing of the saltwater waste product.

With the increases in oil prices to record levels in 2007 and 2008, along with technological advances in drilling techniques, the oil industry is again booming. Drilling activities have been on the increase. From 2003 to 2007, Bowman County led the way in both exploration and production with the most oil wells drilled at 523 followed by McKenzie at 230. With the new push because of the prolific Bakken formation discovery in North Dakota, the new hot spot is between Parshall and Stanley in eastern Williams and Mountrail counties. Horizontal drilling in the Bakken formation was first prevalent in eastern Montana, but has now moved to mostly North Dakota. As of June 2008, some 73 rigs are actively drilling in North Dakota. Oil companies many times congregate in the same general area trying to exploit the opportunities. Mineral leases are let by mineral owners giving oil companies the right to drill. Most leases are short term often between two and five years. Once there is production on the mineral acres, unless otherwise stipulated, it secures the mineral acres for the oil company or operator for the life of the well.

This study provided information about the increases in freight over time. The data reveal the needs for the infrastructure that was developed some 50 to 80 years ago. As freight traffic increases so does the need for infrastructure. Transportation is the core of many businesses in the state, and without improving the infrastructure future growth may be hampered. The agricultural sector will continue to grow along with oil, gas, and mining. As these sectors grow so will all aspects of the economy.

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APPENDIX A: INTELLIGENT TRANSPORATION SYSTEMS

Intelligent transportation systems (ITS) or ITS technology is –the use of communication and computer science technologies to help manage transportation systems.” [21]Many transportation departments in cities, counties, and states use technologies to manage traffic, transit, and freight or commercial traffic. These systems provide real time information, collect data, improve emergency response, and manage commercial vehicle traffic. Washington‘s Department of Transportation identified some benefits of ITS, including:

- Better use of infrastructure
- Reduce accident numbers and delays
- Cost savings
- Advanced travel information
- More convenient use of transit
- Reduced freight delays
- Strong federal incentives

Intelligent Transportation System applications are used to improve a range of freight and commercial vehicle operations with a goal of improving efficiencies and minimizing or reducing costs. The information infrastructure enabled by ITS and the institutional relationships from state to federal levels allows the exchange of fleet information necessary to promote competitive commercial vehicle (CV) operations.

Commercial vehicle ITS applications can be categorized as Commercial Vehicle Information Systems and Networks (CVISN), which includes Safety Information Exchange, Electronic Screening, and Electronic Credentialing applications; and Commercial Vehicle Operations Program(CVO). CVO, which was formed by a joint operation of the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Highway Administration (FHWA), states, motor carriers, and other transportation stakeholders. CVO includes development, testing, and deployment of technologies that enhance safety and promote efficiency of trucking operations.

ITS/CVO applications address many concerns of the trucking industry and include Hazardous Material Incident Response, International Border Electronic Clearance, Administrative Processes, and Onboard Safety Monitoring.

Safety Information Exchange

Safety Information Exchange systems are software applications that monitor CVs by collecting driver and vehicle data and communicating the safety and credential data to roadside agencies, allowing those agencies to check safety history before granting credentials.

State administrative offices and state law enforcement agencies use this information to make decisions about which vehicles to inspect and who should receive credentials and permits based on safety performance history. It also helps focus inspection on high-risk carriers.

[21] Cutchin,, C. Freight and Commercial Vehicle Operations, 2005.
http://www.calccit.org/itsdecision/serv_and_tech/Freight_operations/freight.html#SAFER

Electronic Screening

Electronic Screening (or Clearance) is a roadway inspection system allowing trucks with good safety records to bypass screening sites, while requiring trucks with poor or questionable safety records to stop for further inspection. Each state sets criteria determining roadside inspections of trucks for confirmation of safety compliance. These criteria are based on driver and vehicle safety records.

The screening process may take place in motion, saving time and eliminating the need for some unnecessary manual inspections. It is nearly impossible to physically inspect each truck that passes by a screening facility. Because of the need to enforce roadway safety, almost half of the states in the United States and some 7,000 motor carrier fleets participate in electronic screening programs.

Electronic Credentialing

Commercial vehicle operations in the United States require several types of credentials, or forms of evidence that indicate a CV meets the specified qualifications. Electronic credentialing is a cost reducing method of checking the status of a CV's credentials. Electronic credentialing uses software to send credentials applications to state agencies and to retrieve credential status for evaluation at roadside stations.

Even though many credentials are nationally recognized, some states have their own credentials requirements.

Hazardous Materials Incident Response

According to the Federal Motor Carrier Safety Administration (FMCSA), the transportation of hazardous materials is the most security sensitive activity of the motor carrier industry. An estimated 800,000 shipments of hazardous materials are transported each day in the United States. In addition, about 300,000 shipments of large quantities of flammable liquids are moved each day.

The FMCSA uses of remote vehicle tracking systems, off-route alert systems, vehicle disabling systems, and electronic ignition locks, reduce the risks associated with the transporting of hazardous materials. The FMCSA, along with the US DOT, conducted Safety and Security Technology Field Operational Tests in 2003 and 2004. The tests focused on four HazMat transportation scenarios: Bulk petroleum, bulk chemical, less-than-truckload, and truckload explosives industries. Technologies tested were:

- Wireless mobile communications
- In-vehicle technologies
- Personal identification
- Mobile data management
- Vehicle tracking

International Border Electronic Clearance

The goal of the International Border Clearance (IBC) program initiated by the U.S. DOT was to improve vehicle inspections at border crossings by reducing manual inspections of trucks entering the United States. Because of the traffic levels at peak times, automation reduces the possibility that customs and safety violations go undetected.

