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Shuttle Trains

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The purpose of this component of the STrategic Freight Analysis was to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain industry.

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NORTH DAKOTA STRATEGIC FREIGHT ANALYSIS

Item III. Shuttle Trains

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October 2001

EXECUTIVE SUMMARY

Investment in shuttle facilities and the ability of these facilities to utilize the more competitive rates in attracting grain has the potential to strongly influence future local grain flow patterns. As these local grain flow patterns adjust to new market signals, demands on the local grain gathering system must be addressed. The purpose of this component of the Strategic Freight Analysis was to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain industry.

Facility infrastructure requirements, economic incentives, investment requirements, and financing packages are unique to each shuttle venture. Based on an earlier UGPTI study, a $6 million green field facility required approximately 10 million bushel handle for profitable returns. Discussions with grain companies and railroads suggest a target of 12 to 15 million bushels for a shuttle facility. This bushel requirement compares to the current average annual handle of 1.2 million bushels for the North Dakota elevator population, and average annual handle of 5.6 million bushels for the state's largest elevators. Therefore, redistribution of bushels in the local elevator industry seems imminent.

HRS wheat, durum, barley, and corn were considered in this economic analysis of shuttle rail rates on the local grain marketing. In the base case — wheat, the boundary of grain draw areas estimated for the 10 shuttle facilities encompassed 45 percent of the total North Dakota land area. Regarding production, approximately 88.6 million bushels of HRS wheat and 32.9 million bushels of durum were contained in the estimated shuttle draw areas. The 10 draw areas encompassed about 38 percent of North Dakota HRS wheat production and slightly more, 39 percent, of the state's durum production. In the cases of barley and corn, the shuttle facilities have the potential to accumulate 26.5 million bushels (24 percent of average North Dakota production) and 14.2 million bushels (19 percent of average North Dakota production), respectively, based on the estimated boundaries of the draw areas.

Considering these four crops, the 10 shuttle facility draw areas have the potential to originate about 162 million bushels. In relative terms, 2 percent of the elevators may originate up to 32 percent of the average annual production of wheat, barley, and corn. This market share of North Dakota production translates to an average 16.5 million bushels per facility. This potential concentration of bushels has implications for local roads, short line railroads, bridge infrastructure, local processors, local communities, and the North Dakota elevator industry.

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INTRODUCTION

The agricultural sector attributed 11 percent of North Dakota's gross state product in 1996 (U.S. Department of Commerce, 1999). The state's agricultural sector includes production and processing activities. A majority of the average 600 million bushels of grain and oilseeds produced annually by North Dakota farmers is marketed to destinations beyond the state border, with a small population of local processors and feeders consuming a limited share. Domestic and foreign destinations are unique for each commodity and fluctuate with supply and demand conditions. Therefore, an efficient and flexible grain logistical network is critical for future success of this industry.

The North Dakota grain industry has evolved from early days when horses and wagons were used to deliver grain to a large population of single rail car elevators to today's market where truck deliveries are made to a rationalized local market. This market includes local processors and elevators — some with no access to rail and others with differing capabilities for rail loading, such as single-car, multicar, unit train, and, most recently, shuttle trains. Single-car elevators are those equipped to load up to 24 cars without a railroad switch. Multicar elevators can load 25 to 49 cars without a switch. Unit train facilities have track capacity to load 50 cars or more, without a railroad switch. Shuttle facilities can handle more than 100 cars, and are eligible for railroad efficiency programs described later in this section.

Approximately 1,800 elevators were in business within state borders in 1922. On average, these elevators housed storage capacity of 30,000 bushels and drew from a 250 square mile trade area (Ming and Wilson, 1983). For the 1999-2000 crop year, the North Dakota Public Service Commission reported that 443 facilities in North Dakota were licensed to buy grain. The average storage capacity for these facilities was 551,000 bushels. Based on discussions with several North Dakota elevator managers, today's unit train[1] facilities draw from approximately a 45-mile radius or a 6,362 square mile trade area. A 2000 survey of North Dakota elevator managers suggests that elevator numbers will continue to decline, with respondents predicting that more than 25 percent of the elevators currently operating in the state will discontinue business over the next decade.[2] Declining elevator numbers and increasing size of elevator draw areas illustrate the impact market influences, such as technological advancements, government policy, and investment decisions, have in shaping the local infrastructure.

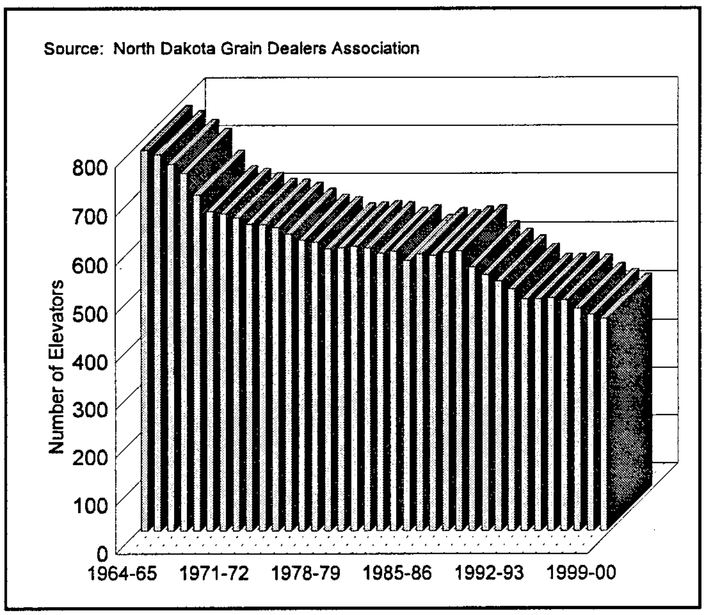

Figure 1. Number of Licensed North Dakota Grain Storage Facilities

The North Dakota grain industry competes for markets and investment dollars in a world market. The decisions made in production, marketing, infrastructure, and equipment investments influence the ability to retain and attract resources and investment dollars, which are crucial to

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[1] Unit train equipped facilities handled about half of the bushels originated by elevators in 1998-99 (Vachal, 1999).

[2] Upper Great Plains Transportation Institute, 2000 ND Elevator Survey Results, April 2000.

North Dakota's continued success in offering competitively priced products that meet customer demands. As technological advancements are made and market information exchanges become more liquid, producers and agribusinesses continue to seek to incorporate efficiencies into their marketing channels. The marketing channels cover a vast array of supplier and customer relations, from on-farm feeding operations to large-volume international buyers.

An important component in each of the marketing channels is the physical delivery, or logistical flow, of the product. Although many factors are encompassed in the logistical flow of a product, a primary factor for grain marketing in a rather homogeneous, bulk product fashion often is the freight rate. For example, consider freight costs for a bushel of wheat grown in western North Dakota and purchased by a buyer in Taiwan - delivery via Portland, Ore. The farm-to-elevator freight cost is estimated to be $0.12 per bushel, assuming a 20-loaded mile trip (Vachal, et. al, 1996). Rail freight from western North Dakota to Portland is $1.21[3] per bushel. Ocean freight from Portland to Taiwan is approximately $0.45.[4] In a simplistic transfer, considering only acquisition price and freight, given a Minneapolis futures price of $3.50 per bushel and the total freight costs of $1.78, freight would account for about one-third of the delivered cost of that bushel of wheat. This hypothetical sale illustrates the importance of freight rates in this type of supplier-receiver relationship.

Railroads play an important role in many grain transactions, offering a for-hire alternative to move grain from supplier to customer. Railroads have developed a multitude of rail services to attract grain business, differentiating service and price based on factors such as competition,

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[3] Source: Burlington Northern Santa Fe, Published Tariff Rate Item 43521, 52-Car Rate, June 2000.

[4] Source: Grain Transportation Report, SEA/USDA.

equipment, service requirements, and operational efficiency. These differentiated rate levels affect competitiveness of rail service for a commodity and route, relative to other modes and markets, and influence the investment decisions of customers. Shuttle trains are one alternative in the multitude of service options that rail carriers offer their grain customers.

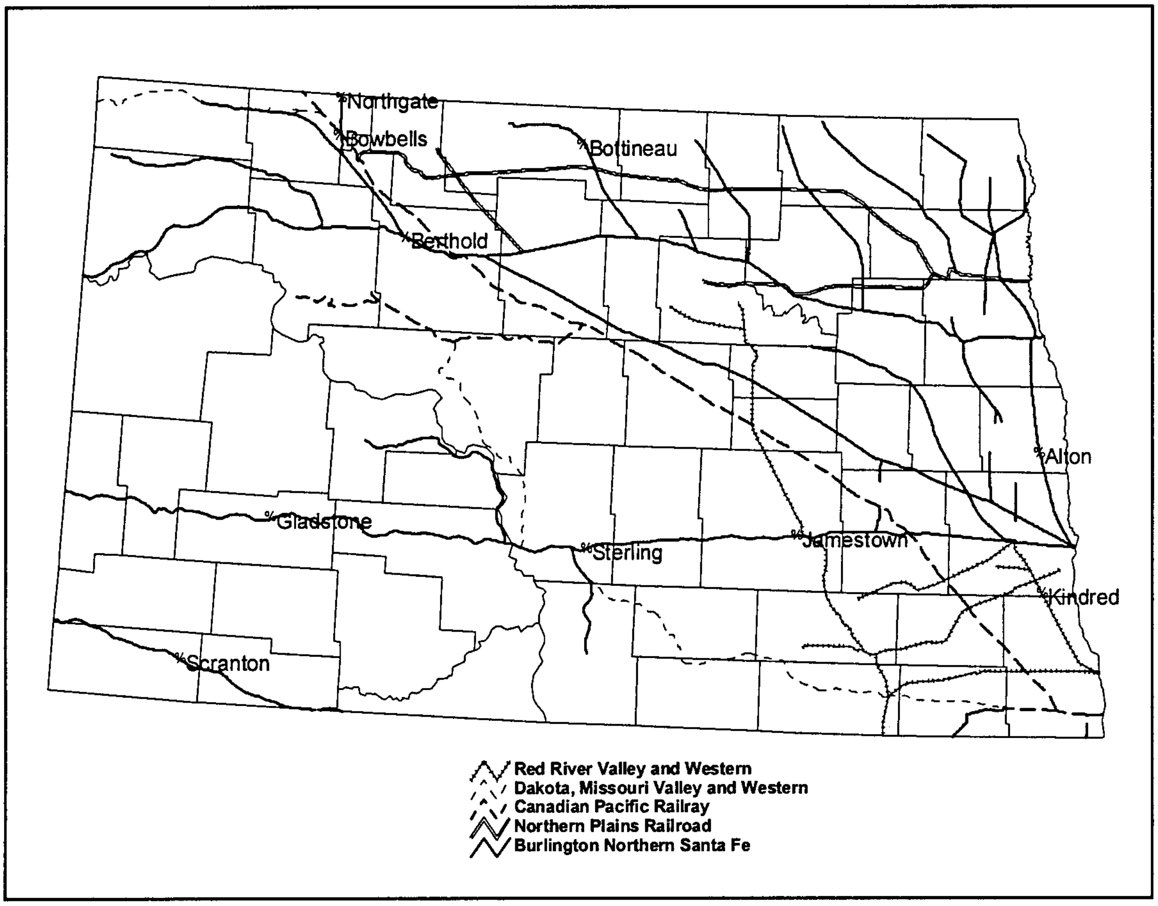

Figure 2. Location of Shuttle-Equipped Elevators in North Dakota

Shuttle trains offer rail carriers operational savings, which can be reflected in rates spreads (Vachal, et. al, 1998). The potential impact of shuttle train marketing on the North Dakota grain-gathering network is of interest in this study. Class I railroads serving North Dakota elevators — the Canadian Pacific Railway (CPR) and Burlington Northern Santa Fe (BNSF) — offer shuttle train programs to their customers. The BNSF serves seven shuttle-equipped facilities in North Dakota with two additional facilities expected to be on line this fall.[5] The CPR currently does not serve any shuttle-equipped facilities in North Dakota, but does market a shuttle program with provisions such as co-loading, which allows its customers to compete in markets eligible to receive shuttle trains. No shuttle facilities are currently located on any of the three short lines operating in North Dakota.

BNSF shuttle train service is offered via auction as a "rail transportation package." This shuttle service may be applied to eligible origins and destinations. Primary destinations are export facilities, with a limited population of domestic processors and feeders also equipped to receive this type of shipment. Shippers may order a package of 6, 12 or 24 trains of 100[6] cars. These trains are to be used consecutively under railroad specified loading, unloading, testing, and billing guidelines. The railroad estimates turn times at approximately 11 days for a North Dakota-Portland trip (Bobb, 1999). Therefore, a buyer who commits to the minimum six-trip package will be required to load 2.7 trains per month. The six trains, or 600 cars, would equate to approximately two million bushels of wheat.

Beyond the published tariff rates spread, performance incentives and penalties are specifically defined for the shuttle train program. The origin efficiency program (OEP) offers shippers a $100 discount if they meet certain loading time, electronic billing/payment, and origin weight requirements. An additional $100 discount is offered to receivers who meet specified requirements. Penalties include: $1,100 per hour for late release of cars by shipper/receiver; a

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[5] A shuttle facility is included at Kindred for coverage in this analysis, but a facility has not been sited at Kindred.

[6] "100" car units will be used in discussions of the "shuttle" train. The exact number of cars included in a shuttle train is typically between 100 and 115, varying by railroad and commodity.

cancellation fee of $100 to $300 per car per train for shipper; and a late placement penalty of $0 to $2,200 to be paid by the railroad for late placement of cars.

Existing facility infrastructure, economic incentives, investment requirements, and financing packages are unique to each shuttle venture. Based on a feasibility estimate developed for a green field facility, approximately a 10 million bushel handle was required for profitable returns (Vachal et.al, 1998). Discussions with grain companies and railroads suggest a target of 12 to 15 million bushels for a shuttle facility. This bushel requirement compares to the current average annual handle of 1.2 million bushels for the North Dakota elevator population, and average annual handle of 5.6 million bushels for the state's largest elevators. Therefore, redistribution of bushels in the local elevator industry seems imminent. Currently rate/efficiency incentives for a 24-trip shuttle train were estimated to be 15 cents per bushel. In the context of rail rates, an elevator housing a 50-car facility at Jamestown, N.D., would pay $1.21 per bushel to ship a unit train of wheat to Portland. A 100-car facility at Jamestown would pay between $1.06 and $1.14 per bushel to ship a shuttle train of wheat to Portland, depending on how the shuttle advantage is shared between origin and destination.

Table 1. Distribution of North Dakota Elevator Population and Bushels, by Average Annual Handle

Elevator Groups*	Number of Elevators	Total Bushels Handled by Elevator Grou	Avg. Bushels Handled by Elevator	Percent of Elevators	Percent of Bushels
under 1M	211	77,780,252	368,627	58%	17%
1-1.9M	65	97,250,072	1,496,155	18%	21%
2-2.9M	44	108,739,204	2,471,346	12%	23%
3-3.9M	20	66,684,584	3,334,229	6%	14%
4M+	21	119,891,547	5,709,121	6%	25%

*Elevator Groups Based on Annual Bushel Handle Reported in ND PSC Grain Movement Report

Based on discussions with industry experts, this rate advantage allows an elevator to expand its draw area by 25 percent, to 60 miles. This compares to the 45-mile draw area attributed to a unit train elevator discussed previously in this report. The additional 15 miles expands the estimated facility draw area to 11,310 square miles, a 77 percent increase in the area included in the elevator draw area, compared to the unit train facility. Theoretically, this suggests that the shuttle may have substantial influence in shaping the local grain industry in North Dakota.

Implications

The rate advantage available to the shuttle-equipped facility has implications for producers, elevators, local processors, rural communities, and local and state governments. Just as unit train rates were instrumental in redefining local grain flow patterns in the 1980, shuttle train rates too have the potential to dramatically influence local grain distribution patterns. As grain is transferred among markets and modes, a new pattern of grain flows will be established in the local grain market. This pattern will determine infrastructure employment for local grain market, and provide signals for decision makers in establishing policy and distributing limited resources to maximize returns to the user group.

Objectives

In looking to the future of North Dakota's local grain industry infrastructure it is important to (1) view our local infrastructure as part of global grain marketing network (2) determine, with the best current knowledge, what resources our segment of that much larger network will require, and (3) rationally allocate available resources to maximize returns to our segment of the network. In support of these efforts, the objective of this study is to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain industry. Secondary objectives are to (1) profile the local grain procurement network, (2) develop alternative network scenarios to analyze the influence of shuttle trains, and (3) discuss the longer-term implications of shuttle trains for North Dakota's grain industry and infrastructure.

Methodology

Case study analysis will be used to define grain draw areas, which are indicators of grain flow patterns. The draw areas will be determined by rail freight rates and producer delivery costs. Sensitivity will be conducted to examine relative influences of market factors, such as demand and producer truck investment. In addition, this research will be considered in the heavy axle load (HAL) hopper car analysis. These analyses may then be customized and applied to assess local impacts and discuss local investments.

Data

The data sources for this analysis are secondary. Production data will be compiled based on information published by the National Agricultural Statistics Service and the North Dakota Agricultural Statistics Service. Rail rate information included in the analysis is based on BNSF and CP public tariffs. Truck rates are estimated based on a 1995 survey of North Dakota wheat producers and the commercial truck cost model developed by Berwick and Dooley (1997). A summary of each data source are provided later in this report.

Organization

This report includes three sections beyond this introduction. The following section contains a profile of the local grain industry, including production, infrastructure, and market demand. Case studies and sensitivity analysis are presented in section three. Project results are summarized in the final section of the report.

LOCAL GRAIN INDUSTRY

For purposes of this analysis the local grain industry will be defined as the system of decisions and infrastructure underlying farm-to-market product flows. Seven indiscrete components of this system are described in that they provide the base for analysis of grain flows over local infrastructure. The seven components are:

(1) grain and oilseed production
(2) producer trucking
(3) local elevator industry
(4) road system
(5) rail network
(6) local processors
(7) market demand

Grain and Oilseed Production

The farm-to-market product flow is initialized when a farmer determines his production plan for the year. Although weather will impact volumes, quality, and crop maturity, many assumptions about the flow from farm-to-market are commodity-based. Each commodity has a unique set of market supply and demand conditions, in turn, making unique demands on the local grain industry.

North Dakota produces a broad array of grains and oilseeds. To better manage research efforts, four crops are considered in this analysis: hard red spring wheat (HRS), barley, durum, and corn. These crops were selected based on crop production statistics for 1995 to 1999. They accounted for approximately 75 percent of the average annual grain and oilseed production over the five-year period (ND Agricultural Statistics).