Administrative Processes

Commercial vehicle administrative processes attempt to ensure that all commercial vehicles are operating legally on the roadways. The process includes the automatic collection and recording of travel distance, fuel purchase, and trip and vehicle data by jurisdiction. This information is useful in preparing fuel tax and registration reports for affected jurisdictions. Electronic administration for commercial vehicles can replace manual paperwork, providing efficiency and reduced costs for motor carriers and CV agencies.

Onboard Safety Monitoring

Onboard safety systems monitor the safety status of the vehicle, driver, and cargo of a commercial vehicle. These systems are becoming more common, however, some concepts are still in the development stage. Commercial trucking companies and government-sponsored research groups have been testing prototypes of different systems. While truck manufacturers have focused their efforts on creating devices that monitor vehicle performance, government research groups have been investigating technologies that monitor driver performance.

Summary

As more and more trucking businesses are becoming technologically integrated organizations, they are requiring more sophisticated and cost-effective information systems to remain competitive. With an eye towards safety and productivity, these companies are looking for ways to more closely monitor individual vehicle and driver performance.

The widely implemented ITS/CVO programs in safety information exchange, electronic screening, and electronic credentialing propose lower cost means of maintaining safe roadways by focusing inspections on high-risk vehicles. Similarly, the growing number of electronic border clearance initiatives can limit time consuming inspections at borders to those vehicles with non-compliant or questionable credentials. Hazardous Materials Incident Response systems can likewise safeguard the roadway by ensuring the safe transportation and storage of HazMat by closely tracking HazMat vehicles and responding quickly to HazMat-related accidents.

The onboard safety monitoring systems can automatically update drivers and fleet managers on the condition of their vehicles, thus, reducing costs that can result from overdue maintenance checks.

APPENDIX B: OIL & GAS EXPLORATION AND ACTIVITY

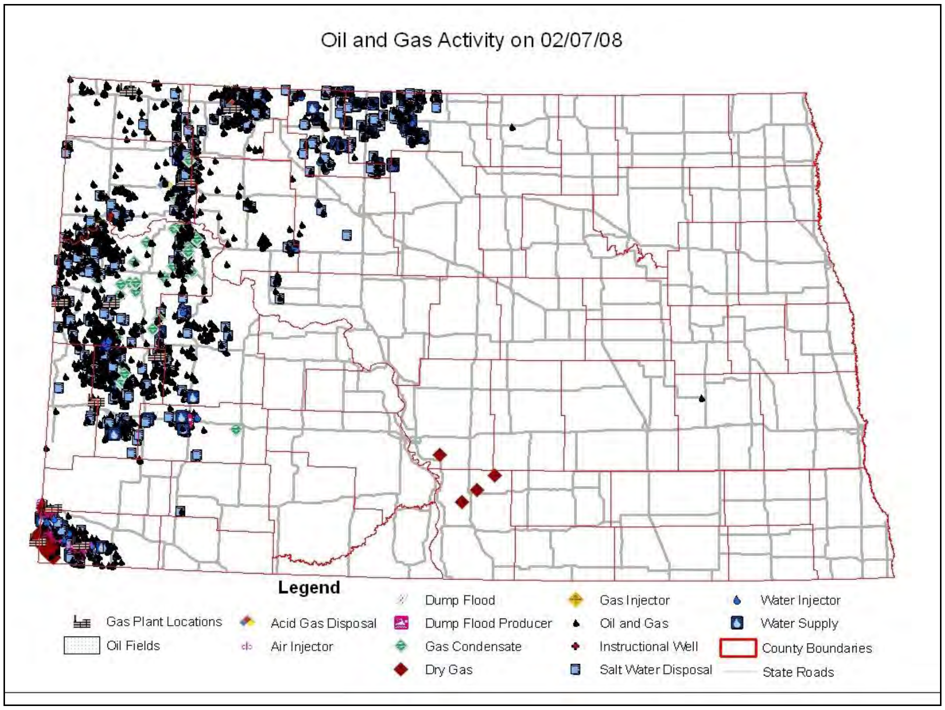


Figure B1. Oil & Gas Activity in North Dakota (NDDOT February, 2008)

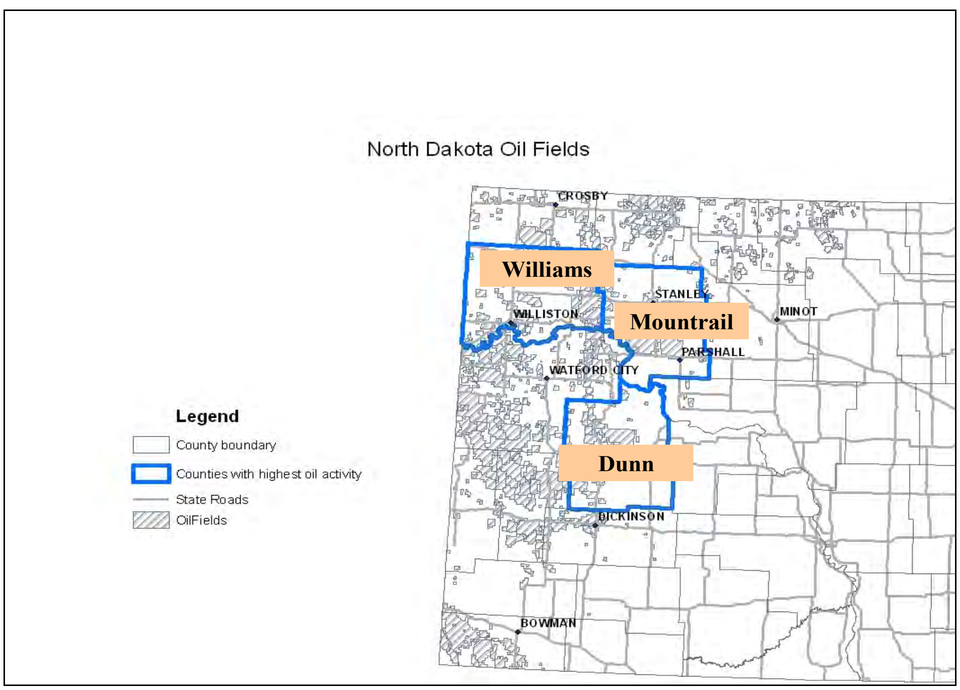


Figure B2. North Dakota Oil Fields (NDDOT 2008)

Table B1. Number of Wells Drilled 2003-2007 (ND Oil & Gas Commission 2008)

County	2003	2004	2005	2006	2007	Total
Barnes					1	1
Billings	24	26	40	54	33	177
Bottineau	18	18	15	15	11	77
Bowman	133	90	132	112	56	523
Burke	5	6	15	17	24	67
Burleigh				1		1
Divide	4	7	15	14	16	56
Dunn	5	1	5	22	62	95
Emmons	1			2	1	4
Golden Valley	4	8	13	14	5	44
McHenry			1			1
McKenzie	22	38	50	66	54	230
McLean		1	3		1	5
Morton		1				1
Mountrail		2	7	18	60	87
Renville	2	10	8	20	17	57
Rolette				1		1
Slope			2	2		4
Stark	4	5	6	1	4	20
Stutsman				1		1
Ward		4	1	2	2	9
Wells					1	1
Williams	19	18	20	57	61	175
Total	**241**	**235**	**333**	**419**	**409**	**1637**

Table B2. Equipment Needed to Complete an Oilwell (NDDOT 2008)

Gravel Trucks	Tankers
Low Boy Trailers/Transporters	Backhoes/Trackhoes
Scrapers	Cherry Pickers
Motor Graders	Cement Transporters
Dozers	Sand Trucks
Bed Trucks	Pump Trucks
Hauling Trucks	Roustabouts
Concrete/Cement Trucks	Utility Vehicles
Wireline Trucks	Cranes
Coil Tubing Units	Fracturing Rigs
Workover Rigs	Etc.

Table B3. Weights of Oil Rig Components (NDDOT 2008)

Generator House (3)	111,180	Crown Section of Derrick	140,000
Shaker Tank	122,000	Derrick	159,000
Suction Tank	131,000	VFD house	130,100
Mud Pump (2)	164,000	Mud Boat	114,380
Shaker Skid	111,760	Substructure (2)	136,440
Draw Works	130,880	Centerpiece	139,440
Hydraulic Unit	127,640	Manifold Choke	126,000
Tool Room/Junk Box	124,140	MCC House	145,160
Blow Out Preventer Skid	138,680	BOP Setting Machine	111,000
Top Dog House	117,000		

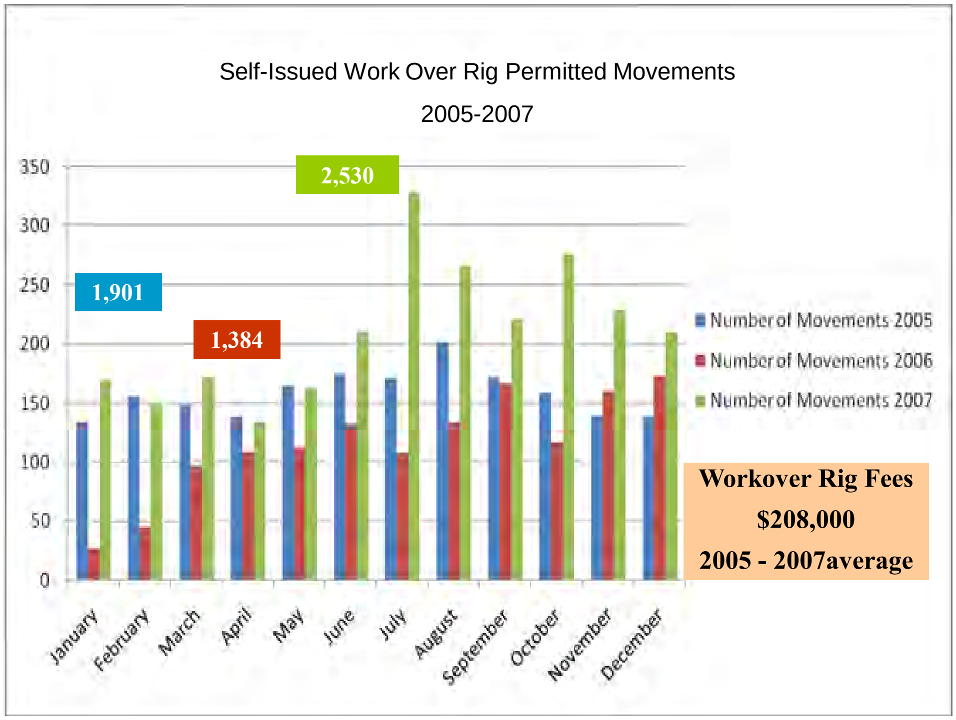


Figure B3. Self-Issued Work Over Rig Permits (2005-2007) (NDDOT 2008)