Table 2. North Dakota Grain and Oilseed Production, 1995-1999

Crop	Planted Acres (1,000 Acres) 1995	1996	1997	1998	1999	Average	Avg. Bu/Acre	Avg Production 1,000 Bu.	%
Barley	2,300	2,650	2,400	2,000	1,350	2,140	51	109,140	16%
Dry Edible Bean	600	580	620	750	630	636	23	14,628	2%
Canola	215	220	460	800	855	510	27	13,770	2%
Corn	700	750	780	970	820	804	95	76,380	11%
Durum Wheat	2,950	3,000	2,750	3,000	3,450	3,030	28	84,840	13%
Flaxseed	130	80	125	280	330	189	18	3,402	1%
Oats	650	530	700	730	650	652	53	34,556	5%
Rye	25	20	22	65	40	34	34	1,170	0%
Soybeans	660	850	1,150	1,550	1,350	1,112	30	33,360	5%
HRS Wheat	8,300	9,600	8,800	6,700	5,900	7,860	30	235,800	35%
Sunflower	1,250	900	1,150	1,600	1,250	1,230	50	61,500	9%
Winter Wheat	40	80	75	70	60	65	30	1,950	0%
Total						18,262	37	670,496	

Source: North Dakota Agricultural Statistics Service, Fargo, ND. Various Reports.

Wheat constituted approximately 46 percent of North Dakota's grain and oilseed production between 1995 and 1999. HRS wheat, the largest single commodity in planted acres, was seeded on about 35 percent of the state's estimated annual planted acreage over the five-year period. HRS wheat is typified by high protein and strong gluten. It is milled into flour and used primarily as a blending wheat in the production of bread products. Durum wheat, which accounted for 13 percent of annual grain and oilseed production, is the hardest wheat type. Because of this strength its milled product, semolina, is an essential ingredient in premium pasta products. Barley and corn, used in the processing and feed industries, represented about 16 and 11 percent of the average annual production, respectively. Analysis for this report will consider aggregate annual county production volumes. Seasonal delivery patterns for marketing of

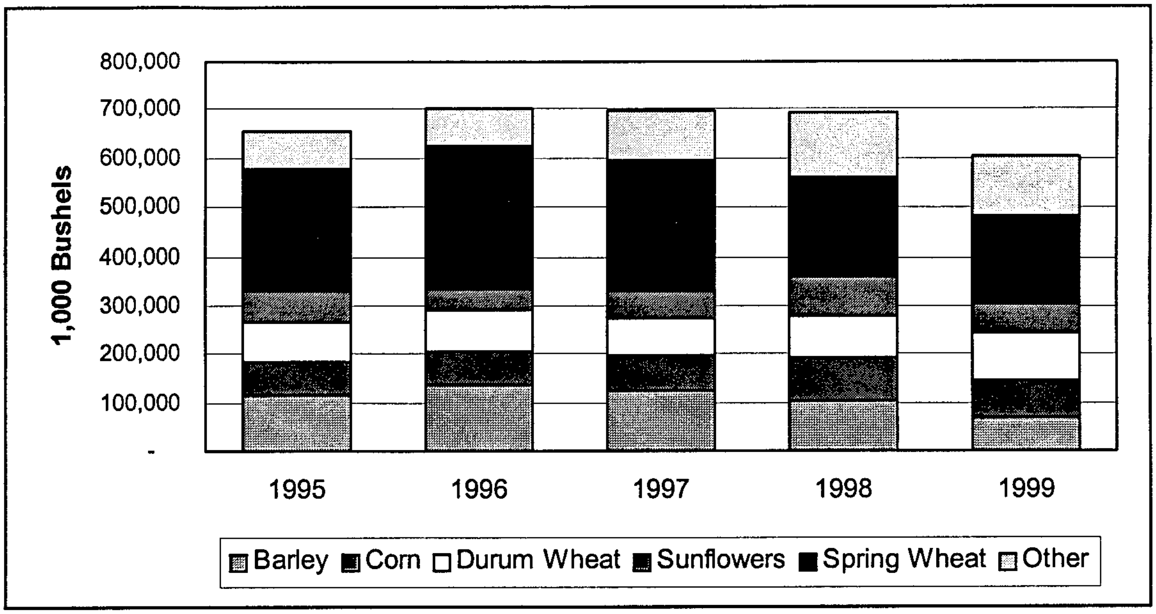

Figure 3. **Composition of North Dakota Grain and Oilseed Production, Average 1995 to 1999**

individual commodities may be useful in discussing local infrastructure issues, such as load restrictions and bridge issues, but will not be considered in the content of the report.

Local Grain Truck Costs

As aforementioned, this analysis is based on a market clearing assumption that annual grain shipments are equal to a five-year county average level of grain production. A primary model input required for the producer side of the farm-to-market decision is the truck delivery cost. The three factors considered in this truck delivery cost are truck cost estimates, distance to market, and composition of the farm truck fleet.

Truck Cost Estimates

Two types of truck costs considered in this analysis are producer and commercial. Producer truck costs are representative of this delivery cost for farmer-delivered grain traffic. The commercial trucking industry represents the custom haul traffic and is an indicator for future potential costs in this industry. The commercial trucking industry is a highly competitive industry with its large number of firms, few economies of size, virtually perfect information, and ease of entry into and exit from the industry. When profits are available competitors will enter the industry until rates are forced down, and vice versa. Truck costs are considered a proxy for truck rates in this analysis. Truck cost estimates reflect 1999 dollar values.

Producer truck costs are based on a 1995 survey of North Dakota wheat producers (Vachal, et. al, 1996). Cost estimates were developed for a single-axle truck, tandem-axle truck, and a semi-tractor and trailer. Fixed costs considered in the model were depreciation, return on investment, insurance, license fees, and housing. The variable costs included tires, fuel, maintenance and repair, and driver's labor. The single-axle truck estimate included $1,277 of annual fixed costs and a variable cost of $0.648 per mile. The tandem-axle truck costs included $2,890 of fixed costs and variable costs of $0.668 per mile. Semi-truck and trailer costs were $5,113 of annual fixed costs and variable costs of $0.825 per mile of variable costs.

Characteristics of the producer truck industry span the array of farm operations in the state. In addition to truck type, costs are influenced by factors such as length of haul, average load, and total bushels hauled. Therefore, three average producer truck cost scenarios are considered. These annual miles are 1,500; 5,000; and 18,000. The 1,500 and 5,000 annual truck mile estimates, which reflect truck costs for farming operations including 800 and 3,000 acres. Average farm size of North Dakota farms, 1,274 acres, is in the mid-range of these estimates (ND Agricultural Statistics, 1999). In addition, annual miles of 18,000 is considered as a proxy for truck costs of large farms and custom trucking activities.

Table 3. Annual Mile Estimates for Producer Truck Costs

Acres	Average Yield/Acre	Round Trip Miles	Average Load	Annual Miles
800	30	20	316	1,519
3,000	30	50	890	5,056
11,000*	30	50	890	18,539

*Reflects Large Farm and Custom Haul Annual Mileage

Three truck types, single-axle, tandem-axle, and semi-truck and trailer, are considered in the producer truck cost estimates. Average bushels per load were 316; 570; and 890; respectively, for the single-axle and semi-truck and trailer. The single-axle costs were estimated to be $.0095, $.0057, and $.0046 per bushel mile for 1,500, 5,000, and 18,000 annual miles. Tandem-axle cost estimates were $.0091, $.0044, and $.0029 per bushel mile for annual mileage totals of 1,500, 5,000, and 18,000. Semi-truck and trailer costs were estimated to be $.0095, $.0042, and $.0025 per bushel mile for 1,500, 5,000, and 18,000 annual miles.

Table 4. Producer Truck Costs, 1999 Dollars

Cost per Mile:		**Annual Mileage**		
		1,500	**5,000**	**18,000**
Single-Axle		$1.50	$0.90	$0.72
Tandem-Axle		$2.59	$1.25	$0.83
Semi-Truck and Trailer		$4.23	$1.85	$1.11
Cost per Bushel Mile: (Backhaul: 0%)	**Bushels per Load**	**Annual Mileage 1,500**	**5,000**	**18,000**
Single Axle	316	$0.0095	$0.0057	$0.0046
Tandem-Axle	570	$0.0091	$0.0044	$0.0029
Semi-Truck and Trailer	890	$0.0095	$0.0042	$0.0025

Commercial truck costs are estimated based on a 1997 study of owner-operator truckload operations by Berwick and Dooley. Parameters included in the cost estimate of the hopper truck include (1) 80,000 gross vehicle weight, (2) 53,200 net payload weight, (3) 100,000 miles per year, (4) 50 percent loaded miles, (5) $0.29 per mile cost for driver wages, (6) $10 hour cost for waiting time, (7) $1.25 per gallon for fuel price, (8) average speed of 45 miles per hour, and (9) an average round trip of 100 miles (Berwick and Dooley, 1997). Cost was estimated to be $1.15 per mile, with variable costs equal to $0.72, or 63 percent of the total costs. The $1.15 per mile equates to $.0023 per bushel mile for a payload of 890 bushels (60-pound commodity), with no backhaul. Backhaul opportunities would influence this cost. For example, if a backhaul is secured to cover half of the return trip cost, the per bushel mile cost would fall to $.0017.

Producer grain marketing decisions influence local grain delivery patterns. These marketing decisions are based on distance to market, market price, and trucking costs. The producer and commercial truck costs developed in this section will be applied to the local grain procurement model to assess the sensitivity of this industry to local grain delivery costs. The spans of truck costs discussed in this section provide a multitude of local grain delivery scenarios to reflect the diverse truck equipment inventory of North Dakota farms. In addition, alternative trucking scenarios that consider future investment in truck equipment and employment of custom and commercial grain truck operators are considered. Truck costs range from a high of $.0095 per bushel mile for the single-axle producer truck to a low of $.0017 per bushel mile for a commercial truck operator, based on parameters specified in this section of the report. This range of truck costs will be considered in the local grain distribution model and sensitivity analysis.

Local Grain Delivery Truck Fleet

As indicated by the wide range of truck costs, the composition of the truck fleet employed in making local grain deliveries in North Dakota is an important factor in estimating producer truck costs and grain flows. In 1980, the North Dakota truck fleet was dominated by the single-axle truck configuration, as 82 percent of the farm truck fleet was reported to be attributed to this category. By 1995, the single-axle truck category had declined 30 percent of it's representation in the North Dakota farm truck fleet. Frequency tandem axle trucks doubled between 1980 and 1995, to account for about one-third of the 1995 farm truck fleet. Representation of semi-truck and trailers in the North Dakota farm truck fleet remains relatively small, but did increase substantially over the 15-year period, representing 1 percent of the fleet in 1980 and 4 percent of the fleet in 1995. Preliminary results of a 2000 UGPTI study of the farm truck fleet in North

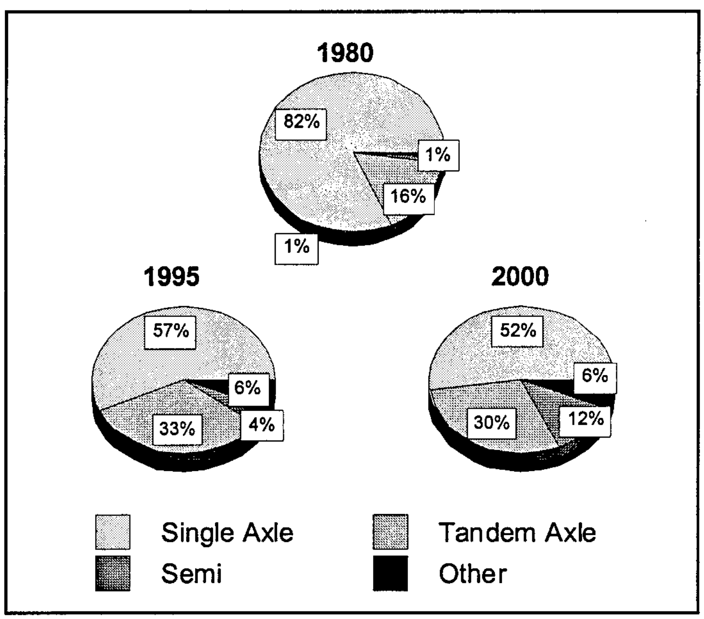

Figure 4. Composition of North Dakota Farm Truck Fleet

Dakota supports the trend toward investment in larger capacity trucks (UGPTI, to be published). Just slightly more than half of the North Dakota farm truck fleet is single axle in 2000. The fleet is comprised of 53 percent single axle, 30 percent tandem, and 12 percent semi-truck and trailer. Approximately 6 percent of the fleet is other truck types such as tridem axle. The share of the fleet represented by semi-truck trailers increased by 200 percent, compared to 1995. This trend toward larger, more efficient producer farm trucks is an important factor in understanding local market trends and in assessing the future role and value of local elevators in the local grain marketing industry.

North Dakota Elevator Industry

When grain is harvested, the producer may choose from four markets for grain — on-farm use, local elevator, terminal elevator, or processor/feeder. Selection of the delivery point is a function of net price including storage considerations, delivery costs, and opportunity cost. The local North Dakota elevator industry handled an average 506 million bushels annually between 1995 and 1999. The North Dakota Public Service Commission reported that 443 elevators were licensed to handle grain in 1999. Based on North Dakota Grain Movement Statistics, the 361 elevators actively shipping grain were operated by 252 companies. These 252 grain companies make grain sales to major grain companies, local livestock feeding operations, and local processors.

Producers marketed about three-fourths of the grain and oilseeds they produced between 1995 and 1999 through the local elevator network, based on a ratio of local elevator shipments to production. The prevalence of the elevator's role marketing varies by commodity. HRS wheat and barley ratios indicate more producers use local elevators in their marketing plan than with durum or corn. Ratios indicate that approximately 87 percent of the HRS wheat production and

88 percent of barley production was delivered to local elevators during the five-year period. Local elevators also were a primary recipient in the durum market, as the shipment to production ratio was 75 percent. Corn, as expected with a relatively large local processor interest, has the lowest shipment/production ratio, 42 percent. This ratio suggests that 58 percent of the corn grown by North Dakota producers between 1995 and 1999 was used on-farm or delivered to local processors or remote markets, bypassing the local elevator network.

Table 5. Shipment/Production Ratio for North Dakota Grain and Oilseeds, 1995-1999

	Shipments	Production	Shipment/ Production Ratio
HRS Wheat	206,085	235,800	87%
Durum	63,438	84,840	75%
Barley	96,344	109,140	88%
Corn	32,098	76,380	42%
All Grains & Oilseeds	507,798	670,496	76%

Source: UGPTI Grain Movement Statistics, ND Agricultural Statistics, various years.

Elevators compete for their share of the North Dakota grain and oilseed market through service and pricing mechanisms. It is the pricing that is considered in this analysis. Elevator board price is equal to the market price, less handling and transportation costs. Transportation cost is a primary determinant in the relative board prices of elevators competing for grain in the local market. The primary elevator factor considered in this analysis is the applicable freight rate. The applicable freight rate varies with shipment volume, origin, destination, and commodity. For purposes of this analysis, the handling cost, or margin requirement, are assumed to be equal for all North Dakota elevators. This assumption is premised on the belief that the local elevator industry is competitive, so that excess profits such as high handling fees cannot be extracted due to competitive pressures.

Five freight rate categories defined for this study are defined by the structure of rail tariffs for bulk agricultural commodities. These categories[7] are (1) No-Rail - elevators with no on-site access to a rail siding, (2) Single-Car - elevators with track space for loading 1 to 24 cars, (2) Multicar - elevators with track space to accommodate 25 to 49 cars, (3) Unit Train - elevators with track space to load out 50 to 99 cars, (4) 100-car - elevators with track space to accommodate a railroad spot of 100 cars, but not qualifying for the railroad efficiency programs discussed previously in this report, and (5) Shuttle Train - as defined earlier, elevators equipped to market trains of more than 100 cars in the railroad efficiency program guidelines.

Approximately 28 percent of the North Dakota elevator population was equipped at trains of at least 50 cars in 1999 (UGPTI). This group included 101 unit train elevators, seven 100-car elevators, and nine shuttle train elevators. These elevators originated 61 percent of the annual North Dakota elevator industry's grain and oilseed shipments in 1999. The remainder of the elevator population is comprised of 58 no-rail elevators, 159 single-car elevators, and 86 multicar facilities.

Patterns in activity among elevators can be discussed in reviewing historical volume and modal shipping activities. Volume tends to be concentrated in that group of elevators able to load unit trains or larger. The average annual handle for these elevators is 2.6 million bushels. This handle is more than double the average annual handle for the next largest average annual

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[7] The range for the category definitions may vary slightly by railroad and commodity.

handle, for multicar elevators, of about 1.2 million bushels. Single-car and elevators with no-rail service handle, about 512,000 and 246,000 bushels annually, respectively.

Rail market share for grain shipments originated from North Dakota elevators has ranged from 59 percent in 1978-79 to 79 percent in the 1986-87 crop year. Between 1976-77 and 1999-00, North Dakota elevators shipped an average 71 percent of their annual grain shipments via

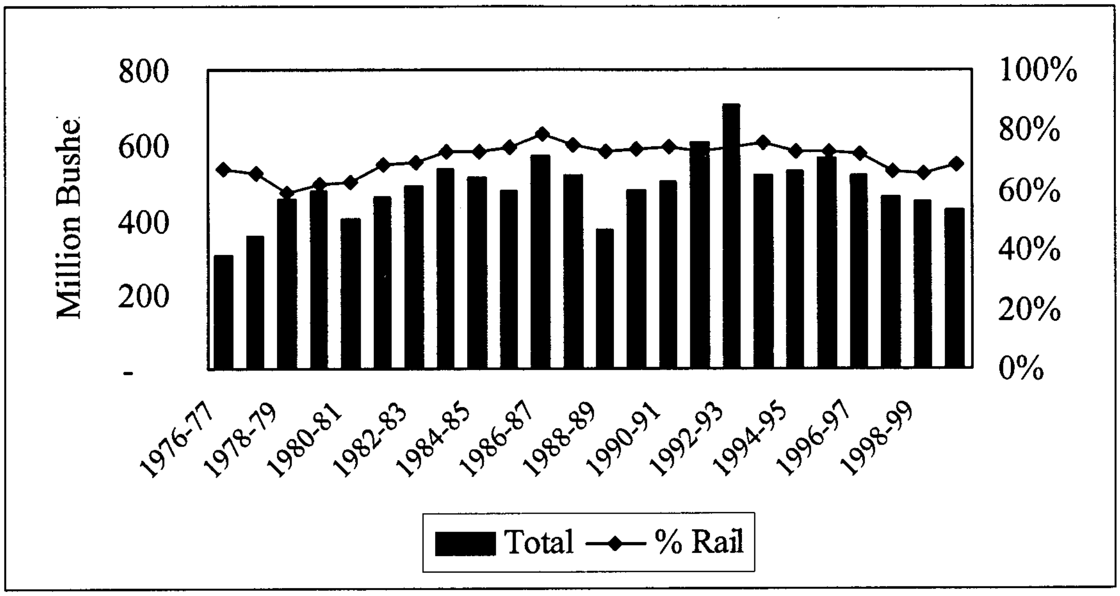

Figure 5. Rail Market Share for Grain Shipments Originated from North Dakota Elevators

rail. In the recent past, from 1995 to 1999, North Dakota elevators marketed 76 percent of their grain and oilseed shipments via rail. This modal distribution illustrates the importance of a competitive rail alternative in marketing North Dakota grain and oilseed production.