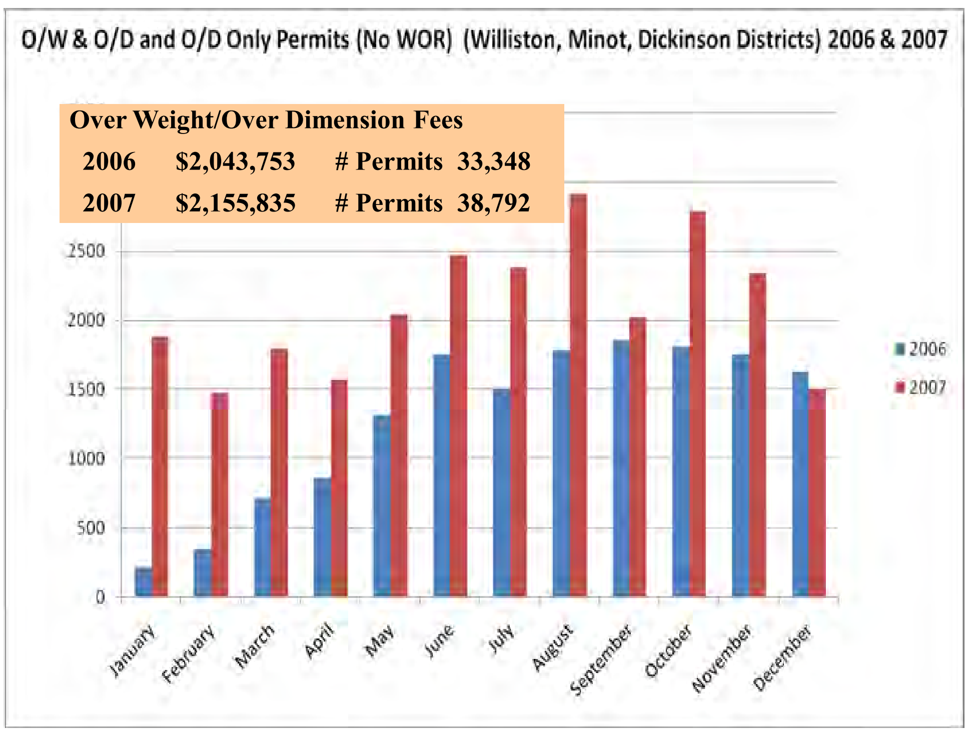


Figure B4. Over Weight & Over Dimension Fees for Williston, Minot & Dickinson (2006/2007) (NDDOT 2008)

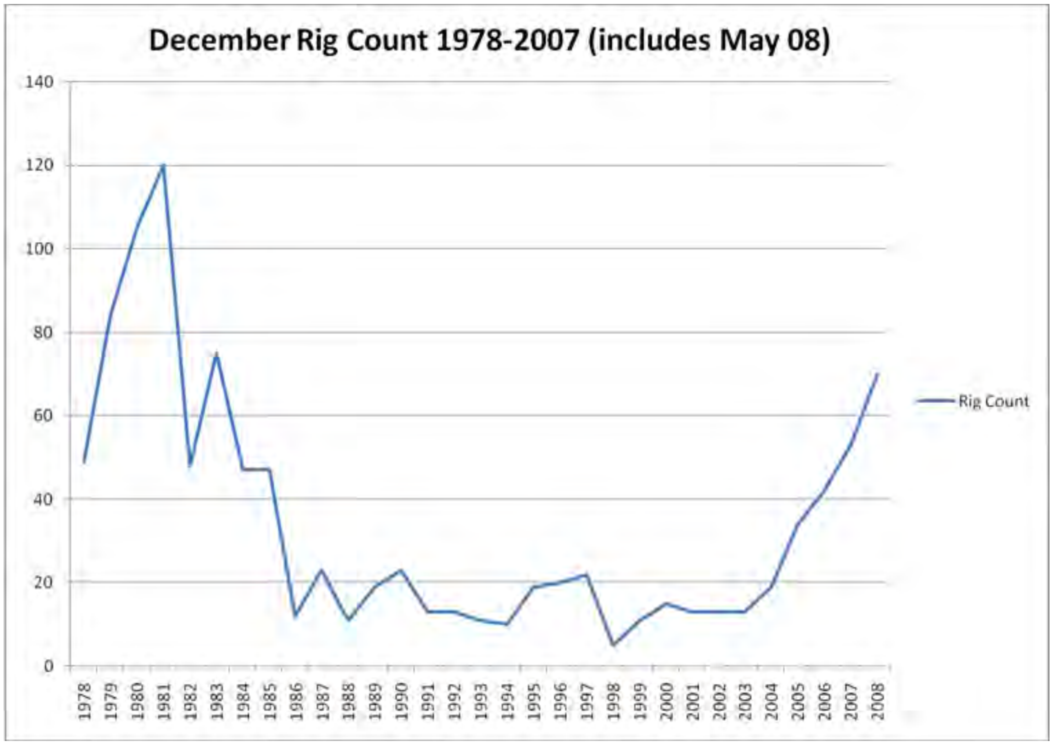


Figure B5. Rig Count (1978 to 2007) (NDDOT 2008)