Table 6. **Shipments from North Dakota Elevators from 1995 to 1999, by Track Capacity**

Elevator Groups*	Number of Elevators	Total Bushels Handled by Elevator Group	Avg. Bushels Handled by Elevator	Percent of ND Elevators	Percent of ND Elevator Bushels
No Rail	58	14,275,400	246,128	14%	3%
Single Car	159	81,471,800	512,401	38%	16%
Multicar	86	101,940,800	1,185,358	20%	20%
Unit Train**	117	308,518,400	2,636,909	28%	61%

*Elevator Groups Based on Track Capacity
**Includes 100-car and Shuttle Facilities

The relative importance of rail varies among individual elevator marketing plans. A general illustration of modal shipments for each elevator group is illustrated in the following graphic. Based on average annual shipment data for 1995 to 1999, elevators that made the largest investment in their rail capacity - the group including unit train, 100-car and shuttle facilities - tend to market relatively more bushels via rail than truck.

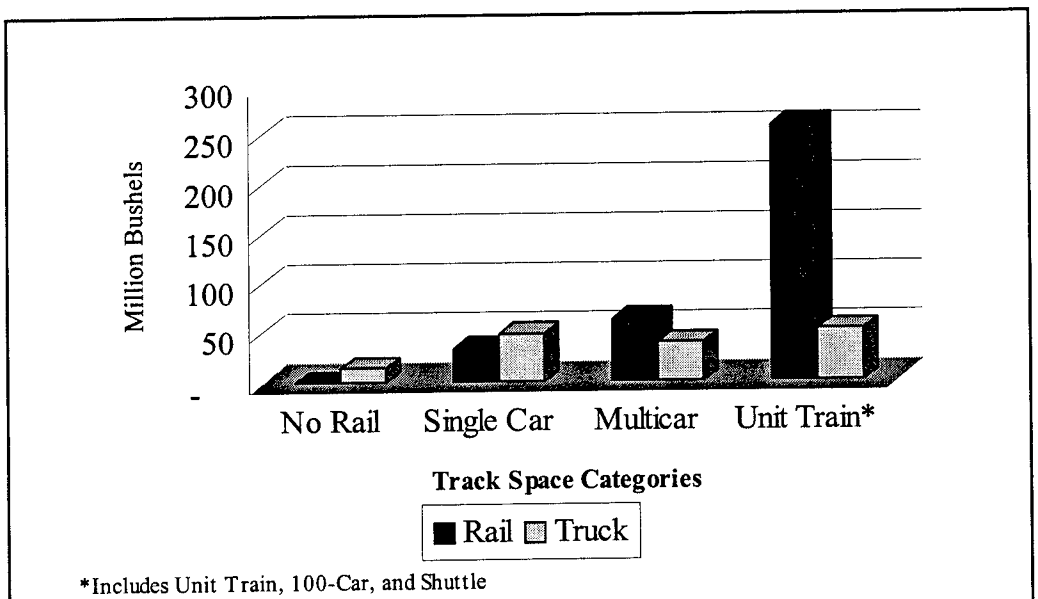

Figure 6. **Modal Distribution of North Dakota Elevator Grain and Oilseed Shipments by Elevator Group, Avg. 1995-99**

This group of elevators marketed 83 percent of the grain and oilseed bushels shipped by multicar elevators via rail during the five-year period. Although multicar facilities marketed relatively less of their average annual handle via rail, a majority was still loaded to rail for shipment. For the five-year span, 62 percent of the grain and oilseeds they shipped were attributed to rail. Single-car elevators were the only group with rail access that did not market a majority of their average annual handle via rail, as 59 percent of the grain and oilseed bushels they marketed annually moved via truck. This trend in use of rail for marketing is logical, given the lesser and severely-limited ability of multicar and single-car elevators, respectively, to access economies of scale in shipping grain. These volume and modal shipping patterns are important in discussing how the elevator industry will be impacted by the introduction of a shuttle influence in the local grain market.

Road System

The North Dakota road system includes 106,514 miles. Seven percent — 7,378 miles are state highway miles. The composition of the remaining mileage is: 18 percent county roads, 53 percent township roads, 3 percent local city roads, and 18 percent trails. The average age of the State Highway System is 17 years. Approximately 57 percent of the interstate highway miles and 55 percent of the state highway miles are in good to excellent condition.

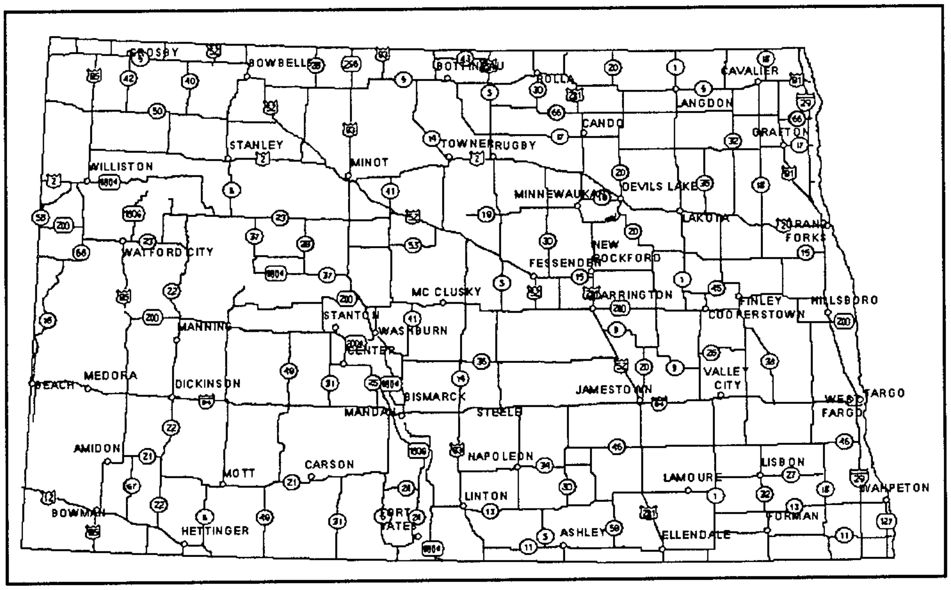

Figure 7. North Dakota Department of Transportation Highway Map

Rail Network

North Dakota elevators with access to rail may be served by one or two of the state's five railroads. For industry purposes, railroads are classified by their annual operating revenue. Class I railroads have an annual operating revenue of $259.4 million or more. Regional and short line railroads have annual revenues of less than $259.4 million. Two of the seven Class I carriers in the United States - the BNSF and the CPR - operate track in North Dakota. Three short line carriers - the Dakota, Missouri, Valley and Western (DMVW), Northern Plains Railroad (NPR), and Red River Valley and Western (RRVW) - operate the non-Class I track in the state.

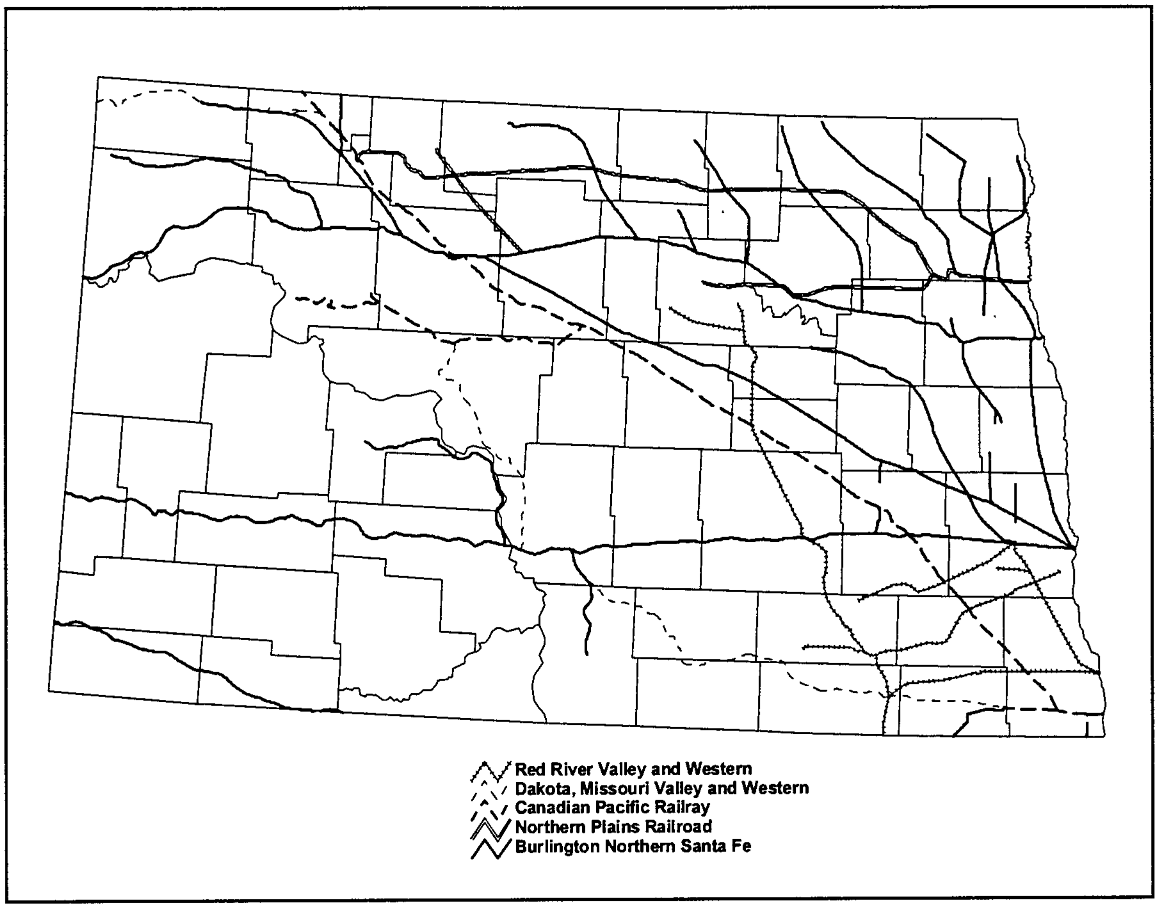

Figure 8. North Dakota Rail Network Map

Table 7. North Dakota Rail System Statistics

Railroad	**ND Track Miles*** Main Line	Branch Line	Railroad Share	**ND Elevators Served****	**1997-1999 Avg. Bushels Originated**	**Avg. Grain Traffic Density** (1,000 Bu./Mile)
BNSF	1,107	999	55%	230	208,734,711	99
CPR	353	112	12%	53	65,906,095	142
RRVW	0	579	15%	58	53,093,354	92
DMVW	0	376	10%	18	23,275,586	62
NPR	0	332	9%	29	25,831,895	78
	1,460	2,398				

* Source: North Dakota Public Service Commission, www.psc.state.nd.us.
**In North Dakota, 15 elevators are served by two railroads.

The short line railroads were formed during the past 15 years when track spun-off by the Class I carriers was leased/purchased by the respective companies. Short lines use labor savings and service initiatives to continue operating lines that the former Class I owner's deemed unprofitable in their operations (Tolliver, 1989). The relationship with the former Class I owner remains exclusive for the short lines in North Dakota. The RRVW is affiliated with the BNSF, and the DMVW and NPR are affiliates of the CPR. In these relationships, the Class I partner maintains pricing authority for movements originated on the short line, supplies cars for short line customers, and is the sole recipient of traffic originated by short line customers for off-line delivery.

The North Dakota rail network includes 3,858 miles of track (ND PSC). The largest share of track miles are served by the BNSF, as it operates 55 percent of the total track miles. The other Class I carrier, CPR, accounts for 12 percent of track miles. The remainder of the mileage is shared among the three short line carriers, with the RRVW, DMVW, and NPR operating 15, 10 and 9 percent of North Dakota track miles, respectively. Considering the track distribution among Class I's, with the short line miles attributed to their respective Class I partner, the BNSF operates 70 percent of the rail in North Dakota with the CPR owning the remaining 30 percent.

The state has 1,460 miles of track classified as main line. The BNSF owns 76 percent of this main line track, with the remaining 353 miles attributed to the CPR. A majority of track in North Dakota — 62 percent, is classified as branch line. The BNSF operates the majority of this branch line track as well, accounting for 42 percent of this category mileage. The RRVW comprises the largest share of the balance of the branch line miles, with 579 system miles. The DMVW and NPR operate 14 percent and 16 percent of the North Dakota branch line miles, with the remaining 5 percent controlled by the CPR (ND PSC, 2000).

Indicators of grain activity among the railroads are volume, market share, and traffic densities. The BNSF handled more than two-thirds of the rail shipments reported by North Dakota elevators between 1997 and 1999. With 55 percent of the market and the 14 percent originated by its RRVW short line partner, the BNSF originated 69 percent of the rail grain shipments made by North Dakota elevators. The CPR accounted for the remaining 31 percent, with about half of those bushels originated by the CPR and the other half originated by its two short line partners (UGPTI, unpublished).

Traffic densities also are important in understanding the composition of the North Dakota rail system. Densities are an indicator of resource employment and rail viability. For purposes of this study, only grain traffic is considered in the calculation of traffic density so overall traffic densities are understated. Individual railroad traffic density is defined as grain and oilseed bushels originated per mile of track. The CPR rail network is supported by the most dense grain volumes, with its traffic density equal to 141,000 bushels per mile. Traffic density for the BNSF Class I carrier, is estimated at 99,000 bushels per mile.

The short lines originated about 38 percent of the grain North Dakota elevators shipped via rail over the past five years (UGPTI). The RRVW serves the more traffic-dense branch lines with an average 92,000 bushels originated per mile operated. The NPR is second among short line traffic densities averaging 62,000 bushels originated per system mile between 1997 and 1999. The DMVW operates with the lightest density of all North Dakota railroads, at 78,000 bushels per mile. For a more in-depth analysis of traffic densities, refer to the 286,000-car analysis in this research compendium.

Market Demand

A fundamental part of understanding market demand is comprehending the magnitude of the U.S. grain market and the role of North Dakota grain production. In the coarse grain market, the United States is the world's leading supplier of corn and a minor supplier of barley. The United States accounted for approximately 71 and 6 percent of world corn and barley exports, respectively between 1995 and 1999. In the world wheat market, the United States attributed about 30 percent of world wheat exports during the same five-year time period.

In the context of national grain supplies, North Dakota is a leading producer of wheat. North Dakota durum and HRS wheat production accounted for 78 percent and 47 percent of the United States annual production of these commodities between 1995 and 1999. Growers in the state also are notable suppliers of barley, attributing about one-third of the average annual United States production. North Dakota is a minor supplier of United States corn, attributing about one percent of the average annual United States production during the five-year period.

In addition to the relative importance of North Dakota growers as suppliers of the alternative grains, understanding the prevalence of domestic and export demand sales is important because consistency and substitutability for United States grains varies among these markets. The ratio of United States domestic use to United States exports illustrates the relative importance of the export market among the four grains considered in this analysis. The domestic/export ratio for barley is 7.5, this compares to 1.1 for HRS wheat, 2.1 for durum, and 3.8 for corn. The relative importance of the export market for HRS wheat is evident.

Table 8. North Dakota Grains in Context of United States Grain Industry, Average 1995-1999

(1,000 Bushels)

Supply	**U.S. Share of World Exports**	**U.S. Total**	**ND Total**	**ND Share of U.S. Total**
HRS Wheat	30%	504,592	235,800	47%
Durum	30%	108,669	84,840	78%
Barley	6%	350,054	109,140	31%
Corn	71%	9,014,350	76,380	1%

Demand	**Domestic Use**	**U.S. Exports**	**Domestic/ Export Ratio**
HRS Wheat	250,000	228,000	1.1
Durum	87,000	42,300	2.1
Barley	338,789	45,166	7.5
Corn	7,097,949	1,878,592	3.8

Source: USDA National Agricultural Statistics Service, 'Crop Production Summary,' various years. USDA Economic Research Service, 'Quarterly Wheat Situation,' various quarters. USDA Foreign Agricultural Service, 'Grain: World Markets and Trade, July 2000.'

Two sources of demand are considered in understanding the role that a shuttle rate might play in influencing the landscape and product flow of North Dakota's grain industry. These sources are local processor and remote markets. Local processors encompass the multitude of businesses within state borders that create market value by transforming raw grain and oilseed products through practices such as milling, manufacturing, or feeding. Remote markets are markets beyond state borders.

Local Processors

Introduction of shuttle rates into the market will have an impact on local processors as they compete to purchase grain from producers and local elevators. Local supplies of grain are assumed to be a principal source in processor procurement of raw product. Lower freight costs from shuttle-equipped origin/destination pairs will influence market flows as they are reflected in the board price of shuttle facilities. To maintain consistency in the analysis provided in this report, HRS wheat, durum, barley and corn are considered. A brief description of major local processors is presented in this section. Results of sample cases illustrate the impact of shuttle train freight rates on local processor procurement. In addition to the procurement considerations, each plant has by-product business interests, such as feed, that also may be influenced by changes in the relative delivered prices of substitutable products. These product issues are noted, but not addressed in the scope of this analysis.

Local processors consume volumes equal to approximately 16 percent of the annual production of the four commodities considered in this analysis. Major local processors of HRS wheat are the North Dakota Mill in Grand Forks and the Cenex Harvest States (CHS) Mill at Fairmont. The North Dakota Mill purchases 11 million bushels of HRS wheat annually.[8] It began operating in 1922, and continues to be the sole state-owned milling facility in the United States. The CHS Mill is equipped to process about 4.5 million bushels of HRS wheat each year.[9] The mill was opened in 1998 with local private ownership. It was purchased by CHS in 2000. The 15.5 million bushels processed by these plants is equal to about 7 percent of the state's average annual production of HRS wheat.

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[8]Source: Dan Korynta, Grain Dept. Manager, ND State Mill, Grand Forks, ND.

[9]Source: Cenex Harvest States, St. Paul, MN.

Four North Dakota companies are considered major local processors of durum. The largest of these processors is Dakota Growers Pasta in Carrington, N.D. Dakota Growers Pasta distributes the primary milled durum product, semolina, to its own mills and through sales to other pasta manufacturers. It currently is the second largest supplier of pasta in the United States. This grower-owned processor has been in business since 1993. Its annual purchases of durum average 11 million bushels.[10] Noodles by Leonardo, Minot Milling, and the North Dakota State Mill also mill semolina. Noodles by Leonardo, housed in Cando, N.D., uses about 900,000 bushels of durum producing semolina for its vertically-integrated pasta plant. It has been in business as a

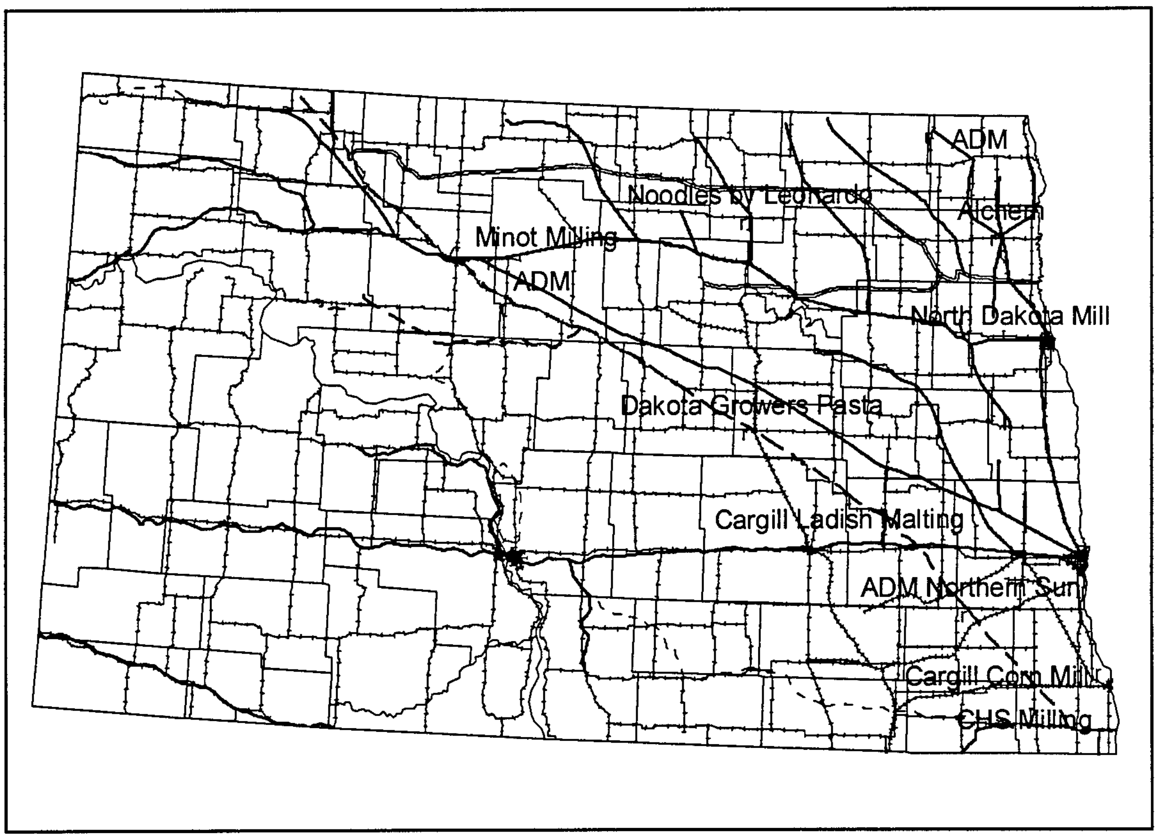

Figure 9. Map of North Dakota HRS Wheat, Barley, Durum, and Corn Processors

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[10]Source: Bonnie Mullenberg, Executive Director, Northern Grains Institute, Carrington, ND.

privately-owned processing plant since 1980. Minot Milling and the North Dakota State Mill are semolina suppliers for the pasta industry. Minot Milling, sited in Minot, N.D., purchases approximately 7.5 million bushels of durum each year.[11] The mill, a subsidiary of the Philadelphia Macaroni Company, began producing semolina in 1998. The North Dakota State Mill purchases about three million bushels of durum annually for its semolina production line. The 22.4 million bushels milled annually by these local processors is equal to 26 percent of North Dakota's average annual production of durum between 1995 and 1999.

Table 9. Summary of North Dakota Processor Demand

Crop	Plant		Annual ND Plant Demand (000 bu)	ND Production Avg. 1995-99 (000 bu)	Demand/ Production Ratio
HRS Wheat					
	North Dakota State Mill		11,000		
	CHS Milling		4,000		
		HRS Total	15,000	235,800	6%
Barley					
	Cargill Ladish Malting		10,000	109,140	9%
Durum					
	Dakota Growers Pasta		11,000		
	Minot Milling		7,500		
	North Dakota State Mill		3,000		
	Noodles by Leonardo		900		
		Durum Total	22,400	84,840	26%
Corn*					
	Cargill Corn Milling		29,000		
	Alchem		3,700		
		Corn Total	32,700	76,380	43%
Total			**80,100**	**506,160**	**16%**

*ADM Walhalla capacity (11,000,000 bu) currently idle.

[11]Source: Based on 340 active milling days per year - www.made-minot.com/projects.htm.

Cargill's Ladish Malting in Spiritwood, N.D., is the largest malting house in the United States. Cargill acquired this plant with the 1991 purchase of the Wisconsin-based Ladish Malting Company. The Spiritwood plant has capacity to malt approximately 10 million bushels, or 9 percent of the average North Dakota barley production, annually.[12]

Three corn processing plants are major local buyers of corn production for the ethanol and sweetener industries. Cargill Corn Milling at Wahpeton began producing high-fructose corn sweetener in 1996. This business, incorporated as the grower-industry partnership "ProGold," was leased to Cargill in 1997. The plant processes approximately 29 million bushels of corn annually.[13] Alchem at Grafton, N.D., and Archer Daniels Midland Co. (ADM) in Walhalla, N.D., both opened in 1985 and produce ethanol. Alchem procures about 3.7 million bushels of corn annually for its production line.[14] The ADM plant was built by Dawn Enterprises of Walhalla. It was operated by the local owners for about a year before closing. ADM purchased the plant in 1992 and reopened it. ADM elected to cease production at the facility in 1999 based on market economics. Its 10 million bushel annual capacity continues to sit idle.[15] Absent the ADM capacity, local processors are equipped to process 43 percent of North Dakota's average annual corn production.

Remote Markets

As aforementioned, North Dakota sells a majority of the grains and oilseeds it produces to markets beyond state borders, which are called the remote market in this analysis. This market

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[12]Source: Cargill, Inc., www.cargill.com/malt/hist.htm.

[13]Based on 340 active grind days per year - www.cargill.com/today/releases/10021997.htm.

[14]Source: Brent Kohls, Alchem, Mayville, N.D.

[15]Source: www.ethanol.org/in_the_news/petroleum_pain.html.

includes a dynamic mix of customers in domestic and foreign markets. Determining the specific end-market for each bushel of grain originated from North Dakota is a cumbersome and likely impossible task. Industry experts and secondary data will be used to describe typical grain flow patterns and characterize markets.

The commodity grain industry in the United States works as a funnel. A multitude of producers deliver grain to a network of local elevators. These elevators, in turn, make sales either through brokers or direct to large grain companies. The large grain companies take positions in the market (buy/sell) based on expected domestic use/sales and export sales. The domestic use and sales may include supply for internal processing plants, as well as sales to other processors. UGPTI Grain Movement Statistics, Public Use Waybill, and USDA information provide some statistics about grain marketing patterns. This information is discussed in its relationship to the potential for accessing shuttle train rates for the four grains discussed in this report.

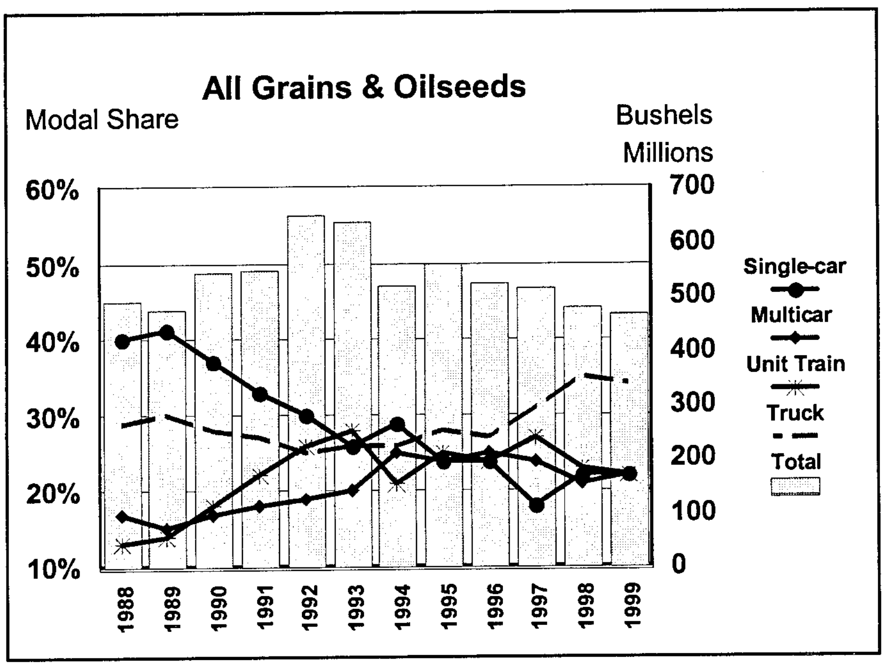

Figure 10. Modal Distribution of Aggregate Grain and Oilseed Shipments from North Dakota Elevators, 1988-1999.

North Dakota Grain Movement Statistics (UGPTI) are based on mandatory reports from elevators in North Dakota, regarding the quantity, market, and mode used for grain shipments. This data may be used to discuss marketing trends for North Dakota elevators. Traffic sources for shuttle shipments are producer and elevator truck shipments and existing rail shipments. Railroad introduction of shuttle rates into the market provide a more competitive rail option for elevators.

In the short-term, the transfer of rail shipments moved under the existing rate structure likely may be for current unit-train traffic to shuttle, as this traffic typically is bound for export facilities and large domestic processors - the remote markets most likely equipped to handle shuttle train shipments. Single-car and multicar shipments typically are bound for domestic markets. It seems unlikely that this traffic would be delivered via shuttle in the near-term, unless railroads offer shuttle-type alternatives for smaller train sizes.

In the long-run, more of the single and multicar traffic may be shifted to shuttles as investments are made in rail/truck transfer facilities or in domestic processor's rail handling capabilities. In regard to potential for transferring truck traffic to rail using the more competitive shuttle rate structure, elevators reported that an average 31 percent of annual shipments were marketed via truck between 1995 and 1999. This truck market share is up 20 percent, compared to its market share for the previous five-year period, 1990 to 1994. A more competitive rail rate may shift a portion of this traffic back to rail.

Trends in the modal distribution of individual commodities also provide insight into the potential for shuttle shipments. Unit train shipments of HRS wheat have been relatively stable over the last decade, accounting for 38 percent of the average annual shipments originated by North Dakota elevators. Trucks have gained market share over recent years, increasing market share by 31 percent between the first and last half of the 1990s. Multicar shipments also have increased by 23 percent, suggesting an increased prominence of domestic markets. In addition, rail investments in the domestic milling industry may be reflected in the average annual use of the single-car rail shipment option. Use declined 35 percent between 1995 to 1999, compared to 1990 to 1994.

Table 10. Modal Distribution of North Dakota Grain and Oilseed Shipments, 1990-94 and 1995-99

		Single	Multi	Unit	Truck	Shipments
HRS Wheat	90-94 Avg	23%	22%	38%	16%	253,800
	95-99 Avg	15%	27%	38%	21%	206,085
Durum	90-94 Avg	33%	28%	19%	20%	82,133
	95-99 Avg	25%	31%	25%	20%	63,438
Barley	90-94 Avg	44%	22%	6%	28%	122,879
	95-99 Avg	28%	29%	10%	33%	96,344
Corn	90-94 Avg	29%	10%	32%	28%	23,604
	95-99 Avg	31%	19%	29%	21%	32,098
All Grain	90-94 Avg	31%	20%	23%	26%	578,502
	95-99 Avg	22%	23%	24%	31%	507,798

Source: UGPTI Grain Movement Statistics, various years.

Durum and barley shipments also have exhibited a declining interest in single-car shipments during the last decade. Elevator use of single-car shipments declined by 24 and 36 percent respectively, during the last decade. Truck share of the market remained stable over the decade for durum. Truck market share increased by 18 percent for barley from the first half of the decade, compared to the last half. Elevators increased use of multicar and unit train alternatives for durum and barley from 1995 to 1999, compared to the previous five years. Barley use of unit trains is relatively stable, while use for marketing durum has exhibited an upward trend in recent years.

Elevator marketing of corn has shifted from truck to rail over the past decade, with rail market share increasing by 25 percent. Single and multicar shipments increased by 7 and 47 percent, accounting for half of the average annual elevator shipments between 1995-99, compared to 1990-94. Unit train shipments declined by 10 percent for the same time period. Some of this shift from truck to rail may be volume related, as average shipments increased by 36 percent for 1995 to 1999, compared to the previous five years.

Information detailing the destination for grain shipments originating in North Dakota also may provide insight for application of shuttle rates since the initial discussions of North Dakota shuttles have centered on the Pacific Northwest (PNW) export market facilities. Prevalence of the PNW as a market for HRS wheat is illustrated in Appendix A. Two data summaries are considered in assessing the relative importance of this market for North Dakota elevators, the UGPTI grain movement statistics and the U.S. Public Use Waybill. Public Use Waybill origins are defined by regions known as Bureau of Economic Analyses (BEAs).[16] Waybill statistics show that, on average, 21 percent of all wheat originated from the four BEAs covering North Dakota origins was destined for the PNW between 1994 and 1998.[17] The U.S. Public Use Waybill does not distinguish between wheat types.

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[16]BEAs do not follow state borders.

[17]1998 was the most recent U.S. Public Waybill sample available at the time of this analysis.

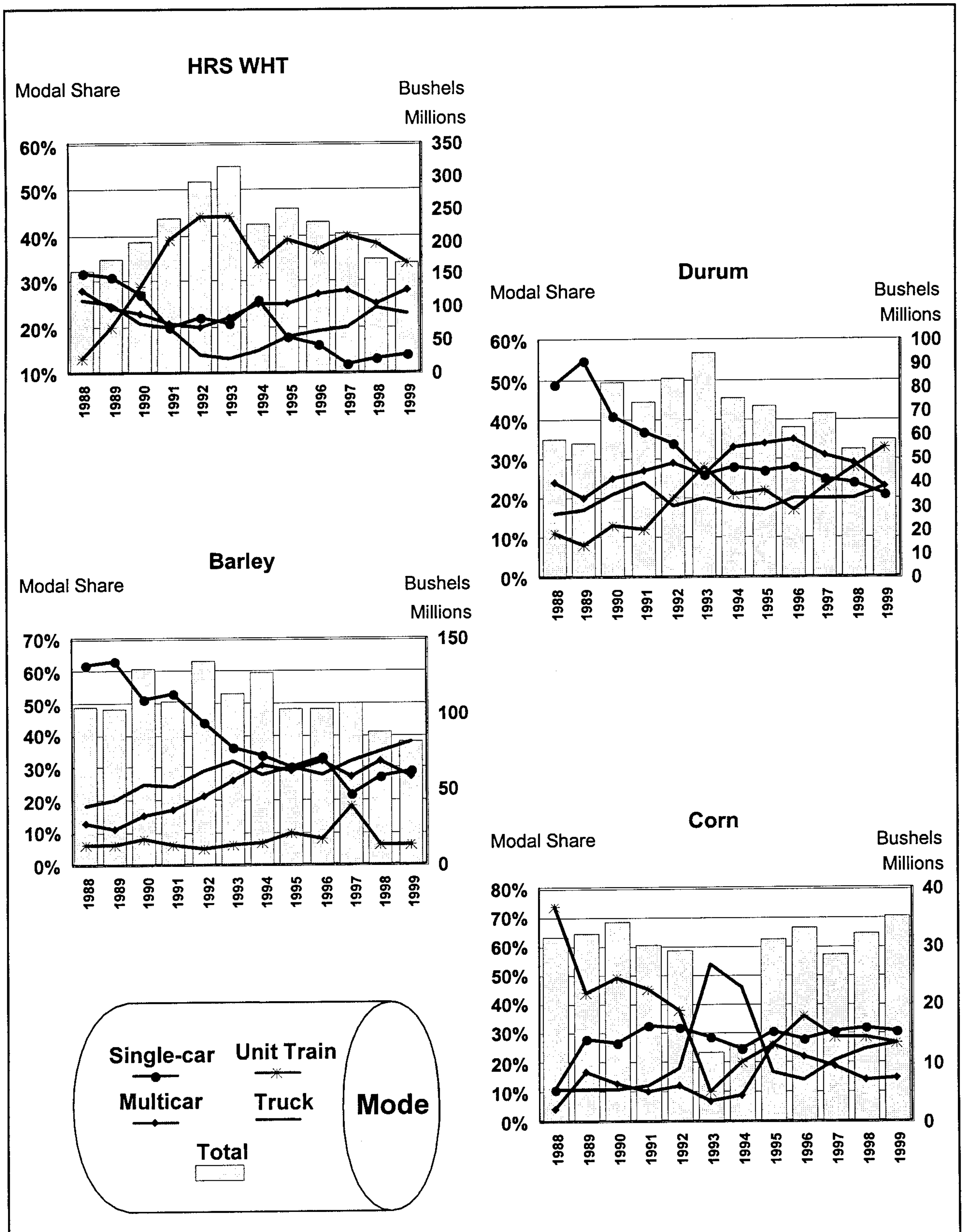

Figure 11. Modal Distribution of Grain Shipments from North Dakota Elevators, 1988-1999

North Dakota Grain and Oilseed Statistics, UGPTI, do distinguish HRS wheat and durum movements. Based on the North Dakota Grain and Oilseed Statistics, approximately 17 percent of the HRS wheat shipped by North Dakota elevators between 1995 and 1999 was destined for the PNW. This is a decline of 10 percent compared to shipments between 1990 and 1994, when 19 percent of the HRS shipped by North Dakota elevators was bound for the PNW. The year-to-year trend in HRS wheat shipments to the PNW is illustrated in Figure 11. The PNW has been a rather insignificant market for durum, accounting for less than 2 percent of the shipments originated by North Dakota elevators.

Table 11. North Dakota Elevator Shipments to PNW

	1990-1994		1995-1999	
	Total Shipments	% Shipped to PNW	Total Shipments	% Shipped to PNW
HRS Wheat	253,800,001	19%	206,085,367	17%
Durum	82,133,427	2%	63,437,774	1%
Barley	122,879,265	8%	96,344,316	7%
Corn	23,603,707	55%	32,097,933	47%
All Grains	578,501,598	14%	507,797,834	13%

Source: ND Grain and Oilseed Statistics, UGPTI, NDSU

The Public Use Waybill and North Dakota Grain Movement Statistics are closely correlated for barley shipments. Both data sources attribute about 7 percent of the market for barley shipments from North Dakota elevators to the PNW between 1995 and 1999. The PNW peaked as a market in 1991 was a recipient of 11 percent of all the barley shipped from North Dakota elevators. The market share reached 10 percent in 1998, but declined to 3 percent in the most recent year (UGPTI).