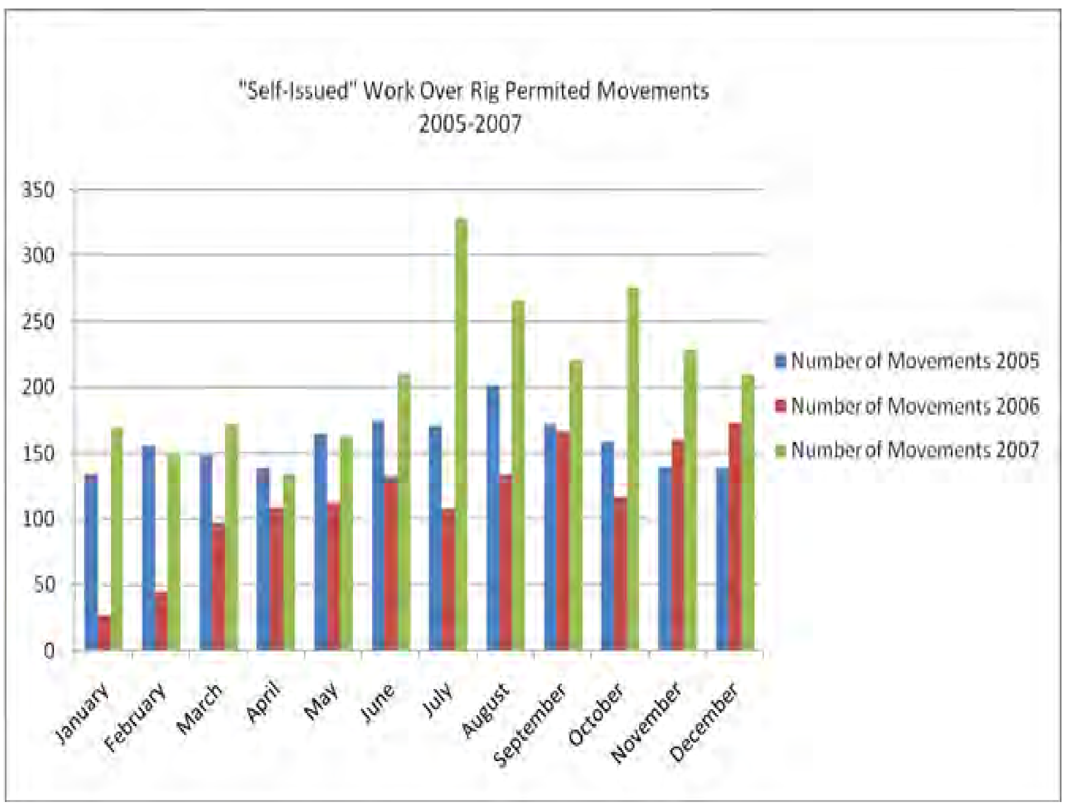


Figure B6. Self-Issued Work Over Rig Permits (2005-2007) (NDDOT 2008)

Table B4. Distance Oil & Gas Development Sites are From State Highway (NDDOT 2008)

County	# All Sites	¼ < Mile State Hwy	% More 1/4 Mile
McKenzie	1046	977	93.40%
Bowman	892	890	99.78%
Bottineau	767	745	97.13%
Billings	671	657	97.91%
Williams	616	570	92.53%
Burke	419	378	90.21%
Renville	373	367	98.39%
Mountrail	282	264	93.62%
Dunn	269	255	94.80%
Divide	153	145	94.77%
Stark	121	103	85.12%
Golden Valley	85	83	97.65%
Slope	26	22	84.62%
Ward	30	0	100.00%
McLean	27	0	100.00%
McHenry	25	0	100.00%
Hettinger	2	0	100.00%
Totals	5804	5456	94.00%