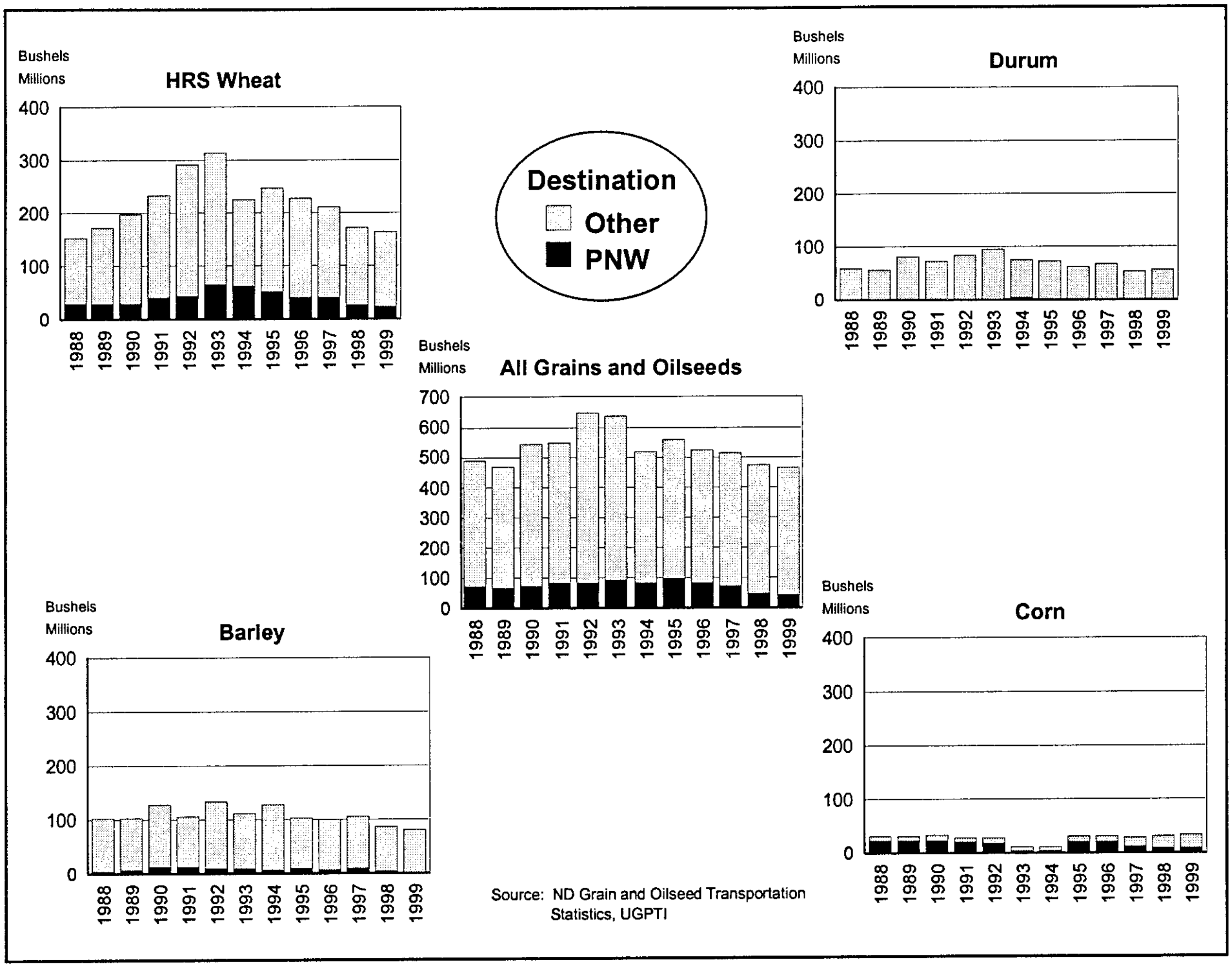

Figure 12. Trends in North Dakota Elevator Shipments to the PNW, 1988 to 1999

The PNW consistently is an important market to North Dakota elevators shipping corn. Public Use Waybill statistics suggest that the PNW was the market chosen for 68 percent of the corn originated from ND elevators between 1994 and 1998. The UGPTI statistics show a lower, but still large, share for this market of 47 percent. The North Dakota Grain and Oilseed Statistics suggest that the PNW has become less dominant as a market for North Dakota corn, accounting for 55 percent of the corn shipped between 1990 and 1994 - a 14 percent decline compared to the most recent five-year period.

The information discussed in this section of the report provides resources for understanding the market in which shuttle train facilities will compete for grain produced in North Dakota. Analysis of the potential impact that shuttle facilities may have on the local infrastructure is provided in the next section of this report. The goal of the analyses is to develop a framework for considering shuttle facility impacts on marketing patterns and traffic flows in local investment and policy decisions.

Table 12. Summary of North Dakota Rail Shipments, Public Waybill Data Average 1994 to 1998

Commodity	Destination BEA	Bushels	Percent	$/bu	$/bu mi
Wheat					
	Duluth	67,974,890	20%	0.73	0.1629
	Gulf	14,195,843	4%	0.75	0.1383
	Minneapolis	40930275	12%	0.79	0.2047
	PNW	71,197,911	21%	1.30	0.0910
	Other	141694331	42%	0.87	0.1123
	Total Wheat	335,993,250			
Barley					
	Duluth	13,971,251	13%	0.41	0.1300
	Minneapolis	29,950,942	29%	0.54	0.1384
	North Dakota	12,043,861	12%	0.27	0.1990
	PNW	7,693,842	7%	0.87	0.0600
	Other	40,839,854	39%	0.98	0.0773
	Total Barley	104,499,750			
Corn					
	Duluth	5,820,528	16%	0.27	0.0810
	Minneapolis	2,167,418	6%	0.30	0.1183
	PNW	24,435,293	68%	0.90	0.0575
	Other	3,390,650	9%	0.57	0.0764
	Total Corn	35,813,890			

ANALYSIS

The primary objective of this analysis is to compile methodology and information to assess the potential impact of shuttle train rates on the local grain market. Although shuttle rates are the market phenomenon addressed in this analysis, methodology generally is applicable for developing market synopsis for other factors influencing local grain delivery patterns. The analysis assumes a profit maximizing goal for local producers in their grain marketing decisions. Although elevator loyalty and other qualitative factors may influence the producer delivery decision, it is assumed that the local grain delivery patterns will satisfy profit maximizing criterion in the long run.

The analysis has two fundamental components. The first component concentrates on decisions made by North Dakota farmers in marketing their grain. Spatial analysis is used to couple producer trucking costs with local market board prices to estimate producer delivery patterns. Grain production and draw area spans are used as quantitative measures in discussing the delivery patterns. The second component specifically emulates local processor position in the local grain market. An economic decision model illustrates the impact of changes in elevator rail rates and producer trucking costs on the relative competitiveness of local processors.

Producer Delivery Patterns

Estimation of producer delivery costs is a rudimentary, yet essential, task in understanding local grain marketing patterns. A spreadsheet-based mathematical model of the decision was created to allow for replication of this analysis by local decision makers. The model relies on rail rates, truck costs, and distance in estimating producer decisions for local grain deliveries.

The delivery scenarios for marketing grain in proximity to shuttle facilities are estimated by calculating and plotting a series of indifference points for the producer decision. An indifference point is defined by that distance at which the net price to a producer is equalized for two competing markets. The net price considered by the producer, in this model, is equal to the market price less the cost of delivering the commodity to that market. A series of these indifferent points defines the outlying edge of the draw area for the shuttle market. The point of indifference, is defined by this equation:

$$\frac{\left[(P_z - R_{zs}) - (P_z - R_{zi})\right] - T(D_{zs} - D_{zi})}{-2T}$$

where,

s	=	Focal (Shuttle) Facility
i	=	Competitor (Elevator/Processor) Facility
z	=	Terminal Market
T	=	Producer Truck Cost
R_{zs}	=	Rail Rate from Local Competitor Facility to Terminal Facility
R_{zi}	=	Rail Rate from Local Focal Facility (Shuttle) to Terminal Facility
P_z	=	Terminal Market Price (eg. Nearby Minneapolis Futures)
D_{zs}	=	Distance between Local Competitor Facility and Terminal Market
D_{zi}	=	Distance between Focal Facility (Shuttle) and Terminal Market

This equation is applied to a multitude of market combinations to estimate grain draw area boundary scenarios for 10 shuttle facilities considered in this analysis. The boundaries provide a base for identifying likely grain origin territory for the facilities. The share of grain the facility handles from within the boundary vary across commodities, facilities, and time, because production and market conditions are dynamic. Each facility also has an individual business plan and a goal for annual grain volume, which will affect its market decisions and influence local grain distribution patterns. The model and estimated draw area boundaries do, however, provide a base for discussing local grain delivery patterns and infrastructure.

Base Case - Wheat

An initial step in assessing the influence shuttle train rates will have on the local grain market is identifying the area affected by estimating draw area boundaries for facilities with access to these rates. Wheat accounted for almost half of the grain produced in North Dakota between 1994 and 1999, thus, it is the base case commodity for this analysis. A truck cost of $.0025 is applied in the base case. This cost reflects the cost of operating a semi-truck and trailer, as described in the previous section of this report. Minneapolis is the terminal market used for defining applicable rail rates. A shuttle rate is not published for the Minneapolis market, so the proxy shuttle rate was applied based on industry comments and shuttle train rates quoted for other markets. The shuttle rate is assumed to be $300 per car (9.1 cents per bushel) lower than the unit train rate. The boundaries estimated using these parameters form the base case scenario and provide an approximation of the affected market area. The sensitivity analysis developed later in this analysis illustrates a range of potential impacts and the affect of alternative market influences on local grain marketing patterns.

The base case shuttle draw areas are illustrated in Figure 14. The unique shape of draw areas for individual shuttle facility locations reflect rail rate relationships, road network, and truck costs represented in the producer marketing decision. Because commodity weights and rail rates are equal, the base case draw areas are applicable for HRS wheat and durum. These draw area boundaries were applied to county wheat production data to calculate the volume contained in each of the draw areas. The production densities for the commodities are illustrated in Appendix B.

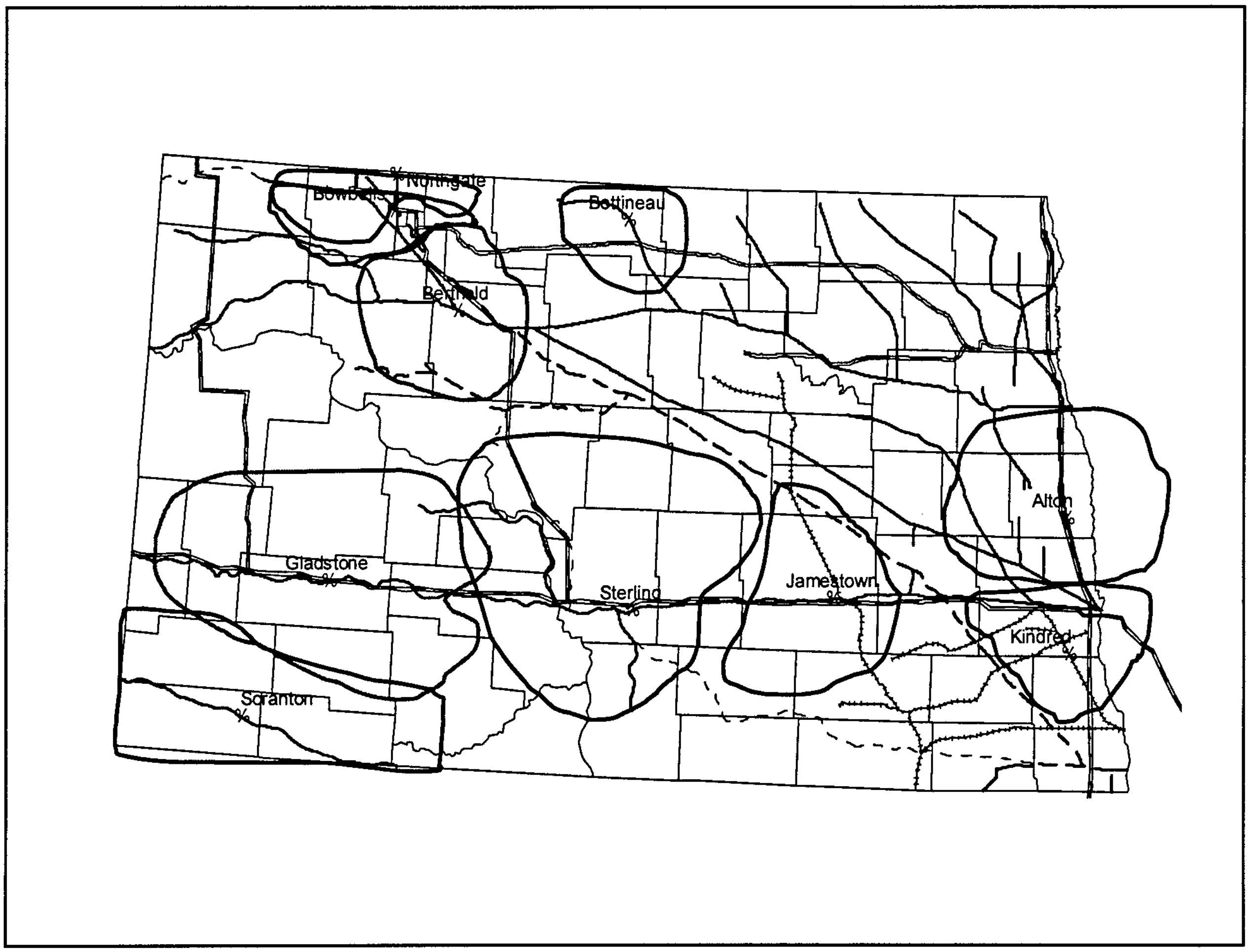

Figure 13. Base Case Shuttle Draw Estimates (HRS Wheat and Durum)

HRS wheat production is most dense in the eastern half of the state, with Pembina and Cass offering the greatest densities among North Dakota counties. The area included in the 10 shuttle facility boundaries accounts for approximately 45 percent of the total North Dakota land area. The 10 draw areas encompass about 38 percent of North Dakota HRS wheat production and 39 percent of the state's durum production. The net bushel estimates the combined draw area totals and accounts for the approximate draw area overlaps among shuttle facilities, of 7 and 17 percent, for HRS wheat and durum production, respectively, and a 6 percent overlap of land in wheat draw areas.

The draw area for the Alton location offers the highest volume of total wheat among the shuttle facilities, with an estimated 23.4 million bushels. Sterling, Gladstone, and Berthold draw areas are estimated to contain more than 17 million bushels of wheat. Approximately 21.1 million bushels attributed to Sterling and 18.5 and 17.8 to Gladstone and Berthold, respectively. Draw areas for Kindred, Scranton, and Jamestown fall in the 10 to 15 million bushel range, with 14.7, 14, and 11 million bushels of wheat produced in their respective draw areas. The Bowbells, Northgate, and Bottineau facilities are encompassed by draw areas each estimated to include less than 10 million bushels of wheat.

Of these six facilities, the "wheat" available to facilities in Berthold and Bowbells is predominately durum, while the other facilities HRS wheat bushels are a greater share of total wheat bushels. The composition of the "wheat" bushels is important because, as previously discussed, durum has not exhibited as strong a market as HRS wheat for sales via unit train and shuttle vehicles. In addition, note that overlap among shuttle facility draw areas should be considered when discussing volumes, delivery patterns, and competition among markets.

Table 13. Shuttle Facilities - Draw Area Estimates for Wheat

Location	HRS Wheat	Durum	Total Wheat
		(1,000 Bushels)	
Alton	22,792	571	23,363
Sterling	15,411	5,735	21,146
Gladstone	16,040	2,498	18,538
Berthold	4,085	13,729	17,814
Kindred	14,405	315	14,720
Scranton	11,592	2,452	14,044
Jamestown	9,822	1,167	10,989
Bowbells	2,445	6,067	8,512
Northgate	2,050	5,080	7,130
Bottineau	3,048	2,028	5,076

**Draw area extending to MN is included.*

Commodity

The draw areas defined for wheat establish the base case scenario for the remainder of the discussion regarding producer grain deliveries. The following economic analysis addresses the sensitivity of these patterns to factors such as commodity, rail rates, producer truck costs, and commercial truck delivery. The first factor, commodity effects, is illustrated by comparing shuttle-rate based draw areas for barley and corn to the shuttle-rate based wheat draw areas. The barley analysis illustrated is completed for eight of the shuttle facilities. Corn analysis is provided for a single facility, Kindred. To better manage time and form a more coherent discussion of the remaining four factors, Berthold, Jamestown, and Kindred were selected for additional individual case analysis.

Barley

Spatial comparison of draw areas for wheat and barley results in smaller draw areas for shuttle facilities in the barley market, with the exception of Bottineau. Due to production patterns and consistency among analysis (Appendix C) seven of the 10 shuttle facility locations are considered in the barley case. Facilities in Gladstone, Scranton, and Kindred were excluded. The draw areas estimated for the remaining seven shuttle facilities covered approximately 23 percent of the land area in North Dakota. Production in these draw area boundaries is estimated to be 26,354,000 bushels. Less the 119,000 bushels produced in

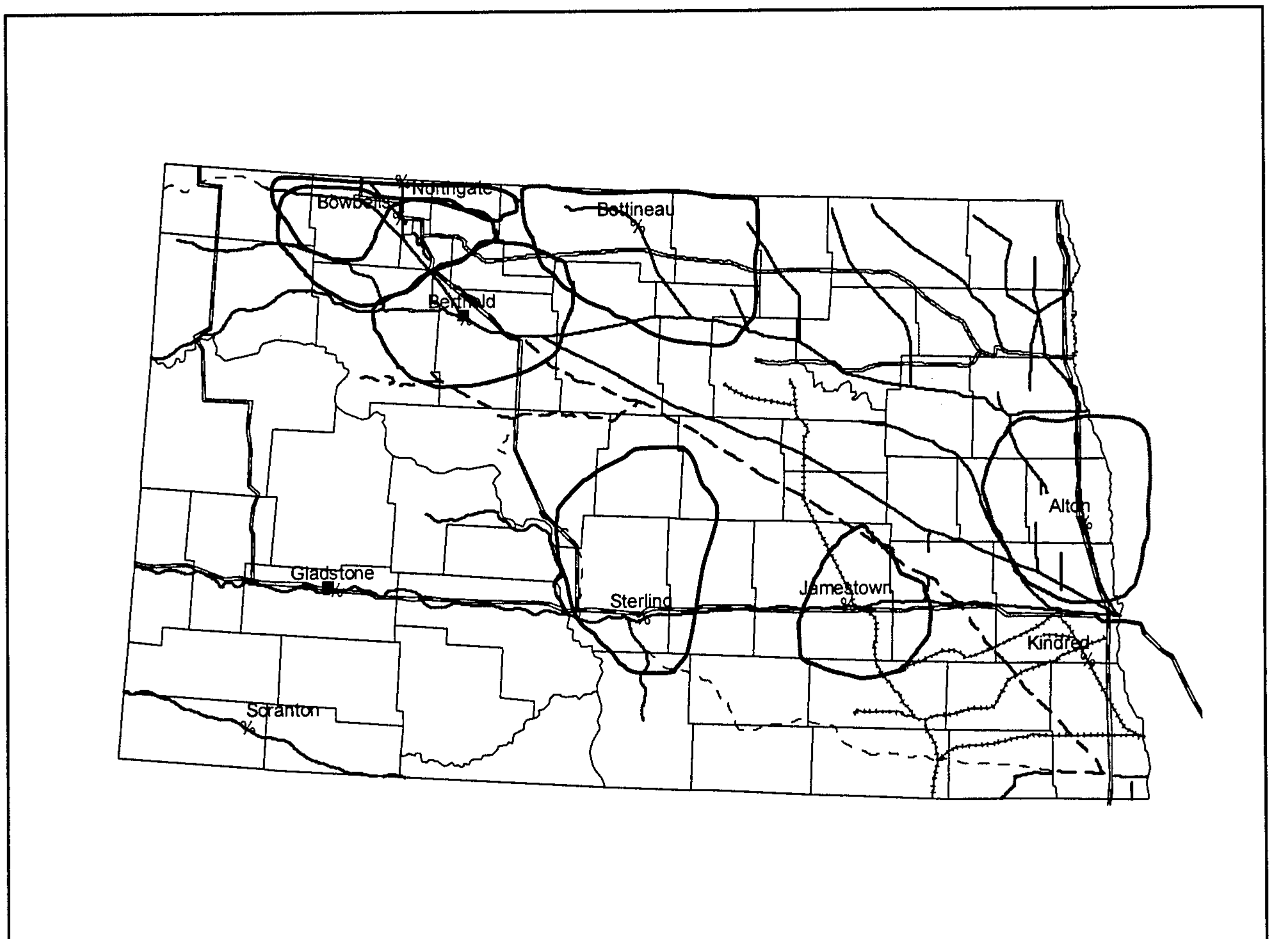

Figure 14. Shuttle Draw Areas for Barley

Minnesota, the combined draw areas of the seven facilities equate to 24 percent of North Dakota's annual barley production.

Table 14. Shuttle Facilities - Draw Area Estimates for Barley

Location	Barley *(1,000 Bushels)*
Bottineau	7,675
Berthold	5,892
Alton	5,058
Jamestown	3,105
Bowbells	2,760
Sterling	2,686
Northgate	1,631

**Draw area extending to MN is included.*

Bottineau has the draw area with the largest volume of barley — 7.7 million bushels. Barley available in the draw areas for facilities in Berthold and Alton is over the 5 million mark, at 5.8 and 5.1 million bushels respectively. The other four facilities have draw area totals for barley that range from 3.1 to 1.6 million bushels. Considering that market discussions usually quote a 10 to 15 million bushel requirement for a feasible shuttle operation, given current market conditions, a facility would not be economically successful using barley as the sole commodity for the shuttle market. In addition, barley has exhibited some of the same tendencies as durum in its dependence on smaller freight lots, based on market comments and the UGPTI North Dakota Grain Movement Statistics discussed previously in this report.

Corn

The final commodity considered in this analysis is corn. Corn production is concentrated in the southeastern region of North Dakota (Appendix C), thus, a draw area was estimated for only the Kindred location. The draw area is estimated to include 974,000 acres. In terms of land, the draw area estimated for corn is about two-thirds the scope of the draw area estimated for wheat.

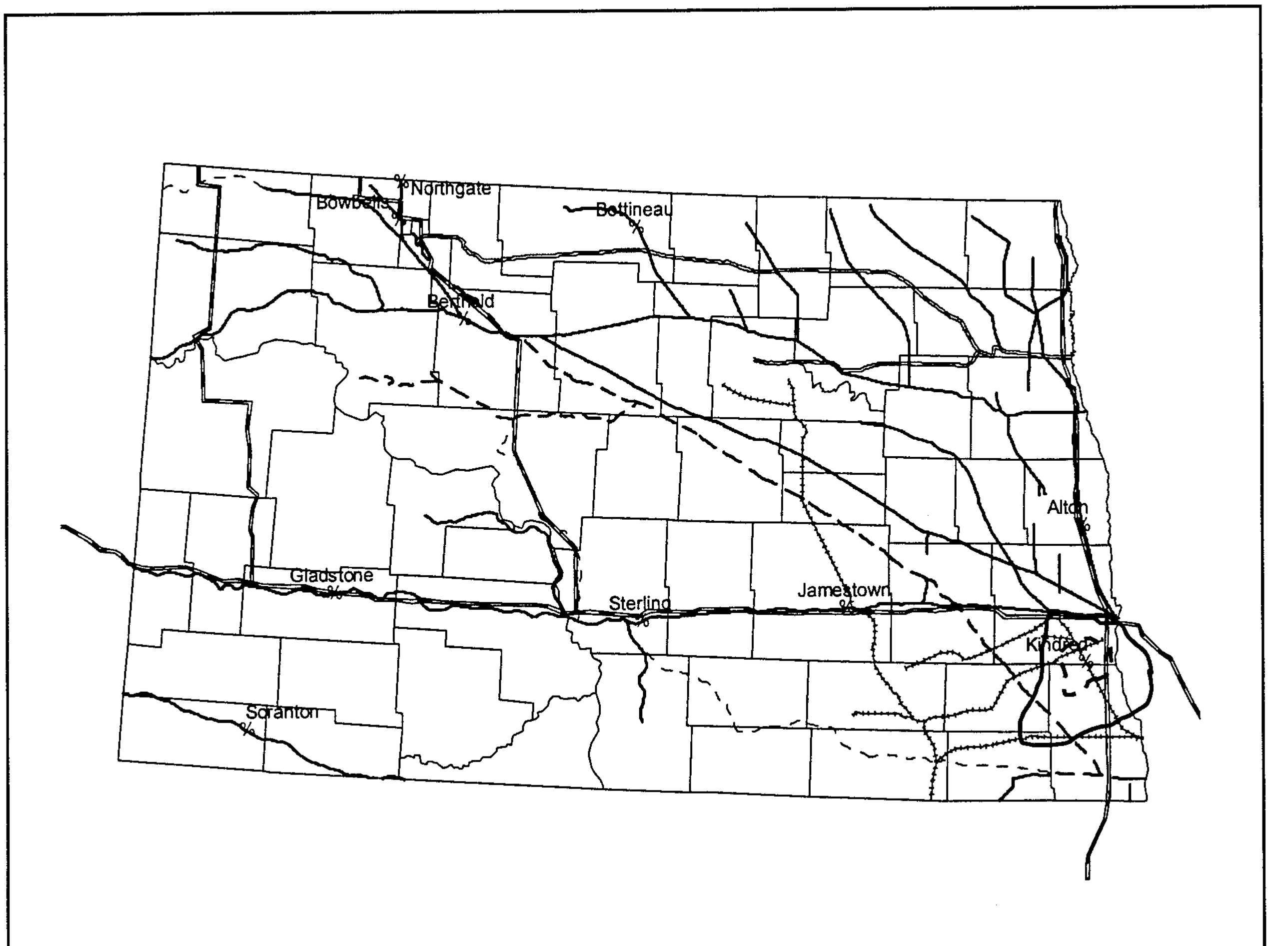

Figure 15. **Shuttle Draw Area for Corn**

Approximately 14.2 million bushels of corn are included within the Kindred draw area boundary. Six percent of the production was attributed to Minnesota, with the balance calculated for the North Dakota portion of the draw area. This bushel estimate represents the forth largest volume attributed to a location for a single commodity. As discussed in the previous section, corn has a tendency toward adaptability to larger shipment sizes. Therefore, the shuttle rate influence is likely to be strong compared to the other commodities.

Production Densities

Production densities are an important aspect of potential adjustments in local grain delivery patterns. Individual facilities have business goals, which typically include projected grain volumes for operating profitable grain handling operations. As the projected grain volumes increase for an individual facility, that facility seeks to penetrate more distant markets and increase share for grain available in the local area. In some circumstances the additional volume may be available in the current draw areas.

When it is necessary to extend the draw area to attract additional business, the degree to which a draw area must be expanded to obtain needed additional bushels is directly related to the density of production in the draw area. For example, elevator A has a 1,000 acre draw area with an average density of 10 bushels per acre. Elevator B also has a 1,000 acre draw area, but with an average density of 30 bushels per acre. If elevator A expands its draw area acreage by 25 percent, and total available bushels increase by 2,500 bushels. This compares to an increase of 7,500 in available bushels for a 25 percent draw area acre expansion by elevator B. The previous section has included production and land area estimates for 10 shuttle facilities. A brief discussion of differences in density of production among regions and commodities completes this section. This discussion is important as it lends itself to understanding differences in the shuttle facility draw areas as they are sited in different regions of the state.

Production density, measured in bushels per acre, averaged 10.1 for the composite of the shuttle train facility draw areas. For comparison, the production densities for other areas of the U.S. Midwest region were estimated in a 1998 study of shuttle trains. Densities were estimated to be 52.4 bushels per acre in a region that covered much of central and eastern Iowa and 39.4 bushels per acre in a region covering counties in southern Minnesota, southeast South Dakota, eastern Nebraska, and western Iowa (Vachal, et. al 1998). The densities assigned to alternative Midwest locals provides an example of regional variation that should be considered in local grain market assessments.

Regarding the production densities estimated for this study, production densities vary across the state. Corn produced in the Kindred draw area raises the production density for this facility to nearly double that of Northgate, the facility ranked second when the 10 facilities are ranked by production density. Densities for Alton, Berthold, and Northgate range from 10.0 to 13.8 bushels per acre. The balance of the facilities have draw areas with an estimated production density under 10.0. Bowbells, Bottineau, and Jamestown form the mid-range group for production densities at 9.7, 8.1, and 8.0, respectively. Three elevators in the south-central and southwestern regions have the lowest production densities. The densities for the Sterling, Scranton, and Gladstone facilities average 4.8 bushels per acre. The range of production densities from a high of 24.6 to a low of 4.1 illustrates the vast difference in the landscape of North Dakota's local grain industry. It is important to recognize characteristics such as these in discussing how shuttle rates may impact the local grain industry and its infrastructure needs in specific regions.

Table 15. Production Density in Shuttle Facility Draw Areas

	HRS	Durum	Barley	Corn	Total
Kindred	9.8	0.2		14.6	24.6
Alton	10.0	0.3	3.5		13.8
Berthold	2.0	6.6	3.0		11.6
Northgate	2.3	5.7	2.0		10.0
Bowbells	2.3	5.7	1.7		9.7
Bottineau	2.9	1.9	3.3		8.1
Jamestown	4.7	0.6	2.7		8.0
Sterling	3.1	1.2	1.2		5.5
Scranton	4.0	0.8			4.8
Gladstone	3.5	0.6			4.1
Average					10.0

Rail Rates

North Dakota elevators marketed 69 percent of bushels they handled via rail between 1995 and 1999. Therefore, rail rates are a critical factor in discussing the relative competitiveness of markets and projecting future producer delivery patterns. The sensitivity of delivery patterns to adjustments in rates among elevators and railroad pricing strategies is addressed in this section. Case studies for Berthold, Jamestown, and Kindred illustrate the influence of rate adjustments on the relative competitiveness of elevators, and thus, the delivery patterns of producers.

The rail rate case study examines the effect of alternative shipping costs on the competitiveness of a local elevator. The base case elevator grain draw territories, as aforementioned, include shuttle rates for those facilities equipped to handle shuttle trains. To gauge the affect of these rates on local grain delivery patterns, grain draw territories were estimated for select case studies. In these rail rate case studies, other parameters including competing elevator rail rates and producer truck costs, are held constant while the rail rate for the selected shuttle station is replaced with a unit train rate. These results are an effective measure of the potential impact of shuttle rates on local grain delivery patterns, because in the recent past the unit train rate has been the lowest cost and most competitive alternative for shipping grain via rail.

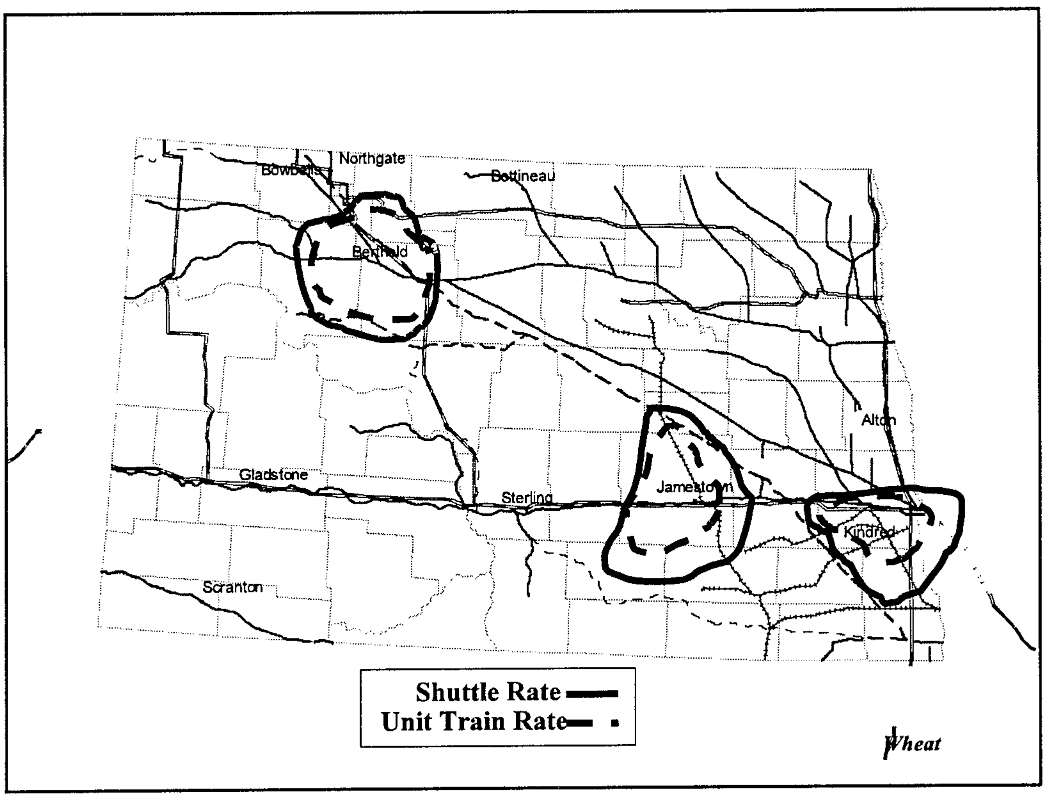

Figure 16. Sensitivity of Elevator Draw Area Boundary to Rail Rate, Wheat

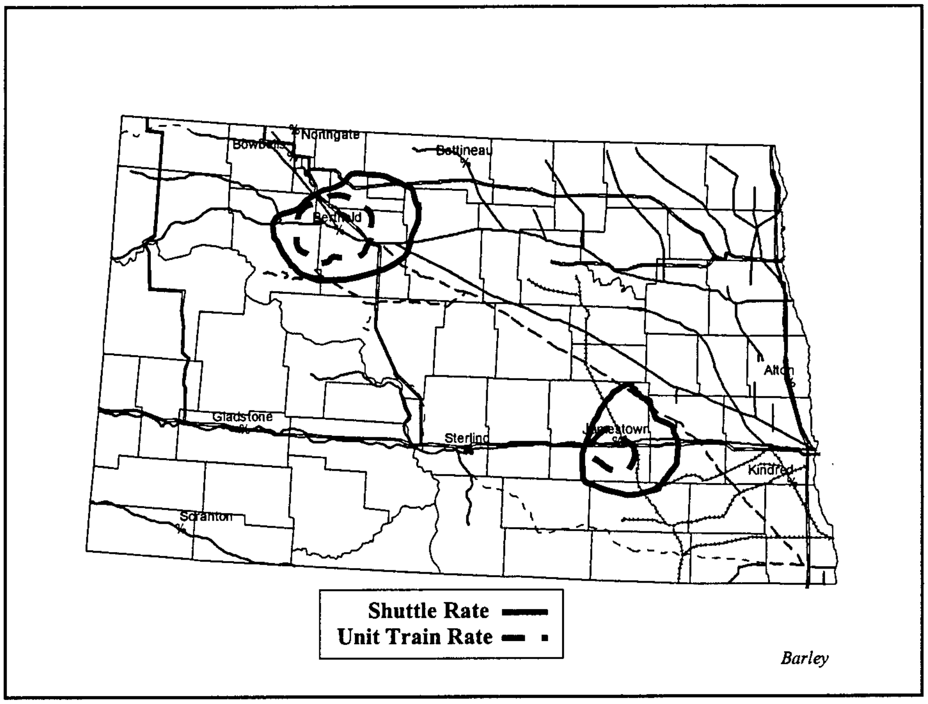

Figure 17. **Sensitivity of Elevator Draw Area Boundary to Rail Rate, Barley**

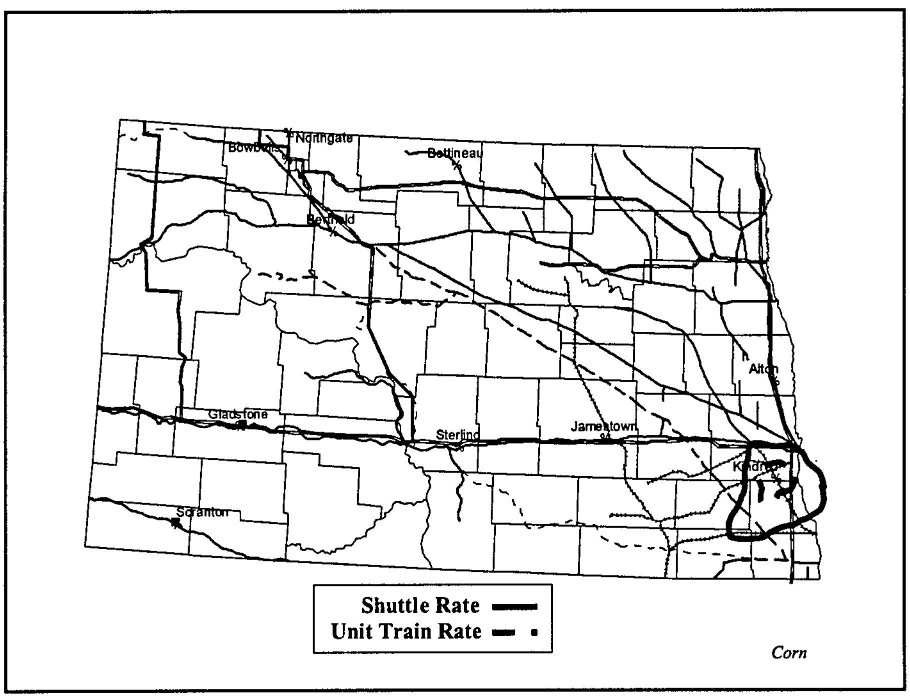

Figure 18. **Sensitivity of Elevator Draw Area Boundary to Rail Rate, Corn**

The case study analyses show that rail rates have a substantial affect on the reach of an elevator's draw area. When the shuttle rate is replaced with the applicable unit train rate, draw areas contract in each case. The largest percentage decrease in acreage, 73 percent, is attributed to a facility in Kindred competing for corn bushels. The smallest decrease in draw area size, 23 percent, is attributed to Jamestown in the barley market. When the shuttle rate shipping option cannot be used, the Berthold and Kindred average draw areas are reduced by an average of 36 and 56 percent, respectively, for the commodities considered. Given the range of commodities and location considered in these estimates, it appears that shuttle train rates increase an elevator's draw area by approximately 50 percent, compared to the unit train draw area.