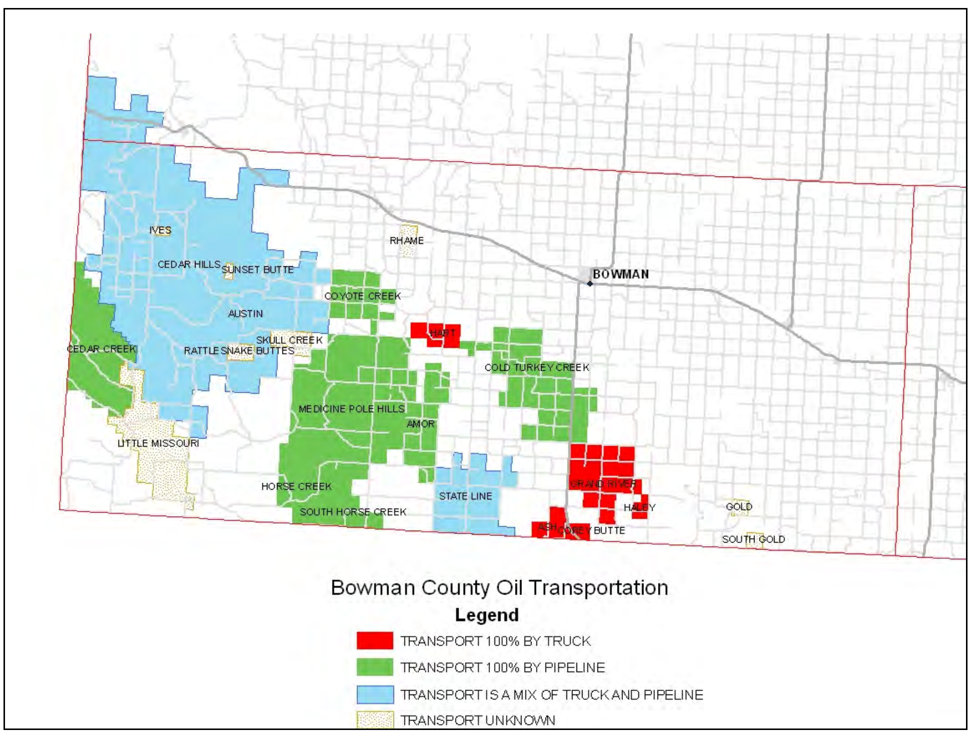


Figure B7. North Dakota's Bowman County Oil Transportation in 2008 (NDDOT 2008)

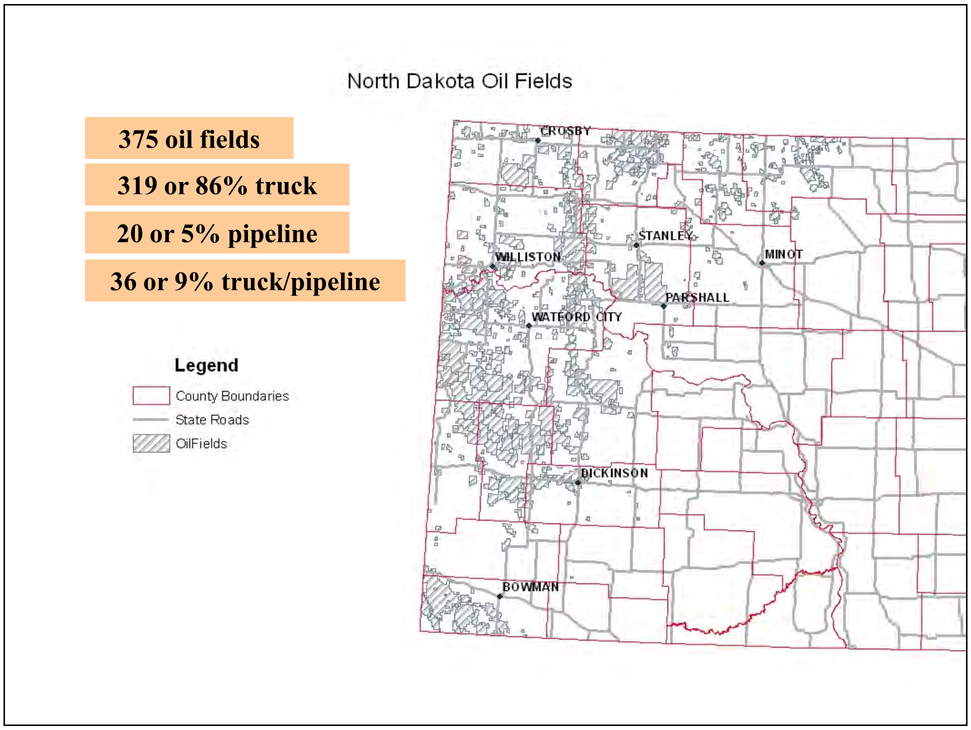
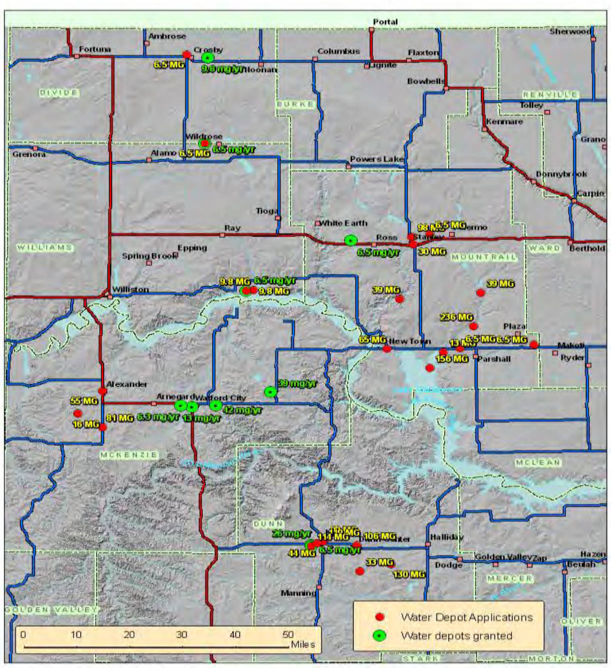


Figure B8. North Dakota's Known Oil Fields (NDDOT 2008)



Water depots and locations of proposed depots (water permit application made)

Figure B9. Water Depots and Proposed Location of Water Depots (NDDOT 2008)