Table 16. Effect of Rail Rates on Local Grain Industry, Case Study Results of Land in Elevator Draw

		(1,000 Acres)	
Berthold	Wheat	Barley	Average
Base Case	2,073	1,987	2,030
Unit Train Case	1,575	1,021	1,298
Change in draw acres with elimination of shuttle rate	-24%	-49%	-36%
Jamestown	Wheat	Barley	Average
Base Case	2,068	1,150	1,609
Unit Train Case	809	890	850
Change in draw acres with elimination of shuttle rate	-61%	-23%	-42%
Kindred	Wheat	Corn	Average
Base Case	1,422	974	1,198
Unit Train Case	589	262	426
Change in draw acres with elimination of shuttle rate	-59%	-73%	-66%

As discussed, density in the draw area also is an important factor in understanding how shuttle train rates might affect local grain distribution patterns. Grain volume encompassed by draw area radii is defined by joining land area and production density values. Among the nine cases considered, the draw area volume decreases by an average 48 percent when shuttle rates are eliminated from the market. When unit train rates are applied for estimating draw area volumes, Kindred volume (considering wheat, durum, and corn) declines by 47 percent. Corn, the largest single volume commodity for the Kindred facility, decreases by 76 percent compared to the base case volume. HRS wheat volumes decline by about one-third and durum by about 16 percent.

Table 17. Effect of Rail Rates on Local Grain Industry, Case Study Results of Volume in Elevator Draw

(1,000 Bushels)

Berthold	HRS Wheat	Durum	Barley	Total
Base Case	4,085	13,729	5,892	23,706
Unit Train Case	3,009	10,484	2,641	16,134
Change in Draw Area Volume with Elimination of Shuttle Rate	-26%	-24%	-55%	-32%
Jamestown	HRS Wheat	Durum	Barley	Total
Base Case	9,822	1,167	3,105	14,094
Unit Train Case	4,247	656	2,540	7,443
Change in Draw Area Volume with Elimination of Shuttle Rate	-57%	-44%	-18%	-47%
Kindred	HRS Wheat	Durum	Corn	Total
Base Case	14,405	315	14,188	28,908
Unit Train Case	6,365	200	3,464	10,029
Change in Draw Area Volume with Elimination of Shuttle Rate	-56%	-37%	-76%	-65%

The volume in the Jamestown draw area is 47 percent lower when the unit train rate draw area is compared to the base case shuttle draw case. Berthold experiences the smallest change in volume when individual elevator unit and shuttle train rate draw areas are compared. The Berthold facility loses access to about one-quarter of its volume it has access to with shuttle train rates for its largest volume commodity, durum, when compared to the draw area for unit train rate. Overall volume available to the Berthold facility declines by about one-third. The relative reduction in grain draw volumes are similar for HRS wheat, at 26 percent, but total volumes of HRS wheat are about one-third of durum volumes in the Berthold trade area. Barley volume, about 5.9 million bushels in the base case, is most impacted as volumes available under the unit train scenario are less than half of the volume available when the shuttle rail rate can be accessed. Land area and volume statistics are similar in conclusions. Shuttle rates provide elevators with an opportunity to penetrate a new grain draw territory. The additional territory attributed to shuttle train rates is estimated to be 18 to 76 percent farther than the most distant market available to the elevator when it utilizes unit train rates, depending on commodity and location. The average increase in volume attributed to the shuttle rate is about 50 percent.

Producer Truck Costs

The primary factor on the producer side of the farm-to-market delivery decision model is cost of delivery. The cost of delivery is based on distance and truck cost in the model applied for this study. The North Dakota producer truck fleet, as discussed previously in this report, includes an array of trucks from single-axle to semi-truck and trailer. To address the producer truck cost factor, sensitivity to truck costs is analyzed by developing truck costs at opposite ends of the truck cost spectrum - single-axle and commercial semi-truck. The results generated from this scenario are compared to results of the base case scenario - producer semi-truck costs. With this methodology, the diversity of the current producer truck fleet, changing fuel prices, opportunity for custom trucking, and potential for future investment is addressed through the range of results estimated with alternative truck costs.

The one measure of applicable producer truck costs is its effect on the size of draw areas for the case study facilities and commodities. For base case in wheat, which uses the producer semi-truck rate of $.0025 per bushel mile, Berthold, Jamestown, and Kindred have draw areas of 2,073; 2,068; and 961 thousand acres, respectively. The first of the two alternative truck costs considered in the sensitivity analysis is the single-axle truck cost. This cost is considered to be the

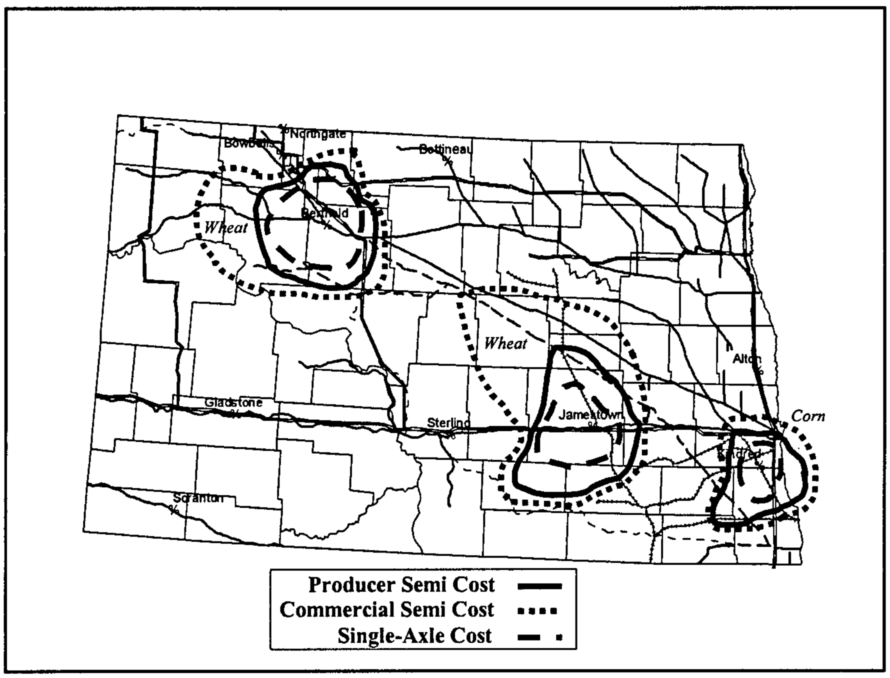

Figure 19. Sensitivity of Elevator Draw Area Boundary to Producer Truck Costs, Base Case - Wheat

maximum cost among possible producer truck cost scenarios. The cost for operating the single-axle truck is nearly three times higher than the semi-truck trailer, with a cost $.0091 per bushel, as detailed in a previous section. The effect of replacing the semi-truck rate with the single-axle rate is a reduction in the spans of each draw area, compared to the base case, considered in the case study analysis. The average draw area size decreases by about 44 percent. The draw area for Berthold is reduced by 18 percent, 1,704 acres, compared to reductions of 53 percent (978 acres) and 62 percent (589 acres) at Jamestown and Kindred, respectively in the base case.

Table 18. Effect of Producer Truck Costs on Local Grain Industry, Case Study Results of Land in Elevator Draw for Wheat

Scenarios	**Berthold**	**Jamestown** *(1,000)*	**Kindred**
Producer Semi	2,073	2,068	961
Single Axle	1,704	978	365
Change in draw acres vs. base	-18%	-53%	-62%
Commercial Semi	3,803	3,312	1,769
Change in draw acres vs. base	83%	60%	84%

Considering the impact of increased producer truck costs across other commodities, Jamestown experiences the greatest reduction in size of draw area when the draw area for single-axle truck deliveries is compared to the draw area for producer semi deliveries. Considering wheat, the single-axle draw area is 74 percent smaller than the draw area defined by the producer semi scenario. The relative changes at Kindred and Jamestown are similar for corn and barley, respectively, as draw areas are reduced by about 60 percent compared to the area estimated under the producer semi scenario.

Effects vary substantially in the case of lower producer truck costs, as illustrated by the second scenario in the truck sensitivity analysis - commercial semi-truck. In this truck scenario, a producer truck cost of $.0017 per bushel reflects the costs for operations such as large farms, custom combine/trucks, elevator-owned trucks, and commercial truck operations. The commercial semi-truck rate is approximately one-third lower than the producer semi-truck operation costs due to economies of equipment use. This truck cost provides the minimum cost for the producer truck cost sensitivity analysis.

Considering wheat, the base case commodity, application of a commercial truck rate has a substantial impact on the reach of draw areas for each of the facilities. Berthold and Kindred have similar relative increases in draw area acres when commercial truck draw areas are compared to the draw areas estimated for the producer semi, enjoying more than 80 percent increase in the size of their respective draw areas. A smaller, but still notable impact, also is estimated for Jamestown at a 60 percent increase in draw area acres.

Table 19. Effect of Producer Truck Costs on Local Grain Industry, Case Study Results of Land in Elevator Draw for Barley and Corn

	Berthold	**Jamestown**	**Kindred**
Scenarios		*(1,000 Acres)*	
Commodity	*Barley*	*Barley*	*Corn*
Producer Semi	1,987	1,150	974
Single Axle Case	795	294	435
Change in draw acres vs. semi	-60%	-74%	-55%
Commercial Semi Case	2,075	1,410	1,359
Change in draw acres vs. semi	4%	23%	40%

The impact of commercial truck rates on the draw areas for barley is less significant than for wheat. Draw area is increased by only 4 and 23 percent, respectively, for Berthold and Jamestown when draw areas are estimated using a commercial semi-truck cost compared to the draw areas estimated using the producer semi-truck cost. The commercial truck rate does provide a larger draw area for Kindred in attracting corn, compared to the draw area available for producer semi deliveries. The difference in the effect of truck rates on draw areas among facilities may be attributed to factors such as the ratio of truck-to-rail cost in the marketing equation, a relatively flat gradient in rail rates,"blanket" rail rates, and proximity of competitors. Blanket rail rates refer to application of the same rate for elevators in a region rather than scaling rates.

Table 20. Effect of Producer Truck Costs on Local Grain Industry, Case Study Results of Volume in Elevator Draw

		(1,000 Bushels)		
Berthold	HRS Wheat	Durum	Barley	Total
Base Case	4,085	13,729	5,892	23,706
Single Axle Case	3,050	9,408	2,019	14,477
Change in Draw Volume	-25%	-31%	-66%	-39%
Commercial Semi Case	7,509	22,666	6,851	37,026
Change in Draw Volume	84%	65%	16%	56%
Jamestown	HRS Wheat	Durum	Barley	Total
Base Case	9,822	1,167	3,105	14,094
Single Axle Case	3,474	552	685	4,711
Change in Draw Volume	-65%	-53%	-78%	-67%
Commercial Semi Case	16,338	1,845	3,946	22,129
Change in Draw Volume	66%	58%	27%	57%
Kindred	HRS Wheat	Durum	Corn	Total
Base Case	9,457	239	14,188	23,884
Single Axle Case	3,553	103	6,933	10,589
Change in Draw Volume	-62%	-57%	-51%	-56%
Commercial Semi Case	16,659	522	18,849	36,030
Change in Draw Volume	76%	118%	33%	51%

A second measure of the relative importance of producer truck costs in the local grain delivery decision is grain volumes. The effects on draw area are similar to those found in analyzing changes in the land area included under the alternative scenarios. The average reduction in volume available to the facility when deliveries are made via single-axle truck, compared to producer semi, is 54 percent among the three facilities. Considering HRS wheat, durum, and barley, total volumes decline by 67 and 39 percent, for Jamestown and Berthold, respectively, when volume in the draw areas for single-axle producer deliveries are compared to the draw volumes estimated for producer semi deliveries. The Kindred total has a different composition as it includes HRS wheat, durum and corn. Application of the single-axle truck rates reduces volume in the Kindred draw area to less than half the volume (56 percent reduction) available in the producer semi draw area. Differences between the commodities may be attributed to factors such as differences in density across the draw area, gradient of rail rates, and commodity truck costs.

The effects of defining commercial semi-truck costs as the applicable cost for local producer grain deliveries suggest longer truck deliveries would likely occur as producer would truck farther to access lower rail rates. Considering the nine case studies (three facilities and three commodities), the volume of grain available to the facility increased approximately 55 percent when deliveries based on commercial truck costs were compared to deliveries based on producer semi-truck costs. Total volumes, considering HRS wheat, durum, and barley, increased by 13.5 and 8 million bushels (56 and 57 percent), respectively, for Berthold and Jamestown when the lower truck rate was applied. The Kindred facility had access to an additional 12 million bushels - a 51 percent increase from volumes available with the higher producer semi-truck rate. As illustrated in the array of results, local grain deliveries are influenced by many factors. The results summarized in this section provide a base for understanding the sensitivity of grain flows to inbound truck delivery costs and outbound rail rates. The range of results may be valuable in interpreting market phenomenon and forecasting needs of the local grain industry continues to seek means for competing in a global market.

Local Processor Relation Model

The second component in the discussion of local grain delivery patterns is the effect of alternative local grain market scenarios on local processors. North Dakota has long been a proponent of local processing. Its government supported the establishment of the State Mill and Elevator nearly eight decades ago. The state continues, through financial and legislative efforts, to develop local processing. Thus, understanding the influence of local grain market factors on the competitive position of the facilities is important for decision makers involved in infrastructure, economic development, and policy, as well as to producers who supply these markets. This relationship is described in the following equation:

$$MaxZ = \left(\sum_{i=1}^{L} P_L - \sum_{c=1}^{D} D_{LF} \right) \sum Q_F$$

where,

L	=	Local Grain Market (Elevator or Processing Facility)
F	=	Producer Grain Field F
P_L	=	Price at Local Market
D_L	=	Producer Delivery Cost to Local Market
Q_F	=	Quantity of Grain Produced in Field F

The key factor in understanding economic influence of a shuttle rate on the local processing market is in the determination of P_L, the price at the local market, where for example, the current price is a market equilibrium for supply and demand. The opportunity for the elevator to access a lower freight rate through use of a shuttle train rate effectively shifts the export market supply curve to the right. The local processor, in comparison, continues to face the same total transportation cost, but the lower cost in the competing market effectively shifts the supply curve to the left.

In the short run, the shift in the supply curve, which results from a change in the price of a competing product, will increase prices for the domestic market. Where economically feasible, the domestic market will internalize a portion of its freight rate and continue to operate. Over the long-run, competitive pressures will establish a new market equilibrium where marginal domestic buying will be eliminated and/or additional volume will enter the market.

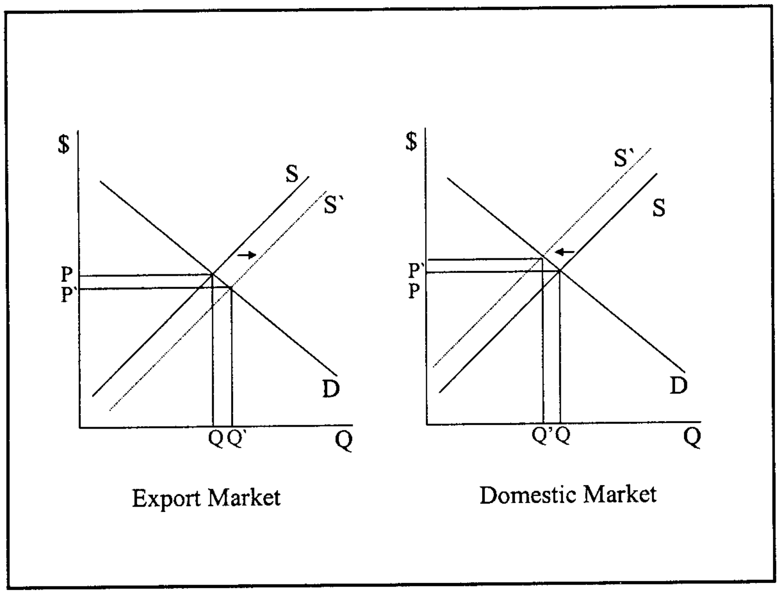

Figure 21. Short-Run Effects of Shuttle Rates on Market Equilibrium

Three case study examples illustrate how producer truck cost and elevator pricing scenarios affect economics of the local processing industry. Case studies include wheat producers close to Rugby and Forest River, and a corn producer near Colfax. The relationship is viewed through two steps. First is the determination of the elevator price, second is the producer marketing decision. The elevator price is an input to the producer marketing decision. Three alternatives are considered in the elevator pricing portion of the relationship: (1) local processor, (2) domestic or eastern market (Minneapolis, MN), and (3) western export market (PNW or Pacific Northwest). The highest return among these alternatives — simply defined as market price less transportation cost, becomes the elevator board price among the producer options. The producer marketing decision is defined by two options, (1) elevator and (2) local processor. Producer return is defined as market price less trucking costs. It is assumed that the producer will choose that market the maximizes his net return, given the truck he operates, as this truck type will determine his truck cost per mile. The impact of alternative truck costs on this decision is illustrated through a comparison of single-axle, tandem, and semi-truck deliveries to the two markets.

In the first example of the local processor and shuttle rate relationship, the elevator maximizes its return by selling into the PNW at the shuttle rate. The highest return to the producer with any truck type is to market through the elevator for a net return of $2.22; $2.35; or $2.40 per bushel, respectively, for deliveries made via a single-axle, tandem, and semi-truck. When the shuttle option is removed from the market, the State Mill and the PNW are at par for the elevator, based on market price and freight rates. The elevator remains the best delivery option for producers, regardless of truck type. Returns to the producer are reduced by nine cents per bushel to $2.13; $2.26; and $2.31 per bushel for single-axle, tandem and semi-truck deliveries, respectively.