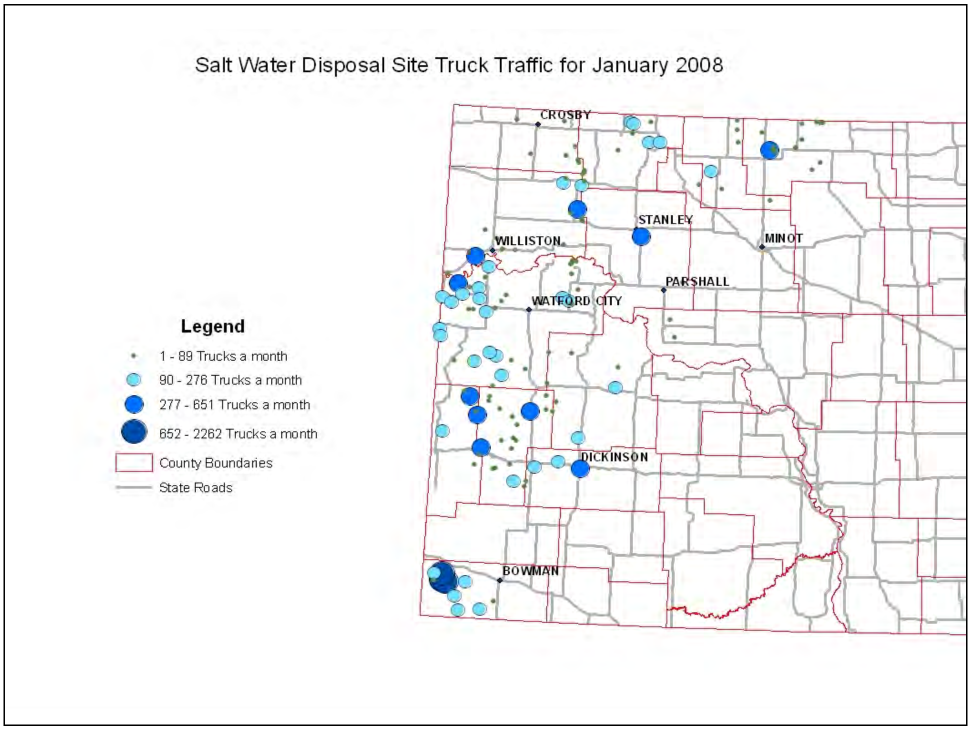


Figure B10. Salt Water Disposal Site Truck Traffic for January 2008 (NDDOT 2008)

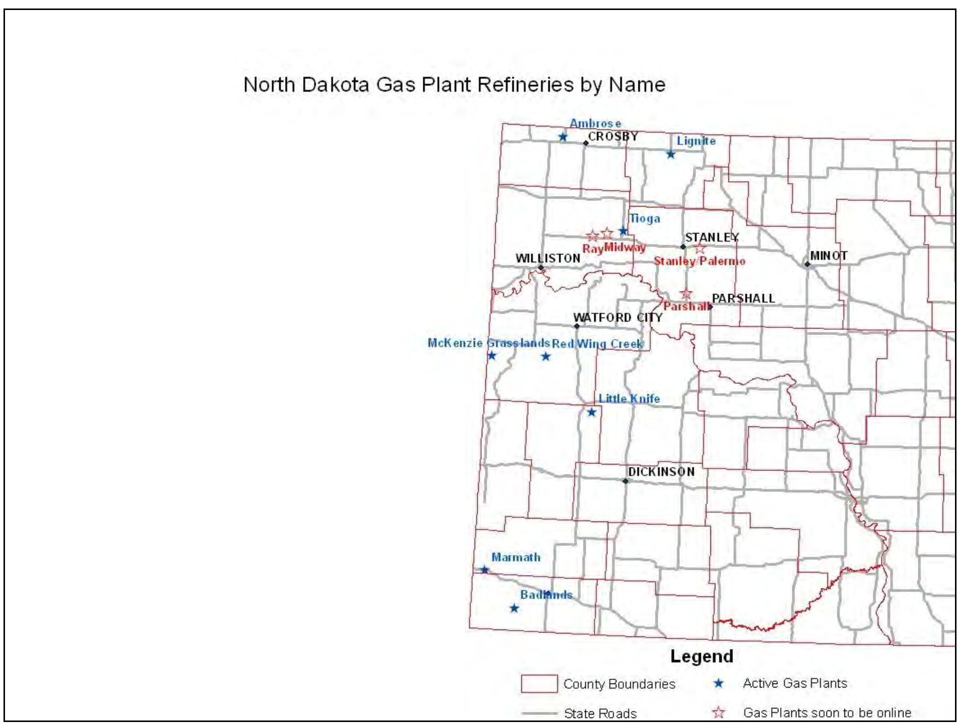


Figure B11. North Dakota Gas Plants. (NDDOT 2008)

Table B5. Road Miles by County and Type (NDDOT 2008)

	State Highway Miles	Local Road Miles	Federal Road Miles
Billings	48.4	730.4	251.8
Bottineau	173.3	2834.8	8.3
Bowman	79.2	1198.8	0
Burke	126.7	1526.5	21.6
Divide	110.1	1891.9	0
Dunn	146.5	1723.5	119.7
Golden Valley	69.9	1023.6	41.3
Hettinger	99.2	1641.7	0
McHenry	175.1	2839.5	26.7
McKenzie	278.3	2011.2	341.7
McLean	287.4	3088	64.8
Mountrail	173.2	2431.8	17.4
Renville	73	1493.8	2.6
Slope	71.8	1022.6	21.3
Stark	135.9	1954.9	0
Ward	230.1	3140	139.7
Williams	230.7	3176.1	0.2
Totals	2508.8	33729.1	1057.1

Table B6. State and County Structures and Status By County 3/4/2008 (NDDOT 2008) (Functionally Obsolete (FO),[22] Structurally Deficient (SD) [23]

County	State	FO	SD	County	FO	SD	Total
Billings	25	2	1	31	2	0	56
Bottineau	27	0	0	123	11	45	150
Bowman	25	0	0	49	4	0	74
Burke	24	0	0	16	0	6	40
Divide	7	0	0	10	0	3	17
Dunn	40	0	2	58	1	15	98
Golden Valley	20	2	0	22	2	5	42
Hettinger	27	0	0	60	5	22	87
McHenry	21	0	1	96	14	26	117
McKenzie	68	1	5	82	4	6	150
McLean	31	0	0	32	3	2	63
Mountrail	16	0	1	22	1	3	38
Renville	13	0	0	17	0	1	30
Slope	28	0	1	30	0	4	58
Stark	108	1	5	104	9	32	212
Ward	97	3	3	74	5	6	171
Williams	56	2	1	66	9	29	122
Totals	633	11	20	892	70	205	1525

(Structure replacement cost is between $150,000 &$450,000 with an average of $400,000) (NDDOT, 2008).

[22] Deck Geometry rated 3 or Less – Example: Bridge is too narrow. Underclearance rated 3 or Less – Example: Bridge over an Interstate Route with a clearance of less than 15 feet. Approach Roadway Alignment rated 3 or Less – Example: Crossing the bridge requires a major speed reduction due to horizontal or vertical curvature of the roadway at the bridge. Very Low Load Rating (sign posted for Max loading) and Bridge needs repair. Occasional Floods causing traffic delays.

[23] Structurally Deficient. FHWA uses in conjunction with sufficiency rating to determine allocation for federal bridge replacement funds. Deck, Superstructure, Substructure and/or Culvert rated 4 or less (poor or worse condition) All ratings are described in the *FHWA Specification For National Bridge Inventory*.

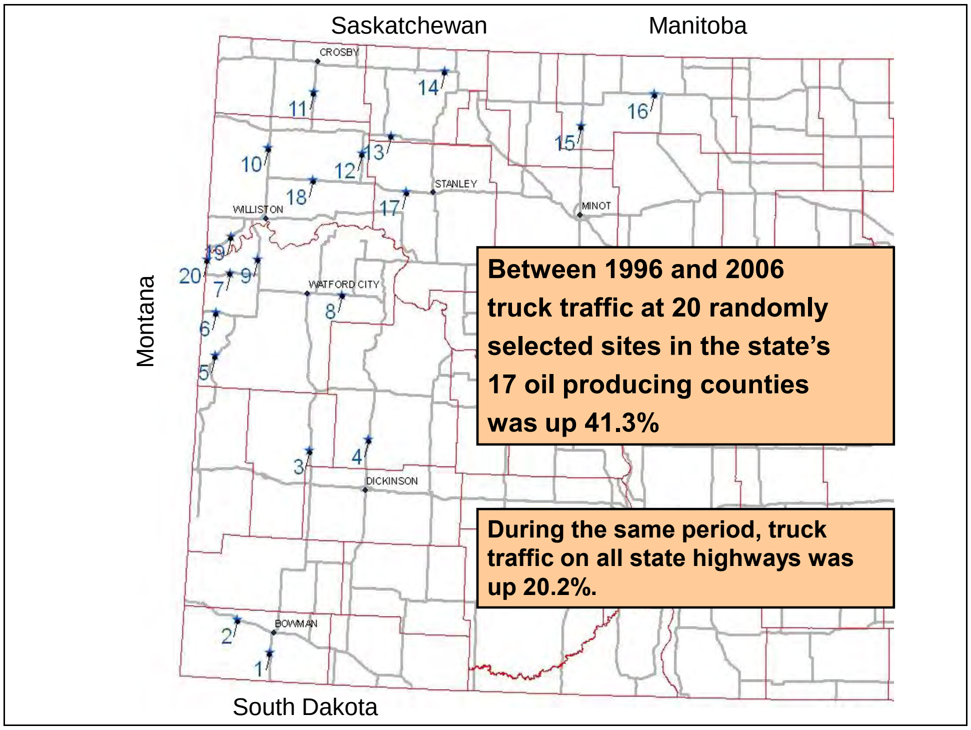


Figure B12. Between 1996 and 2006 Truck Traffic Increased 20 Percent More in Oil Producing Counties (NDDOT 2008)

Table B7. Truckloads to Complete an Oil Well & Cumulative Annual Truckloads (NDDOT 2008)

Type	Truck loads
Non-Bakken (150)	60,000
Bakken (650)	520,000
Workover Rig Movements	
New Wells (800)	2,800
Existing Wells (3,870)	775
Acid (2-3 truck/well)	2,000
Crude-oil truck loads (Existing)	81,500
Crude-oil truck loads (New-Bakken)	325,620
Crude-oil truck loads (Non-Bakken)	23,965
Freshwater (Bakken)	101,560
Freshwater (Non-Bakken)	1,675
Sand (Bakken only)	23,400
Salt Water (Existing)	222,300
Salt Water (New Bakken)	137,765
Salt Water (Non-Bakken)	162,230
Abandon 100-150 Wells Annually	3,750
Gas Plant Truck Movements	360
	1,669,700