Table 21. Rail Rate Spreads for Local Processor vs. Shuttle Relationship: Wheat Producer - Rugby

$/Bushel

Elevator Options:	**Offer**	**Freight**		**Net Market Price**	
		With Shuttle	No Shuttle	With Shuttle	No Shuttle
State Mill	$2.71	$0.34	$0.34	$2.37	$2.37
Minneapolis, MN	$3.02	$0.65	$0.74	$2.37	$2.28
PNW	$3.59	$1.13	$1.22	$2.46	$2.37
Maximum Price:				**$2.46**	**$2.37**

Producer Options:	Miles to		**Net Return to Producer**	
Truck Type	Market	Truck Cost	With Shuttle	No Shuttle
Single-Axle				
Elevator	50	$0.24	$2.22	$2.13
State Mill	292	$1.39	$0.98	$0.98
Tandem				
Elevator	50	$0.11	$2.35	$2.26
State Mill	292	$0.64	$1.73	$1.73
Semi-Truck				
Elevator	50	$0.06	$2.40	$2.31
State Mill	292	$0.36	$2.01	$2.01
Maximum Return:			**$2.40**	**$2.31**

The other two examples of this relationship are considered for producers in closer proximity to local processors. The first of these scenarios considers a wheat producer located near Forest River. The elevator is offered the same market options, the State Mill, Minneapolis, MN, and the PNW. The elevator maximizes returns with a sale to the State Mill with or without the shuttle rate shipping option. The highest return for the producer considers two market alternatives, local elevator and the State Mill. For the producer making the delivery via single-axle or tandem axle, the returns are at par for delivery to the elevator or the State Mill. When the shuttle option is removed from the market, the marketing choices and returns to the producer remain stable at $2.56; $2.61; and $2.63 per bushel. The close proximity of this elevator to the State Mill requires a more substantial rail rate adjustment for a definitive shift of traffic from the local processing truck market to a more distant rail market.

Table 22. Rail Rate Spreads for Local Processor vs. Shuttle Relationship: Wheat Producer - Forest River

$/Bushel

Elevator Options:	**Offer**	**Freight**		**Net Market Price**	
		With Shuttle	No Shuttle	With Shuttle	No Shuttle
State Mill	$2.71	$0.06	$0.06	$2.65	$2.65
Minneapolis, MN	$3.02	$0.43	$0.52	$2.59	$2.50
PNW	$3.59	$1.13	$1.22	$2.46	$2.37
Maximum Price:				**$2.65**	**$2.65**
Producer Options:				**Net Return to Producer**	
Truck Type	Miles to Market	Truck Cost		With Shuttle	No Shuttle
Single-Axle					
Elevator	50	$0.09		$2.56	$2.56
State Mill	292	$0.24		$2.41	$2.41
Tandem					
Elevator	50	$0.04		$2.61	$2.61
State Mill	292	$0.11		$2.54	$2.54
Semi-Truck					
Elevator	50	$0.02		$2.63	$2.63
State Mill	292	$0.06		$2.59	$2.59
Maximum Return:				**$2.63**	**$2.63**

The final example of the shuttle rate/local processor relation is illustrated for a corn producer near Colfax. In this market relation, the elevator is again provided with three alternatives: (1) Cargill, a local processor, (2) Minneapolis, MN, (eastern or domestic market), and (3) the PNW (western export market). Among these markets, the PNW provides the highest return to the elevator when a shuttle shipping option is available. The producer maximizes his net return, considering market price less transportation cost, by delivering to the local elevator for all

Table 23. Rail Rate Spreads for Local Processor vs. Shuttle Relationship: Corn Producer - Colfax

$/Bushel

Elevator Options:	**Offer**	**Freight**		**Net Market Price**	
		With Shuttle	No Shuttle	With Shuttle	No Shuttle
Cargill-Wahpeton	$1.46	$0.06	$0.06	$1.40	$1.40
Minneapolis, MN	$1.53	$0.30	$0.39	$1.23	$1.14
PNW	$2.36	$0.91	$1.00	$1.45	$1.36
Maximum Price:				**$1.45**	**$1.40**

Producer Options:	Miles to		**Net Return to Producer**	
Truck Type	Market	Truck Cost	With Shuttle	No Shuttle
Single-Axle				
Elevator	20	$0.09	$1.36	$1.31
Cargill-Wahpeton	50	$0.24	$1.16	$1.16
Tandem				
Elevator	20	$0.04	$1.41	$1.36
Cargill-Wahpeton	50	$0.11	$1.29	$1.29
Semi-Truck				
Elevator	20	$0.02	$1.43	$1.38
Cargill-Wahpeton	50	$0.06	$1.34	$1.34
Maximum Return:			**$1.43**	**$1.38**

truck types. The return to the producer varies at $1.36; $1.41; and $1.43 per bushel for deliveries made via single-axle, tandem, and semi-truck, respectively. When the shuttle option is removed from the market, the local processor becomes the best market for the elevator. Producer returns continue to be maximized through delivery to the local elevator, but per bushel revenues are reduced by 5 cents per bushel. Thus, the impact of the shuttle rate on the ability of the local processor to compete for bushels should be a consideration in local grain delivery patterns and in viability of local processing.

CONCLUSION

The local grain industry in North Dakota includes 440 elevators, two Class I rail carriers, three short line railroads, several local processors, 3,858 rail miles, 106,514 road miles, and thousands of farmers. In looking to the future of North Dakota's local grain industry infrastructure it is important to (1) view the local infrastructure as a part of global grain marketing network (2) determine, with the best current knowledge, what resources the local segment of that much larger network will require, and (3) rationally allocate available resources to maximize returns to the local segment of the network. Shuttle rail rates are, in today's grain industry, the railroad's most competitive rate. Shuttle rates are available to shippers equipped to meet specific volume, transaction, and operational commitments. Investment in shuttle facilities and the ability of these facilities to utilize the more competitive rates in attracting grain has the potential to strongly influence future local grain flow patterns. As these local grain flow patterns adjust to new market signals, demands on the local grain gathering system will need to be addressed. The objective of this study was to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain industry. Secondary objectives were to (1) profile the local grain procurement network, (2) develop alternative network scenarios to analyze the influence of shuttle trains, and (3) provide framework for understanding the longer-term implications of shuttle trains for North Dakota's grain processing industry, infrastructure, and rural communities.

Facility infrastructure requirements, economic incentives, investment requirements, and financing packages are unique to each shuttle venture. Based on an earlier UGPTI study, a $6 million green field facility required approximately 10 million bushel handle for profitable returns.

Discussions with grain companies and railroads suggest a target of 12 to 15 million bushels for a shuttle facility. This bushel requirement compares to the current average annual handle of 1.2 million bushels for the North Dakota elevator population, and average annual handle of 5.6 million bushels for the state's largest elevators. Therefore, redistribution of bushels in the local elevator industry seems imminent.

Spatial analysis was used to estimate producer delivery patterns for alternative rail rate and producer truck cost scenarios. Grain production and draw area spans were used as quantitative measures in discussing the delivery patterns. An economic decision model was employed to illustrate the impact of changes in elevator rail rates and producer trucking costs on the relative competitiveness of local processors. HRS wheat, durum, barley, and corn were considered in this economic analysis of shuttle rail rates on the local grain marketing. In the base case, wheat, the area included in the 10 shuttle facility boundaries accounted for approximately 45 percent of the total North Dakota land area. Regarding production, approximately 88.6 million bushels of HRS wheat and 32.9 million bushels of durum were contained in the estimated shuttle draw areas. The 10 draw areas encompassed about 38 percent of North Dakota HRS wheat production and 39 percent of the state's durum production. In the cases of barley and corn, shuttle facilities have the potential to accumulate 26.5 million bushels (24 percent of average North Dakota production) and 14.2 million bushels (19 percent of average North Dakota production), respectively, based on the estimated draw areas.

Considering these four crops, the 10 shuttle facility draw areas have the potential to originate about 162 million bushels. In relative terms, 2 percent of the elevators may originate up to 32 percent of the average annual production of wheat, barley, and corn. This market share of

North Dakota production translates to an average 16.5 million bushels per facility. This potential concentration of bushels has implications for local roads, short line railroads, bridge infrastructure, local processors, local communities, and the North Dakota elevator industry.

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Appendix A . U.S. Exports of HRS Wheat, Durum, Corn and Barley, by Port 1990 to 1999

	HRS Wheat			Durum			Corn			Barley		
	PNW	Gulf	Total	PNW	Gulf	Total	PNW	Gulf	Total	PNW	Gulf	Total
1990	45%	44%	259,573	4%	27%	79,721	21%	71%	2,080,438	24%	5%	128,570
1991	41%	51%	288,093	4%	43%	43,619	18%	75%	1,752,116	38%	10%	66,665
1992	33%	56%	395,060	2%	31%	60,815	15%	80%	1,691,804	25%	12%	85,550
1993	43%	44%	380,973	3%	43%	49,013	15%	78%	1,553,410	30%	7%	63,815
1994	65%	21%	267,168	15%	68%	39,348	11%	83%	1,330,564	14%	4%	69,618
1995	56%	25%	317,523	2%	63%	36,814	26%	67%	2,329,833	68%	11%	62,126
1996	48%	27%	321,915	1%	57%	31,932	21%	73%	2,006,439	68%	10%	35,989
1997	53%	31%	250,132	0%	55%	45,017	26%	71%	1,589,131	54%	0%	75,996
1998	53%	24%	247,426	5%	57%	32,140	11%	78%	1,545,109	79%	0%	25,646
1999	55%	26%	230,692	3%	59%	39,714	17%	73%	1,967,320	82%	0%	25,366
90-94 Avg.	45%	43%	318,173	6%	42%	54,503	16%	77%	1,681,666	26%	8%	82,844
95-99 Avg.	53%	27%	273,538	2%	58%	37,123	20%	73%	1,887,566	70%	4%	45,025

Source: Agricultural Marketing Service, USDA, Grain and Feed Weekly Summary and Statistics, various issues.

Note: Percents to not sum to 100, due to exports through others ports. Total (in 1,000 bushels) reflects exports through all ports.

APPENDIX B. Individual Commodity Production Densities

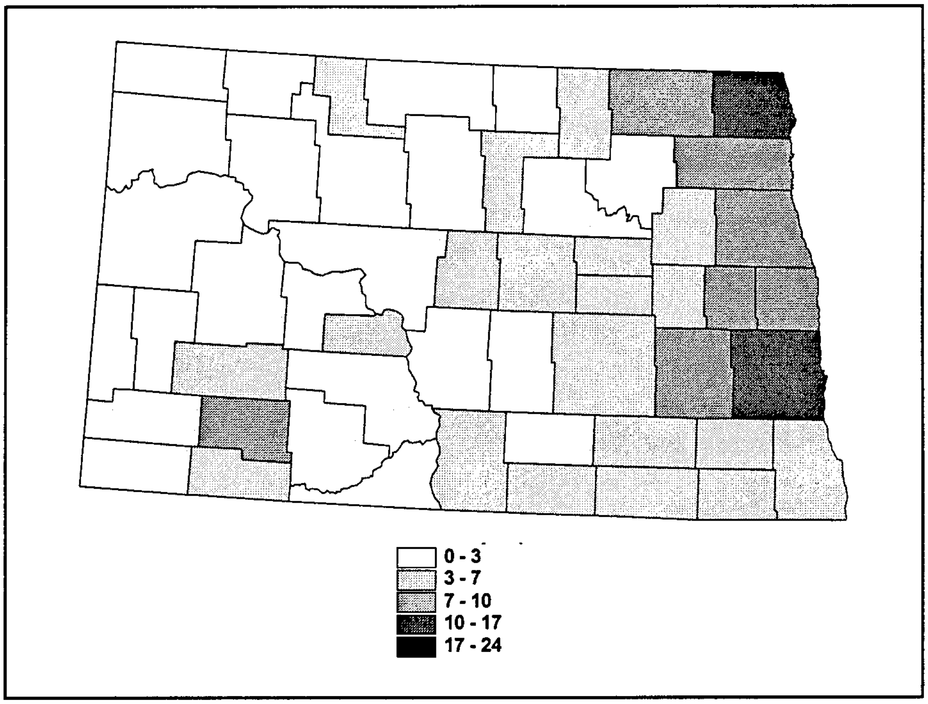

Figure 22. **Production Density for North Dakota HRS Wheat Production, Avg. 1994-1999**

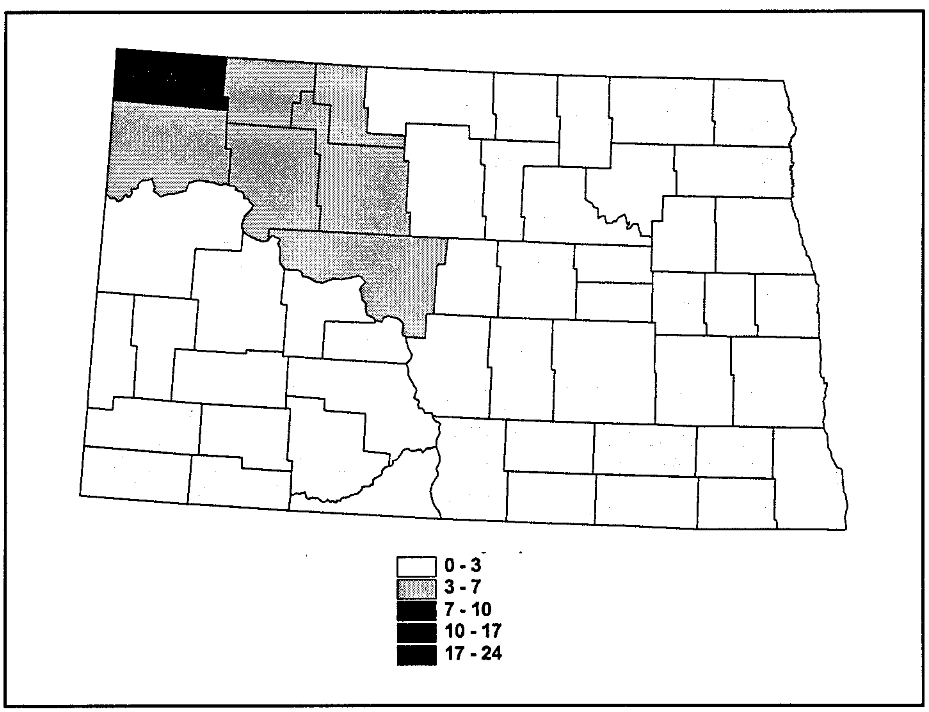

Figure 23. **Production Density for North Dakota Durum Production, Avg. 1994-1999**

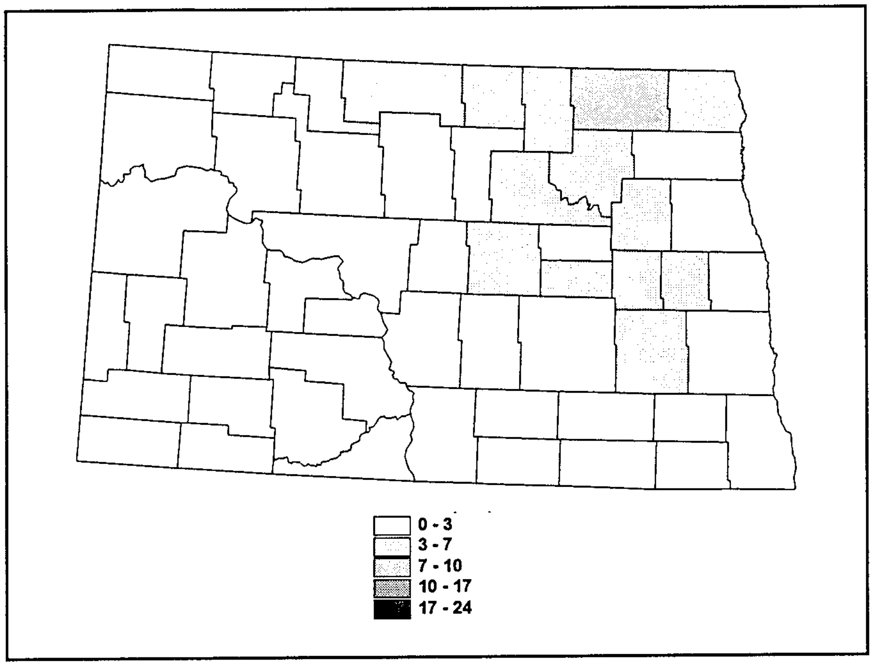

Figure 24. **Production Density for North Dakota Barley Production, Avg. 1994-1999**

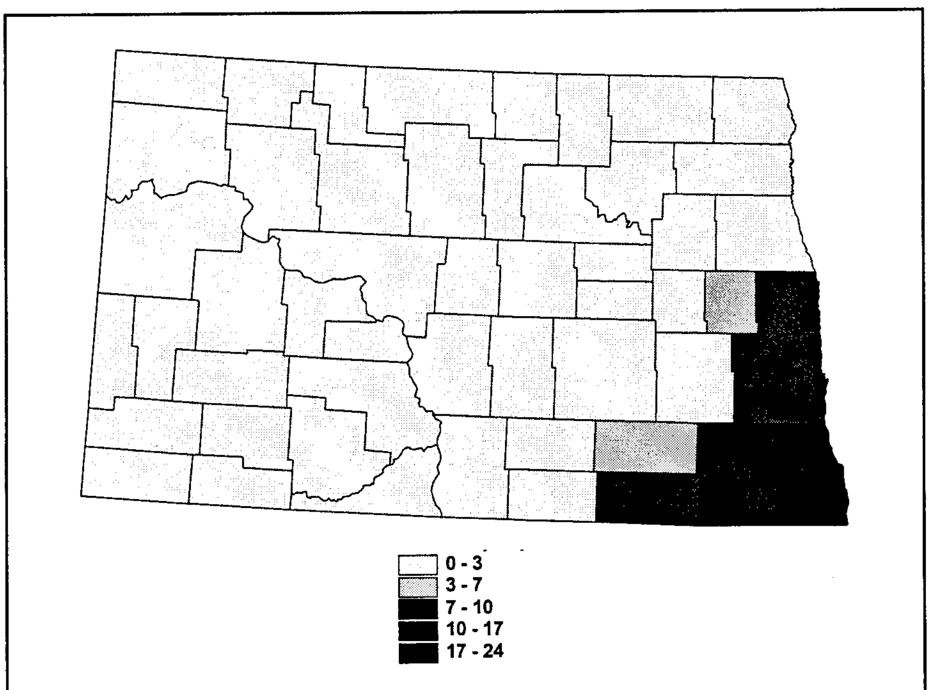

Figure 25. **Production Density for North Dakota Corn Production, Avg. 1994-1999**